NET WORK LISER

Discussion Paper Series

IZA DP No. 19032

October 2026

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The Division of Labor: Productivity, Coordination, and Learning*

Abstract

The division of labor is fundamental to how firms organize production. Since Adam Smith, economists have recognized that dividing tasks more finely increases productivity through specialization but also raises coordination costs—a tradeoff formalized by Becker and Murphy (1992). Yet we have little systematic evidence on how this tradeoff operates within firms. Moreover, this classical perspective overlooks a second, dynamic tradeoff: firms not only produce output, but also develop a central input into future production—their workers' human capital. A finer division of labor allows workers to develop greater expertise through repeated performance of narrowly defined tasks, but may also reduce opportunities to learn from coworkers by limiting interactions and knowledge exchange. We study both tradeoffs using population-wide Norwegian employer–employee records, linked workplace surveys, quasi-experimental variation in coworker availability, and randomized experiments with workers and managers. We find that more specialized firms exhibit higher productivity but also greater coordination costs. Their workers report more learning-by-doing but substantially less coworker learning, resulting in lower overall learning and slower wage growth. To establish the importance of coworker learning for human capital accumulation, we exploit extended coworker absences and show that losing access to colleagues reduces subsequent wage growth, particularly in occupations characterized by greater task overlap and coworker learning. To isolate the role of the division of labor from other workplace characteristics, we conduct randomized experiments that vary task allocation in otherwise identical workplaces. Workers and managers anticipate greater coordination demands, weaker coworker interactions, and lower skill accumulation under greater specialization. The experiments then ask workers to choose their preferred workplace and managers how they would organize production. Both favor greater task overlap, citing coworker interactions and learning opportunities as key reasons for their choices. Together, our findings show that the division of labor shapes not only the efficiency of current production but also the accumulation of human capital and future productive capacity.

JEL classification

J24, J31, M53, M54

Keywords

division of labor, learning, firm organization

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* This research includes randomized experiments targeting both workers and managers, which were registered at the AEA RCT registry as AEARCTR-0019015 and AEARCTR-0019016, respectively. This project was partially funded by the Research Council of Norway through its Centers of Excellence Scheme, FAIR project no. 262675. Alexander gratefully acknowledges financial support from the European Research Council through its Starting Grant Scheme (ERC-StG-101302557).

"*But if they had all wrought separately and independently, and without any of them having been educated to this peculiar business, they certainly could not each of them have made twenty, perhaps not one pin in a day; that is, certainly, not the two hundred and fortieth, perhaps not the four thousand eight hundredth, part of what they are at present capable of performing, in consequence of a proper division and combination of their different operations*."

—Chapter 1: Division of Labor, *The Wealth of Nations* (Smith, 1776)

1 Introduction

Ever since Adam Smith's famous example of the pin factory, the division of labor has been central to thinking about how firms organize production (Smith, 1776). By allocating different tasks to different workers, firms enable workers to specialize in what they do best, generating productivity gains that would not arise if each worker performed every stage of production themselves. But a finer division of labor can also create costs. As production becomes organized around increasingly distinct roles, firms become more dependent on coordination across workers, and the resources required to coordinate production rise. Becker and Murphy (1992) formalize this tradeoff, showing that the productivity gains from a finer division of labor are ultimately constrained by rising coordination costs within firms, which eventually outweigh the benefits of further specialization.

This productivity–coordination tradeoff has played a central role in theories of the division of labor (DoL) and the organization of production. Largely missing from this perspective, however, is the dual role of firms in both producing output and developing a core input into future production: their workers' human capital (e.g. Lucas, 1988). How firms divide labor determines both the tasks workers perform and the coworkers with whom they interact, thereby shaping two central channels of workplace learning.[1] A finer division of labor concentrates workers' time on a narrower set of tasks, potentially deepening skills through learning-by-doing. At the same time, it separates workers into more distinct roles, potentially reducing the interactions through which they learn from coworkers. The division of labor may therefore generate a second tradeoff: between learning-by-doing and learning through coworkers. Unlike the canonical productivity–coordination tradeoff, which governs current production, this tradeoff shapes human capital accumulation and productivity over time. Its net effect is ambiguous, depending on the relative strength of the two learning channels.

These considerations raise several questions that remain largely unanswered empirically, and in some cases conceptually: How pervasive are the productivity gains and coordination costs associated with a finer division of labor? How does the division of labor shape the way workers learn and accumulate human capital? Do workers and managers recognize these tradeoffs and respond to

[1]Together, learning-by-doing and coworker learning account for approximately three-quarters of all reported workplace learning in a large-scale survey of 20,000 workers in Norway conducted by Silliman and Willén (2025).

them in their workplace and organizational choices? And how do these dynamics influence workers' subsequent labor market outcomes and firms' decisions about how to acquire human capital?

In this paper, we study these two tradeoffs by combining the perspectives of firms and workers and examining how the division of labor within firms shapes current production and the accumulation of human capital. As these concepts are unobserved even in highly detailed administrative data, we combine population-wide linked employer–employee records with a large-scale workplace survey of 10,000 workers and newly collected survey experiments involving 814 managers and 975 workers. Together, these data allow us to open the black box of the firm and study how the division of labor within a firm relates to productivity and coordination costs; interactions among coworkers; learning and human capital accumulation; and the extent to which workers and firms recognize and respond to these tradeoffs.

To study these questions empirically, we construct two complementary measures of the division of labor within firms using administrative records and worker survey responses. Our administrative measure captures the distribution of employment across detailed four-digit occupations, calculated as one minus the occupational Herfindahl–Hirschman Index. Higher values indicate that employment is distributed more evenly across distinct occupational roles, consistent with a finer division of labor across workers rather than concentration in similar, potentially substitutable roles. Our survey measure instead captures the division of labor from the perspective of individual workers. Workers report their agreement with the statement *"Many people at my company could do my job"*, which we reverse-code so that higher values indicate more distinct, less substitutable roles. Unlike the administrative measure, this measure captures differences in the division of labor even among workers within the same occupation or firm.

The two measures capture complementary dimensions of the division of labor: the administrative measure characterizes the occupational structure of the firm, while the survey measure captures the distinctiveness of individual workers' roles. The measures are strongly correlated, suggesting that firms with greater occupational differentiation also tend to employ workers in less substitutable roles. In our empirical analysis, we use the administrative measure primarily to study firm outcomes, controlling for detailed industry and municipality, and the survey measure to study worker outcomes, controlling for detailed occupation and municipality.

Our empirical analysis combines descriptive, quasi-experimental, and experimental evidence. We begin by providing systematic, economy-wide evidence on the classical productivity–coordination tradeoff, which, despite its central role in economic theories of the firm, has received little empirical examination. Using population-wide administrative data, we examine how the division of labor relates to firm productivity, wage premia, and the resources devoted to managerial coordination. The longitudinal dimension of the administrative data further allows us to examine how changes in a firm's division of labor over time are associated with changes in worker and firm outcomes.

A particular advantage of our linked workplace survey is that it allows us to also move beyond these firm-level outcomes and examine the coordination demands and frictions experienced by workers in everyday production, including meetings, supervisory responsibilities, and the need to coordinate activities with colleagues.

We then extend the analysis beyond this classical tradeoff to examine how the division of labor shapes workplace interactions, learning, and human capital accumulation. Here, the survey data are particularly critical, as these outcomes are challenging to capture in administrative measures. For example, the survey data provide insight into not just how much workers report learning—something we can validate with the administrative data measure of wage-growth—but also how workers learn, what they learn, and how transferable those skills are perceived to be.

We complement this descriptive evidence with a quasi-experimental design that investigates the role of coworker interactions in human capital accumulation. Specifically, we exploit periods of extended parental and sick leave among coworkers in the same establishment and detailed 3-digit occupation. These absences temporarily reduce the thickness of the occupation within the firm. This reduces opportunities for interaction and learning from coworkers, while potentially requiring remaining workers to take on more tasks themselves and increasing opportunities for learning-by-doing.

Using population-wide administrative data, we examine whether exposure to these absences affects workers' subsequent wage growth. The two learning channels imply opposing forces: taking on greater responsibility during a coworker's absence may strengthen learning-by-doing, while losing access to that coworker may reduce learning through colleagues. We further investigate whether these effects vary with occupational DoL and the importance of coworker learning, as measured in our survey. If coworker learning is an important input into human capital accumulation, the negative effects should be smaller for workers in occupations with a finer DoL and larger for those relying more heavily on coworker learning. While coworker absences constitute a bundled treatment, we view changes in access to same-occupation coworkers and in the tasks undertaken by remaining colleagues as two first-order components of this bundle.

Identifying the causal effect of the division of labor within firms presents a distinct challenge. Because firms choose how to organize production and workers sort across workplaces and roles, the descriptive and even quasi-experimental relationships we document may reflect unobserved differences across firms and workers or endogenous firm responses to coworker absences rather than the effects of the division of labor itself. Addressing this challenge is particularly difficult because it is not obvious what naturally occurring variation would change the division of labor without also changing other features of the workplace.

The ideal thought experiment would randomly vary the extent to which employees perform overlapping tasks while holding the workers, firm, and production environment otherwise fixed.

We approximate this ideal through large-scale vignette experiments among workers and managers. Specifically, respondents evaluate hypothetical workplaces in which employees either perform narrow, differentiated tasks with little overlap or broader tasks with substantial overlap, while the tasks required for production and other workplace characteristics are held fixed. By randomly varying task overlap across otherwise identical hypothetical workplaces, we isolate how respondents perceive the division of labor to affect productivity, coordination, workplace interactions, and learning. Following the vignette experiments, respondents choose between the two workplaces and explain their choices, allowing us to examine whether these perceived tradeoffs shape workers' workplace preferences and managers' organizational decisions. Together, the experiments provide complementary evidence on the perceived consequences of the division of labor and their importance for workplace choices. Importantly, because respondents are actual workers and managers, their assessments are likely informed by their experiences in real workplaces

We document four sets of results. First, we examine the implications of workplace DoL for the tradeoff between production and coordination. We provide economy-wide evidence showing that a finer division of labor within firms is associated with higher productivity, but also requires greater resources devoted to coordination. Specifically, firms with a finer division of labor have higher revenue per worker, higher firm-specific wage premia, and higher wages, consistent with productivity gains from task trading. At the same time, they employ more managers, devote a larger share of the wage bill to managerial workers, and require more coordination in daily work, including more meetings and supervisory responsibility. These patterns are not restricted to between firm comparisons, but are also present when we study how changes in within-firm specialization over time are associated with changes in productivity and coordination costs.

Second, we turn from production to workplace interactions. Workers in more specialized roles report lower levels of social connectedness with colleagues, feel less supported by their coworkers, collaborate less, and experience more frictions in teamwork. These results suggest that the division of labor is associated not only with the formal costs of coordinating production, but also with how workers interact with one another.

Third, we examine the relationship between the division of labor and human capital accumulation. On the one hand, workers in narrower roles report greater learning-by-doing, consistent with deeper exposure to a narrower set of tasks. On the other hand, a finer level of labor division is associated with lower levels of coworker learning, consistent with the weaker workplace interactions documented above. This difference in coworker learning more than offsets the increase in learning-by-doing, such that workers in more specialized roles report substantially lower overall skill accumulation. The magnitude is economically meaningful, with workplace learning nearly 0.2 standard deviations lower among the most specialized workers than among the least specialized workers. Consistent with these patterns, workers in firms with a high division of labor also exhibit slower wage growth.

Our quasi-experimental analysis provides complementary evidence on the role of coworker learning. When a worker takes extended leave, their same-occupation coworkers experience reduced wage growth, with effects varying significantly by the degree of the occupational DoL. Specifically, coworker leave has a considerably larger negative effect on subsequent wage growth among workers who are in occupations with a lower DoL and in occupations in which coworker learning is more prevalent. This heterogeneity closely mirrors the cross-sectional associations we observe in the data, and provides support to the idea that reduced task-overlap with colleagues reduces human capital accumulation.

Fourth, we examine how firms' broader organizational and human resource practices respond to these differences in productivity and human capital accumulation. Population-wide administrative records reveal that firms with a finer division of labor hire older and more experienced workers, are less likely to recruit recent graduates, and rely less on internal promotions when filling managerial positions. These patterns are consistent with firms responding to weaker internal skill formation by acquiring more of their human capital externally. Although these results are descriptive, the patterns suggest that the division of labor in the firm may shape not only the skill development of their existing employees, but also the employment opportunities firms offer and how talent is acquired over time.

Taken together, these four results reveal a systematic set of relationships between the division of labor in a firm, production, coordination, social interactions, human capital accumulation, and worker and firm behavior. Many of these relationships have received little attention either conceptually or empirically. Our coworker-leave design goes further by providing quasi-experimental evidence that access to same-occupation coworkers facilitates human capital accumulation. At the same time, we are cautious about assigning a causal interpretation to the broader set of relationships: firms choose how to organize production, and workers sort across firms and roles.

To make progress on this question, we complement the above analyses with large-scale vignette experiments. The experimental design goes beyond simply testing whether workers' and managers' perceptions reproduce the relationships we document in the observational data. By randomly varying the division of labor while holding other features of the workplace fixed, we can isolate how workers and managers perceive its consequences for productivity, coordination, social interactions, and learning. The experiments also allow us to examine whether managers respond to these consequences by changing how they acquire human capital, and whether the tradeoffs generated by the division of labor shape workers' workplace choices and managers' organizational choices.

Workers and managers perceive a finer division of labor as making it harder for workers to coordinate tasks among themselves and to ask colleagues for help, and managers see their own coordinating role as more important. They also anticipate weaker social connectedness and less learning from coworkers, with little offsetting gain in independent learning. Both groups expect workers to improve less each year and to acquire skills that are less transferable across firms. Managers

also place more weight on hiring generalists when tasks overlap, consistent with narrow roles favoring recruits who already hold task-specific skills. Finally, when asked to choose, 63 percent of workers and 68 percent of managers prefer greater task overlap, with these workers consistently indicating social interactions and learning opportunities as reasons for this preference.

The core contribution of this paper is to broaden how economists think about the division of labor within firms. Existing theories view increasingly specialized production through the lens of a static tradeoff between productivity gains and coordination costs. We show that the division of labor also shapes the accumulation of human capital by altering workplace interactions and opportunities for learning. As a result, the consequences of the division of labor extend beyond the organization of current production to the formation of future productive capacity.

First, we contribute to the literature on the division of labor and the organization of production within firms. Beginning with the insights of Smith (1776) and Ricardo (1817), and formalized by Becker and Murphy (1992), this literature argues that increasingly specialized production allows workers to exploit comparative advantage, generating productivity gains but also creating coordination costs that limit the extent of specialization (see also Dessein and Santos, 2006; Garicano and Rossi-Hansberg, 2015). Despite the central role of the division of labor in theories of firm organization, large-scale empirical evidence remains scarce. Existing evidence largely comes from specific occupations or settings, including cashiers (Gong and Png, 2024), beauty salons (Kohlhepp, 2026), physicians (Karadakic et al., 2026), software developers (Liu, 2025), and teachers (Eastmond et al., 2026).

We provide economy-wide evidence on both sides of the classical productivity–coordination tradeoff. Consistent with existing theories, firms with greater specialization exhibit higher productivity and pay higher wages. At the same time, they devote more resources to coordination through managerial inputs, meetings, and supervisory structures. Importantly, while administrative data allow us to measure the formal organizational responses to specialization, our survey data reveal how specialization also reshapes interactions among coworkers. We show that more specialized workplaces exhibit weaker social connectedness, less collaboration, lower-quality teamwork, and reduced coworker support, suggesting that the organizational consequences of the division of labor extend beyond the formal coordination costs emphasized in existing theories. Finally, we show that a substantial share of the firm wage premium (e.g. Abowd et al., 1999; Kline, 2024) is associated with differences in the structure of the division of labor across firms.

Second, we contribute to a growing literature that views firms as environments for human capital accumulation rather than simply sites of production (Mincer, 1974; Gregory, 2020; Deming, 2023; Arellano-Bover and Saltiel, 2024). While this literature provides clear evidence highlighting the importance of firms for developing their workers' human capital, there is considerably less attention paid to how this relates to firms' organizational choices. On the other hand, existing theories of the

division of labor focus primarily on how specialization shapes current production, but have little to say about how it affects the accumulation of skills. We bring these two literatures into conversation with one another: the effect of firms' organizational choices on human capital development is theoretically ambiguous. Greater specialization within a firm may increase learning-by-doing by allowing workers to accumulate experience in a narrower set of tasks (e.g. Arrow, 1962; Rosen, 1972; Deming, 2023). At the same time, it may reduce opportunities for coworker learning by limiting task overlap, social well-being, collaboration, and knowledge exchange among colleagues (e.g. Mas and Moretti, 2009; Jarosch et al., 2021; Emanuel et al., 2026b; Herkenhoff et al., 2024; Emanuel et al., 2026a).

We provide evidence on this tradeoff by opening the black box linking the division of labor to workplace learning. In a first step, we show that an increased division of labor within the firm reduces social connectedness among coworkers, but increases the extent of task specialization. Next, we document that specialization within a firm changes both sources of workplace learning in opposite directions: workers in more specialized roles learn more through their own tasks but less from their coworkers. The decline in coworker learning dominates, resulting in lower overall skill accumulation, and our coworker-leave design provides complementary causal evidence on the role of coworker interactions in human capital accumulation. These findings provide a new explanation for why workers and firms differ in their rates of human capital accumulation, highlighting the role of workplace interactions and the organization of production in shaping the formation of future productive capacity.

2 Conceptual framework

This section develops a simple conceptual framework that extends the classical theory of the division of labor to incorporate human capital accumulation. The starting point is the productivity–coordination tradeoff emphasized by Smith (1776) and Becker and Murphy (1992): dividing production more finely across workers generates productivity gains from specialization, but also increases the resources required to coordinate production. We add a second margin by allowing the division of labor to shape how workers accumulate human capital. We conclude by outlining a set of empirical predictions that follow from this stylized framework.

2.1 Task-based production with learning

We consider a simple task-based representation of production. Firms produce a single final good Y by combining a continuum of complementary tasks, indexed by $s \in [0, 1]$ (see, e.g., Becker and Murphy, 1992; Autor et al., 2003; Acemoglu and Autor, 2011; Deming, 2017). Tasks represent the activities required for production, and workers allocate their labor across these tasks. We aggregate task output

using a Cobb–Douglas technology, which provides a simple representation of complementarity across the tasks required for production:

$$Y = \exp\left(\int_0^1 \ln y(s), ds\right). \tag{1}$$

As in Becker and Murphy (1992), the interdependence and difficulty of tasks are assumed to be uniform. Workers can nevertheless specialize by performing only a subset of the tasks required for production. The degree of each worker's specialization is represented by the width of the task set ($w \in [0, 1]$) assigned to them, with a smaller w corresponding to a greater division of labor and higher level of within-firm specialization. The extent to which tasks can be divided across workers is limited by firm size. Under a perfect division of labor across workers, the width of the task set performed by each worker is given by $w = 1/n$, where n is the total workforce at the firm. Productivity per worker (i) is a function of the firm's total factor productivity (A), the worker's human capital (H_i), and the degree of division of labor:

$$y_i(H_i, w) = A \cdot H_i^{\alpha} \cdot (1/w)^{\beta}, \quad \text{where } \alpha, \beta > 0. \tag{2}$$

Workers carry their own human capital, whereas the scaling factor (A) and the degree of division of labor (w) are workplace-specific. The term $(1/w)^{\beta}$ captures the static productivity gains from a finer division of labor emphasized in the classical framework. Final output Y aggregates task-level outputs according to the Cobb–Douglas technology above, capturing complementarities across tasks rather than a simple sum of worker outputs.[2]

A finer division of labor also increases the resources required to coordinate production across workers. We capture these coordination costs (C_s) by assuming that they rise at an increasing rate as tasks are divided more finely across workers:

$$C_s(w) = c \cdot (1/w)^{\gamma}, \quad \text{where } c > 0, \gamma > 1. \tag{3}$$

Coordination costs can take many forms, including the time and resources required to communicate across workers, monitor and integrate their activities, and ensure that separately performed tasks fit together in production. In practice, a finer division of labor may therefore require more managers and supervisory responsibility, a larger share of the wage bill devoted to managerial workers, or more time spent in meetings and other coordinating activities. These are examples of the broader resources firms may devote to coordinating production as tasks are divided more finely across workers.

Together, these two forces generate the classical tradeoff at the center of the division of labor. A finer division of labor raises productivity, but also increases the resources required to coordinate

[2]Cobb–Douglas provides a tractable representation of complementarities across tasks; the specific aggregation technology is not essential to the tradeoffs we study.

production.

We extend this static productivity–coordination tradeoff stemming from the division of labor from Becker and Murphy (1992) by allowing the DoL to also shape human capital accumulation over time. We capture this by allowing the rate of human capital accumulation to depend on a baseline rate of learning (δ), the worker's existing stock of human capital (H_i), and the degree of division of labor (w):

$$L = \frac{dH_i}{dt} = \delta H_i^{\varepsilon} w^{\phi}. \tag{4}$$

More specifically, the technology of workplace skill production (ϕ) determines how the division of labor shapes learning. As Smith (1776) proposes, the subdivision of tasks may facilitate greater learning-by-doing, and therein increase what he calls the dexterity of the workers. In fact, this is Smith's first explanation of why the division of labor increases worker productivity. On the other hand, a finer division of labor reduces task overlap between workers, potentially limiting opportunities for interaction, knowledge exchange, and coworker learning. The parameter ϕ captures the relative importance of these two forces. If coworker learning dominates, then greater task overlap facilitates learning and $\phi > 0$. If learning-by-doing dominates, then narrower task assignments increase learning and $\phi < 0$:

$$\frac{\partial L}{\partial w} > 0 \text{ if } \phi > 0, \qquad \frac{\partial L}{\partial w} < 0 \text{ if } \phi < 0.$$

The introduction of human capital accumulation adds a dynamic dimension to the firm's optimization problem. In the classical framework, firms balance the productivity gains from the DoL against the coordination costs it creates. When firms benefit from workers' future productivity, however, they also have an incentive to consider how the division of labor affects the technology of workplace skill formation and, through it, worker productivity in later periods. The firm's choice of how finely to divide tasks therefore depends not only on its consequences for current production, but also on its implications for future productivity. Appendix Figure A.1 provides a schematic illustration of how the division of labor shapes current production and human capital accumulation, and how these channels jointly influence future productivity.

To make this tradeoff explicit, we consider a firm with identical workers, so that $H_i = H$ for all i, and characterize the firm's dynamic choice of the division of labor using the following present-value Hamiltonian:

$$\mathcal{H} = e^{-rt} \cdot [Y(H, w) - C_s(w) - W] + \lambda(t) \cdot L(H, w). \tag{5}$$

In this problem, the firm chooses the width of the task set assigned to workers, $w(t)$, in each period, taking the coordination cost function, total labor costs W, and the discount rate r as given.

The firm's optimization problem is constrained by how human capital evolves through learning and by the worker's initial stock of human capital:

$$\frac{dH}{dt} = L(H(t), w(t)), \quad H(0) = H_0. \tag{6}$$

Bringing these elements together, the firm's problem is to choose the level of division of labor within the firm which maximizes profits over several periods, where $\lambda(t)$ denotes the present-value shadow value of an additional unit of human capital. This yields the following first-order condition with respect to within-firm DoL:

$$\frac{\partial \mathcal{H}}{\partial w} = 0 \quad \Longrightarrow \quad e^{-rt} \cdot \left[\frac{\partial Y}{\partial w} - \frac{\partial C_s}{\partial w}\right] + \lambda(t) \cdot \frac{\partial L}{\partial w} = 0. \tag{7}$$

The first-order condition implies that firms must balance three forces when choosing their level of division of labor over time. The first two correspond directly to the mechanisms emphasized by Becker and Murphy (1992):

1. *Productivity ($\partial Y/\partial w < 0$)*: A finer division of labor raises current productivity.
2. *Coordination ($\partial C_s/\partial w < 0$)*: A finer division of labor increases coordination costs.
3. *Learning ($\partial L/\partial w \gtrless 0$)*: A finer division of labor may strengthen learning-by-doing but weaken coworker learning, leaving the net effect ambiguous.

2.2 Predictions

The stylized framework highlights four ways in which the division of labor may shape the workplace: through productivity, coordination, interactions among coworkers, and human capital accumulation.

First, workplaces with a higher level of division of labor (specialization within the firm) should exhibit higher contemporaneous productivity and, to the extent that these productivity gains are shared with workers, higher firm wage premia. This reflects the static gains from task trading and complementarities between workers. In the data, this should appear as a positive relationship between within-firm DoL and measures such as firm fixed effects, revenue per worker, or value added.

Second, a finer degree of within-firm DoL should be accompanied by higher coordination inputs. As production becomes more fragmented, firms should employ more managers, employ different kinds of managers, devote a larger share of wages to coordination roles, or report greater time spent on coordination-related activities. These patterns would provide direct evidence that higher levels of within-firm specialization are accompanied with greater investments in coordination.

Third, increased levels of within-firm DoL should be associated with lower levels of collaboration, social connectedness, and coworker learning. As workers specialize in a narrower width of the firm's

tasks, they have fewer opportunities to interact and exchange knowledge, collaborate less frequently, and report weaker collegial ties or support.

Fourth, the relationship between the division of labor and human capital accumulation is ambiguous. As noted above, narrower task assignments may reduce coworker learning. However, they may also strengthen learning-by-doing through repetition and independent problem-solving. The overall effect depends on the relative strength of these two learning channels.

Finally, while more speculative, these considerations may also have implications for firms' hiring strategies and workers' mobility decisions. If a finer division of labor reduces overall human capital accumulation, firms may rely more on hiring experienced workers rather than developing talent internally. The composition of skills may also matter. Narrower roles may favor recruits who already possess task-specific human capital, whereas greater task overlap may facilitate coworker learning and enable firms to develop less experienced recruits on the job. For workers, acquiring fewer and narrower skills that are potentially less transferable may limit outside opportunities and reduce mobility across employers. Although our framework does not explicitly model hiring or mobility decisions, we explore these possibilities in the data.

3 Context and data

3.1 Norwegian Labor Market

Our empirical analysis is conducted in Norway. Norway has a highly educated workforce and a diverse industry composition spanning manufacturing, energy, maritime industries, business services, and the public sector. Production across these sectors involves substantial variation in occupational structure, task differentiation, and the extent to which production requires coordination across workers with different skills and responsibilities.

The Norwegian labor market is characterized by a relatively high labor force participation rate and substantial worker mobility across firms over the life cycle (Silliman and Willén, 2025). Employment protection is moderately strict by OECD standards and comparable to several other European economies (Huttunen et al., 2018). Wage setting operates through a two-tier collective bargaining system (Dodini et al., 2022). Centralized negotiations establish broad wage norms and minimum standards, while firm-level bargaining allows wages to vary with local productivity, rents, and other firm-specific conditions. Despite high union density and collective bargaining coverage, there is therefore meaningful variation in wages and firm wage premia across workplaces (Dodini et al., 2026).

The extent to which our estimates generalize beyond Norway is ultimately an empirical question. Institutional features, industry composition, and the organization of production may affect both

the extent of the division of labor and the magnitude of its consequences. At the same time, we have no particular reason to expect the mechanisms we study—the links between the division of labor, productivity, coordination, interaction, and learning—to be unique to the Norwegian setting. Examining these relationships in other countries and institutional settings is an important direction for future work.

3.2 Data

Our analysis draws on three complementary sources of data: comprehensive administrative registers covering the universe of workers and firms in Norway; a large-scale workplace survey that provides detailed information on tasks, coordination, collaboration, sociability, connectedness, and learning at work; and a separate set of vignette experiments that experimentally vary the division of labor to study how workers and managers perceive and respond to its consequences for productivity, coordination, and learning. The administrative data allow us to study workplace organization, wages, and productivity over time and at scale, while the workplace survey captures dimensions of work that are not observable in the registers. The vignette experiments provide complementary experimental evidence on the mechanisms behind our findings.

Population-wide administrative data. Our primary data source consists of linked administrative registers maintained by Statistics Norway, covering the full population of workers and firms from 2000 to 2024. The registers contain annual information on workers' earnings, employment status, occupations, education, demographic characteristics, and geographic location. Workers can be followed over time and across employers, allowing us to study career trajectories, wage growth, and mobility within and between firms.

The administrative data also provide detailed information on firms, including industry classification, employment, revenues, and wage bills. These data allow us to measure workplace size, occupational composition, and firm-level outcomes such as revenue and wage premia.

A key advantage of these data is their coverage of all workers and firms in the Norwegian economy, allowing us to provide economy-wide evidence on the relationship between the division of labor, productivity, and coordination costs. They also allow us to assess the representativeness of our worker survey and benchmark and validate our survey-based measures. On their own, however, the administrative records lack the direct measures of workplace interactions and learning needed to study how the division of labor shapes human capital accumulation.

Large-scale worker survey. We complement the administrative records with a newly collected survey of approximately 10,000 workers in Norway, which was conducted by Norstat. The survey measures aspects of workplace organization that are typically absent from administrative data: the tasks workers perform, how substitutable their roles are with those of coworkers, and how they collaborate and coordinate production. Detailed questions cover team organization, coworker support,

social connectedness, supervisory responsibility, and the time spent in meetings and other work activities.

The survey also measures what workers learn and how they learn it. Respondents report their overall improvement at work, the acquisition of new skills and development of existing skills, and the extent and sources of learning across 13 skill domains and 13 task domains. These questions distinguish learning from coworkers, learning-by-doing, formal training, and other channels. Additional questions capture the perceived transferability of acquired skills across employers, occupations, and industries, learning incentives, and outside job opportunities. Linking these responses to administrative records allows us to connect workers' accounts of workplace organization and learning to their employment and wage trajectories and the characteristics of their employers. Selected learning questions build on those used in the earlier survey of 20,000 workers analyzed by Silliman and Willén (2025); the survey used here is a separate data collection with additional measures of workplace organization and interaction. The aspects of the survey we use in this paper are detailed in Section 4, and the full survey is provided in the Appendix B.

Linking this large-scale survey to the population-wide administrative records allows us to connect detailed measures of workplace organization and learning to workers' employment and wage histories and the characteristics of their employers. However, the survey measures are observed only once, limiting our ability to study changes in workplace organization and learning or exploit quasi-experimental variation in these measures. Table 1 compares the means and standard deviations of worker characteristics in the survey sample and the population. This table indicates that while our survey sample is broadly representative of the population, it is somewhat positively selected in the workers it encompasses.

Complementary survey experiments with real-world workers and managers. We complement the administrative records and large-scale worker survey with vignette experiments conducted among 975 workers and 814 managers in the summer of 2026. Each survey took approximately ten minutes to complete. We describe their design and content in Section 7.

These samples are less broadly representative than the large-scale worker survey and are not linked to administrative records. Their key advantage is experimental: we randomly vary the degree of task overlap across employees in otherwise identical hypothetical workplaces, identifying how workers and managers perceive the division of labor to affect productivity, coordination, workplace interactions, and learning. Following the vignette experiment, respondents choose between the two workplaces and explain their choices, allowing us to examine whether these perceived tradeoffs also matter for workers' workplace preferences and managers' organizational decisions.

Table 1: Summary Statistics: Administrative Population and Survey Sample

	Full Population		Survey Sample	
Variable	Mean	(SD)	Mean	(SD)
Annual earnings (NOK)	640,045	(460,213)	713,410	(338,613)
Disability benefits	6,009	(40,097)	6,995	(42,052)
Unemployment benefits	1,570	(13,946)	1,307	(13,207)
Sickness benefits	18,673	(59,609)	19,443	(59,673)
Parental benefits	8,011	(43,506)	8,038	(43,835)
Age	42.26	(13.79)	45.61	(12.19)
Female	0.486		0.487	
Less than High school	0.150		0.070	
High school	0.385		0.326	
Bachelor's degree	0.305		0.401	
More than bachelor's degree	0.156		0.203	
High-skill occupations	0.526		0.699	
Clerical/service	0.280		0.209	
Manual/trades	0.150		0.073	
Elementary	0.044		0.018	
Primary/extraction	0.034		0.027	
Manufacturing/utilities	0.093		0.078	
Construction	0.082		0.036	
Trade/transport/hospitality	0.208		0.170	
Finance/professional services	0.131		0.156	
Other services	0.451		0.533	
Permanent contract	0.872		0.922	
Manager	0.053		0.048	
Workplace size	76.04	(234.97)	85.68	(251.09)
Task specialization index	0.250	(0.334)	0.233	(0.328)
Occupations per firm	12.00	(12.54)	13.89	(13.28)
Firm size	301.10	(907.60)	365.57	(985.78)
Observations	2,541,834		9,119	

Notes: This table reports the means and standard deviations of a broad range of outcomes in the full population of the administrative data we access, as well as in the linked survey-administrative linked data samples.

4 Operationalization and measurement

To examine the predictions outlined in Section 2, we construct complementary measures of the division of labor suited to different levels of analysis and empirical approaches. Our main analyses use administrative records to capture how work is divided across occupational roles within firms and survey responses to capture how differentiated individual workers' roles are within their workplaces. We subsequently use an occupation-level measure to study heterogeneity in responses to coworker absences and experimentally vary task overlap to examine how workers and managers evaluate alternative organizational structures. Appendix Table A.2 summarizes these four measures and their applications. This section describes the construction of our main measures, together with the outcomes used to study productivity, coordination, social connectedness, and learning.

4.1 Measuring the degree of workplace specialization

Division of labor—administrative measure. We measure the division of labor within firms by the degree of internal task differentiation. Conceptually, this captures whether production is carried out by workers performing similar, substitutable roles or by workers allocated to distinct occupational roles. Empirically, we measure this dimension using the distribution of detailed four-digit occupations within establishments in the administrative registers. Let n_{jeo} denote the number of workers in occupation o at establishment e of firm j, and let N_{je} denote total establishment employment. We first compute occupational employment shares, $s_{jeo} = n_{jeo}/N_{je}$, and summarize the occupational distribution using a Herfindahl–Hirschman Index (HHI),

$$HHI_{je} = \sum_{o} s_{jeo}^2. \tag{8}$$

The HHI approaches 1 when employment is concentrated in a small number of occupations and 0 when employment is spread across many occupations. Since our interest lies in occupational differentiation rather than occupational concentration, we define the establishment-level division of labor as $D_{je} = 1 - HHI_{je}$. Because our firm-level outcomes are measured at the firm rather than establishment level, we aggregate this measure to the firm level using establishment employment weights. In practice, most firms in our sample operate a single establishment, in which case the establishment- and firm-level measures coincide.[3] Higher values of D_j indicate a finer division of labor, with workers distributed across a larger and more balanced set of occupational roles. Importantly, the measure captures how firms organize work across occupations, rather than whether individual workers are themselves specialists or are in occupations which might be considered

[3]Appendix Table A.1 illustrates the measure using two fictional software firms of the same size. Firm A employs workers in several distinct software roles—including IT operations, systems analysis, and QA/testing—whereas Firm B relies more heavily on the general role of software developer. The resulting values of D_j are 0.86 and 0.62, respectively.

specialized. In all of our analyses of firm-level outcomes, we include industry fixed effects to ensure that the variation in this measure comes from within-industry differences across firms, rather than variation across industries.

We construct D_j annually for each firm, allowing us to examine both cross-sectional differences in the division of labor and changes within firms over time.

In complementary analyses, we construct analogous measures using coarser one-digit occupational codes, which capture broader differences in occupational roles and hierarchical positions within firms. We also estimate specifications that include both levels of occupational differentiation (one-digit and four-digit). The latter allows us to capture differences in fine-grained task differentiation among firms with similar distributions of workers across broad occupational categories.

Division of labor—survey measure. We complement the firm-level administrative measure of DoL with a worker-level measure of DoL capturing the extent to which individual workers perform differentiated tasks. While the firm-level administrative measure provides information on how the division of labor is organized within the workplace, it may mask substantial heterogeneity in how DoL is experienced by individual workers. Workers employed in the same firm can differ in the breadth of their responsibilities, the uniqueness of their tasks, and the extent to which they can be substituted by coworkers even if they hold the same occupational role. In the fictional firms described in Appendix Table A.1, advertising is a more specialized role in Firm B than in Firm A—even though the overall firm-level measure of DoL is higher in Firm A. Moreover, occupational codes may be an imperfect proxy for the actual degree of DoL embodied in a worker's day-to-day activities.

In the workplace survey, workers are asked to what extent they agree with the statement *"Many people at my company could do my job."*, with responses recorded on a scale from 1 to 10. The question captures the degree to which a worker's role is perceived to be unique or substitutable within the workplace. We reverse-code the measure so that higher values indicate lower perceived substitutability and hence greater worker specialization (or firm division of labor). In all our analysis of worker-level outcomes, we include detailed four-digit occupation fixed effects such that the variation in this measure comes from within-occupation differences across firms, rather than variation across occupations.

Beyond capturing a distinct dimension of DoL from an independent data source, the survey measure also provides a useful validation of our register-based measure of the division of labor. Aggregating survey responses to the firm level, we show that workers report substantially lower substitutability in firms with a finer division of labor according to the administrative measure. This correspondence suggests that the occupation-based measure captures meaningful variation in the degree to which tasks are divided across workers within firms.

We further use the survey to distinguish the breadth of workers' tasks and skill requirements from the intensity with which they perform tasks and rely on particular skills. Less substitutable roles

need not involve fewer tasks or skills overall; instead, they may involve a similarly broad range but place greater emphasis on a smaller subset. Respondents rate the time spent on different tasks and the importance of different skills on a 1–10 scale. For tasks and skills separately, we report the number of items rated above 1, the number rated above 7, and the share of answered items rated 10. These measures allow us to assess whether differences across roles concern the overall range of tasks and skills or the subset performed frequently and considered highly important.

Interpretation of the division of labor measures. Measuring the division of labor within firms is challenging because the allocation of tasks across workers is rarely directly observed. Our two measures capture different, but closely related, aspects of how work is divided: the distribution of employment across occupational roles and the extent to which individual workers are substitutable with their coworkers. Neither provides a perfect measure of the division of labor, and alternative operationalizations are possible. We therefore examine how the two measures relate to one another and to workers' reported tasks and skill requirements to assess whether they capture meaningful variation in how work is organized within firms.

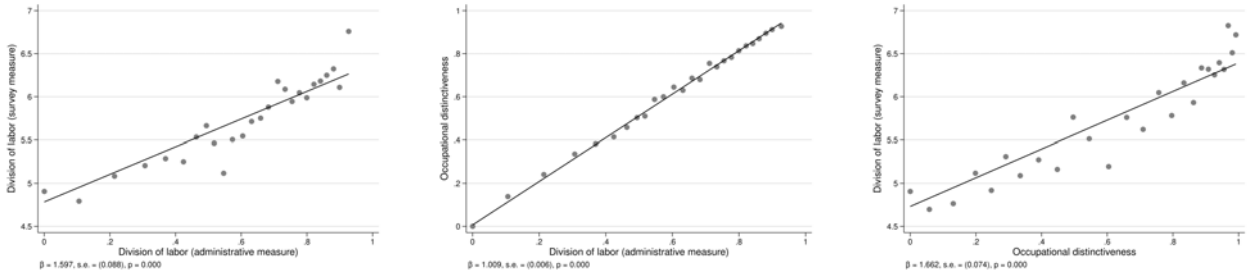
Figure 1(a) relates the survey-based worker-level measure of DoL to our administrative-based firm-level measure of DoL. Despite being constructed from different data sources and capturing DoL at different levels of analysis, the two measures are strongly related. Workers employed in firms with a finer division of labor report substantially lower substitutability. The relationship is helpful for interpreting both measures as capturing related dimensions of how work is divided within firms.

Figure 1 relates the administrative-based DoL measure (b) and the survey-based DoL measure (c) to workers' occupational distinctiveness, measured as one minus the share of workplace employment in their own occupation. Higher values indicate that fewer coworkers share the worker's occupation. Even though the measures capture related aspects of the occupational structure of the workplace, they describe it at different levels. The positive relationships illustrate how a finer division of labor across occupations corresponds to greater occupational distinctiveness at the worker level.

Finally, Appendix Figure A.2 relates the survey-based DoL measure to workers' tasks and skill requirements. Workers in less substitutable roles report a similar overall range of tasks and skills, but fewer tasks performed frequently and fewer skills considered highly important. Together, these patterns suggest that less substitutable roles involve greater concentration on a narrower set of core tasks and skills rather than a narrower overall range of responsibilities.[4]

[4]In subsequent analyses that rely on quasi-experimental variation in coworker access and experimental variation in task overlap, we introduce two additional measures of the division of labor: an occupation-level measure based on aggregated survey responses, used in our quasi-experimental analysis of coworker absences, and an experimental measure based on randomized variation in task overlap across workers. Appendix Table A.2 summarizes the construction, interpretation, and empirical applications of all four measures.

Figure 1: Measures of the within-firm division of labor



(a) Survey and administrative measures

(b) Administrative measure and occupational distinctiveness

(c) Survey measure and occupational distinctiveness

Notes: Panel (a) plots the survey measure of the division of labor against the administrative measure, defined as one minus the Herfindahl–Hirschman Index of four-digit occupational employment shares within an establishment. The survey measure reverse-codes agreement with the statement that many people at the workplace could perform the respondent's job, so that higher values indicate lower perceived substitutability across coworkers. Panel (b) plots occupational distinctiveness against the administrative measure. Occupational distinctiveness is constructed by subtracting the share of establishment employment in the respondent's own four-digit occupation from one. Higher values indicate that a smaller share of establishment employees belong to the respondent's occupation. Panel (c) plots the survey measure against occupational distinctiveness. All panels use survey respondents linked to 2023 administrative employment records and show unadjusted relationships. Dots report mean values of both variables within 30 quantile bins of the horizontal-axis variable; solid lines show linear fits estimated using the underlying worker-level observations.

4.2 Measuring productivity and coordination costs

Productivity. We use revenues from firms' accounting records to construct proxies for labor productivity. We consider revenue in two ways. First, revenue per worker captures whether DoL is associated with an increase in output intensity. Second, motivated by the Becker–Murphy tradeoff between DoL and coordination, we examine revenue per non-managerial worker. Because a finer degree of DoL may require additional managerial coordination, excluding managers from the denominator helps isolate how DoL relates to the productivity of production workers themselves. These measures naturally capture productivity with noise, but provide the best available proxies in the accounting data.

Firm fixed effects as a measure of production complementarities. We complement these observable proxy measures of firm productivity with estimates of firm wage-premia. Following Becker and Murphy (1992), a finer division of labor may increase output by allowing workers to specialize according to comparative advantage and exploit production complementarities. Firm wage premia estimated from matched employer–employee data may provide information about such complementarities. These premia capture persistent differences in pay across firms after accounting for worker fixed effects (Abowd et al., 1999; Kline, 2024). To the extent that production complementarities raise workers' productivity and these gains are shared with them, they may be reflected in firm-specific wage premia. We therefore examine whether firms with a finer internal division of labor—and firms that become more specialized over time—also exhibit higher estimated

firm effects. Firm effects are estimated on the largest connected set of workers with flexible controls for life-cycle wage profiles (fourth order polynomials in age). Following Lachowska et al. (2023), we use the estimated effects directly without empirical Bayes shrinkage.

To study dynamics, we estimate firm wage premia separately over two long windows (2008–2012 and 2018–2022) and relate changes in these premia to changes in workplace DoL over the same period. This allows us to capture long-run adjustments in firm wage premia as firms reorganize production and adjust their internal division of labor.

Coordination. We measure coordination using both administrative and survey data. Using occupational codes, we construct measures of formal coordination structures within firms, including the share of workers employed in managerial roles, the share of the wage bill paid to managers, and the degree of specialization among managers themselves. These measures capture the organizational resources devoted to coordinating production. We complement these administrative measures with detailed survey evidence on how coordination operates within workplaces. Workers report time spent in meetings, participation in coordination-related meetings, and supervisory responsibilities, allowing us to capture coordination activities and managerial duties beyond those identified by occupational codes. We also measure active collaboration and how easy it is to align work across workers. Together, these measures reveal how coordination demands and frictions manifest in day-to-day work, capturing dimensions that managerial employment and wage shares alone cannot show.

4.3 Measuring social connectedness and learning

Social connectedness and collaboration. We measure workplace interactions using a combination of survey-based measures of social connectedness, collaboration, and coworker support. Our primary measure of social connectedness is based on the Inclusion of Other in the Self (IOS) scale (Aron et al., 1992; Cialdini et al., 1997), which asks respondents to select the pair of overlapping circles that best captures their sense of closeness with colleagues at work (Appendix Figure A.3). The IOS scale has been widely validated in psychology and has increasingly been used in economics to measure social connectedness and group cohesion (e.g. Gächter et al., 2015; Baader et al., 2024; Gächter et al., 2025; Carvajal, 2026).

We complement the social-connectedness measure with detailed questions on how workers interact: how often they collaborate, whether colleagues help with demanding tasks, and whether teamwork improves efficiency, speeds up work, and helps them meet goals and deadlines. We also ask whether workers learn from coworkers and feel supported and fairly treated by management. Together, these questions capture both how connected workers feel and how their relationships function in daily work, providing information on workplace interactions that is typically unavailable in administrative data.

Workplace learning. We measure workplace learning using both survey-based and administrative

outcomes. Our primary survey measure follows Silliman and Willén (2025) and asks workers to indicate their agreement with the statement *"I am better at my job than I was a year ago."* This measure captures perceived skill development and is well suited to capturing learning that may not immediately translate into observable changes in tasks, occupations, or wages.

We complement this measure with administrative data on wage growth, which capture the labor-market valuation of accumulated skills. Our primary administrative measure is worker-level wage growth between consecutive years, measured in logs.

Beyond overall skill development, the survey distinguishes whether workers acquire new skills or deepen existing ones, allowing us to examine how the division of labor shapes the nature of human capital accumulation. Across 13 skill domains, respondents report how much they learn and through which channels, including learning-by-doing, learning from coworkers, formal training, and other sources. This detail allows us to connect workplace organization to both the content of learning and the channels through which it occurs. Workers also report whether acquired skills can be used in other firms, occupations, and industries, allowing us to understand how DoL contributes to broad and generalizable skills versus narrow and specific skills. Together, these measures reveal not only how much workers learn, but what they learn, how they learn it, and where those skills can be used.

5 Economy-wide evidence

In this section, we present economy-wide evidence on how the division of labor within firms relates to productivity, coordination, workplace interactions, learning, and worker and firm behavior. We organize the results into three parts. First, we examine the relationship between the division of labor, productivity, and coordination. Second, we study how the division of labor relates to social connectedness, collaboration, and workplace interactions. Third, we examine the association between the division of labor and learning, human capital accumulation, and wage growth.

Our main specifications include detailed four-digit industry and municipality fixed effects when using the administrative DoL measure, and four-digit occupation and municipality fixed effects when using the survey measure. We residualize both the DoL measure and the outcome on the corresponding fixed effects. The firm-level specifications therefore account for systematic differences across industries and locations, while the worker-level specifications account for systematic differences across detailed occupations and locations. Thus, the firm-level analyses compare firms with different divisions of labor after accounting for industry and location, while the worker-level analyses compare workers in the same detailed occupation who differ in how substitutable their roles are with those of their coworkers, adjusting also for location.

We do not additionally condition on firm size in the main specifications because scale is central to the division of labor itself. In Becker and Murphy (1992), larger firms can allocate workers to

narrower sets of tasks, making a finer division of labor feasible. Holding size fixed would therefore exclude a meaningful source of variation in how firms organize production. Workforce composition may likewise reflect both determinants of organizational choices and firms' hiring responses to those choices. We nevertheless assess whether the relationships persist after accounting for these characteristics. Appendix Tables A.3, A.4, and A.5 progressively add industry and municipality fixed effects, firm-size controls, and workforce characteristics in the firm-level analyses, and occupation and municipality fixed effects, firm-size controls, and individual characteristics in the worker-level analyses. Most magnitudes change relatively little, and all coefficients remain statistically significant, although the relationship between the division of labor and wage growth—our administrative proxy for learning—attenuates when controlling for worker age. These relationships remain descriptive.

5.1 Division of labor, firm performance, and coordination

We begin by examining how the division of labor within firms relates to firm performance and coordination. We first document the relationship across firms, using both administrative and survey data, before examining whether similar patterns emerge as the division of labor changes within firms over time.

Performance. Figure 2 (a) plots revenue per worker against our firm-level measure of the division of labor after conditioning on municipality and four-digit industry fixed effects. The relationship is strongly positive and approximately linear: firms with a finer division of labor are associated with substantially higher revenue per worker.[5]

Figure 2 (b) complements the evidence on revenue per worker by examining the firm wage premia described above. Firm wage premia capture persistent differences in wages across firms after accounting for persistent worker heterogeneity. This is useful because a positive relationship between the division of labor and average wages could simply reflect differences in the types of workers employed across firms.[6]

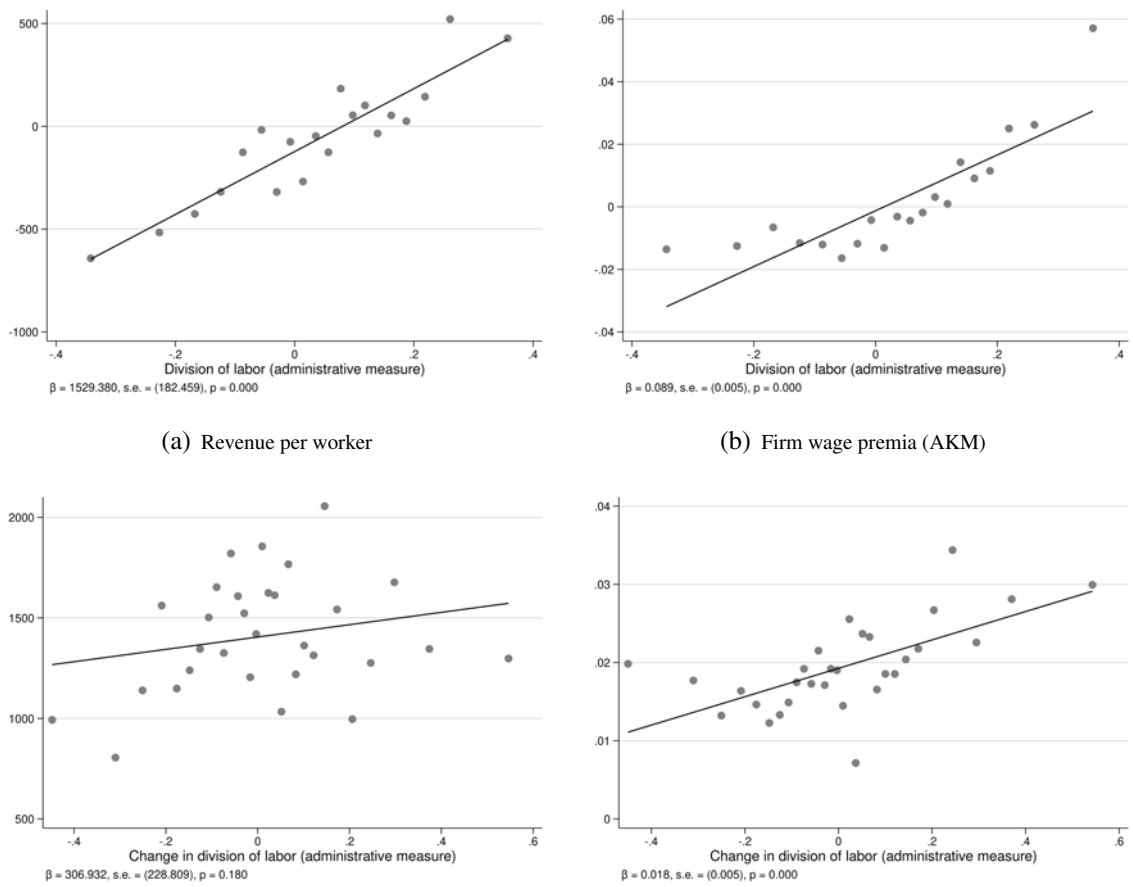
The patterns outlined in Panels (a) and (b) of Figure 2 provide initial support for the idea that higher levels of workplace specialization may allow for improved firm performance. In particular, the increase in firm wage premia—beyond differences in the individual productivity of workers—is consistent with complementarities within the firm, which would allow workers to be more productive than in other settings.

Appendix Table A.3 examines the sensitivity of this relationship to a range of observable firm characteristics. Since we are interested in organizational decisions of firms conditional on industry, our

[5]Appendix Figure A.4 shows that the positive cross-sectional relationship between the division of labor and revenue per worker persists after netting out managerial costs.

[6]Indeed, average wages increase strongly with increases in the division of labor (Appendix Figure A.5). Importantly, however, Figure 2 (b) shows that firms with a finer division of labor also have substantially higher firm wage premia. The relationship is strongly positive and approximately linear.

Figure 2: The division of labor and productivity



(a) Revenue per worker

(b) Firm wage premia (AKM)

(c) Change in revenue per worker

(d) Change in firm wage premia (AKM)

Notes: Panel (a) plots revenue per worker in 2023, expressed in thousands of NOK, against the administrative measure of the division of labor. Panel (b) plots firm wage premia estimated over 2019–2023 following Abowd et al. (1999) and Kline (2024) against the same measure. Panel (c) plots changes in revenue per worker between 2008 and 2023 against changes in the division of labor over that period. Panel (d) plots changes in firm wage premia between the 2008–2012 and 2019–2023 estimation windows against changes in the division of labor between 2008 and 2023. The division-of-labor measure is one minus the Herfindahl–Hirschman Index of four-digit occupational employment shares within an establishment, averaged across a firm's employees. Both variables in each panel are residualized with respect to industry and municipality fixed effects; industry and municipality are assigned using the most common classifications among each firm's employees. For panels (c) and (d), the underlying measures are residualized separately in each period before taking differences. The sample includes firms with 4–5,000 employees. Dots report mean values of both variables within quantile bins of the horizontal-axis variable; solid lines show linear fits estimated using the underlying firm-level observations.

main specification includes industry fixed effects; this does attenuate the raw associations considerably, particularly for firm wage-premia. As firm size may be endogenous to a firm's organizational structure, we refrain from controlling for it in our main results. However, we also report specifications conditioning on detailed firm-size bins. These yield qualitatively similar associations, although they capture a different comparison by holding fixed a firm characteristic that may itself be shaped by the division of labor. Additional controls for workforce composition, including education, gender, and age, have little effect on the estimates. Overall, the results suggest that the relationship between workplace specialization and productivity is not driven by differences in firm size, location, industry, or workforce characteristics.

Next, panels (c) and (d) of Figure 2 examine whether changes in workplace DoL within firms are accompanied by corresponding changes in firm performance over a ten-year period. Because this exercise compares firms to themselves over time, it differences out all time-invariant firm characteristics and therefore provides a more demanding test of the relationship between DoL and production.

The results broadly mirror the cross-sectional evidence. The association between changes in the firm's division of labor and changes in revenue per worker is positive, but a bit weaker and somewhat noisier. In contrast, changes in firm wage premia exhibit a clear positive relationship with changes in the division of labor. The magnitude of this relationship is similar to that observed in the cross-sectional specifications with the full set of firm controls. As in the case of the cross-sectional results, however, these results do not necessarily imply that increases in the division of labor cause increases in firm performance.

Coordination. A finer division of labor may also require firms to devote greater resources to coordinating production across workers. We begin by examining this relationship in the cross section. Figure 3 shows a strong and approximately linear relationship between the division of labor and the share of workers employed in managerial roles (Panel a). Firms with a finer division of labor devote a substantially larger fraction of their workforce to managerial roles. This relationship is robust in both sign and magnitude to the inclusion of industry and municipality fixed effects, firm-size controls, and workforce characteristics (Appendix Table A.3).

We complement the manager share measure with additional indicators capturing the role of managers. First, we examine the share of the firm's wage bill paid to managers. Second, we examine managerial differentiation, measured as the number of distinct managerial occupations within the firm. Third, we construct a manager-level specialization measure analogous to our worker specialization measure, allowing us to assess whether managerial roles themselves become more differentiated as the division of labor expands. Appendix Figure A.6 shows that within-firm DoL is strongly associated with each of these measures. Firms with a finer degree of DoL not only employ more managers, but also devote a larger share of resources to managerial workers, employ a broader range of managerial

roles, and exhibit greater specialization within their managerial workforce.[7]

To further probe these relationships, Panel (b) of Figure 3 examines whether changes in workplace division of labor within firms are accompanied by corresponding changes in coordination costs. The results closely mirror the cross-sectional evidence. Firms that increase their DoL over time also increase the share of workers employed in managerial roles, with estimates that are similar in magnitude to those obtained in the cross-sectional specifications. Together, these findings suggest that the productivity gains associated with a finer division of labor are accompanied by an increased need for managerial coordination and oversight.

To gain insight into coordination costs that are not directly observable in administrative data, we turn to the survey evidence. Workers in more specialized roles report spending more time in meetings and exercising greater supervisory responsibility (Panels (c) and (d) of Figure 3). Moreover, these meetings are disproportionately focused on coordination rather than production, and workers report that they are less productive overall (Panels (e) and (f) of Appendix Figure A.6). These results suggest that the costs of coordinating a finer division of labor extend beyond the managerial structures visible in administrative records. They also appear in greater time devoted to coordination activities and a shift in workers' responsibilities away from direct production and toward supervision and coordination.

5.2 The social costs of the division of labor inside the firm

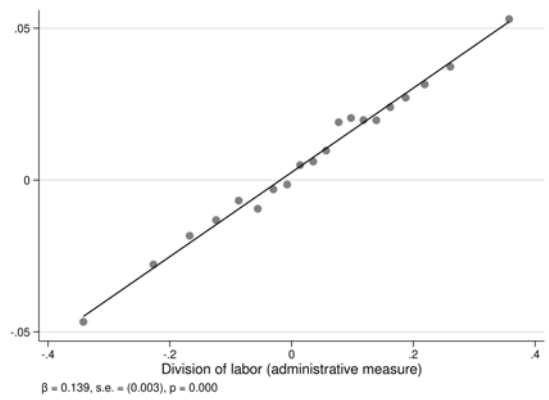
Our framework emphasizes that the consequences of the division of labor extend beyond productivity and coordination. By assigning workers to increasingly distinct and non-overlapping roles, a finer division of labor reshapes how workers interact with one another. Workers may collaborate less, share fewer tasks, and develop weaker social ties to their colleagues. If workplace learning depends in part on social interaction and knowledge exchange, these changes may have important consequences for human capital accumulation within firms.

Since it is not possible to measure the intensity and quality of social interactions in administrative data, we turn to the survey data which provides direct information on how workers perceive their social environment at work. Our primary measure of social connectedness in the workplace is based on the Inclusion of Other in the Self scale, a widely used measure of interpersonal closeness in psychology that has recently been adopted in economics. Figure 4, Panel (a), shows a clear negative relationship between worker specialization and social connectedness. Relative to workers in more general roles within the same industry, workers in highly specialized roles report being approximately 0.2 standard deviations less connected to their colleagues.

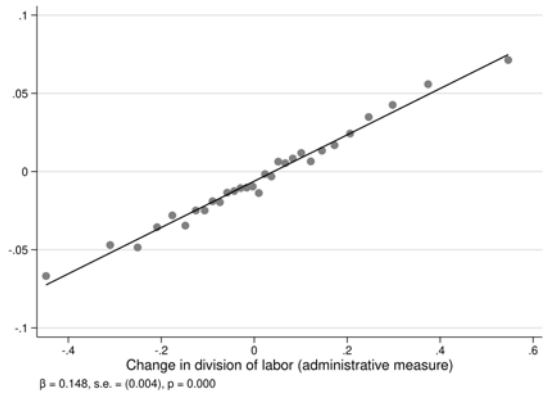
Appendix Table A.4 examines the sensitivity of this relationship to a progressively richer set

[7]The positive relationships between the division of labor and both productivity and managerial coordination are also present across broad industry groups and among both smaller and larger workplaces (Appendix Figure A.7).

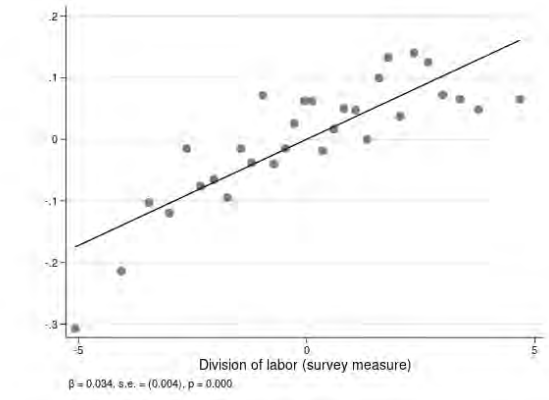
Figure 3: The division of labor and coordination costs



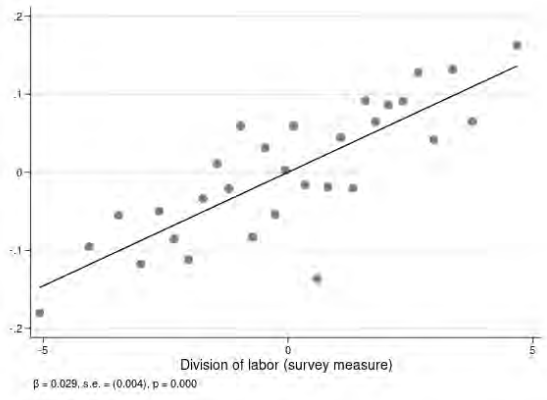
(a) Manager share



(b) Change in manager share



(c) Time spent in meetings



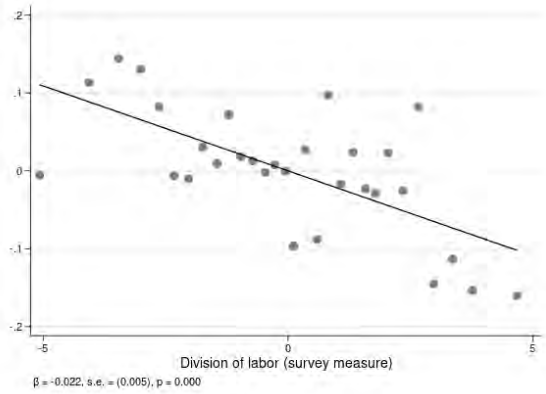
(d) Supervisory responsibility

Notes: Panel (a) plots managers as a share of employment in 2023 against the administrative measure of the division of labor. Panel (b) plots changes in the manager share between 2008 and 2023 against changes in the administrative measure over the same period. The administrative measure is one minus the Herfindahl–Hirschman Index of four-digit occupational employment shares within an establishment, averaged across a firm's employees. Both variables are residualized with respect to industry and municipality fixed effects, using the most common classifications among each firm's employees. In panel (b), the underlying measures are residualized separately in each period before taking differences. Panel (c) plots reported time spent in meetings against the survey measure of the division of labor. Panel (d) plots reported supervisory responsibility against the same measure. The survey measure reverse-codes agreement with the statement that many people at the workplace could perform the respondent's job, so that higher values indicate lower perceived substitutability across coworkers. In panels (c) and (d), outcomes are standardized, and both variables are residualized with respect to municipality and four-digit occupation fixed effects. Dots report mean values of both variables within quantile bins of the horizontal-axis variable; solid lines show linear fits estimated using the underlying firm-level observations in panels (a) and (b) and worker-level observations in panels (c) and (d).

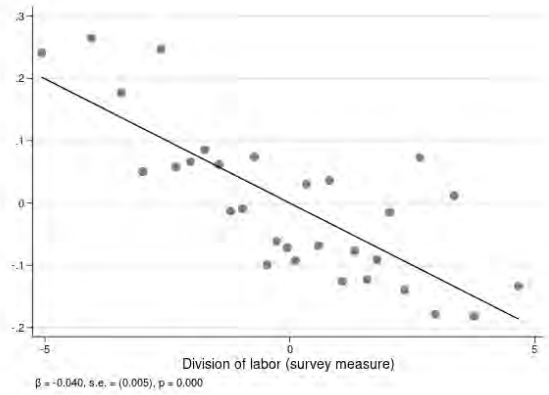
of controls. The estimates are very stable to the inclusion of occupation fixed effects, firm-size controls, and worker characteristics such as age and gender. The negative relationship between specialization and social connectedness therefore does not appear to be driven by differences in occupations, workplace size, or workforce composition.

We complement this measure with a second indicator capturing support from colleagues in Figure 4, Panel (b). Workers in more specialized roles report substantially lower levels of coworker support. Taken together, these results suggest that a finer division of labor is associated with a meaningful weakening of the social ties that connect workers within firms.

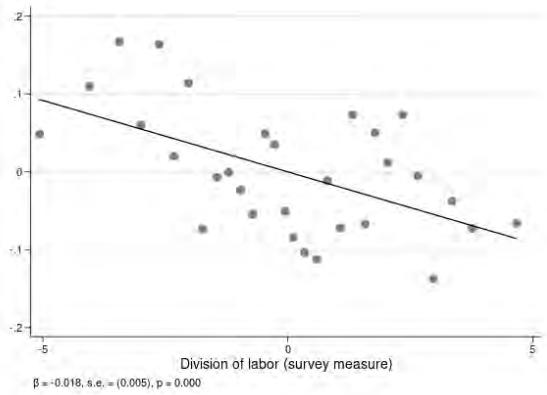
Figure 4: The division of labor and workplace social interactions



(a) Social connectedness



(b) Support from colleagues



(c) Daily collaboration

Notes: Panel (a) plots social connectedness against the survey measure of the division of labor. Panel (b) plots reported support from colleagues against the same measure. Panel (c) plots the reported frequency of daily collaboration against the same measure. The survey measure reverse-codes agreement with the statement that many people at the workplace could perform the respondent's job, so that higher values indicate lower perceived substitutability across coworkers. Outcomes are standardized, and both the division-of-labor measure and each outcome are residualized with respect to municipality and four-digit occupation fixed effects. Dots report mean values of both variables within 30 quantile bins of the residualized division-of-labor measure; solid lines show linear fits estimated using the underlying worker-level observations.

We next examine whether these patterns extend beyond social connectedness to day-to-day

workplace interactions. Figure 4, Panel (c), shows that workers in more specialized roles collaborate less frequently with their colleagues. Thus, DoL is associated not only with weaker social ties, but also with fewer opportunities for direct interaction and knowledge exchange.

A reduction in collaboration need not imply lower productivity if interactions become more focused or effective. To investigate this possibility, we examine workers' assessments of teamwork quality. Appendix Figure A.8 shows that workers in more specialized roles report that teamwork is slower and less effective (Panels (a) and (b)). Consistent with these perceptions, teams composed of more specialized workers are also less likely to meet their goals and deadlines (Panel (c)).

These patterns raise the possibility that the division of labor may affect human capital accumulation not only through learning-by-doing, but also by changing workplace interactions and opportunities for knowledge exchange.

5.3 Workplace division of labor and learning

As we outline in our conceptual framework (Section 2), the division of labor has an ambiguous effect on overall human capital accumulation. A key reason is that workers acquire skills through multiple channels in the workplace. In prior work using these survey measures, Silliman and Willén (2025) show that coworker learning and learning-by-doing constitute the two most important sources of workplace skill acquisition, accounting for nearly 75 percent of all learning that takes place at the workplace. A finer division of labor may affect these two channels in opposite directions. As we showed in the previous section, workers in more specialized roles interact and collaborate less with their colleagues, potentially limiting opportunities for coworker learning. At the same time, greater focus on a smaller set of tasks may increase opportunities for learning-by-doing. Whether a finer division of labor ultimately increases or decreases human capital accumulation therefore depends on the relative importance of these competing forces.

To provide insight into how the degree of within-firm DoL shapes learning, Figure 5 plots measures of coworker learning and learning-by-doing against worker DoL. Panel (a) shows a sharp decline in coworker learning as the division of labor increases. Workers in the most specialized roles report nearly 0.6 standard deviations less coworker learning than workers in less specialized roles. By contrast, Panel (b) shows that DoL is associated with higher levels of learning-by-doing. However, this positive relationship is considerably weaker in magnitude, amounting to roughly one-third of the decline observed for coworker learning.

The results on how workers learn suggest that workplace DoL is associated with a substantially larger reduction in coworker learning than increase in learning-by-doing. Nonetheless, overall human capital accumulation depends not only on the prevalence of these learning channels, but also on their productivity and the contribution of other sources of workplace learning. We therefore turn to a deliberately broad measure of workplace skill accumulation based on workers' assessments

of whether they are *"better at their job than they were a year ago."* Rather than focusing on any particular skill or learning channel, this measure captures workers' overall perception of how much they have improved over the preceding year.

Figure 5, Panel (c), shows a clear negative relationship between firm division of labor and workplace learning. Workers in the most specialized roles report approximately 0.2 standard deviations lower levels of human capital accumulation than workers in less specialized roles.[8]

We complement the survey-based measures of learning with an administrative measure of wage growth. Unlike the self-reported learning measures, wage growth reflects how skill accumulation is valued and rewarded in the labor market. Panel (d) plots workplace division of labor against worker wage growth and shows a clear negative relationship. Workers in more specialized roles experience slower subsequent wage growth than workers in firms with a lower degree of DoL. This pattern closely mirrors the survey-based evidence on workplace learning, suggesting that the lower rates of skill accumulation reported by workers in specialized roles are also reflected in subsequent labor-market outcomes.

Appendix Table A.4 reports all four associations under progressively richer specifications. Accounting for age, occupation, education, and other covariates leaves the relationship between the survey division-of-labor measure and coworker learning largely unchanged. The positive association with learning-by-doing attenuates somewhat but remains statistically significant and economically meaningful. Across specifications, a finer division of labor is associated with a larger reduction in coworker learning than increase in learning-by-doing.

Turning to aggregate human capital accumulation, the inclusion of detailed covariates likewise has little effect on the relationship between workplace division of labor and overall workplace learning. We also re-estimate the specifications excluding managers to ensure that the results are not driven by managerial workers (Appendix Table A.6), with no economically meaningful change in the estimates.[9]

[8]These relationships are also robust to including workplace fixed effects. This specification provides a different comparison from our baseline: rather than examining differences in specialization across workplaces, it exploits differences in the substitutability of workers' roles within the same workplace. While this absorbs differences in workplace-wide learning environments, it also removes variation in how firms organize their division of labor, which is central to our analysis. We therefore only view this as a complementary robustness exercise. The results show that greater specialization is associated with less overall learning ($\beta = -0.024$, SE = 0.010, $p < 0.05$), less learning from coworkers ($\beta = -0.042$, SE = 0.010, $p < 0.01$), and more learning-by-doing ($\beta = 0.021$, SE = 0.010, $p < 0.05$). These findings suggest that the relationships are not driven solely by differences in learning environments across workplaces.

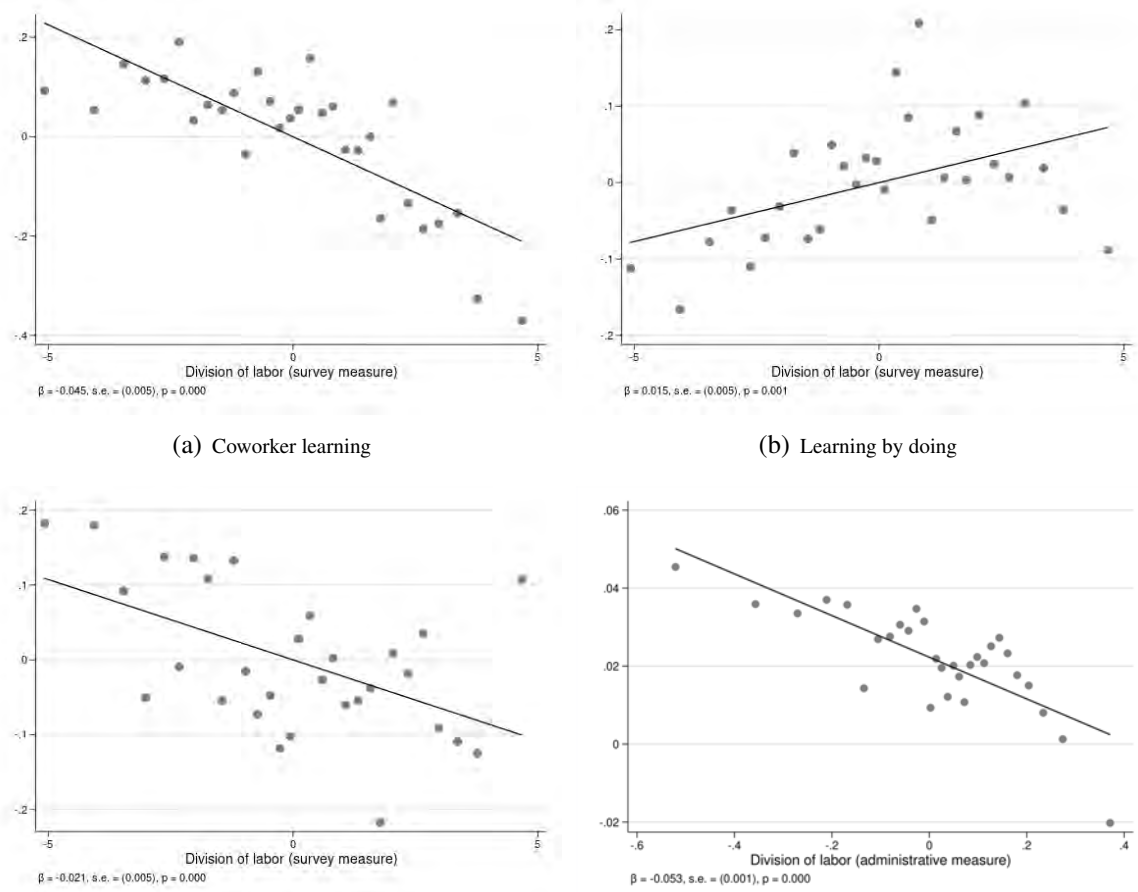
[9]We perform an additional set of analyses to examine whether our findings reflect broad differences in occupational structure, potentially capturing vertical differentiation and organizational hierarchy, or finer horizontal differentiation across specialized roles. Specifically, we augment our main specifications with a measure of broad occupational differentiation, constructed as one minus the Herfindahl–Hirschman Index of employment shares across one-digit occupations. Appendix Table A.7 shows that the relationships between the division of labor and productivity, coordination, and workplace learning remain statistically significant after accounting for broad occupational differentiation. This suggests that our findings are not driven solely by broad occupational or hierarchical differences, but also reflect finer differentiation across specialized roles.

Finally, Appendix Table A.5 reports the wage-growth results with additional controls. The negative association between the division of labor and wage growth remains similar after accounting for occupation, industry, firm size, education, and gender. Adding age attenuates the estimate somewhat and makes the result slightly noisier, although the association remains statistically significant and qualitatively unchanged. One possible explanation is that firms with different divisions of labor employ workers at different stages of their careers. As workforce composition may itself respond to the division of labor, controlling for age changes the comparison rather than necessarily providing a more appropriate specification. We return to this possibility below.

Next, we examine how DoL shapes the content of learning. A reduction in overall workplace learning need not imply that workers accumulate less valuable human capital. Indeed, specialized roles may facilitate the development of deeper expertise in a narrower set of activities. An important question is therefore not only how much workers learn, but also what they learn and whether those skills transfer beyond their current role, firm, or industry.

Panels (a) and (b) of Appendix Figure A.9 compare how worker specialization is associated with learning new skills versus developing existing skills. Both panels indicate a strong negative relationship. As one might expect, however, worker specialization is associated with a substantially larger decline in the acquisition of new skills than in the development of existing ones. Panels (c)–(e) then examine the transferability of the skills workers acquire. These figures show that workers in more specialized roles are considerably less likely to report learning skills that transfer across occupations, firms, and industries. Thus, workplace specialization is associated not only with lower rates of learning, but also with the accumulation of human capital that is less portable across jobs and workplaces.

Figure 5: The division of labor and workplace learning



(a) Coworker learning

(b) Learning by doing

(c) Overall learning

(d) Wage growth

Notes: Panel (a) plots coworker learning against the survey measure of the division of labor. Panel (b) plots learning by doing against the same measure. Panel (c) plots self-assessed improvement, measured by agreement with the statement that respondents are better at their jobs than they were one year earlier, against the survey measure. The survey measure reverse-codes agreement with the statement that many people at the workplace could perform the respondent's job, so that higher values indicate lower perceived substitutability across coworkers. Panel (d) plots the change in log wage between 2022 and 2023 against the administrative measure of the division of labor in 2022. In panels (a)–(c), outcomes are standardized, and both variables are residualized with respect to municipality and four-digit occupation fixed effects. In Panel (d), variables are residualized with respect to industry and municipality. The administrative measure is one minus the Herfindahl–Hirschman Index of four-digit occupational employment shares within an establishment. Dots report mean values of both variables within 30 quantile bins of the horizontal-axis variable; solid lines show linear fits estimated using the underlying worker-level observations.

6 Coworkers as an input into human capital accumulation

The results above show that workers in more specialized roles interact and collaborate less with their colleagues, report less coworker learning, and accumulate less human capital overall. These patterns suggest that reduced access to coworkers as a source of learning may help explain the relationship between the division of labor and human capital accumulation. However, these relationships remain descriptive. In this section, we provide more direct evidence on the role of coworkers in skill

accumulation.

We study how access to coworkers shapes human capital accumulation by exploiting temporary disruptions arising from extended spells of parental leave or sick leave. These absences reduce opportunities for collaboration, observation, feedback, and knowledge exchange. They may also require remaining workers to take on additional tasks and responsibilities, potentially strengthening learning-by-doing and offsetting the loss of coworker learning. Because absences can also affect workloads and production, this variation does not isolate coworker learning. It nevertheless provides complementary evidence on the role of coworker access by examining subsequent wage growth and whether the effects vary across occupations with different degrees of division of labor and reliance on coworker learning. These heterogeneity analyses allow us to assess whether the consequences of coworker absences align with the learning patterns documented in our survey evidence.

6.1 Data and empirical approach

We construct measures of coworker absence using administrative records on parental leave and sick leave benefits. Although these records report benefit payments rather than the exact number of days absent, they allow us to identify workers who experience economically meaningful periods of leave. In our preferred specification, we classify a worker as taking substantial leave if their annual leave benefits exceed 30% of their earnings in the preceding year. Under Norway's earnings-related sickness and parental benefit schemes, this threshold corresponds approximately to three-and-a-half months of full-time leave for workers with stable earnings below the benefit cap of six times the National Insurance basic amount (USD 72,000 in 2023). This threshold is necessarily somewhat arbitrary, but is intended to capture absences sufficiently substantial to disrupt workplace interactions, rather than shorter or more incidental periods of leave. We examine the sensitivity of our results to alternative thresholds and continuous measures of leave intensity in Appendix Table A.8.

To identify the coworkers potentially affected by these absences, we group workers employed at the same establishment and in the same three-digit occupation, and we refer to this establishment-occupation group as the worker's workplace throughout this section. This definition reflects both the assumption in our conceptual framework and patterns in the observational data suggesting that workers performing similar tasks within the same establishment are particularly likely to interact and learn from one another. For each worker-year, we then measure coworker-leave exposure as the share of other workers in the same establishment-occupation group who experienced substantial leave during the preceding year, excluding the worker themselves.

We focus on parental and sick leave because they generate periods during which coworkers are temporarily unavailable, potentially disrupting opportunities for workplace interaction and learning. Both forms of leave are recorded in administrative benefit data, allowing us to measure coworker absences systematically across establishments and occupations. Moreover, these absences are

generally driven by circumstances outside the focal worker's control, providing a useful source of variation in coworker availability. Nevertheless, leave-taking may be correlated with workplace characteristics, a concern we return to in our empirical analysis below.

Appendix Table A.9 reports descriptive statistics for the estimation sample. We report the prevalence of coworker leave events, worker characteristics, workplace characteristics, and measures of workplace specialization and learning from coworkers defined below. Appendix Table A.10 examines how exposure to coworker leave varies across workers, firms and workplaces. Overall, coworker absences are common and occur across a broad range of occupations, industries, and workplaces, generating substantial variation in workers' exposure to temporary disruptions in coworker interactions. This widespread occurrence is important for our setting, as it implies that the estimated effects are not driven by a narrow set of occupations or workplaces but instead reflect a pervasive feature of modern labor markets.

We examine the relationship between coworker absences and subsequent wage growth using two complementary empirical approaches. First, we employ a stacked event-study design to trace wage-growth dynamics before and after a coworker absence. To isolate clearly defined events, this analysis restricts attention to workers who experience at most one qualifying coworker-leave exposure during our 2015–2023 panel. Treated workers therefore experience exactly one exposure, while comparison workers are never exposed during the sample period. This restriction allows us to trace outcomes around a single event without the complications introduced by repeated exposure. Second, we complement this analysis with a panel difference-in-differences specification that exploits variation in coworker-leave exposure across a broader population of workers and workplaces, without imposing the single-event restriction.

Since these designs rely on temporal variation, we cannot use our survey data to measure human capital accumulation directly, but need to rely on administrative data proxies for learning. We follow the convention in labor economics and interpret life-cycle dynamics in wage growth as, at least in part, reflecting human capital accumulation (e.g. Mincer, 1974; Lucas, 1988; Arellano-Bover and Saltiel, 2024; Deming, 2023).

In terms of the event study, we implement this as a stacked difference-in-differences design (Cengiz et al., 2019; Baker et al., 2022; Wing et al., 2024). For each event year $g \in \{2018, 2019, 2020\}$ we construct a separate stack s containing the workers exposed in g together with the workers who are never exposed during the sample period, each observed from three years before to three years after g.[10] We estimate

[10]The panel covers 2015–2023, and we follow every cohort from three years before to three years after the event, so the event year must lie between 2018 and 2020. With these three cohorts, each cohort contributes to every event time, and the mix of cohorts does not change across the event window. Workers whose exposed years fall outside 2018–2020 are in neither the treated nor the control group.

$$Y_{ist} = \sum_{k \neq -1} \beta_k \left(D_{is} \cdot \mathbf{1}\{t - g_s = k\} \right) + \alpha_{is} + \delta_{ts} + \varepsilon_{ist}, \tag{9}$$

where D_{is} equals one for a worker treated in stack s and zero for a never-exposed comparison worker, $t - g_s$ is event time, α_{is} are worker×stack fixed effects and δ_{ts} are year×stack fixed effects. The year immediately preceding exposure ($k = -1$) is the omitted reference period. Standard errors are clustered at the level of the worker's workplace in the event year. Workers who are themselves on extended leave in any year of the event window, or in the year before it, are excluded, so that a worker's own absence does not enter the comparison.

We use event-study plots of the above form to trace wage-growth dynamics before and after coworker absences. These event study plots serve two purposes. First, they allow us to examine whether treated and comparison workers exhibit similar wage-growth trajectories before exposure, providing an assessment of potential pre-trends. Second, they allow us to investigate whether the effects of coworker absences persist beyond the initial exposure. Because the outcome is wage growth rather than wage levels, persistence must be interpreted carefully. An effect on wage growth that disappears after coworkers return can still imply a permanent wage-level loss. Persistent negative effects on wage growth would instead indicate that the wage-level gap continues to widen. Under a human capital interpretation, we would not necessarily expect these effects to disappear once coworkers return. Temporary disruptions to workplace learning may result in foregone human capital accumulation, with consequences for subsequent wage growth even after the absence has ended.

We complement the event study analysis with panel difference-in-differences estimates from a broader population of workers, firms, and leave-takers. A potential pitfall of using the stacked event-study design is that by restricting to workers with exactly one exposed year in the panel, the sample and identifying variation may not be representative of the full set of leave-takers in the broader population. Our difference-in-differences strategy allows us to include a fuller set of workers and firms in our estimation sample, and helps to ensure that the results our event-study design yields are not specific to the sample restrictions it requires.

$$Y_{it} = \kappa_0 + \beta Leave_{it-1} + X_{it}\Gamma + \alpha_i + \delta_t + \varepsilon_{it}, \tag{10}$$

where Y_{it} denotes worker i's subsequent log wage growth, and $Leave_{it-1}$ measures exposure to coworker absences in the preceding year, defined as the share of worker i's coworkers who experienced a qualifying parental- or sick-leave spell during that year. All specifications control for quartic polynomials in worker age and include worker and year fixed effects. Our more saturated specification additionally includes fixed effects for the worker's firm in $t - 1$, absorbing permanent differences across firms. Standard errors are clustered at the level of the worker's workplace in $t - 1$.

Finally, we examine whether the effects of coworker leave vary across occupations characterized

by different degrees of division of labor and reliance on coworker learning. We construct survey-based occupation-level indices of both characteristics and assign them to workers in the administrative data according to their occupation. This approach allows us to extend our survey-based measures of the division of labor and coworker learning to the population-wide administrative data, while capturing variation across occupations rather than individual workers or workplaces. The division-of-labor index is built from two survey statements: "Many people at my company could do my job" and "It would be easy for my company to train someone new to do my job." We average a respondent's agreement with the two statements and reverse the scale, so that higher values indicate lower perceived substitutability. We interpret lower substitutability as an indicator of a finer division of labor, reflecting more distinct and differentiated roles within the workplace. The index of learning from coworkers is built from the survey questions on skill development. Respondents report the extent to which they have developed each of a list of skills at their current workplace and, for each skill they have developed, how they learned it. The measure is the share of a worker's skill development for which learning from coworkers or participation in a mentoring program is reported as a source, weighting each skill by the extent to which it was developed. Higher values indicate that coworkers are a more important source of learning in the workplace.[11]

To examine whether the effects of coworker absences depend on the occupational division of labor, we estimate the event study specification separately for workers whose occupation is above the median occupation on each measure and for those at or below it. Additionally, we extend our baseline specification by interacting coworker-leave exposure with our measure of occupational DoL:

$$Y_{it} = \kappa_0 + \beta Leave_{it-1} + \gamma Z_{it-1} + \theta \left(Leave_{it-1} \times Z_{it-1} \right) + X_{it}\Gamma + \alpha_i + \delta_t + \varepsilon_{it}, \qquad (11)$$

where Z_{it} denotes either our measure of worker DoL (substitutability) or our measure of learning from coworker assigned to worker i's three-digit occupation in $t-1$. Since both indexes are standardized across occupations, θ measures the change in the effect of coworker leave per standard deviation of the index.

6.2 Results

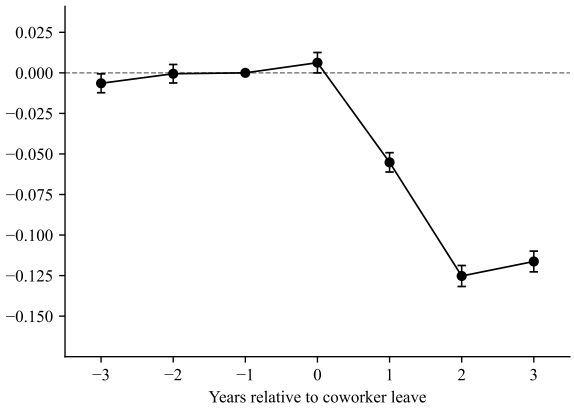
To assess whether access to same-occupation coworkers shapes opportunities for human capital accumulation, we examine wage-growth trajectories for workers exposed to extended coworker absences due to leave. Compared to their peers who are not exposed to such absences, workers experiencing coworker leave exhibit a sharp decline in subsequent wage growth (Figure 6, panel (a)). Importantly, the two groups exhibit similar wage-growth trajectories in the years preceding the leave

[11] For both measures, we average responses within three-digit occupations, pooling the two survey waves and keeping occupations with at least ten respondents, and standardize the result to mean zero and unit standard deviation across occupations.

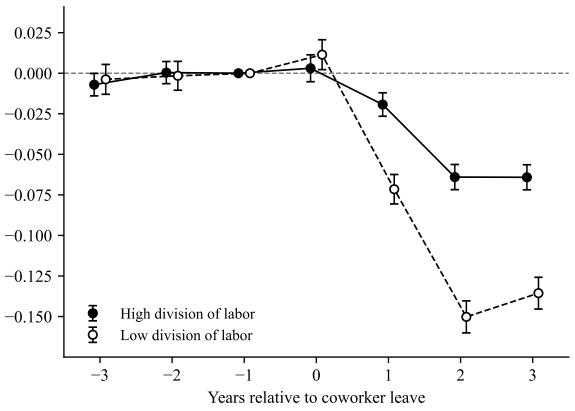
event, suggesting that the subsequent divergence does not simply reflect differences in wage-growth trends that were already present before coworkers took leave. This pattern lends support to the interpretation that the observed decline in wage growth is attributable to the disruption in coworker availability. Quantitatively, the estimates suggest that exposure to substantial coworker leave reduces subsequent wage growth by approximately 5.5 percentage points in the year after the event and by about 12 percentage points in the two years that follow. Appendix Figure A.10 shows that the pattern is similar when firm$\times$year$\times$stack fixed effects are added.

To further assess the role of coworker learning, we examine how these effects vary across occupations with different levels of worker DoL and reliance on coworker learning. Panels (b) and (c) indicate that the effects are considerably attenuated for workers in occupations associated with a finer DoL and are larger in occupations where coworker learning is more prevalent. These patterns of heterogeneity are consistent with the interpretation that coworker leave is harmful for wage growth particularly because of its impact on coworker learning.

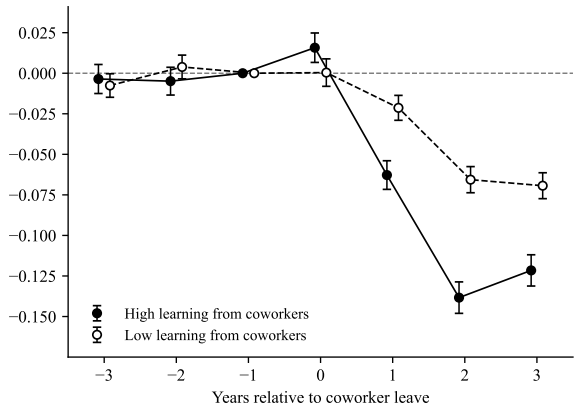
Figure 6: Event study: coworker leave and log wage growth



(a) All workers



(b) By occupational division of labor



(c) By occupational coworker learning

Notes: This figure reports stacked difference-in-differences event-study estimates for log wage growth. An event is a year in which at least one coworker—another worker in the same establishment and 3-digit occupation—takes extended parental or sick leave, defined as benefits exceeding 30 percent of previous-year wage income. Treated workers have exactly one exposed year during 2015–2023, occurring in 2018, 2019, or 2020. Each event cohort forms a stack with workers who are never exposed during 2015–2023; workers are observed from three years before through three years after the event. Workers who are themselves on extended leave in any year of the event window, or in the year before it, are excluded. The regressions include worker×stack and year×stack fixed effects and no other controls. Points are coefficients relative to the year before the event ($k = -1$); bars show 95 percent confidence intervals. Panel (a) pools all workers. Panels (b) and (c) split workers by whether their occupation in the event year is above the median occupation, or at or below it, on the division-of-labor index and on the index of learning from coworkers, respectively.

Importantly, the negative estimates persist beyond the initial exposure rather than dissipating immediately. This is particularly notable because our outcome is annual log wage growth rather than wage levels. Persistent reductions in wage growth imply that the wage-level gap continues to widen over time, rather than reflecting a one-time loss. These findings suggest that temporary disruptions to coworkers may generate lasting losses in skill accumulation that continue to compound even after the initial absence.

Table 2 presents the panel difference-in-differences estimates. This approach exploits variation

in the intensity of coworker-leave exposure over time and allows us to examine how wage growth varies with the share of coworkers taking substantial leave, rather than focusing exclusively on the occurrence of a leave event. Because the two approaches use both different treatment definitions and scales, their coefficient magnitudes are not comparable. Column (1), which includes worker and year fixed effects, shows a negative and statistically significant relationship between coworker-leave exposure and subsequent wage growth. Column (4) additionally includes fixed effects for the worker's firm in the year prior to coworker leave, absorbing time-invariant differences across firms. The estimated coefficient remains negative and statistically significant, although its magnitude declines from -0.028 to -0.021. These estimates indicate that greater exposure to coworker absences is associated with lower subsequent wage growth even after accounting for time-invariant differences across firms.

Table 2: Coworker-leave exposure effect on log wage growth

	(1)	(2)	(3)	(4)	(5)	(6)
	Baseline	Division of labor	Learning from coworkers	Baseline	Division of labor	Learning from coworkers
Coworker leave exposure $t-1$	-0.0284^{***}	-0.0216^{***}	-0.0247^{***}	-0.0213^{***}	-0.0152^{***}	-0.0178^{***}
	(0.0022)	(0.0018)	(0.0017)	(0.0012)	(0.0012)	(0.0012)
Occupation index		-0.0045^{***}	0.0084^{**}		-0.0117^{***}	0.0056^{***}
		(0.0009)	(0.0033)		(0.0008)	(0.0007)
$\times$ Occupation index		0.0157^{***}	-0.0128^{***}		0.0143^{***}	-0.0109^{***}
		(0.0019)	(0.0034)		(0.0013)	(0.0012)
Observations	14,997,989	14,911,703	14,911,703	14,945,156	14,859,204	14,859,204
Clusters	454,123	448,059	448,059	442,694	436,853	436,853
Worker FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	No	Yes	Yes	Yes

Notes: This table reports estimates of how exposure to coworker leave in the previous year affects a worker's log wage growth, and how this effect varies with the occupation-level indices of the division of labor and of learning from coworkers. The outcome is the change in log annual wage income between $t-1$ and t. Coworker leave exposure is the share of the worker's coworkers who were on extended parental or sick leave in $t-1$, where coworkers are all other workers in the same establishment and 3-digit occupation (the workplace) and the worker is excluded from both numerator and denominator. A coworker is on extended leave if their parental or sickness benefits in the year exceed 30 percent of their previous-year wage income. Columns (1) and (4) report the baseline specification. Columns (2) and (5) add the division-of-labor index and its interaction with leave exposure; columns (3) and (6) do the same for the index of learning from coworkers. Both indices are standardized (mean zero, unit standard deviation across occupations) survey measures, attached by the worker's 3-digit occupation in $t-1$. Every column controls for a quartic polynomial in the worker's age, entered as the square, the cube and the fourth power; the linear term is collinear with the worker and year fixed effects and is excluded. Columns (1)–(3) include worker and year fixed effects. Columns (4)–(6) add firm fixed effects for the worker's firm in $t-1$. The sample covers worker-years 2016–2023 in which the worker is not on extended leave themselves and log wage growth is observed; armed forces occupations are excluded. It is defined by the baseline regression in column (1) and is the sample summarized in Appendix Table A.9. Standard errors, clustered at the level of the workplace in $t-1$, are reported in parentheses. $^{*}p<0.10$, $^{**}p<0.05$, $^{***}p<0.01$.

Columns (2) and (3) show that the interaction with the worker DoL is positive and statistically significant (0.016), while the interaction with learning from coworkers is negative and statistically significant (-0.013). Both relationships remain statistically significant when we introduce firm fixed effects in Columns (5) and (6). The magnitudes are economically meaningful. In Column (5), a one-standard-deviation increase in a the occupation-level DoL index offsets approximately 94% of the negative baseline association between coworker absences and wage growth, reducing the estimated coefficient from -0.015 to -0.001. Conversely, in Column (6), a one-standard-deviation increase in learning from coworkers strengthens the negative association by approximately 61%, from -0.018 to -0.029. These patterns are consistent with our proposed learning mechanism. More

specialized workers rely relatively more on learning-by-doing and have fewer opportunities to learn from coworkers, making them potentially less vulnerable to disruptions in coworker availability. By contrast, workers in occupations where coworker learning is more prevalent may lose an important source of human capital accumulation when coworkers are absent.

7 Experimental evidence on the tradeoffs of the division of labor

To examine how workers and managers understand and evaluate the tradeoffs associated with the division of labor, we field two vignette experiments, pre-registered as AEARCTR-0019015 and AEARCTR-0019016 for workers and managers, respectively. These survey experiments are provided in their entirety in Appendix Section C. In each experiment, respondents are presented with two hypothetical workplaces in randomized order. The vignettes are intentionally minimalist: rather than describing workplaces that differ along multiple dimensions, we vary a single feature of how production is organized—the degree of task overlap between workers.

To operationalize the division of labor experimentally, consider a production process requiring ten tasks. At one extreme, every worker performs all ten tasks, implying complete task overlap and essentially no division of labor. At the other extreme, tasks are divided among workers, with each performing a narrower and more differentiated subset. Our experimental treatment captures this distinction by holding fixed the tasks required for production while varying how they are allocated across workers. This allows us to manipulate the division of labor through differences in task overlap, without explicitly characterizing either workplace as more or less specialized. Workers are presented with the following two hypothetical workplaces:

> *You are hired by a medium-sized firm in your present occupation and industry. Production at the firm requires completing a fixed set of tasks. In this firm, workers each perform a [narrower and more differentiated / broad] set of those tasks, with [little / substantial] overlap between workers.*

Managers receive an analogous pair of hypothetical workplaces:

> *You are a manager in a medium-sized firm in your present industry. Production at the firm requires completing a fixed set of tasks. In this firm, workers each perform a [narrower and more differentiated / broad] set of those tasks, with [little / substantial] overlap between workers.*

Importantly, respondents are not provided with any information about productivity, wages, management, workplace culture, learning opportunities, or hiring practices. The sole experimental

manipulation is the degree of task overlap between workers. Unlike our administrative and survey measures, which capture occupational differentiation and perceived substitutability in existing workplaces, the experiment directly varies the allocation of tasks across workers.

Respondents are subsequently asked about a range of outcomes that correspond directly to the core empirical analyses in the paper, including productivity, managerial oversight, social connectedness, coworker learning, learning-by-doing, and human capital accumulation. We then ask both workers and managers to choose between the two organizational structures and elicit the reasons underlying their choices. This allows us to move from whether respondents perceive the consequences of the division of labor to how they value those consequences when making workplace and organizational choices.

A key feature of our experimental design is that each respondent evaluates both organizational structures, with the order of presentation randomly assigned. This provides both within-subject and between-subject variation, allowing us to examine how the same worker or manager evaluates alternative divisions of labor while also ensuring that any results are not driven by presentation order. The within-subject comparisons hold fixed individual characteristics, experiences, and beliefs, while the randomized order allows us to assess whether the perceived consequences of the division of labor depend on which organizational structure respondents encounter first. The analysis restricted to the first round, relying exclusively on between-subject variation, provides an initial test for experimenter demand by limiting respondents' ability to identify the experimental manipulation. We also examine the robustness of our findings to potential experimenter demand effects by re-estimating the results after excluding respondents with high levels of measured social desirability bias.

By holding the tasks required for production fixed and varying only their allocation across workers, the experiments allow us to isolate how the division of labor shapes workers' and managers' expectations about productivity, coordination, and workplace learning. The choice exercises then allow us to examine whether these perceived consequences translate into preferences over workplace organization and which features of the two organizational structures drive those choices. Specifically, we ask workers which type of firm they would prefer to work for and managers how they would choose to organize production, before eliciting the reasons underlying their decisions. This allows us to examine whether the productivity, coordination, social, and learning tradeoffs associated with the division of labor matter not only for how workers and managers evaluate alternative organizational structures, but also for which structures they ultimately prefer.

Although the experiments isolate the role of organizational structure in shaping respondents' expectations, the workplaces themselves are hypothetical. The results should therefore not be interpreted as direct evidence of how changing the division of labor would affect outcomes in actual firms. Rather, they provide experimental evidence on how workers and managers perceive the consequences of alternative organizational structures and how these perceptions shape their

preferences. Importantly, respondents are real-world workers and managers who can draw on their own workplace experiences when evaluating these scenarios. Moreover, the vignettes are explicitly situated within respondents' own occupations and industries, with the only variation arising from how production tasks are allocated across workers.

Before turning to results, we report descriptive characteristics for these samples of workers and managers, and test for balance in their baseline responses according to vignette order (Appendix Tables A.11 and A.12). While these tables show that workers and managers in this complementary sample are slightly older than those in the population or the larger survey, we are unable to detect any differences in the characteristics between workers or managers relating to the order in which they were shown the vignettes. The only exception is a small difference in managers' perceptions of whether firm competition motivates workers, with slightly higher agreement among those shown the overlapping-task firm first (6.1 versus 5.9, $p = 0.02$). Given that we examine 25 baseline characteristics, one statistically significant difference is consistent with what we would expect by chance.

7.1 Worker Perceptions

We begin by examining whether workers perceive the consequences of the division of labor for three dimensions of the workplace: the nature of work, coordination, and workplace learning. Panel (a) of Figure 7 shows clear differences between the two organizational structures along all three dimensions.

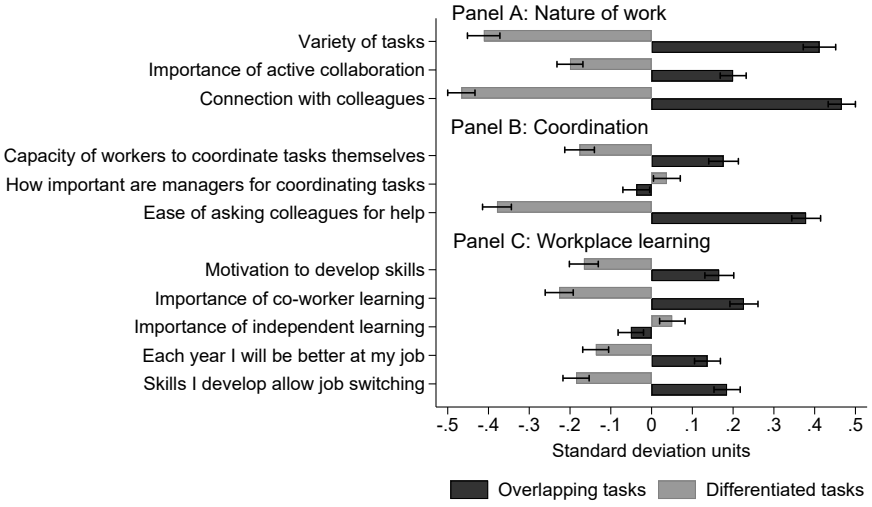
First, workers perceive substantial differences in the nature of work. In workplaces with greater task overlap, workers expect substantially more variety in their own tasks, more active collaboration with coworkers, and a stronger connection with their colleagues. A finer division of labor is therefore perceived not simply as changing which tasks workers perform, but also as changing the extent to which their work brings them into contact with others.

Second, workers recognize the coordination consequences of dividing tasks more finely. When tasks overlap, workers expect to have greater capacity to coordinate tasks themselves and find it easier to ask colleagues for help. The perceived importance of managers for coordinating tasks is instead slightly higher when tasks are differentiated. These responses closely mirror the organizational patterns in the observational data, where a finer division of labor is associated with greater reliance on managerial coordination and less direct interaction among workers.

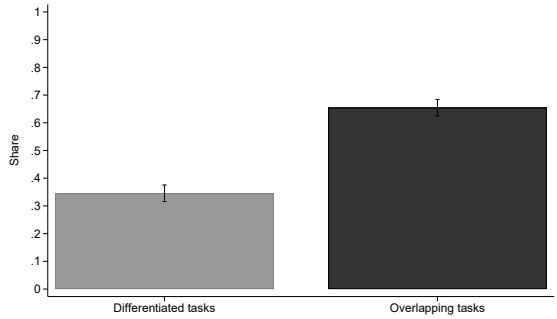
Third, workers perceive important differences in workplace learning. Greater task overlap is associated with stronger motivation to develop skills and substantially greater importance of coworker learning. Differentiated tasks, in contrast, are associated with somewhat greater importance of independent learning. Importantly, workers expect greater overall human capital accumulation when tasks overlap. They are more likely to believe that they will become better at their job over time and that the skills they develop will allow them to switch jobs. Thus, workers appear to perceive

the central learning tradeoff highlighted by our earlier results: a finer division of labor strengthens independent learning while reducing learning from coworkers, with the latter effect dominating in workers' perceptions of their overall skill development.

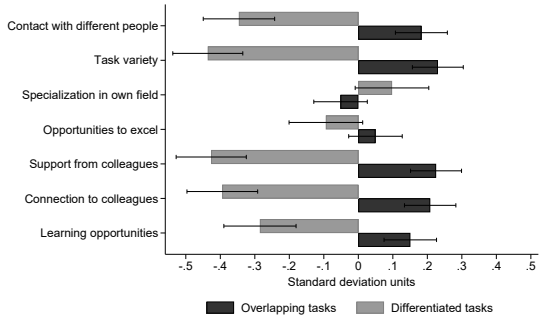
Figure 7: How do workers perceive the implications of a division of labor in the firm?



(a) Vignette experiment results, isolating the role of a firm's division of labor



(b) Preferences for firm type



(c) Reasons for choice

Notes: Figure (a) reports the results from a vignette experiment where workers were shown one of two conditions—each describing a firm which was otherwise similar, but exhibited different degrees of overlap in the tasks of its workers. Workers were shown both treatment conditions in a random order. The specification we use to estimate the treatment effects conditions on both worker and vignette order fixed effects. Figure (b) reports the results from a discrete choice exercise where workers were asked to choose which of the two types of firms they would prefer, and Figure (c) asks workers to indicate the reasons for their choice. The data underlying these figures comes from a complementary survey conducted by NorStat in the summer of 2026 focused on a sample of 975 workers. The sample is described in full in Appendix Table A.11, and the point estimates are reported for all items in our survey are reported in Appendix Table A.13.

Do these perceived differences matter for where workers want to work? Panel (b) suggests that they do. When asked to choose between the two workplaces, 63 percent of workers prefer the workplace with overlapping tasks, compared with 37 percent who prefer the workplace with differentiated tasks. Workers therefore exhibit a clear preference for greater task overlap.

Panel (c) sheds light on what drives these choices. The reasons workers give map closely onto the three dimensions through which the division of labor changes the workplace. Workers who choose greater task overlap place substantially more weight on the nature of work, particularly task variety and contact with different people. They also place greater weight on the social and collaborative aspects of coordination, including support from coworkers and connections with colleagues. Finally, they place substantially greater weight on learning opportunities. Workers choosing differentiated tasks, by contrast, place greater weight on the opportunity to specialize in their own field. Workers choosing greater task overlap also attach greater importance to opportunities to excel.

While Figure 7 reports the results for our primary set of outcomes, we report treatment effects on all endline items in the survey for transparency in Appendix Table A.13. This table also includes estimates of all treatment effects for a sample in which we drop the 25 percent of workers who exhibit the highest levels of social desirability bias. Additionally, we re-estimate our results using only data from the first time a respondent sees the vignette, which restricts all identifying variation to between worker comparisons. Since in this test respondents see only one treatment condition –these point estimates are uncontaminated by any potential biases stemming from re-adjusting their responses after seeing the first condition. The point estimates remain largely unchanged across both alternative specifications, suggesting that experimenter demand effects are unlikely to drive our results.

7.2 Manager Perceptions

We next turn to managers. Panel (a) of Figure 8 shows that managers perceive many of the same consequences of the division of labor as workers. Beginning with the nature of work, managers expect greater task overlap to generate substantially more variety in workers' tasks and stronger connections between coworkers, while differentiated tasks are perceived to increase the importance of occupation-specific skills.

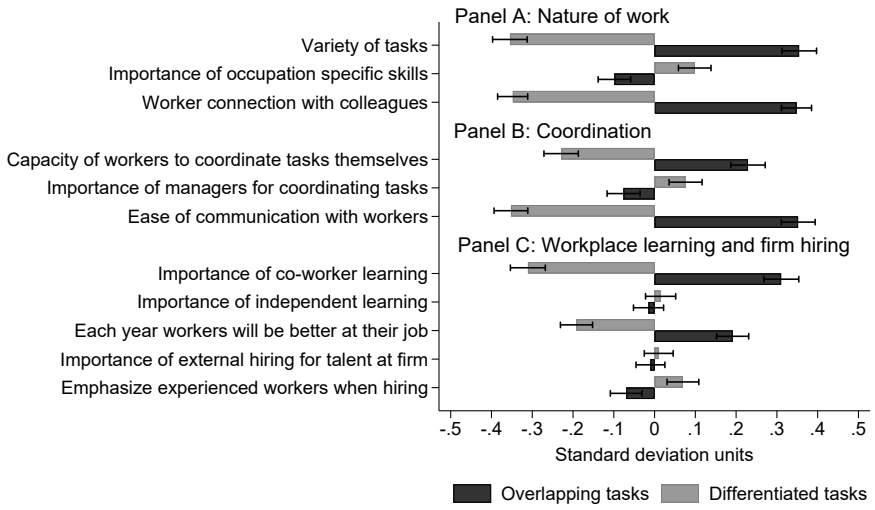
Managers also perceive clear differences in how production must be coordinated. When tasks overlap, they expect workers to have greater capacity to coordinate tasks themselves and find it easier to communicate with workers. With differentiated tasks, by contrast, managers perceive their own role in coordinating production as more important. Managers therefore perceive that a finer division of labor increases the need for managerial coordination as workers become less able to coordinate tasks among themselves, consistent with the coordination costs emphasized in the classical literature on the division of labor.

Turning to workplace learning, managers expect coworker learning to be substantially more important when tasks overlap, while independent learning differs much less across the two organizational structures. As a result, managers expect workers in overlapping roles to become better at their jobs more rapidly over time. These expectations are consistent with an awareness of the dynamic tradeoff associated with the division of labor: greater DoL may increase current productivity while reducing

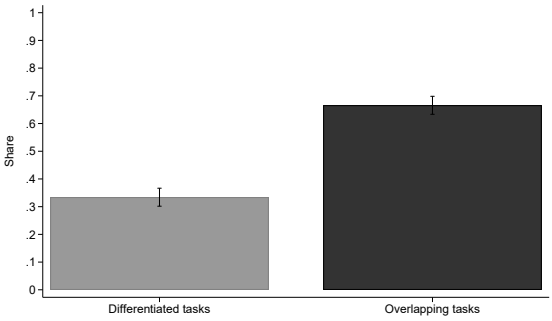
opportunities for human capital accumulation over time. Managers also rate firm productivity higher under overlapping tasks (Appendix Table A.14). Because the item does not distinguish current from future productivity, we do not read this as evidence against static gains from specialization. It is, however, consistent with managers having the dynamic tradeoff in mind: a finer division of labor may raise current productivity while reducing opportunities for human capital accumulation, and thereby productive capacity, over time.

The learning consequences also extend to managers' hiring decisions. When tasks are more differentiated and opportunities for coworker learning are weaker, managers place greater emphasis on hiring experienced workers. This is an interesting result because it suggests that managers may respond to weaker opportunities for internal skill development by acquiring more human capital externally. In the next section, we examine whether this pattern is also reflected in firms' actual hiring and promotion practices using administrative data.

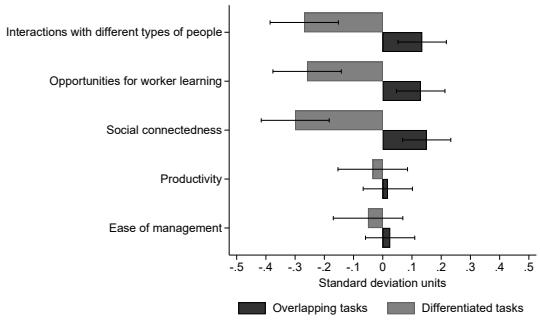
Figure 8: How do managers perceive the implications of a division of labor in the firm?



(a) Vignette experiment results, isolating the role of a firm's division of labor



(b) Preferences for how to organize a firm



(c) Reasons for choice

Notes: Figure (a) reports the results from a vignette experiment where real world managers were shown one of two conditions—each describing a firm which was otherwise similar, but exhibited different degrees of overlap in the tasks of its workers. Managers were shown both treatment conditions in a random order. The specification we use to estimate the treatment effects conditions on both manager and vignette order fixed effects. Figure (b) reports the results from a discrete choice exercise where managers were asked to choose which of the two types of firms they would prefer, and Figure (c) asks managers to indicate the reasons for their choice. The data underlying these figures comes from a complementary survey conducted by NorStat in the summer of 2026 focused on a sample of 814 managers. The sample is described in full in Appendix Table A.12, and the point estimates are reported for all items in our survey are reported in Appendix Table A.14.

We next examine how these perceived tradeoffs enter managers' choices over the organization of production. Rather than evaluating individual workplace outcomes, managers are asked to choose between the two organizational structures. Panel (b) shows that 68 percent choose the workplace with overlapping tasks, compared with 32 percent who choose differentiated tasks. Thus, when faced with a choice between alternative divisions of labor, managers exhibit a clear preference for greater task overlap.

Panel (c) provides further insight into what drives these organizational choices. Managers who

choose greater task overlap place substantially greater weight on interactions with different types of people, opportunities for worker learning, and social connectedness. These differences are large and statistically significant, closely mirroring the dimensions along which managers perceive the two organizational structures to differ in Panel (a). The choice between organizational structures therefore appears closely connected to how managers value the social interactions and learning opportunities generated within the workplace.

By contrast, managers choosing the two organizational structures place similar weight on productivity and ease of management. The absence of a difference in the importance attached to productivity warrants some discussion. Our question does not distinguish between current and future productivity, which may respond differently to the division of labor. A finer division of labor may increase current productivity through specialization, while greater task overlap may support future productivity through human capital accumulation. Managers choosing different organizational structures may therefore attach similar importance to productivity while having different sources of productivity gains in mind.

As for workers, we report treatment effects on the full set of endline items in the survey for transparency in Appendix Table A.14. This table also includes estimates of all treatment effects for a sample in which we drop the 25 percent of managers who exhibit the highest levels of social desirability bias. We also provide estimates of treatment effects using exclusively between-subject variation. The point estimates remain largely unchanged across both alternative specifications, suggesting that experimenter demand effects are unlikely to drive our results.

Together, Panels (a)–(c) reveal a coherent pattern. Managers understand that changing the allocation of tasks changes how workers interact, coordinate, and learn; they anticipate adjusting hiring in response to these learning consequences; and these same social and learning dimensions help explain how they choose to organize production. The experiment therefore connects the learning and social consequences of the division of labor directly to managers' organizational choices.

8 Workplace DoL, mobility, and talent acquisition

In a final set of analyses, we study how the division of labor within firms relates to worker turnover and firms' hiring practices. Firms may increase their workforce to take advantage of the gains from dividing production more finely across workers. Our framework also raises the possibility that the division of labor affects how firms acquire and develop human capital. If workers in more specialized roles accumulate less human capital on the job, firms may rely more heavily on hiring experienced workers rather than developing talent internally.

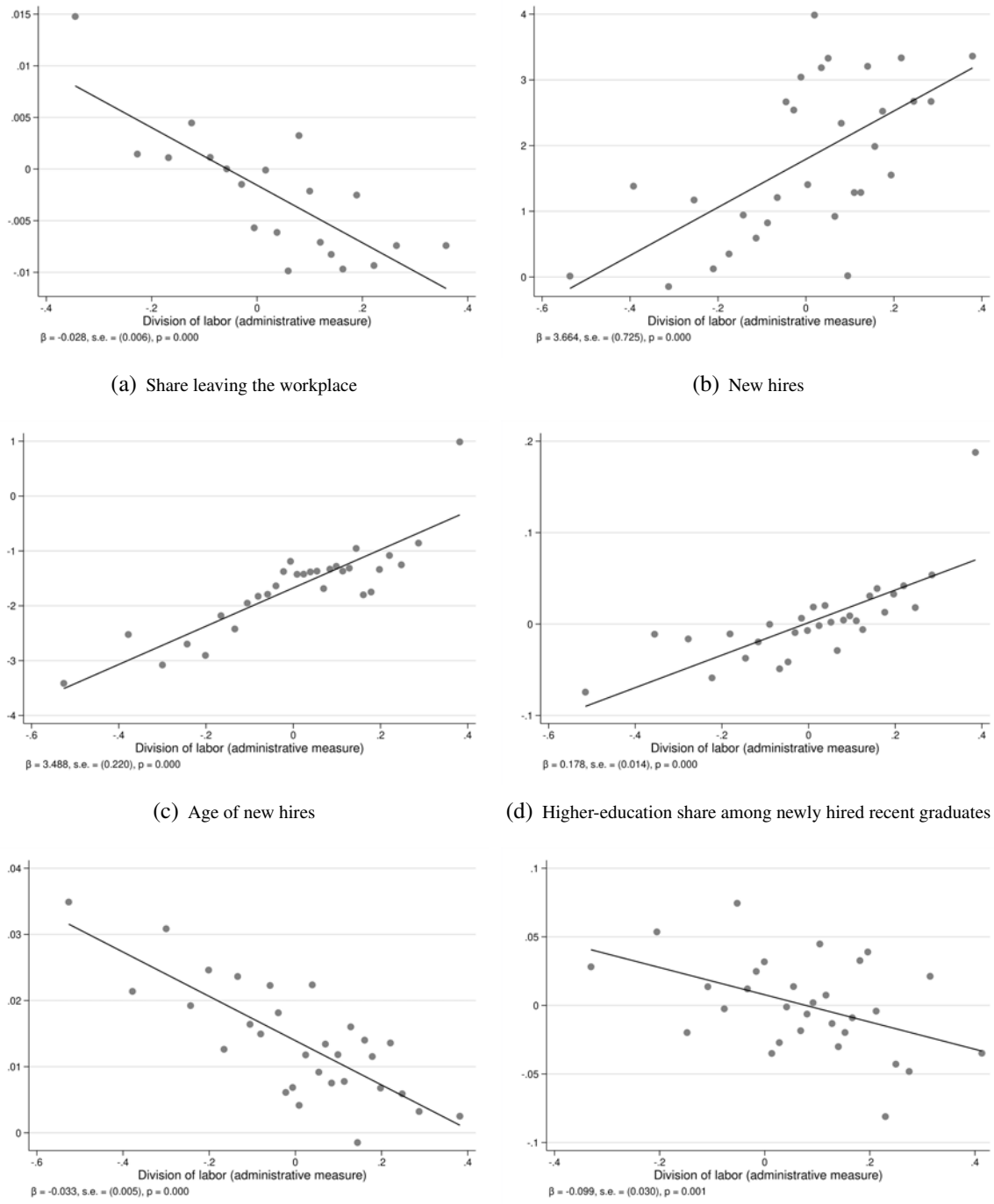
The vignette experiments provide further motivation for examining these relationships. Managers expect workers to accumulate less human capital when tasks are more differentiated and, importantly,

report placing greater emphasis on hiring experienced workers under this organizational structure. This suggests that the learning consequences of the division of labor may carry over to firms' hiring decisions. Workers, meanwhile, express a preference for workplaces with greater task overlap, particularly when they value opportunities for learning. The implications for worker turnover are less clear. On the one hand, workers in firms with a finer division of labor report weaker social ties to their colleagues, which may increase turnover. On the other hand, workers in specialized roles accumulate fewer transferable skills, potentially making it more difficult to move to alternative employers.

Panel (a) of Figure 9 indicates that workers in firms with a finer division of labor are less likely to exit. This pattern runs counter to what we might expect from their weaker social ties, but is consistent with the possibility that a finer degree of DoL generates a degree of worker lock-in by reducing both the amount of human capital workers accumulate and the transferability of the skills they develop. The same logic has implications for firms' hiring and promotion decisions. If firms with a finer level of division of labor generate less workplace learning, they may rely more heavily on hiring experienced workers rather than developing talent internally. Consistent with this idea, Panel (b) shows that firms with a finer DoL engage in more hiring. Moreover, these firms tend to hire older and more experienced workers (Panel (c)). Among the recent graduates they do hire, firms with a finer DoL are also more likely to recruit workers with advanced degrees (Panel (d)). By contrast, firms with less DoL hire younger workers (Panel (e)), consistent with a greater reliance on learning and skill development within the firm.

This interpretation is further supported by promotion patterns. Panel (f) shows that managers in firms with less DoL are more likely to be promoted from within, whereas firms with a finer degree of DoL rely more heavily on external recruitment when filling managerial positions. Taken together, these results suggest that workplace specialization shapes not only how firms organize production, but also how they acquire and develop human capital. Firms relying on a finer division of labor appear to depend more heavily on hiring already-developed talent, while firms employing workers in broader roles appear to play a larger role in developing skills internally.

Figure 9: The division of labor and turnover



(a) Share leaving the workplace

(b) New hires

(c) Age of new hires

(d) Higher-education share among newly hired recent graduates

(e) Recent graduates as a share of new hires

(f) Internal share of workers entering managerial occupations

Notes: Panel (a) plots the share of the 2022 workforce leaving their workplace by 2023 against the administrative measure of the division of labor in 2022. Panel (b) plots the number of workers newly joining the firm in 2023 against the administrative measure in 2023. New hires were either employed by a different firm or had no observed employer in 2022. Panel (c) plots the average age of new hires against the same measure. Panel (d) plots the number of newly hired recent higher-education graduates relative to the number of newly hired recent graduates at any education level. Panel (e) plots recent graduates as a share of all new hires. Recent graduates are workers who completed their education in 2022 or 2023. Panel (f) plots the share of workers entering a managerial occupation in 2023 who were employed by the same firm in 2022. Managers are identified by major occupational group 1. The administrative division-of-labor measure is one minus the Herfindahl–Hirschman Index of four-digit occupational employment shares within an establishment, averaged across a firm's employees. Both variables in each panel are residualized with respect to industry and municipality fixed effects, with classifications assigned using the most common values among each firm's employees. Dots report mean values of both variables within quantile bins of the horizontal-axis variable; solid lines show linear fits estimated using the underlying firm-level observations.

9 Discussion

The division of labor is one of the oldest ideas in economics. From Smith's pin factory to Taylor's scientific management, the division of labor has been central to thinking about how firms organize production. Becker and Murphy (1992) formalized the central economic tradeoff: a finer division of labor raises productivity through the division of tasks, but its extent is constrained by the costs of coordinating an increasingly fine division of tasks across workers. Our results provide large-scale evidence on both sides of this classical tradeoff. Firms with a finer internal division of labor exhibit higher productivity and firm wage premia, but also devote substantially greater resources to managerial and other forms of coordination.

Despite its foundational role in economic theories of the firm, there is no economy-wide empirical evidence on how pervasive the classical tradeoff between specialization and coordination is. A central obstacle is that the internal organization of production is difficult to observe and varies across industries and firms. Administrative data provide detailed information on firm performance and employment structures, but reveal little about how tasks are divided among workers or how production is coordinated on a daily basis. By combining population-wide matched employer–employee administrative records with detailed, linked workplace surveys, we provide large-scale evidence on both sides of this tradeoff. We document how the division of labor relates to firm productivity, including revenue per worker and firm wage premia, as well as the resources firms devote to managerial coordination, including the share of workers employed as managers and the share of the wage bill allocated to managerial positions. The survey data further allow us to examine coordination costs as experienced by workers themselves, including time spent in meetings, the effort devoted to coordinating activities, and the need to align work with colleagues.

Beyond providing systematic empirical evidence on this classical tradeoff, we highlight a second, largely neglected tradeoff: the division of labor is not only a technology for organizing production, but also a technology for producing human capital. How tasks are allocated across workers determines both what they learn through performing their own tasks and what they can learn from their colleagues. A finer division of labor may strengthen learning-by-doing through repetition and specialization, but it also reduces task overlap, collaboration, and opportunities to learn from coworkers. Our evidence suggests that the latter force dominates in our setting. Workers in more specialized roles report less overall learning and experience slower subsequent wage growth. The organization of production therefore determines not only how efficiently firms use their existing human capital, but also how that human capital evolves over time.

Establishing the consequences of the division of labor for human capital accumulation presents considerable empirical challenges. Firms do not randomly assign workers to different organizational structures, and differences in workplace learning may reflect worker selection, firm characteristics, or other features of the work environment. The descriptive relationships we document are informative

in their own right, particularly given how little is known about the relationship between workplace organization and human capital accumulation across the economy. Nevertheless, they cannot establish whether DoL itself reduces learning. We therefore complement these patterns with two approaches that provide additional evidence on the underlying mechanisms. First, we exploit coworker absences to examine how disruptions to opportunities for coworker learning affect subsequent wage growth, and how these effects vary with workplace specialization. Second, we conduct randomized vignette experiments with workers and managers, varying the allocation of tasks while holding other features of the workplace fixed. These experiments allow us to isolate how organizational structure shapes expectations about productivity, coordination, and learning, as well as workers' workplace preferences and managers' organizational choices. Neither approach amounts to randomly assigning firms to different divisions of labor, but together they provide evidence on mechanisms and organizational tradeoffs that cannot be recovered from the descriptive relationships alone.

These dynamic consequences may also have implications for the decisions of firms and workers. In the administrative data, firms with a finer division of labor hire older and more experienced workers and rely less on internal promotion. These patterns are consistent with the possibility that firms with fewer opportunities for internal skill development rely more heavily on acquiring human capital externally, although they do not establish such a response causally. Our vignette experiments provide complementary evidence: managers place greater emphasis on hiring experienced workers when tasks are more differentiated, while workers and managers take account of differences in workplace interactions, coordination, and learning when choosing between alternative organizational structures.

These findings have broader implications for how we think about firms' optimal organization of production. In the classical framework, firms balance the productivity gains from specialization against the costs of coordination. Our findings introduce a third consideration: the consequences of task allocation for human capital accumulation and, consequently, future productivity. A finer division of labor may increase current productivity while weakening the development of workers' productive capacity. The organizational structure that maximizes current output may therefore differ from the one that maximizes productivity over a longer horizon. Moreover, firms may respond to weaker opportunities for internal skill development by acquiring more experienced workers externally, suggesting that decisions about production organization are connected to decisions about how firms acquire and develop talent.

These considerations also have implications for workers. The division of labor may influence not only their current productivity and earnings, but also their opportunities to acquire skills, progress within firms, and move between employers. Workers with similar initial skills may experience different career trajectories depending on how production is organized around them. Greater specialization may reduce both the amount of human capital accumulated and the transferability of the skills that workers develop, with potential consequences for mobility and lifetime earnings inequality. Given

the substantial increase in the division of labor within firms over recent decades (Appendix Figure A.11), these dynamic consequences may be important for understanding how changes in production organization shape the distribution of human capital and career opportunities across workers.

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Online Appendix to:
"The Division of Labor: Productivity, Coordination, and Learning"

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October 16, 2026

A Additional Tables and Figures

Table A.1: Occupational Composition and Diversity Metrics by Firm

Qty	ISCO Code	Occupational Role
Panel A: Firm A (Big Blue), $D_A = 0.86$		
1	1210	CEO / Director
1	1221	Sales Manager
2	2431	Advertising and sales
1	2511	Systems Analyst
3	2512	SW Developers
1	2519	QA / Testing
1	3513	IT Ops Tech
1	3311	Accountant
1	4110	Office Admin
Panel B: Firm B (Swift Orange), $D_B = 0.62$		
1	1210	CEO / Director
1	1221	Sales Manager
1	2431	Advertising and sales
7	2512	SW Developers
1	3311	Accountant
1	4110	Office Admin

Notes: This table outlines the staffing structure by ISCO code for both sampled firms. Panel A displays Firm A (Big blue) with a calculated diversity index of $D_A = 0.86$. Panel B displays Firm B (Swift orange) with an calculated diversity index of $D_B = 0.62$.

Table A.2: Measures of the Division of Labor

Measure	Construction and interpretation	Empirical approach	Application and outcomes
Division of labor—administrative measure	One minus the HHI of four-digit occupational employment shares within establishments. Captures how finely work is divided across distinct occupational roles, with higher values indicating a finer division of labor.	Descriptive	Examines firm productivity, coordination, and organizational practices. Outcomes include revenue per worker, firm wage premia, managerial employment, hiring, and internal promotions. Also examines changes within firms over time.
Division of labor—survey measure	Reverse-coded responses to how easily another employee could perform the respondent's job. Captures the extent to which individual workers perform differentiated tasks, with higher values indicating lower substitutability with coworkers.	Descriptive	Examines coordination demands, workplace interactions, and human capital accumulation. Outcomes include meetings, supervisory responsibilities, social connectedness, coworker support, collaboration, learning-by-doing, coworker learning, and overall skill development.
Division of labor—experimental measure	Randomly varies whether workers perform narrower and more differentiated tasks with little overlap, or broader tasks with substantial overlap. Directly manipulates the allocation of tasks across workers while holding other workplace characteristics fixed.	Experimental	Examines how task allocation shapes workers' and managers' perceptions of productivity, coordination, social interactions, and learning, as well as workers' workplace preferences and managers' organizational choices.
Division of labor—occupation-level measure	Combines survey responses on worker substitutability and ease of training a replacement, aggregated within three-digit occupations and standardized. Captures occupational differences in the distinctiveness of workers' roles.	Quasi-experimental	Assigns occupation-level specialization to workers in the population-wide administrative data to examine whether the effects of coworker absences on subsequent wage growth vary with occupational specialization.

Notes: This table summarizes the four measures of the division of labor used throughout the paper. Conceptually, the division of labor concerns how production tasks are allocated across workers, with a finer division of labor corresponding to narrower and more differentiated task assignments and less overlap between workers. Our experimental measure captures this concept most directly by randomly varying task overlap across workers while holding the tasks required for production and other workplace characteristics fixed. In the observational data, the allocation of tasks across workers is not directly observed. We therefore construct complementary measures based on the distribution of employment across occupational roles and workers' perceived substitutability with coworkers. These measures capture different manifestations of the same underlying organizational choice. The occupation-level measure aggregates survey responses within detailed occupations, allowing us to examine heterogeneity in the effects of coworker absences using population-wide administrative data.

Table A.3: The division of labor, firm wage premia, and manager shares: Sensitivity to covariates

	Specification						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
AKM firm wage premia	0.19***	0.08***	0.08***	0.05***	0.03***	0.03***	0.03***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Manager share of employment	0.15***	0.16***	0.16***	0.21***	0.20***	0.20***	0.20***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Industry FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	No	No	Yes	Yes	Yes	Yes	Yes
Firm size bins	No	No	No	Yes	Yes	Yes	Yes
Education shares	No	No	No	No	Yes	Yes	Yes
Female share	No	No	No	No	No	Yes	Yes
Average age	No	No	No	No	No	No	Yes

Notes: This table reports regression coefficients relating AKM firm wage premia and managers as a share of employment to the administrative measure of the division of labor. Firm wage premia are estimated from an earnings model with worker and firm fixed effects following Abowd et al. (1999) and Kline (2024). They capture firm-specific pay differences conditional on worker fixed effects, rather than directly measuring productivity. The division-of-labor measure is one minus the Herfindahl–Hirschman Index of four-digit occupational employment shares within an establishment, averaged across a firm's employees. Successive columns add the indicated covariates to the baseline bivariate specification.

Table A.4: The division of labor, social connectedness, and learning: Sensitivity to covariates

	Specification							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Social connectedness	-0.03***	-0.02***	-0.02***	-0.02***	-0.02***	-0.02***	-0.02***	-0.02***
	(0.004)	(0.004)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Learning from colleagues	-0.05***	-0.05***	-0.05***	-0.05***	-0.05***	-0.05***	-0.05***	-0.04***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.010)	(0.010)	(0.010)	(0.010)
Learning by doing	0.03***	0.02***	0.02***	0.02***	0.01***	0.01**	0.01**	0.01***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.010)	(0.010)	(0.010)	(0.010)
Better at your job	-0.01**	-0.01**	-0.01**	-0.01***	-0.02***	-0.02***	-0.02***	-0.01*
	(0.003)	(0.003)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Industry FE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Firm size bins	No	No	No	Yes	Yes	Yes	Yes	Yes
Occupation FE	No	No	No	No	Yes	Yes	Yes	Yes
Education FE	No	No	No	No	No	Yes	Yes	Yes
Gender	No	No	No	No	No	No	Yes	Yes
Age bins	No	No	No	No	No	No	No	Yes

Notes: This table reports regression coefficients relating social connectedness and workplace learning to the survey measure of the division of labor. The survey measure reverse-codes agreement with the statement that many people at the workplace could perform the respondent's job, so that higher values indicate lower perceived substitutability across coworkers. Successive columns add the indicated covariates to the baseline bivariate specification.

Table A.5: The division of labor and log wage growth: Sensitivity to covariates

	Specification							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log wage growth	-0.04***	-0.02***	-0.03***	-0.03***	-0.02***	-0.02***	-0.02***	-0.01***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Industry FE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Firm size bins	No	No	No	Yes	Yes	Yes	Yes	Yes
Occupation FE	No	No	No	No	Yes	Yes	Yes	Yes
Education FE	No	No	No	No	No	Yes	Yes	Yes
Gender	No	No	No	No	No	No	Yes	Yes
Age bins	No	No	No	No	No	No	No	Yes

Notes: This table reports worker-level regression coefficients relating the change in log wage between 2022 and 2023 to the administrative measure of the division of labor in the worker's establishment in 2022. The division-of-labor measure is one minus the Herfindahl–Hirschman Index of four-digit occupational employment shares within an establishment. Successive columns add the indicated covariates to the baseline bivariate specification. Workplace characteristics are measured in 2022. Standard errors are heteroskedasticity-robust.

Table A.6: The division of labor, social connectedness, and learning: Excluding managers

Better at your job	-0.01**
	(0.01)
Social connectedness	-0.02***
	(0.01)
Learning by doing	0.02***
	(0.01)
Learning from colleagues	-0.05***
	(0.01)
Industry FE	Yes
Municipality FE	Yes

Notes: This table reports regression coefficients relating social connectedness and workplace learning to the survey measure of the division of labor, excluding workers in managerial positions. The survey measure reverse-codes agreement with the statement that many people at the workplace could perform the respondent's job, so that higher values indicate lower perceived substitutability across coworkers.

Table A.7: The division of labor: Controlling for vertical occupational differentiation

	Administrative outcomes		Survey outcomes		
	Firm wage premia (AKM)	Manager share	Better at your job	Coworker learning	Learning by doing
	(1)	(2)	(3)	(4)	(5)
Division of labor	0.128***	0.088***	-0.013**	-0.047***	0.021***
	(0.008)	(0.005)	(0.005)	(0.005)	(0.005)
Observations	57,879	59,420	7,120	7,120	7,120
Broad occupational differentiation	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes

Notes: This table reports regression coefficients relating the division of labor to firm wage premia, managerial employment, and workplace learning, conditional on broad occupational differentiation. The latter is measured as one minus the Herfindahl–Hirschman Index of employment shares across one-digit occupations. Columns (1)–(2) use the administrative measure of the division of labor, constructed from four-digit occupational employment shares. Columns (3)–(5) use the survey measure of worker specialization, with higher values indicating lower substitutability with coworkers. Survey outcomes are standardized. Heteroskedasticity-robust standard errors are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.8: Coworker-leave exposure effect on log wage growth, alternative definitions of coworker leave

	(1) Baseline	(2) Division of labor	(3) Learning from coworkers
Parental leave: 30% benefit threshold			
Coworker leave	-0.0385^{***}	-0.0320^{***}	-0.0331^{***}
	(0.0024)	(0.0021)	(0.0021)
$\times$ Occupation index		0.0179^{***}	-0.0166^{***}
		(0.0026)	(0.0039)
N	15,555,465	15,466,663	15,466,663
Sick leave: 30% benefit threshold			
Coworker leave	-0.0213^{***}	-0.0144^{***}	-0.0185^{***}
	(0.0025)	(0.0021)	(0.0020)
$\times$ Occupation index		0.0142^{***}	-0.0096^{***}
		(0.0020)	(0.0033)
N	15,301,592	15,214,362	15,214,362
Parental or sick leave: 20% benefit threshold			
Coworker leave	-0.0257^{***}	-0.0205^{***}	-0.0226^{***}
	(0.0022)	(0.0018)	(0.0017)
$\times$ Occupation index		0.0135^{***}	-0.0124^{***}
		(0.0018)	(0.0035)
N	14,541,483	14,456,941	14,456,941
Parental or sick leave: continuous leave intensity			
Coworker leave	-0.0014^{**}	-0.0011^{**}	-0.0018^{***}
	(0.0006)	(0.0005)	(0.0005)
$\times$ Occupation index		0.0025^{***}	-0.0027^{**}
		(0.0008)	(0.0011)
N	14,949,131	14,864,179	14,864,179

Notes: This table reports robustness checks using four definitions of coworker leave. The first two specifications separately measure parental and sick leave, defining a coworker as on leave when their corresponding benefits exceed 30 percent of their previous-year wage income. The third specification lowers this threshold to 20 percent and combines parental and sick leave. The fourth uses a continuous measure of parental and sick leave intensity, defined as the average ratio of leave benefits to previous-year wage income across the worker's coworkers; coefficients for this measure are therefore on a different scale from those for the threshold-based measures. For the threshold-based measures, coworker-leave exposure is the share of the worker's coworkers satisfying the relevant leave definition. The outcome is the change in log annual wage income between $t-1$ and t. Each column within a leave definition is a separate regression. Column (1) includes coworker-leave exposure in $t-1$. Column (2) additionally includes the division-of-labor index of the worker's occupation and its interaction with coworker leave, while column (3) instead includes the index of learning from coworkers and its interaction with coworker leave. In columns (2) and (3), the coefficient on coworker leave and the interaction term are estimated in the same regression; the main effect of the corresponding occupation index is estimated but not reported. All regressions include worker and year fixed effects and control for a quartic polynomial in worker age, entered as the square, cube, and fourth power; the linear age term is collinear with the worker and year fixed effects and is omitted. For each leave definition, the estimation sample is defined by the corresponding column (1) regression and excludes worker-years in which the worker is themselves on the relevant type of leave. N is the number of worker-years in each regression and falls in columns (2) and (3) because worker-years whose occupation has no survey match are excluded. Standard errors, clustered at the level of the workplace in $t-1$, are reported in parentheses. $^{*}p<0.10$, $^{**}p<0.05$, $^{***}p<0.01$.

Table A.9: Summary statistics for the coworker leave analysis sample

	Mean	SD	N
Age	42.36	13.20	14,997,989
Female	0.477	0.499	14,997,989
College	0.481	0.500	14,762,422
Immigrant	0.164	0.370	14,762,422
Married or cohabiting	0.706	0.455	14,997,989
Union member	0.570	0.495	14,997,989
Previous wage (1,000 NOK)	545.75	384.46	14,997,989
Log wage growth	0.106	0.344	14,997,989
Same workplace as previous year	0.801	0.399	14,923,328
Share of coworkers on leave	0.049	0.090	14,997,989
Share of coworkers on parental leave	0.019	0.054	14,997,989
Share of coworkers on sick leave	0.032	0.073	14,997,989
Number of coworkers on leave	5.60	22.26	14,964,830
Number of coworkers	108.83	347.71	14,964,830
Workplace size	8.64	29.36	2,039,668
Division-of-labor index (occupation-level)	−0.30	0.99	2,022,426
Index of learning from coworkers (occupation-level)	0.16	0.92	2,022,426
Establishment size	19.54	105.66	1,003,976
Firm size	30.67	247.56	643,007

Notes: This table reports summary statistics for the estimation sample of Table 2: worker-years 2016–2023 in which the worker is not on extended leave and log wage growth is observed; armed forces occupations are excluded. Each worker-year counts once in the rows above the last three. The last three rows are computed at their own level: the sample is collapsed to one observation per workplace (establishment $\times$ 3-digit occupation) and year, per establishment and year, and per firm and year, using the worker's workplace, establishment and firm in $t-1$, so each unit counts once however many sample workers it has; only units with at least one worker in the sample are included. Shares are reported as fractions. N is the number of non-missing observations of each variable at that row's level: worker-years in the first rows, then workplace-years, establishment-years and firm-years. A worker's coworkers are the other workers in their workplace. A coworker is on leave if their parental or sickness benefits exceed 30 percent of their previous-year wage income; the shares of coworkers on leave, on parental leave and on sick leave are measured in $t-1$ and exclude the worker, and the number of coworkers on leave is the share times the number of coworkers. Same workplace means the same establishment and 3-digit occupation as in the previous year. Workplace, establishment and firm size count main-job workers in the employer register.

Table A.10: Exposure to coworker leave across workers, firms and workplaces

	Share of coworkers on leave	Number of coworkers on leave	N
Panel A. By worker			
Women	0.062	7.60	7,159,019
Men	0.038	3.77	7,838,970
Age under 35	0.050	5.73	4,806,610
Age 35–49	0.051	5.67	5,247,816
Age 50 and over	0.047	5.40	4,943,563
College educated	0.052	8.68	7,098,599
No college	0.047	2.83	7,663,823
Panel B. By firm			
Private sector	0.041	2.28	8,877,969
Public sector	0.062	10.45	6,080,850
Firm size Q1	0.042	0.21	2,339,883
Firm size Q2	0.043	0.98	4,020,319
Firm size Q3	0.052	3.35	4,337,879
Firm size Q4	0.057	15.20	4,266,739
Production industry	0.033	2.24	3,218,692
Market services industry	0.041	3.37	6,553,140
Public and human capital services industry	0.071	10.96	4,959,114
Other services industry	0.058	0.61	231,932
Panel C. By workplace			
1–4 coworkers	0.043	0.10	3,301,988
5–19 coworkers	0.052	0.54	4,731,584
20 or more coworkers	0.051	11.67	6,931,258

Notes: This table reports how exposure to coworker leave varies across workers, firms and workplaces (establishment $\times$ 3-digit occupation). The sample is the estimation sample of Table 2. Every row is a mean over worker-years, so the unit of observation is the same in all three panels and only the grouping variable changes: Panel A groups worker-years by a characteristic of the worker, Panel B by a characteristic of the worker's firm, and Panel C by the size of the worker's workplace. A worker's coworkers are the other workers in their workplace. The worker characteristics in Panel A refer to year t; the firm and the workplace in Panels B and C refer to $t-1$, the year in which exposure is measured. Share of coworkers on leave is the mean share of the worker's coworkers on extended parental or sick leave in $t-1$, and number of coworkers on leave is the mean number; both exclude the worker. N is the number of worker-years in the row. Shares are reported as fractions. Firm size quartiles are quartiles of the distribution of workers across firm sizes, Q1 is the smallest and Q4 is the largest. Industry groups collapse the 21 sections of Statistics Norway's Standard for Industrial Classification (SN2007), the Norwegian implementation of NACE Rev. 2 (`https://www.ssb.no/klass/klassifikasjoner/6`), applied to the employer's primary industry code: Production is sections A–F (agriculture and fishing, mining, manufacturing, electricity and gas, water and waste, construction), Market services is G–O (trade, transport and storage, accommodation and food, information and communication, finance and insurance, real estate, professional and technical services, administrative services, and public administration), Public and human capital services is P–R (education, health and social work, arts and recreation), and Other services is S–U.

Table A.11: Complementary worker survey sample, baseline characteristics

	Full sample mean	Differentiated firm first	Overlap firm first	Difference p-val
Age	49.18	49.40	48.95	0.57
	(12.38)	(12.14)	(12.63)	
Male	0.49	0.49	0.49	0.82
	(0.50)	(0.50)	(0.50)	
Firm experience	18.11	15.56	20.66	0.48
	(111.52)	(90.60)	(129.24)	
Occupation experience	19.19	21.35	17.01	0.30
	(64.97)	(90.87)	(12.64)	
Industry experience	19.45	21.55	17.33	0.31
	(64.95)	(90.85)	(12.55)	
Firm size	4.42	4.44	4.40	0.69
	(1.57)	(1.54)	(1.61)	
Modal worker has at least BA	0.59	0.60	0.59	0.78
	(0.49)	(0.49)	(0.49)	
Wage growth (percent)	5.18	5.14	5.21	0.90
	(9.16)	(8.85)	(9.47)	
No task overlap with colleagues	0.13	0.13	0.13	0.95
	(0.34)	(0.34)	(0.34)	
Task overlap with 1-5 colleagues	0.33	0.33	0.32	0.68
	(0.47)	(0.47)	(0.47)	
Closeness to colleagues	4.11	4.11	4.10	0.87
	(1.66)	(1.65)	(1.67)	
Importance of learning for choice of firm	5.63	5.75	5.52	0.20
	(2.76)	(2.66)	(2.84)	
I get better at my job each year	7.26	7.18	7.34	0.25
	(2.26)	(2.35)	(2.18)	
Workers	975	489	486	

Notes: This table reports the mean characteristics of workers in our complementary survey. The fourth column reports the p-value corresponding to the statistical significance of the differences between the workers who first saw the differentiated versus overlapping firm.

Table A.12: Complementary manager survey sample, baseline characteristics

	Full sample mean	Differentiated firm first	Overlap firm first	Difference p-val
Age	51.70	51.66	51.74	0.91
	(10.23)	(10.39)	(10.09)	
Male	0.63	0.65	0.60	0.14
	(0.48)	(0.48)	(0.49)	
Firm experience	13.16	13.16	13.17	0.99
	(10.96)	(11.07)	(10.86)	
Occupation experience	19.11	19.43	18.80	0.45
	(11.92)	(12.09)	(11.76)	
Industry experience	20.78	21.11	20.46	0.44
	(11.98)	(12.51)	(11.45)	
Firm size	3.84	3.83	3.84	0.89
	(1.86)	(1.86)	(1.86)	
Team size	5.35	5.23	5.48	0.13
	(2.32)	(2.37)	(2.27)	
Modal worker has at least BA	0.58	0.56	0.59	0.47
	(0.49)	(0.50)	(0.49)	
Employee learning is important	8.36	8.35	8.37	0.89
	(1.80)	(1.89)	(1.72)	
Firm competition induces worker motivation	6.00	5.86	6.14	0.02
	(1.70)	(1.71)	(1.68)	
Importance of informal learning	7.25	7.32	7.18	0.32
	(2.07)	(2.09)	(2.06)	
Closeness to colleagues	4.70	4.70	4.71	0.97
	(1.65)	(1.61)	(1.70)	
Managers	814	402	412	

Notes: This table reports the mean characteristics of managers in our complementary survey. The fourth column reports the p-value corresponding to the statistical significance of the differences between the managers who first saw the differentiated versus overlapping firm.

Table A.13: Complementary worker survey sample, vignette experiment treatment effects

	Raw mean (1)	Mean in DoL (2)	TE for Overlap (3)	Difference p-val (4)	Bottom 75 percent Social desirability bias (5)	First round only (between comparison) (6)
Variety of tasks	5.65	-0.41	0.82	0.00	0.84	0.57
	(2.52)		(0.04)		(0.05)	(0.06)
Time working with colleagues	5.02	-0.35	0.70	0.00	0.69	0.47
	(2.31)		(0.04)		(0.05)	(0.06)
Connection with colleagues	3.82	-0.47	0.93	0.00	0.93	0.79
	(1.69)		(0.03)		(0.04)	(0.06)
Ease of communicating with people like me	7.11	-0.00	0.00	0.95	-0.00	-0.01
	(2.33)		(0.04)		(0.04)	(0.06)
Importance of meetings between workers performing different tasks	6.71	-0.04	0.07	0.03	0.09	0.01
	(2.29)		(0.03)		(0.04)	(0.06)
Productivity of meetings	5.93	-0.10	0.20	0.00	0.22	0.07
	(2.17)		(0.03)		(0.04)	(0.06)
Importance of active collaboration	7.04	-0.20	0.40	0.00	0.40	0.19
	(2.40)		(0.03)		(0.04)	(0.07)
Capacity of workers to coordinate tasks themselves	6.44	-0.18	0.35	0.00	0.37	0.21
	(2.33)		(0.04)		(0.05)	(0.06)
How important are managers for coordinating tasks	6.23	0.04	-0.08	0.03	-0.07	-0.05
	(2.30)		(0.03)		(0.04)	(0.06)
How enjoyable is the job socially	6.40	-0.31	0.62	0.00	0.61	0.63
	(2.33)		(0.04)		(0.05)	(0.06)
How enjoyable is the job technically	6.62	-0.13	0.26	0.00	0.29	0.19
	(2.08)		(0.04)		(0.04)	(0.06)
Motivation to develop skills	6.90	-0.17	0.33	0.00	0.33	0.37
	(2.23)		(0.04)		(0.04)	(0.07)
Importance of co-worker learning	7.01	-0.23	0.45	0.00	0.45	0.35
	(2.25)		(0.04)		(0.04)	(0.06)
Importance of independent learning	7.12	0.05	-0.10	0.00	-0.08	-0.02
	(2.01)		(0.03)		(0.04)	(0.07)
Share of learning developing existing skills	6.89	0.01	-0.02	0.58	-0.02	0.03
	(1.86)		(0.03)		(0.04)	(0.07)
Share of learning developing new skills	6.32	-0.12	0.24	0.00	0.26	0.23
	(2.04)		(0.04)		(0.04)	(0.07)
Transferability of learning across firms	6.59	-0.16	0.32	0.00	0.33	0.35
	(2.26)		(0.03)		(0.04)	(0.06)
Ease of asking colleagues for help	6.72	-0.38	0.76	0.00	0.76	0.70
	(2.61)		(0.04)		(0.04)	(0.06)
Skills I develop allow job switching	6.56	-0.19	0.37	0.00	0.36	0.43
	(2.41)		(0.03)		(0.04)	(0.06)
Skill development allow moves into management	5.75	-0.16	0.32	0.00	0.34	0.32
	(2.52)		(0.03)		(0.04)	(0.06)
Each year I will be better at my job	7.15	-0.14	0.27	0.00	0.32	0.37
	(2.16)		(0.03)		(0.04)	(0.07)
Workers	975		975		672	975
Observations	1,950		1,950		1,344	975

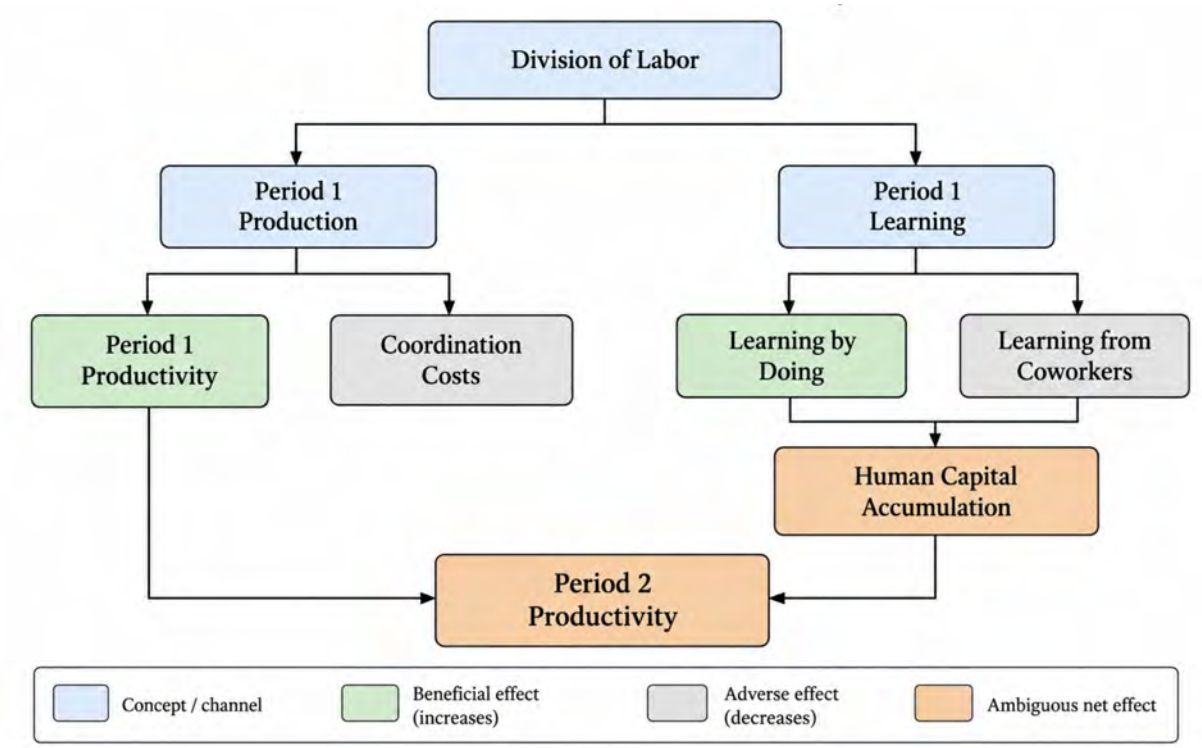
Notes: This table reports the sample mean, standard deviation, and treatment effects—reported in standard deviation units—of the vignette experiment across all outcomes. Column (1) reports the raw mean and standard deviation of each outcome, and is informative about differences in the levels and dispersion across outcomes. Column (2) reports the mean outcome under differentiated tasks, expressed in standard deviation units. Column (3) reports the treatment effect of task overlap, while column (4) reports the corresponding p-value. Columns (5) and (6) report treatment effects from alternative specifications. All treatment effects are estimated using standardized versions of each outcome (mean zero, standard deviation one). The treatment-effect specifications in columns (3) and (5) exploit within-subject variation and include respondent fixed effects, since respondents see both vignette conditions. These specifications also condition on the order in which respondents see the vignettes using order fixed effects. To test the sensitivity of our results to experimenter demand, we re-estimate the specification after excluding respondents with measures of social desirability bias in the top 25 percent of our sample (Crowne and Marlowe, 1960; Reynolds, 1982). These results are reported in column (5). Column (6) restricts our comparison to between-subject variation, includes only data from the first vignette shown to each respondent, and is estimated without respondent or order fixed effects.

Table A.14: Complementary manager survey sample, vignette experiment treatment effects

	Raw mean	Mean in DoL	TE for Overlap	Difference p-val	Bottom 75 percent Social desirability bias	First round only (between comparison)
	(1)	(2)	(3)	(4)	(5)	(6)
Variety of tasks	5.93	-0.35	0.71	0.00	0.68	0.54
	(2.50)		(0.04)		(0.05)	(0.06)
Importance of occupation specific skills	7.09	0.10	-0.20	0.00	-0.22	-0.06
	(2.14)		(0.04)		(0.05)	(0.07)
Firm productivity	6.63	-0.18	0.36	0.00	0.36	0.39
	(1.96)		(0.05)		(0.06)	(0.07)
Capacity of workers to coordinate tasks themselves	5.77	-0.23	0.46	0.00	0.46	0.45
	(2.33)		(0.04)		(0.05)	(0.07)
Importance of managers for coordinating tasks	7.11	0.08	-0.15	0.00	-0.17	-0.11
	(2.04)		(0.04)		(0.05)	(0.07)
Importance of formal meetings	6.95	-0.03	0.05	0.16	0.04	0.06
	(2.16)		(0.04)		(0.04)	(0.07)
Productivity of meetings	6.31	-0.08	0.15	0.00	0.14	0.10
	(2.07)		(0.04)		(0.04)	(0.07)
Connection to colleagues	4.45	-0.35	0.70	0.00	0.68	0.58
	(1.71)		(0.04)		(0.04)	(0.07)
How enjoyable is the job socially	6.60	-0.32	0.65	0.00	0.64	0.62
	(2.24)		(0.04)		(0.05)	(0.07)
How enjoyable is the job technically	6.53	-0.05	0.10	0.02	0.10	0.10
	(1.90)		(0.04)		(0.05)	(0.07)
Ease of communication with workers	6.53	-0.35	0.70	0.00	0.69	0.60
	(2.25)		(0.04)		(0.05)	(0.07)
Importance of co-worker learning	7.27	-0.31	0.62	0.00	0.67	0.54
	(2.25)		(0.04)		(0.05)	(0.07)
Importance of independent learning	7.03	0.01	-0.03	0.43	-0.05	0.06
	(1.99)		(0.04)		(0.04)	(0.07)
Transferability of learning across firms	6.80	-0.23	0.45	0.00	0.43	0.42
	(2.14)		(0.04)		(0.05)	(0.07)
Improvement in existing skills	6.94	-0.20	0.40	0.00	0.38	0.42
	(1.90)		(0.04)		(0.05)	(0.07)
Development of new skills	6.62	-0.27	0.53	0.00	0.57	0.49
	(2.11)		(0.05)		(0.05)	(0.07)
Ease of asking for help from colleagues	6.90	-0.43	0.87	0.00	0.88	0.80
	(2.63)		(0.04)		(0.05)	(0.06)
Each year workers will be better at their job	6.75	-0.19	0.38	0.00	0.41	0.38
	(1.93)		(0.04)		(0.05)	(0.07)
Importance of external hiring for talent at firm	6.43	0.01	-0.02	0.57	-0.02	0.12
	(2.36)		(0.04)		(0.04)	(0.07)
Emphasize experienced workers when hiring	6.71	0.07	-0.14	0.00	-0.14	0.01
	(2.08)		(0.04)		(0.05)	(0.07)
Emphasize generalists when hiring	5.28	-0.26	0.51	0.00	0.50	0.30
	(2.40)		(0.04)		(0.05)	(0.07)
Workers	814		814		566	814
Observations	1,628		1,628		1,132	814

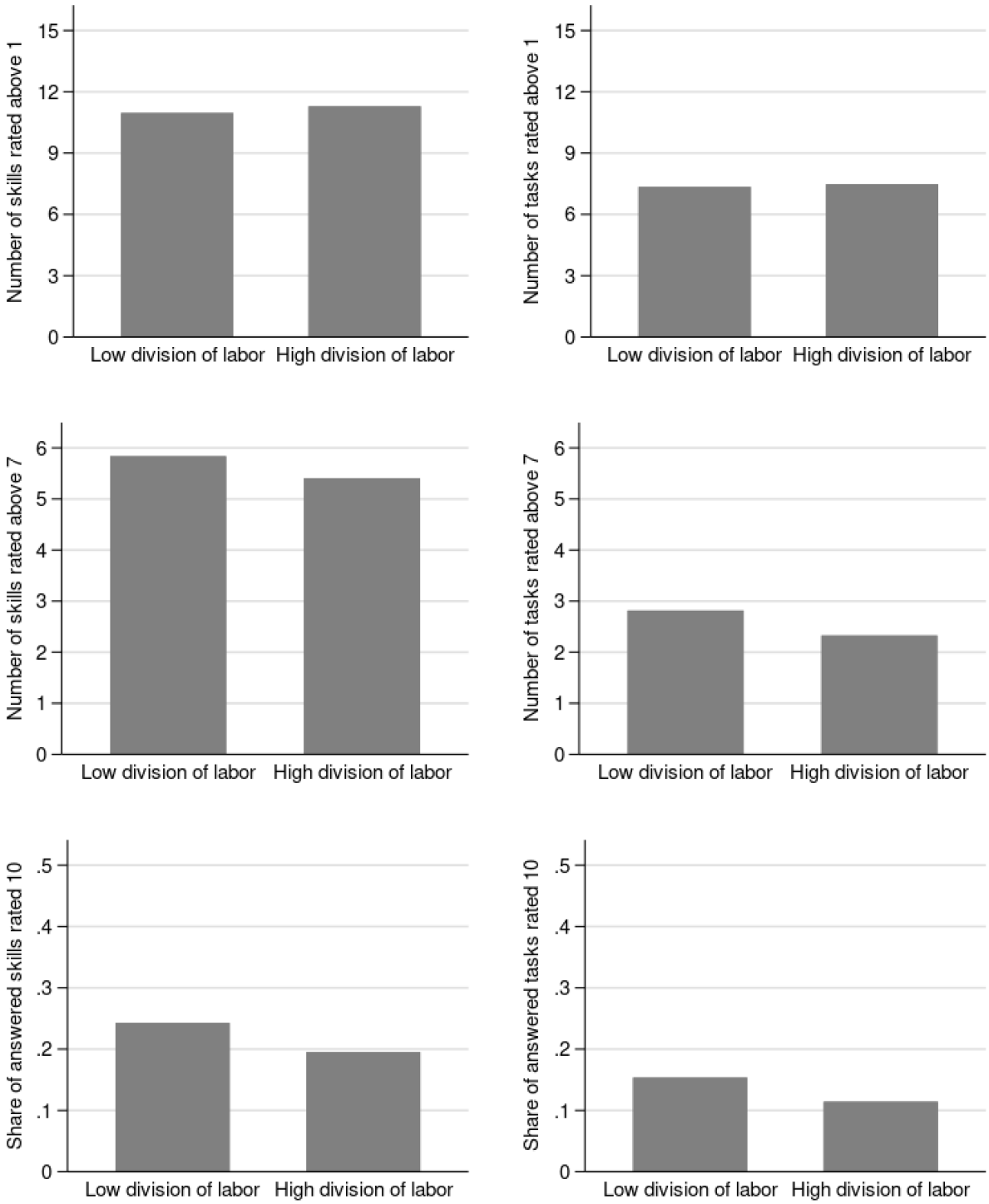
Notes: This table reports the sample mean, standard deviation, and treatment effects—reported in standard deviation units—of the vignette experiment across all outcomes. Column (1) reports the raw mean and standard deviation of each outcome, and is informative about differences in the levels and dispersion across outcomes. Column (2) reports the mean outcome under differentiated tasks, expressed in standard deviation units. Column (3) reports the treatment effect of task overlap, while column (4) reports the corresponding p-value. Columns (5) and (6) report treatment effects from alternative specifications. All treatment effects are estimated using standardized versions of each outcome (mean zero, standard deviation one). The treatment-effect specifications in columns (3) and (5) exploit within-subject variation and include respondent fixed effects, since respondents see both vignette conditions. These specifications also condition on the order in which respondents see the vignettes using order fixed effects. To test the sensitivity of our results to experimenter demand, we re-estimate the specification after excluding respondents with measures of social desirability bias in the top 25 percent of our sample (Crowne and Marlowe, 1960; Reynolds, 1982). These results are reported in column (5). Column (6) restricts our comparison to between-subject variation, includes only data from the first vignette shown to each respondent, and is estimated without respondent or order fixed effects.

Figure A.1: The Division of Labor: Static and Dynamic Tradeoffs



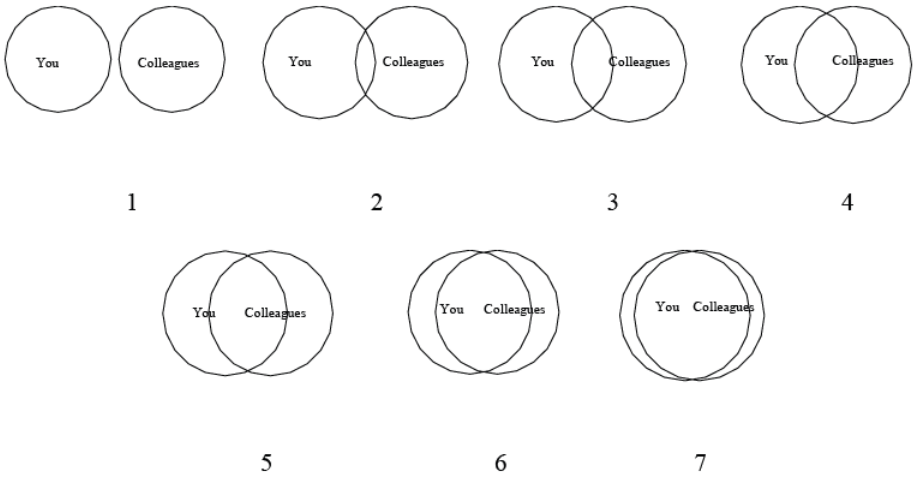
Notes: This figure illustrates the conceptual framework developed in Section 2. The division of labor affects current production through productivity gains and coordination costs. It also shapes human capital accumulation through two competing learning channels: learning-by-doing and learning from coworkers. These channels jointly determine the implications of the division of labor for future productivity.

Figure A.2: The division of labor and the breadth of skills and tasks



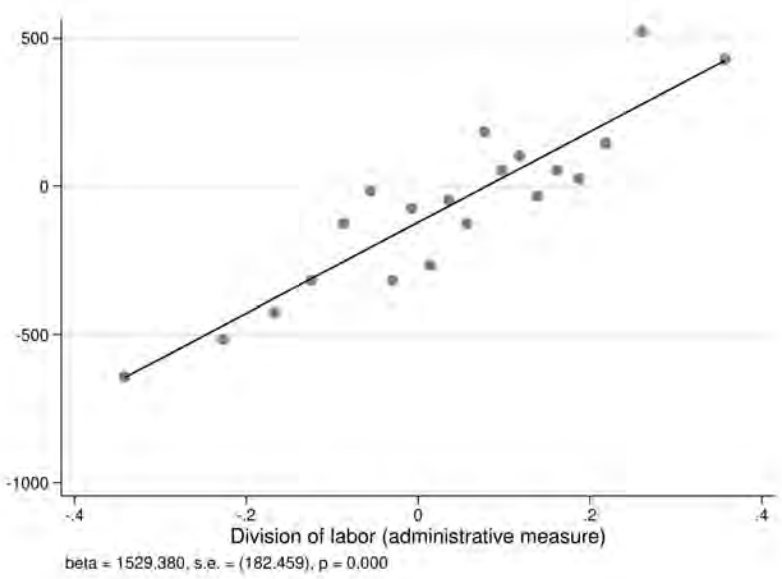
Notes: The left column reports skill measures and the right column reports task measures. All panels compare workers in the bottom and top quartiles of the survey division-of-labor index, labeled low and high, respectively. The index averages reverse-coded agreement with two statements: that many people at the workplace could perform the respondent's job and that the workplace could easily train a replacement. Higher values indicate lower substitutability. The top row reports the average number of items rated above 1. The middle row reports the average number rated above 7. The bottom row reports the average share of answered items rated 10. The measures use 13 skill items and 10 task items, each rated on a 1–10 scale. Missing responses are excluded from the counts and share denominators. Shares are calculated for each worker before averaging within groups. All comparisons are unadjusted.

Figure A.3: Social connectedness



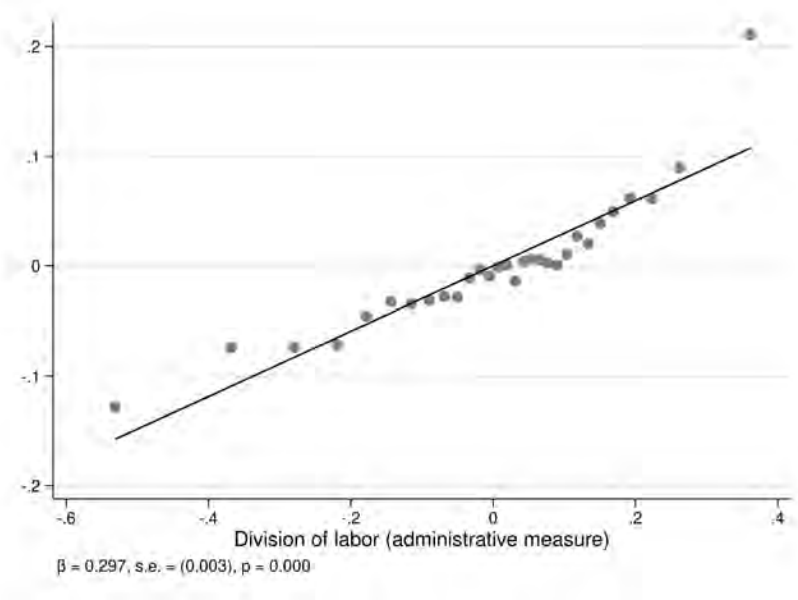
Notes: This figure illustrates how we measure social connectedness using a measure from psychology (Aron et al., 1992) which has been used in recent work by economists (e.g. Gächter et al., 2025; Baader et al., 2024).

Figure A.4: The division of labor and revenue per worker net of managerial costs



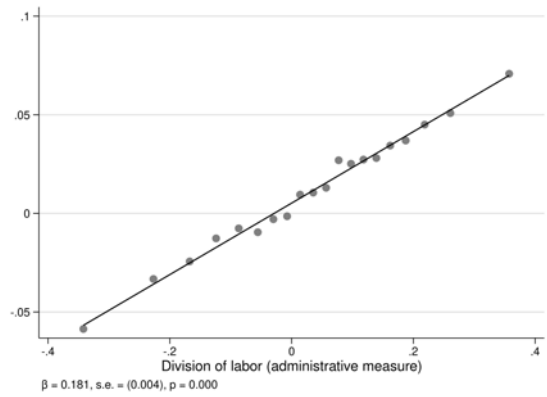
Notes: This figure plots revenue per worker net of managerial costs in 2023 against the administrative measure of the division of labor. The administrative measure is one minus the Herfindahl–Hirschman Index of four-digit occupational employment shares within an establishment, averaged across a firm's employees. Both variables are residualized with respect to industry and municipality fixed effects, using the most common classifications among each firm's employees. Revenue is expressed in thousands of NOK. Dots report mean values within quantile bins of the horizontal-axis variable; the solid line shows a linear fit estimated using the underlying firm-level observations.

Figure A.5: Log wages

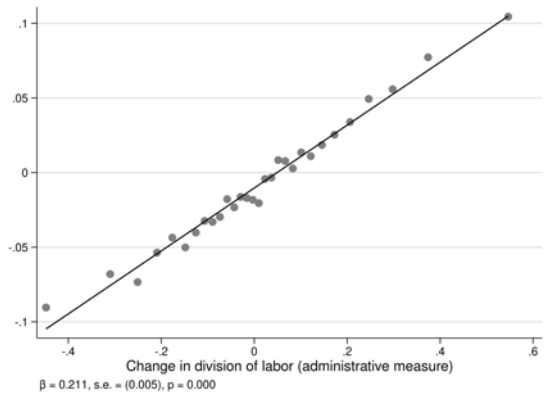


Notes: This figure plots workers' log wage in 2023 against the administrative measure of the division of labor in their establishment in 2023. The division-of-labor measure is one minus the Herfindahl–Hirschman Index of four-digit occupational employment shares within the establishment. Both variables are residualized on industry and municipality fixed effects. Dots report the mean residualized values within 30 quantile bins of the residualized division-of-labor measure. The black line shows a linear fit estimated using the underlying worker-level observations.

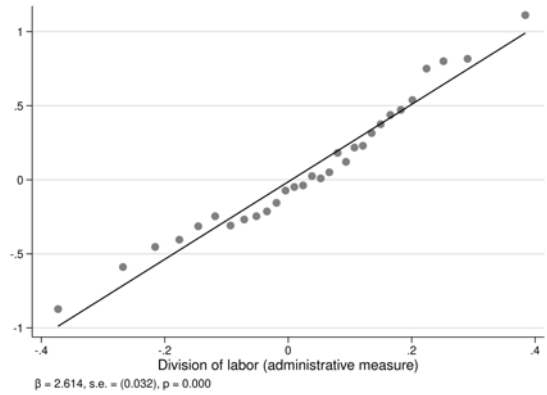
Figure A.6: The division of labor and coordination: Additional measures



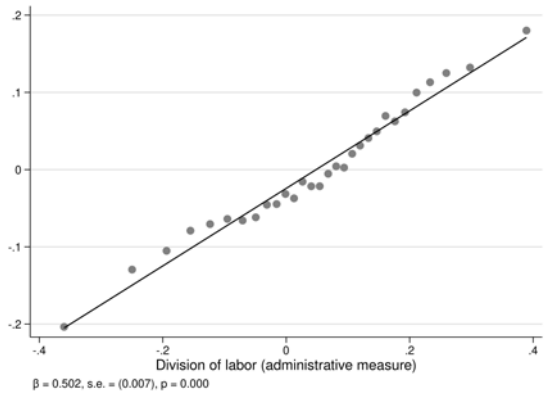
(a) Manager wage share



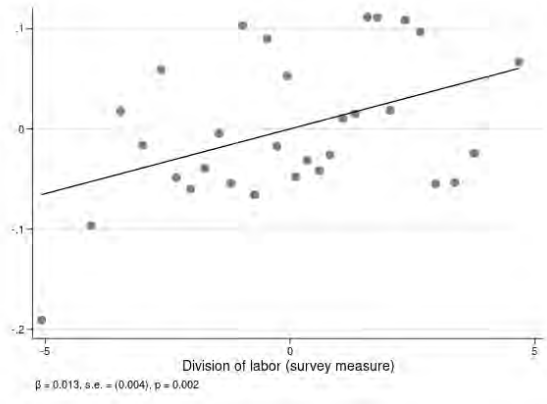
(b) Change in manager wage share



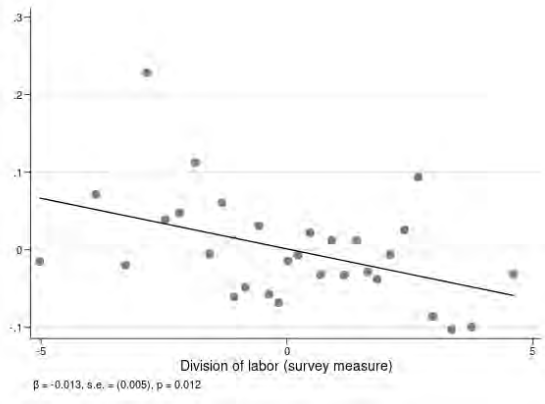
(c) Number of managerial occupations



(d) Managerial occupational diversity



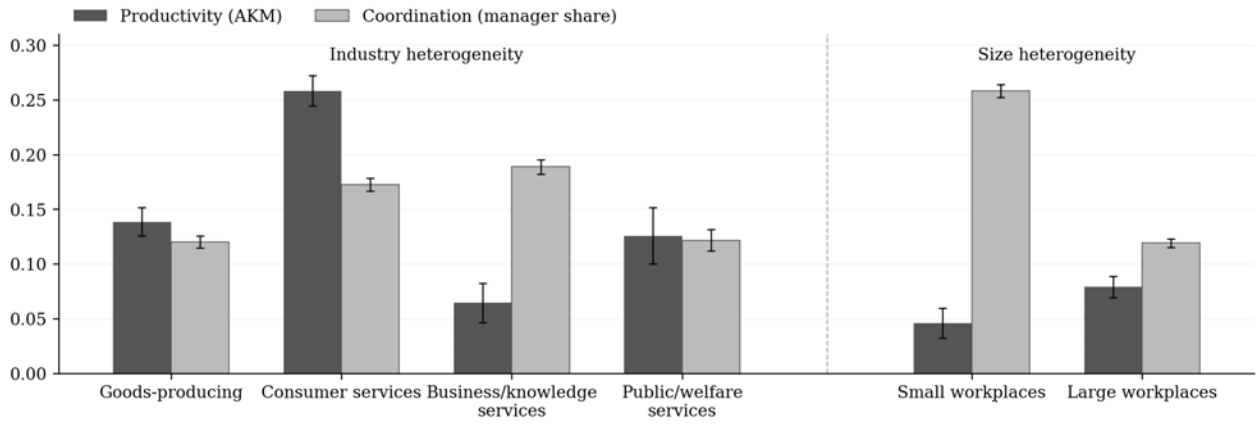
(e) Coordination-related meetings



(f) Meeting productivity

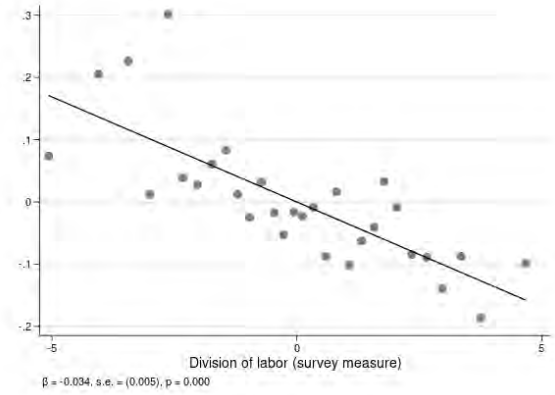
Notes: Panel (a) plots the share of wages paid to managers against the administrative measure of the division of labor in 2023. Panel (b) plots the change in manager wage share between 2008 and 2023 against the change in the administrative measure over the same period. Panel (c) plots the number of distinct four-digit managerial occupations against the administrative measure in 2023. Panel (d) plots managerial occupational diversity, measured as one minus the Herfindahl–Hirschman Index of employment shares across four-digit managerial occupations, against the same measure. Higher values indicate that managerial employment is spread across more occupations. The administrative division-of-labor measure is one minus the Herfindahl–Hirschman Index of four-digit occupational employment shares within an establishment, averaged across establishments within each firm using employment weights. Both variables in panels (a)–(d) are adjusted for industry and municipality fixed effects; changes in panel (b) are calculated after adjusting each year's variables. Panel (e) plots the reported share of meetings devoted to coordination, and panel (f) plots perceived meeting productivity, against the survey division-of-labor measure. This measure reverse-codes agreement that many people at the workplace could perform the respondent's job, so that higher values indicate lower substitutability. The outcomes in panels (e) and (f) are standardized, and both outcomes and the survey measure are residualized on municipality and four-digit occupation fixed effects. Dots report mean residualized values within quantile bins of the corresponding residualized division-of-labor measure. Black lines show linear fits estimated using the underlying observations.

Figure A.7: Division of Labor, Productivity, and Coordination Across Industries and Workplace Sizes

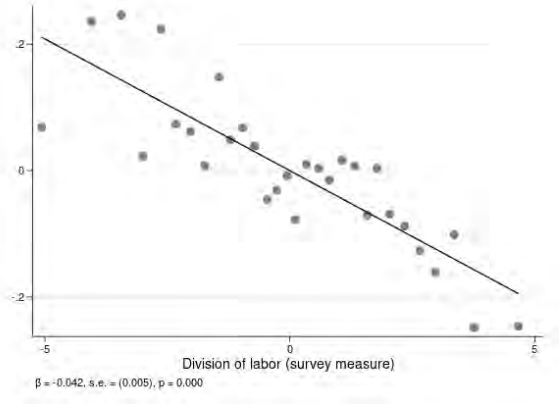


Notes: This figure reports the association between the administrative measure of the division of labor and two firm-level outcomes: productivity, measured using AKM firm wage premia, and coordination, measured by the share of managers in the firm. The first four groups report estimates separately by industry group, controlling for municipality fixed effects. The final two groups report estimates by workplace size, defined relative to the median firm size. For these estimates, both the dependent variables and the division-of-labor measure are residualized on industry and municipality fixed effects in the full sample before estimating separate coefficients by workplace size. Vertical lines indicate 95% confidence intervals based on heteroskedasticity-robust standard errors.

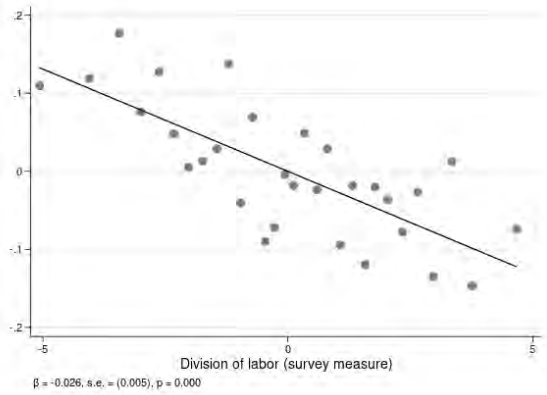
Figure A.8: The division of labor and teamwork



(a) Efficiency of teamwork



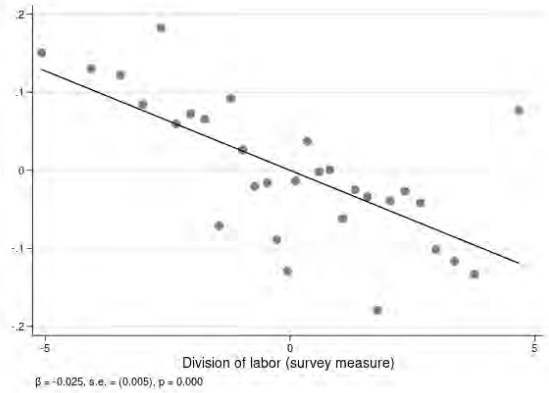
(b) Speed of teamwork



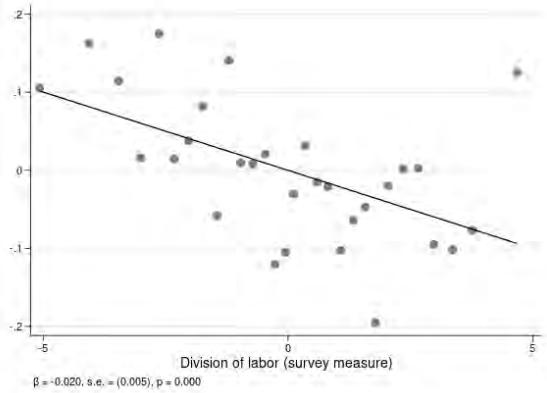
(c) Meeting goals and deadlines

Notes: Panel (a) plots perceived teamwork efficiency against the survey measure of the division of labor. Panel (b) plots perceived teamwork speed against the same measure. Panel (c) plots workers' reports of meeting goals and deadlines on time against the same measure. The division-of-labor measure reverse-codes agreement with the statement that many people at the workplace could perform the respondent's job, so that higher values indicate lower substitutability. Outcomes are standardized, and both outcomes and the division-of-labor measure are residualized on municipality and four-digit occupation fixed effects. Dots report mean residualized values within 30 quantile bins of the residualized division-of-labor measure. Black lines show linear fits estimated using the underlying worker-level observations.

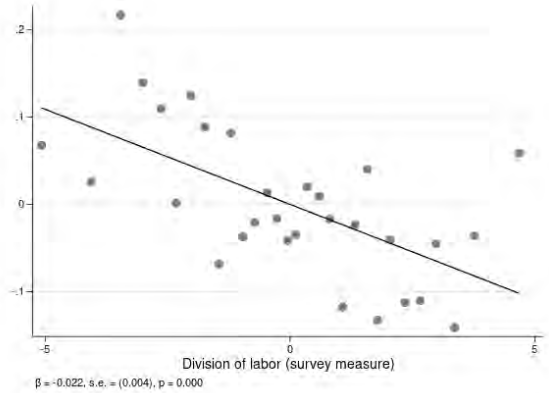
Figure A.9: The division of labor and the content and transferability of learning



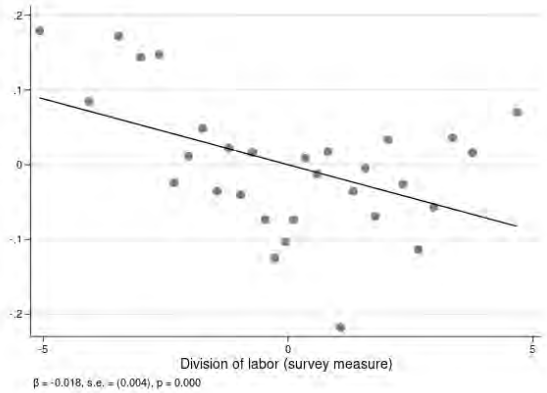
(a) Learning new skills



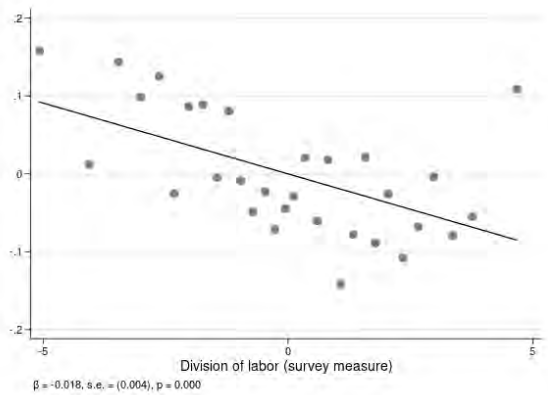
(b) Developing existing skills



(c) Transferability across occupations



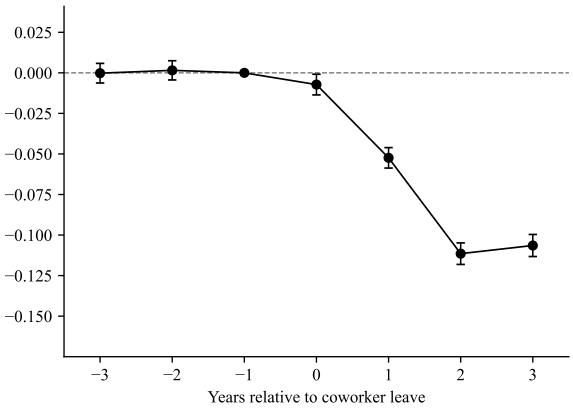
(d) Transferability across firms



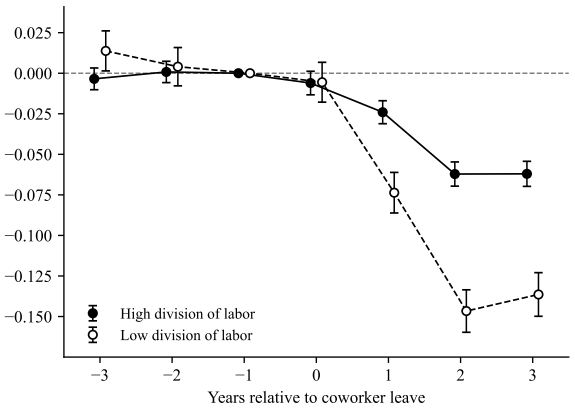
(e) Transferability across industries

Notes: Panel (a) plots the reported extent of learning new skills against the survey measure of the division of labor. Panel (b) plots the reported extent of developing existing skills against the same measure. Panels (c), (d), and (e) plot workers' perceived transferability of learning across occupations, firms, and industries, respectively, against the same measure. The division-of-labor measure reverse-codes agreement with the statement that many people at the workplace could perform the respondent's job, so that higher values indicate lower substitutability. Outcomes are standardized, and both outcomes and the division-of-labor measure are residualized on municipality and four-digit occupation fixed effects. Dots report mean residualized values within 30 quantile bins of the residualized division-of-labor measure. Black lines show linear fits estimated using the underlying worker-level observations.

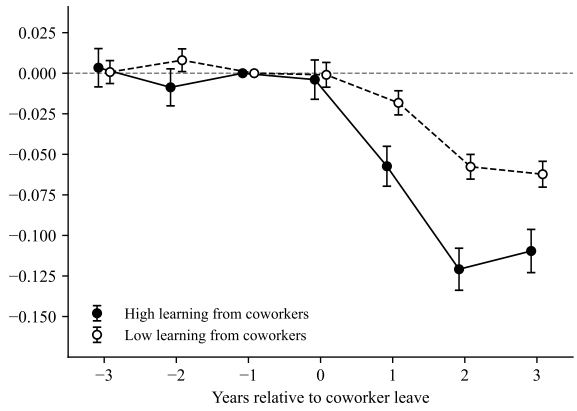
Figure A.10: Event study: coworker leave and log wage growth



(a) All workers



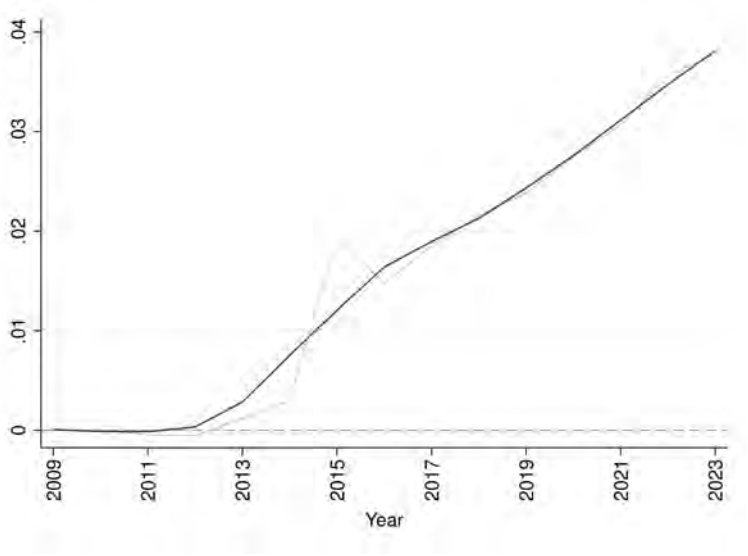
(b) By occupational division of labor



(c) By occupational coworker learning

Notes: This figure reports stacked difference-in-differences event-study estimates of the effect of a coworker's extended leave on log wage growth. An event is the first year in which at least one of the worker's coworkers (the other workers in the same establishment and 3-digit occupation) is on extended parental or sick leave, defined as benefits exceeding 30 percent of their previous-year wage income. Treated workers are exposed exactly once in 2015–2023, with the event in 2018, 2019 or 2020; each event cohort forms a stack with the workers who are never exposed, observed from three years before to three years after the event. Workers who are themselves on extended leave in any year of the event window, or in the year before it, are excluded. The regressions include worker×stack, year×stack and firm×year×stack fixed effects and no other controls. Each point is the coefficient on event time relative to the year before the event ($k = -1$), with 95 percent confidence intervals based on standard errors clustered at the level of the worker's workplace in the event year. Panel (a) pools all workers. Panels (b) and (c) estimate the model separately for workers whose occupation in the event year is above (filled circles, solid line) or at or below (hollow circles, dashed line) the median across occupations of the division-of-labor index and the index of learning from coworkers, respectively. Panels share one vertical scale.

Figure A.11: Workplace specialization over time



Notes: This figure plots trends in within firm specialization from 2009–2023. The line in gray is the raw data; the black line presents a smoothed version of the raw data.

B Survey Questionnaire

B.1 Background Information

1. What is your name (first name(s) and last name)?
2. What is your current address?
3. What is your date of birth?
4. What is your current age?
5. What is your current occupation/title?
6. Which sector do you work in?
7. Do you work in the public or private sector?
8. What is your highest level of education?
9. How long have you been at the firm?
10. Do you have any supervisory or managerial responsibilities?
11. What best describes your current position (full time, part time, etc.)?
12. Roughly how many employees work at your workplace/site?

B.2 Teamwork Module

Teamwork Exposure

1. Do you regularly work with others (e.g., shared tasks, joint planning, or problem-solving)?
    - Yes
    - No
2. What types of teamwork or collaboration do you typically engage in? Select all that apply.
    - I work in a stable, long-term team with consistent members.
    - I participate in short-term or project-based teams that change frequently.
    - I collaborate through meetings or check-ins but mostly work independently.
    - I am part of cross-functional teams involving members from different departments.
    - I engage in informal, ad hoc collaboration as needed.
    - I lead or facilitate team-based activities or initiatives.
    - I rarely or never engage in teamwork.
    - Other: _____
3. How often are you involved in team-based work or collaboration?
    - Never
    - Rarely (less than once per week)
    - Occasionally (one to two times per week)
    - Often (most but not all days of the week)
    - Every day

Work Setting

1. What is your primary work setting?
    - Fully on-site / in person (at a central workplace or office)
    - Fully remote (working from home or another remote location)
    - Hybrid – mostly on-site, occasionally remote
    - Hybrid – mostly remote, occasionally on-site
    - Equally split between remote and on-site
    - Other (please specify): _____
2. How do you usually communicate or interact with your team? (Select all that apply) For each mode, choose: rarely (less than once per week), sometimes (one to two times per week), often (most but not all days of the week), or every day.
    - A. In person
    - B. Video calls (e.g., Zoom, Teams)
    - C. Messaging platforms (e.g., Slack, MS Teams chat)
    - D. Email coordination
3. How does working remotely or virtually affect your ability to collaborate with others?
    - It significantly hinders effective collaboration.
    - It somewhat hinders collaboration.
    - It has no noticeable impact.
    - It somewhat improves collaboration.
    - It significantly improves collaboration.
    - Not applicable – I do not work remotely or virtually.

Nature of Teamwork

1. How often do you actively collaborate with coworkers (e.g., sharing information, problem-solving, co-working) on day-to-day tasks? (1 = never, 10 = very frequently / multiple times per day)
2. How clearly do you understand your role within your team? (1 = very unclear, 10 = very clearly)
3. Do team members generally share responsibilities equally? (1 = never, 10 = always)
4. How often do team members support each other during difficult tasks? (1 = never, 10 = always)
5. How comfortable do you feel giving or receiving feedback within your team? (1 = not comfortable, 10 = very comfortable)
6. How would you rate the overall quality of teamwork in your workplace? (1 = very poor, 10 = excellent)

Structure of Teamwork

1. How clearly are team roles, responsibilities, and communication channels defined in your team? (1 = not clear at all, 10 = extremely clear)
2. Do you usually work with the same team members or do they change often?
    - I usually work with the same team members over time.
    - I work with a mix of recurring and new team members.

- My team members change frequently from one project or task to another.
- Not applicable – I mostly work independently.

3. How much autonomy do you feel you have to make decisions about your own tasks within the team? (1 = no autonomy at all, 10 = full autonomy)
4. What is your typical role within the teams you work with?
    - I primarily lead or manage the team.
    - I primarily contribute as a team member.
    - My role varies depending on the project or context.
    - I do not usually work in a team setting.

Meetings and Coordination

1. How frequently do you attend meetings that involve coordination or teamwork?
    - Never
    - At least once a month, but not weekly
    - 1–2 times per week
    - 3–4 times per week
    - Daily
2. On average, how much of your workweek is spent in meetings?
    - No meetings
    - Less than 1 hour
    - 1–3 hours
    - 4–7 hours
    - 8–11 hours
    - 12–15 hours
    - More than 15 hours
3. How productive do you find team meetings? (1 = not productive, 10 = very productive)
4. In a typical meeting, how is time usually spent? Your best guess – the total should add up to 100%.
    - Sharing updates on what team members are doing: _____%
    - Assigning or coordinating responsibilities for tasks/projects: _____%
    - Discussing and problem-solving to make decisions: _____%
    - Others, please specify: _____% (allow to add as many categories as needed)
5. In meetings, how would you describe your typical level of participation?
    - I primarily listen and rarely speak.
    - I speak occasionally when needed.
    - I contribute actively and listen equally.
    - I speak more than I listen or lead discussions.
    - My level of participation varies between meetings.

Productivity of Teamwork

1. Does teamwork help you complete tasks more efficiently? (1 = never, 10 = very often)
2. How often does poor teamwork reduce your productivity? (1 = never, 10 = very often)
3. Compared to working alone, how does teamwork affect your output speed? (1 = much slower, 10 = much faster)
4. Do you feel your team regularly meets its goals and deadlines? (1 = never, 10 = always)

Importance of Teamwork

1. How important is teamwork for you to perform your job effectively? (1 = not important, 10 = essential)
2. Is collaboration essential for achieving your individual work goals? (1 = not important, 10 = essential)
3. Do you feel teamwork is valued by your department or managers? (1 = not at all, 10 = highly valued)
4. Does working in teams help you learn new things, improve your skills, or develop professionally? (1 = not at all, 10 = always)

Preferences and Beliefs

1. Which work style do you generally prefer?
    - Working independently
    - Working in a team
    - It depends on the task or context
    - No strong preference
2. What team size do you find most effective for completing tasks?
    - 2
    - 3
    - 4
    - 5
    - 6
    - 7
    - 8
    - 9
    - 10
    - More than 10
    - It depends on the task
3. Do you believe teamwork fosters innovation or creativity in your workplace? (1 = never, 10 = always)
4. Do you feel that teamwork improves morale or job satisfaction? (1 = not at all, 10 = always)

Work Schedules

Respondents were asked to open their calendar (e.g., Outlook, Google Calendar, etc.) and refer directly to their scheduled activities to accurately answer the following questions.

1. For each of the following locations, how many days did you work there last week? Please enter a number from 0 to 7 for each.
    - In the office / on-site: _____ days
    - At home / remotely: _____ days
    - Did not work (e.g., days off, leave): _____ days
    - Other location (please specify): _____ days – Location: _____
2. For each of the following locations, on average how many days do you work? Please enter a number from 0 to 7 for each.
    - In the office / on-site: _____ days
    - At home / remotely: _____ days
    - Did not work (e.g., days off, leave): _____ days
    - Other location (please specify): _____ days – Location: _____
3. Choose a recent workday when you worked at the office. Which of the following activities did you do? (Select all that apply.)
    - Meeting (digital or in-person)
    - Email and communication
    - Concentrated individual work
    - Break / coffee / rest
    - Training or professional development
    - Administrative tasks
    - Teaching / presentation
    - Travel / commuting
    - Informal conversation / networking
    - Other (please specify)
    - Never work at the office

    For each activity the respondent selected, they were then asked: "On the selected office workday, approximately how much time did you spend on [activity]?" with response options:

    - Under 1 hour
    - 1 hour
    - 2 hours
    - 3 hours
    - 4 hours
    - 5 hours
    - 6 hours
    - 7 hours
    - 8 hours

- More than 8 hours

4. Choose a recent workday when you worked from home. Which of the following activities did you do? (Select all that apply.)
    - Meeting (digital or in-person)
    - Email and communication
    - Concentrated individual work
    - Break / coffee / rest
    - Training or professional development
    - Administrative tasks
    - Teaching / presentation
    - Travel / commuting
    - Informal conversation / networking
    - Other (please specify)
    - Never work from home

    For each activity the respondent selected, they were then asked: "On the selected work-from-home day, approximately how much time did you spend on [activity]?" with the same response options (Under 1 hour; 1 hour; 2 hours; 3 hours; 4 hours; 5 hours; 6 hours; 7 hours; 8 hours; More than 8 hours).
5. When does your work normally start and end? Report calendar times adjusted to 30-minute intervals.

For respondents who selected "Meeting" as one of the activities, the following follow-up questions were asked:

- Number of people who attended the meeting.
- What type of meeting was it? Select all that apply: planning and strategy discussions; collaborative work / brainstorming / problem-solving; project / task updates; presentations / information sharing; administrative topics (scheduling, budgets, etc.); training or skill development; feedback / appraisal; networking; informal conversations; other (please specify); none of these.
- Number of minutes speaking.
- Number of minutes listening.
- Number of minutes of informal conversation.

Open-Ended Questions

1. What do you enjoy most about working in a team? What do you find most challenging? (open-ended)
2. Can you describe a recent experience where teamwork was especially effective (or ineffective)? What made it that way?
3. In your opinion, what are the key ingredients of a successful team? (open-ended)
4. How do you handle disagreements or conflicting opinions in a team setting? (open-ended)
5. How has remote or virtual work affected your experience of teamwork? (open-ended)
6. How has AI been incorporated into teamwork? (open-ended)
7. Can you describe how your team typically approaches problem-solving or decision-making? (open-ended)

B.3 Skills Survey Module

Work Hours

1. How many hours a week are specified in your work contract?
2. How many hours do you typically work each week?

Time Spent on Daily Activities

Respondents were asked: Please indicate approximately how much of your typical workday is spent on each of the following activities (1 = not at all, 10 = all the time). These categories are not mutually exclusive.

1. Working with machines (not computers)
2. Working with your hands
3. Completing physically demanding tasks
4. Performing repetitive tasks
5. Learning new skills
6. Developing existing skills
7. Encountering new challenges
8. Working with computers
9. Analyzing data
10. Solving analytical problems
11. Working with colleagues at the same level of seniority
12. Working with people at a higher level of seniority
13. Working with people at a lower level of seniority
14. Collaborating on projects
15. Completing administrative work
16. Working with clients
17. Helping others with job-related tasks
18. Leading groups
19. Working from home or a remote location
20. Reading
21. Writing

Perceptions of Work

Respondents were asked: To what extent do you agree with the following statement? (1 = strongly disagree, 10 = strongly agree)

1. I make strategic decisions at work.
2. I have autonomy in my job.
3. Many people at my company could do my job.
4. It would be easy for my company to train someone new to do my job.
5. My job provides opportunities to learn new skills.

Supervisory Role

1. How many people report to you at your workplace?
    - 0
    - 1–3
    - 4–10
    - 11–20
    - 21–50
    - 51+

Skill Importance

Respondents were asked: Please indicate how important each of the following skills is for your job (1 = not important at all, 10 = very important).

1. Manual skills
2. Analytical skills
3. Teamwork
4. Service orientation
5. Leadership
6. Computer programming
7. Decision-making
8. Learning quickly
9. Adapting to new technologies
10. Working under pressure
11. Communication
12. Working with specialized machines (not computers)
13. Using AI tools (e.g., ChatGPT, Grok)

Self-Reported Progress

Respondents were asked: To what extent do you agree with the following statements? (1 = strongly disagree, 10 = strongly agree)

1. Over the past year, I have learned new skills which make me better at my job.
2. Over the past year, I have developed existing skills which make me better at my job.
3. I am better at doing my job today than I was one year ago.

Skill Development at Work

Respondents were asked: Please indicate to what extent you believe you have developed the following types of skills at your current workplace (1 = to a very small extent, 10 = to a very great extent). For skills they reported developing, respondents were asked how they learned each skill.

1. Manual skills
2. Analytical skills
3. Teamwork
4. Service orientation
5. Leadership
6. Computer programming
7. Decision-making
8. Learning quickly
9. Adapting to new technologies
10. Working under pressure
11. Communication
12. Working with specialized machines (not computers)
13. Using AI tools

For each skill above, respondents with applicable responses were asked: How did you learn this skill? Select all that apply.

- Formal training provided by the firm
- Workshops or conferences led by external providers
- Formal education sponsored by the firm
- Learning from co-workers
- Learning by doing
- Self-directed learning
- Participation in a mentoring program
- Other (please specify)

Transferability of Skills

Respondents were asked: To what extent do you agree with the following statements? (1 = strongly disagree, 10 = strongly agree)

1. The skills I have learned would transfer to other firms.
2. The skills I have learned would transfer to other occupations.
3. The skills I have learned would transfer to other industries.

Training History

1. How many years ago did you last participate in formal training at your firm?
    - Never
    - Enter number of years: _____

Incentives and Mobility

Respondents were asked: To what extent do you agree with the following statements? (0 = strongly disagree, 10 = strongly agree)

1. I have incentives to learn skills because of promotion opportunities within my job.
2. I have incentives to learn skills for job opportunities outside my job.
3. The skills I had when I started could have helped me find other jobs in my field.
4. If I wanted to, I could find work at the same or better salary within a reasonable commute.
5. I need to keep learning new things to keep my skills relevant.

Pay and Progression

Respondents were asked: To what extent do you agree with the following statements? (0 = strongly disagree, 10 = strongly agree)

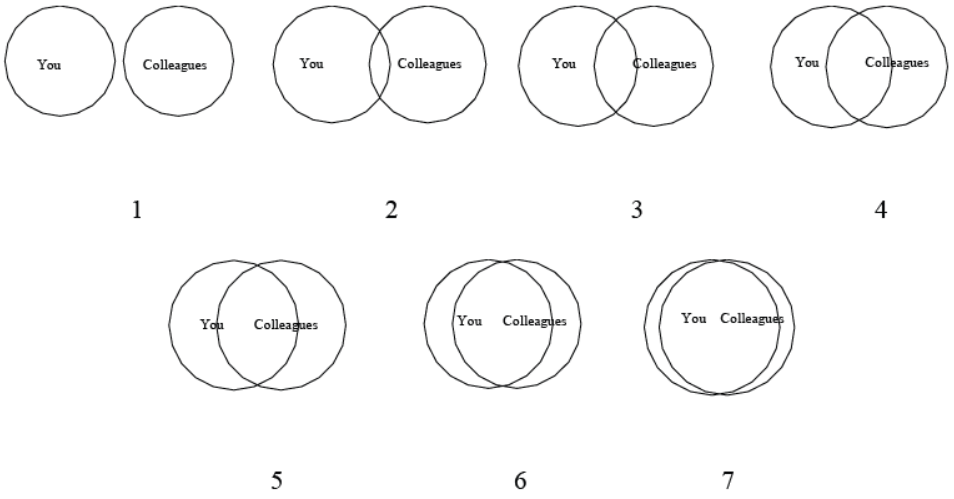
1. I am satisfied with opportunities for pay growth.
2. I am satisfied with my current pay.

Importance of Learning Opportunities

1. How important were learning opportunities in your decision to join your current workplace? (1 = not important, 10 = very important)
    - Learning opportunities for career progression inside the firm
    - Learning opportunities for career progression outside the firm

Workplace Connectedness

1. Please, look at the circles diagram below. Then, consider which of these pairs of circles best represents your connection with your colleagues. By selecting the appropriate number below, please indicate to what extent you and your colleagues are connected. (1 = least connected, 7 = most connected)



C Worker and manager vignette experiments

This appendix provides the text of the online survey administered to 975 workers and 814 managers between June 2026 and August 2026.

C.1 Information and Consent Form

Purpose of the Project This study aims to understand how individuals in Norway perceive workplace learning, training investments, interactions with colleagues, and market conditions. The results will enhance our understanding of how competition and labor market structures influence skill formation and career development.

Who is Responsible for the Project? The project is conducted by Norges Handelshøyskole (NHH). The principal investigator is Alexander Willén, Professor at NHH. Other project members include Katrine Løken (Professor of Economics at NHH) and Mikko Silliman (Assistant Professor at Aalto University). If you have any questions about the study, you may contact Alexander Willen at `alexander.willen@nhh.no`.

What Does Participation Involve? If you choose to participate, you will be asked to complete an online survey, which takes approximately 14 minutes. The survey includes questions about:

- Your work situation, training experiences, and career development.
- Your perceptions of firm-provided training and informal skill acquisition.
- Basic demographic information such as age and sex.

Participation is voluntary, and you may withdraw at any time without providing a reason. All collected information is fully anonymized and will not be shared with third parties. There are no negative consequences if you choose not to participate or decide to withdraw later.

Consent Statement I have received and understood information about the survey and hereby consent:

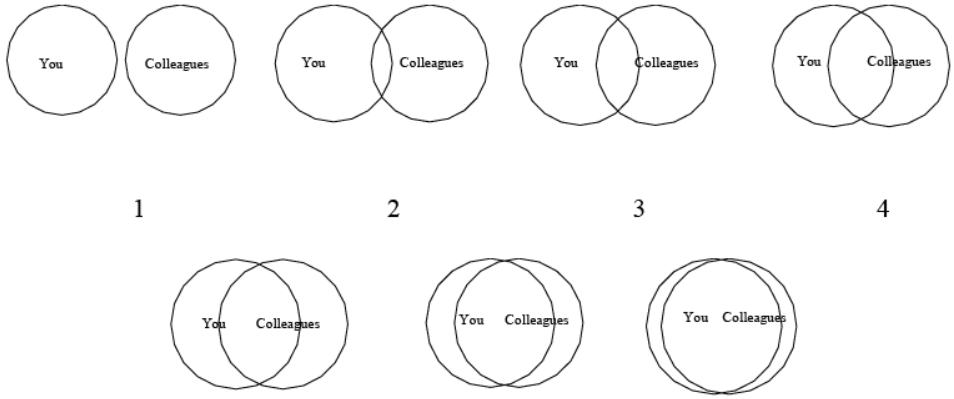
- ✓ To participate in the online survey.
- ✓ To allow researchers to process my anonymized responses for publication in scientific journals and other academic dissemination.

Signature (optional): _____ Date: _____

C.2 Worker Survey

A: Background

1. What year were you born?
2. What is your sex? (0 = Female; 1 = Male)
3. What is your highest level of education? (0 = Less than secondary; 1 = Secondary; 2 = Post-secondary vocational; 3 = Bachelor's degree; 4 = Master's degree; 5 = Doctoral degree)
4. What municipality do you live in? _____
5. How many years have you worked at your firm? (Numeric)
6. How many years have you worked in your current occupation? (Numeric)
7. How many years have you worked in your current industry? (Numeric)
8. How happy are you with your choice of firm? (1 = Not at all happy, 10 = Very happy)
9. How much wage growth did you experience over the past year? (%)
10. How many people work at your establishment? (1 = Less than 5; 2 = 6-10; 3 = 11-20; 4 = 21-50; 5 = 51-100; 6 = More than a hundred)
11. How many people share and complete the same tasks as you at your establishment? (1 = 0; 2 = Less than 5; 3 = 6-10; 4 = 11-20; 5 = 21-50; 6 = 51-100; 7 = More than a hundred)
12. What is the most common education level of your colleagues? (0 = Less than secondary; 1 = Secondary; 2 = Post-secondary vocational; 3 = Bachelor's degree; 4 = Master's degree; 5 = Doctoral degree)
13. Please, look at the circles diagram below. Then, consider which of these pairs of circles best represents your connection with your colleagues. By selecting the appropriate number below (1 to 7), please indicate to what extent you and your colleagues are connected.



14. How important are firm investments in training for your career? (1 = Not at all important, 10 = Very important)
15. How effective is training provided by people at your firm (e.g., internal presentations) for improving your productivity? (1 = Not at all effective; 10 = Very effective)
16. How effective is training provided by people outside your firm (e.g., outside speakers, workshops) for improving your productivity? (1 = Not at all effective; 10 = Very effective)
17. How important is informal learning (e.g., learning-by-doing, self-study, peer learning) for your career? (1 = Not at all important, 10 = Very important)

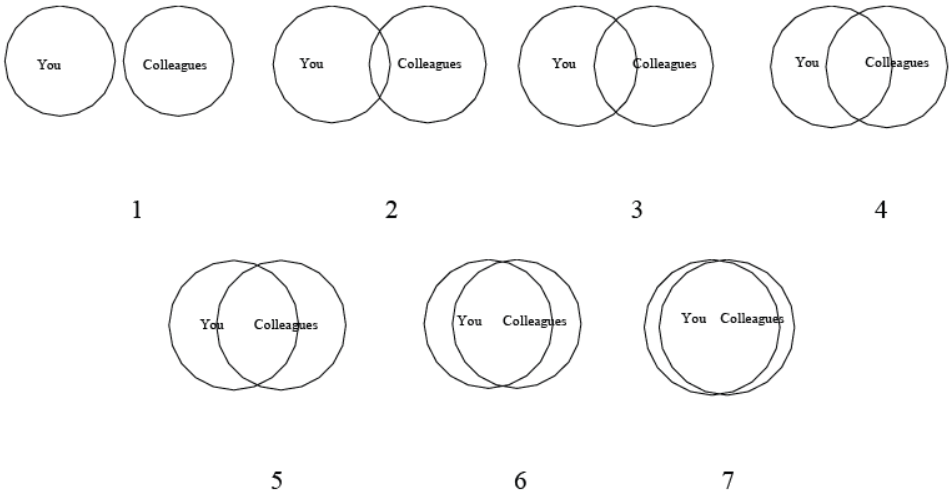
18. How conducive is the culture at your firm for generating informal learning? (1 = Not at all effective; 10 = Very effective)
19. Opportunities for career progression and advancement affect my incentives and motivation for engaging in learning at work. (1 = Disagree, 10 = Agree)
20. How important are formal training programs for worker skill development? (1 = Not at all important, 10 = Very important)
21. How important is workplace culture (relationships with colleagues, incentives, respect) for worker skill development? (1 = Not at all important, 10 = Very important)
22. Each year I spend at this firm will make me better at my job. (Disagree, Agree; Slider 1–10)
23. How important was the opportunity to get better at your job in your choice of firm? (1 = Not at all important, 10 = Very important)
24. Open response: What were the main factors you considered when choosing your firm?

B: Division of Labor in the Workplace

Consider the scenarios below as you answer the following questions. *(Randomize twice without replacement, ask questions 1–21 each time)*

- **Option 1:** You are hired by a medium-sized firm in your present occupation and industry. Production at the firm requires completing a fixed set of tasks. In this firm, workers each perform a narrower and more differentiated set of those tasks, with little overlap between workers.
- **Option 2:** You are hired by a medium-sized firm in your present occupation and industry. Production at the firm requires completing a fixed set of tasks. In this firm, workers each perform a broad set of those tasks, with substantial overlap between workers.

1. How varied do you imagine your daily tasks will be? (1 = Not at all varied; 2 = Very varied)
2. How much of your time would be spent working alone versus with colleagues? (1 = All alone; 10 = All with colleagues)
3. Please, look at the circles diagram below. Then, consider which of these pairs of circles best represents your connection with your colleagues. By selecting the appropriate number below, please indicate to what extent you and your colleagues are connected.



4. "Who do you think it would be easier to communicate with when coordinating work at the firm?" (1 = Workers doing very different tasks from me; 10 = Workers doing very similar tasks to me)

5. "How important do you think formal meetings involving workers performing different tasks would be for the firm?" (1 = Not important; 10 = Very important)
6. How productive do you think your meetings would be? (1 = Not productive; 10 = Very productive)
7. How important is active collaboration where you work in teams side-by-side with your colleagues? (1 = Not at all important, 10 = Very important)
8. How capable do you imagine that workers would be at coordinating activities among themselves without managers? (1 = Not at all capable; 10 = Very capable)
9. How important do you imagine managers are for coordinating across workers? (1 = Not at all important, 10 = Very important)
10. How enjoyable would you find the social aspects of your job? (1 = Not at all enjoyable, 10 = Very enjoyable)
11. How enjoyable would you find the technical aspects of your job? (1 = Not at all enjoyable, 10 = Very enjoyable)
12. How motivated would you be to develop your skill-set? (1 = Not at all motivated; 10 = Very motivated)
13. Consider how you might develop your skills at work: How important would co-worker learning be in improving your skills? (1 = Not at all important, 10 = Very important)
14. Consider how you might develop your skills at work: "How important would independent learning be in improving your skills (e.g. self-study, experimentation, solving problems on your own)?" (1 = Not at all important, 10 = Very important)
15. How much of your learning would be in improving existing skills? (1 = None; 10 = All)
16. How much of your learning would be in developing new skills? (1 = None; 10 = All)
17. How transferable will your learning be across firms? (1 = Not at all; 10 = Very transferable)
18. If you encounter a difficult task, how easy would it be to find a colleague to ask for help? (1 = Very difficult; 10 = Very easy)
19. Do you think that the skills you develop at the firm will make it easier to find another job? (Disagree, Agree; Slider 1–10)
20. Do you think that the skills you develop at the firm will make it easier to move into managerial positions within the firm? (Disagree, Agree; Slider 1–10)
21. Each year I spend at this firm will make me better at my job. (Disagree, Agree; Slider 1–10)

After having been shown both vignettes in randomized order:

1. Consider the following two options:

   A. You are hired by a medium-sized firm in your present occupation and industry. Production at the firm requires completing a fixed set of tasks. In this firm, workers each perform a narrower and more differentiated set of those tasks, with little overlap between workers.

   B. You are hired by a medium-sized firm in your present occupation and industry. Production at the firm requires completing a fixed set of tasks. In this firm, workers each perform a broad set of those tasks, with substantial overlap between workers.

   (a) Which would you prefer?

   (b) Why (Open response)?

   (c) How important are the following reasons in motivating your choice? (Slider 1–10)

      i. Learning opportunities
      ii. Social connections with colleagues
      iii. Support from colleagues
      iv. Opportunities to distinguish oneself

v. Opportunity to delve deep into your specialized area
vi. Exposure to task variety
vii. Exposure to different types of people
viii. Other: _____

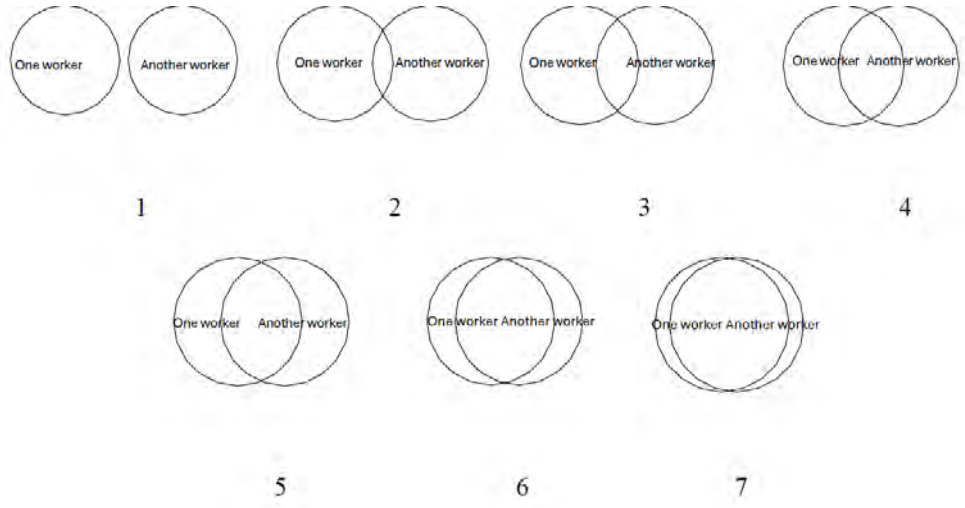
C.3 Social Desirability Bias: Crowne-Marlowe Scale

1. It is sometimes hard for me to go on with my work if I am not encouraged. (Agree/Disagree)
2. I sometimes feel resentful when I don't get my own way. (Agree/Disagree)
3. On a few occasions, I have given up doing something because I thought too little of my ability. (Agree/Disagree)
4. There have been times when I felt like rebelling against people in authority even when I knew they were right. (Agree/Disagree)
5. No matter who I'm talking to, I'm always a good listener. (Agree/Disagree)
6. There have been occasions when I took advantage of someone. (Agree/Disagree)
7. I'm always willing to admit it when I make a mistake. (Agree/Disagree)
8. I sometimes try to get even, rather than forgive and forget. (Agree/Disagree)
9. I am always courteous, even to people who are disagreeable. (Agree/Disagree)
10. I have never been irked when people expressed ideas very different from my own. (Agree/Disagree)
11. There have been times when I was quite jealous of the good fortune of others. (Agree/Disagree)
12. I am sometimes irritated by people who ask favors of me. (Agree/Disagree)
13. I have never deliberately said something that hurt someone's feelings. (Agree/Disagree)

C.4 Manager Survey

A: Background Questions

1. What year were you born? (Numeric)
2. What is your sex? (0 = Female; 1 = Male)
3. What is your highest level of education? (0 = Less than secondary; 1 = Secondary; 2 = Post-secondary vocational; 3 = Bachelor's degree; 4 = Master's degree; 5 = Doctoral degree)
4. What municipality do you live in? _____
5. What industry best describes your firm? (Populate with 2-digit industry codes)
6. How long have you been working at your firm? (Numeric)
7. How long have you been working in your occupation? (Numeric)
8. How long have you been working in your industry? (Numeric)
9. How many people work at your establishment? (1 = Less than 5; 2 = 6-10; 3 = 11-20; 4 = 21-50; 5 = 51-100; 6 = More than a hundred)
10. How much overlap is there in the task content performed by the workers at your firm? (1 = No overlap; 10 = Workers are faced with identical task sets)
11. How many people do you manage? (1 = Less than 5; 2 = 6-10; 3 = 11-20; 4 = 21-50; 5 = 51-100; 6 = More than a hundred)
12. What is the most common education level of those you manage? (0 = Less than secondary; 1 = Secondary; 2 = Post-secondary vocational; 3 = Bachelor's degree; 4 = Master's degree; 5 = Doctoral degree)
13. Please, look at the circles diagram below. Then, consider which of these pairs of circles best represents the connections between your workers. By selecting the appropriate number below, please indicate to what extent your workers feel connected to each other.



14. Worker learning is critical for firm performance. (Disagree, Agree; Slider 1–10)
15. Investments in training by firms play an important role in improving worker productivity. (Disagree, Agree; Slider 1–10)
16. How effective is training provided by people at your firm (ex. internal workshops or presentations) for improving worker productivity? (Not at all effective, Very effective; Slider 1–10)
17. How effective is training provided by people outside your firm (ex. bringing in outside speakers, attending firm-sponsored workshops) for improving worker productivity? (Not at all effective, Very effective; Slider 1–10)

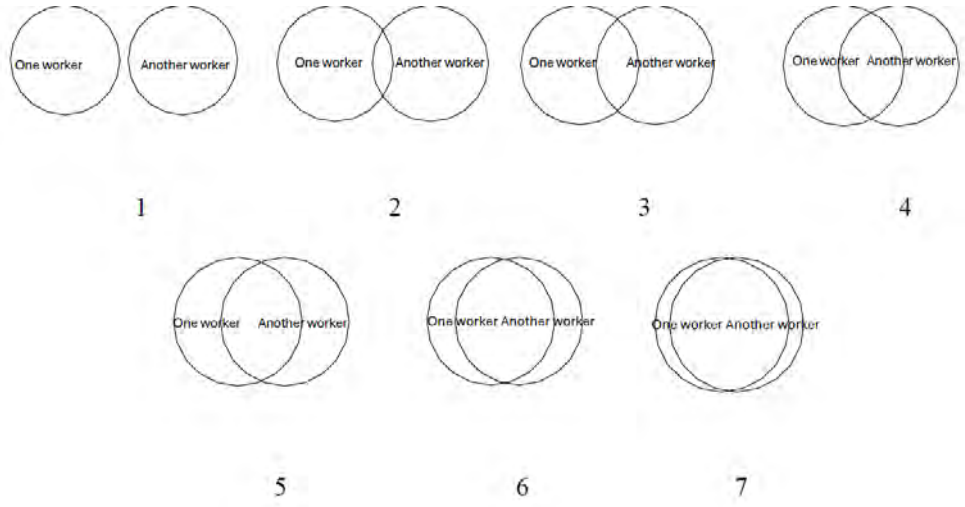
18. The level of competition between firms influences the amount or type of training firms will provide. (Reduces the need for training; Increases the need for training; Slider 1–10)
19. The level of competition between firms influences the effort and incentives of workers to take up training such as those described above. (Reduces effort; Increases effort; Slider 1–10)
20. How do you perceive the relative importance of formal training programs versus workplace culture in facilitating worker skill development? (Formal training more effective; Workplace culture more effective; Slider 1–10)

B: Division of Labor in the Workplace

Consider the scenarios below as you answer the following questions. *(Randomize twice without replacement, ask questions 1-21 each time)*

- **Main Wording 1:** You are a manager in a medium-sized firm in your present industry. Production at the firm requires completing a fixed set of tasks. In this firm, workers each perform a narrower and more differentiated set of those tasks, with little overlap between workers.
- **Main Wording 2:** You are a manager in a medium-sized firm in your present industry. Production at the firm requires completing a fixed set of tasks. In this firm, workers each perform a broad set of those tasks, with substantial overlap between workers.

1. How varied will the tasks assigned to workers be each day? (1 = Not at all varied; 10 = Very varied)
2. How important are occupation-specific skills for their daily work? (1 = Not at all important, 10 = Very important)
3. How productive do you imagine the firm to be? (1 = Not at all productive; 10 = Very productive)
4. How capable do you imagine that workers would be at coordinating activities among themselves without managers? (1 = Not at all capable; 10 = Very capable)
5. How important are managers for coordinating activities across workers? (1 = Not at all important; 10 = Very important)
6. "How important do you think formal meetings involving workers performing different tasks would be for the firm?" (1 = Not important; 10 = Very important)
7. How productive will the meetings be? (1 = Not productive; 10 = Very productive)
8. Please, look at the circles diagram below. Then, consider which of these pairs of circles best represents the connections between your workers. By selecting the appropriate number below, please indicate to what extent your workers feel connected to each other.



9. How enjoyable do you think workers will find the social aspects of their jobs? (1 = Not enjoyable; 10 = Very enjoyable)
10. How enjoyable do you think workers will find the technical aspects of their jobs? (1 = Not enjoyable; 10 = Very enjoyable)
11. How easy would it be to communicate with workers across the firm? (1 = Not at all easy, 10 = Very easy)
12. Consider how workers at the firm might develop their skills at work: How important do you imagine that co-worker learning will be for their skill accumulation? (1 = Not at all important, 10 = Very important)
13. Consider how workers at the firm might develop their skills at work: "How important would independent learning be in improving worker's skills (e.g. self-study, experimentation, solving problems on your own)?" (1 = Not at all important, 10 = Very important)
14. How transferable will the learning from your workers be across firms? (1 = Not at all, 10 = Very much)
15. To what extent will your workers improve their existing skills? (1 = Not at all, 10 = Very much)
16. To what extent will your workers develop new skills? (1 = Not at all, 10 = Very much)
17. If your workers encounter a difficult task, how easy would it be to find a colleague to ask for help? (1 = Very difficult; 10 = Very easy)
18. With each year existing employees spend at the job, how much better will they be at their role? (1 = Not at all, 10 = Very much)
19. How important is external hiring to develop talent at the firm? (1 = Not at all important, 10 = Very important)
20. When you hire workers, would you emphasize junior or experienced workers? (1 = Junior, 10 = Experienced)
21. When you hire workers, would you emphasize specialized or generalist workers? (1 = Specialized, 10 = Generalist)

After having been shown both vignettes in randomized order:
Consider the two options:

A. You are a manager in a medium-sized firm in your present industry. Production at the firm requires completing a fixed set of tasks. In this firm, workers each perform a narrower and more differentiated set of those tasks, with little overlap between workers.

B. You are a manager in a medium-sized firm in your present industry. Production at the firm requires completing a fixed set of tasks. In this firm, workers each perform a broad set of those tasks, with substantial overlap between workers.

1. Given your current industry, which do you choose?
2. Why (Open response)?
3. How important are the following in your choice of firm? (1 = Not at all important, 10 = Very important)
    (a) Ease of management
    (b) Productivity
    (c) Social connectedness at work
    (d) Opportunities for worker learning
    (e) Interactions with different types of people
    (f) Other: _____

C.5 Social Desirability Bias: Crowne-Marlowe Scale

1. It is sometimes hard for me to go on with my work if I am not encouraged. (Agree/Disagree)
2. I sometimes feel resentful when I don't get my own way. (Agree/Disagree)
3. On a few occasions, I have given up doing something because I thought too little of my ability. (Agree/Disagree)
4. There have been times when I felt like rebelling against people in authority even when I knew they were right. (Agree/Disagree)
5. No matter who I'm talking to, I'm always a good listener. (Agree/Disagree)
6. There have been occasions when I took advantage of someone. (Agree/Disagree)
7. I'm always willing to admit it when I make a mistake. (Agree/Disagree)
8. I sometimes try to get even, rather than forgive and forget. (Agree/Disagree)
9. I am always courteous, even to people who are disagreeable. (Agree/Disagree)
10. I have never been irked when people expressed ideas very different from my own. (Agree/Disagree)
11. There have been times when I was quite jealous of the good fortune of others. (Agree/Disagree)
12. I am sometimes irritated by people who ask favors of me. (Agree/Disagree)
13. I have never deliberately said something that hurt someone's feelings. (Agree/Disagree)