Incentives through Job Design and Levels of Hierarchy

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Abstract

Hierarchies, and the prospect to move higher up the ladder through promotions, are just one way to provide work incentives. Organisations may motivate workers through job design. Consequently, organisations offering rewarding jobs may be able to reduce the number of hierarchical layers. Two job design features are particularly relevant: autonomy and problem solving. These are the defining features of complex jobs and autonomous teams. We investigate the relationship between the number of hierarchical layers and job design features empirically using the European Company Survey (ECS 2019). The strength of the negative association between the extent of adoption of complex job design and the number of hierarchical layers depends on the importance of the coordination role played by the hierarchy (as proxied by establishment size). The association may disappear when hierarchies have an important coordination role. The use of autonomous teams is robustly negatively associated with the number of hierarchical layers.

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1. Introduction

Hierarchies are a common feature of social groups, they structure intragroup communication and the way groups function. Hierarchies sometimes are clearly visible; that is, they are explicitly marked by symbols denoting the layer in the hierarchy to which the individual belongs (as the rank insignia marking the chain of command in the army or police corps). In organisational settings, the focus of this study, organigrams or corporate charts often underpin hierarchies. Hierarchies, however, can also be informal and not clearly visible, as when they naturally arise through informal interaction between members of a group or a team.

Organisational hierarchies consist of layers of reporting, which are also called levels or rungs. Workers on any given layer report to a manager or supervisor belonging to the layer above them. Managers and supervisors have workers reporting to them and these are usually referred to as subordinates or (direct) reports. The number of subordinates reporting to a given manager or supervisor defines the span of control of the manager in question.

The ubiquitous presence of hierarchies in organisations can be traced back to the important roles that hierarchies play:

1. Hierarchies function as a coordination mechanism. Individuals high up in the hierarchy can make decisions and issue orders to implement them to people below them in the hierarchy. Therefore, individuals up in the hierarchy can coordinate the actions of their subordinates in a way that would not be possible to the subordinates individually (Hart and Moore 2005).
2. Hierarchies function as a mechanism to allocate talent (knowledge, ability, skills) efficiently by leveraging the gains from specialisation of different types of workers in the hierarchy. Workers are paid wages corresponding to their skill set, higher skilled workers are paid more than low skilled workers. The optimal design of the hierarchy depends on the balance between communication and knowledge acquisition costs. Communication costs represent the costs incurred in evaluating a problem and referring it to higher layers in the hierarchy, which are increasing with the number of layers. Knowledge acquisition costs reflect the costs of acquiring the necessary knowledge to deal with problems typically referred to the various layers of the hierarchy, which are decreasing with the number of layers in the hierarchy. Assume that tasks can be ordered in increasing levels of difficulty. Simple tasks requiring few or no skills are allocated at the bottom of the hierarchy. Complex jobs requiring skilled workers are allocated to the middle or top of the hierarchy. By adopting a pyramidal hierarchical structure, organisations can minimise the total wage bill by recruiting skilled workers in positions high up in the hierarchy (Luis Garicano 2000; Garicano and Rossi-Hansberg 2004; Garicano and Rossi-Hansberg 2015).
3. Hierarchies provide incentives for individuals to contribute to the success of the organisation. In organisations, promotions tend to correspond with the upward passage from one layer of the hierarchy to the next. The possibility of a promotion incentivises workers to improve their work performance (Lazear and Rosen 1981; Prendergast 1993; DeVaro 2006; Oosterbeek, Sloof et al. 2007; Zábojník 2012).

Hierarchies support the collection of information on performance. To this end, supervisors monitor their subordinates (Storey 1985; Datta 1996). Supervisors have authority vested in official positions and not necessarily derived from superior competence; subordinates have to follow directives under the threat

of sanctions. The hierarchical structure in the organisation depends on the span of control, the number of subordinates who supervisors can effectively monitor, which depends on the type of task subordinates carry out (Barrenechea-Méndez, Ortín-Ángel et al. 2014). Large organisations tend to develop tall hierarchies consisting of many layers of reporting, which remove top management from the operating level (Blau 1968).[1] The various functions plaid by hierarchies sometimes conflict with each other. For example, the provision of work incentives may conflict with the efficient allocation of talent. The incentive role prescribes that workers with the best (relative) performance in rung t be promoted up to the next hierarchical level, to jobs in rung t+1. However, jobs in rung t and t+1 often consist of different task bundles. Different skills are needed in different layers of the hierarchy (Mumford, Campion et al. 2007). The allocation of workers based on performance on tasks that are different from those of the jobs they are promoted to, is the reason underlying the Peter principle (Fairburn and Malcomson 2001; Romaine 2014; Brilon 2015; Chan 2018; Benson, Li et al. 2019), which asserts that talent is misallocated as workers are promoted to their level of incompetence (Peter and Hull 1969). Consequently, the drop in performance often experienced by newly promoted workers has to be regarded as a permanent feature of the promotion system and not as a temporary phenomenon due to regression to the mean in performance (Lazear 2004).

Many of the positive effect of hierarchies are predicated on workers high up in the hierarchy being able to make better decisions based on expertise or superior knowledge. However, hierarchies tend to generate homogenous environments prone to groupthink (Prendergast 1993; Bénabou 2012). In stable business environments organisations are presented with a stable set of problems, and expertise can build at the top. Consequently, when the work of organisations is routine, predictable, and stable, they tend to adopt taller hierarchical structures. In contrast, when organisations operate in unstable or ambiguous environments with unpredictable outcomes or future product demands, flat hierarchies tend to be more functional as they allow for the aggregation of opinions of a broader set of members of the organisation (Galton 1907; Surowiecki 2005).

In organisations adopting technologies requiring personnel with minimum qualifications and designing jobs accordingly, operations at the bottom of the hierarchy are relatively self-regulating and independent of direct intervention by management (which control that workers narrowly follow procedures). These characteristics tend to turn flat organisations into tall hierarchies.

Similarly, hierarchies may serve different organisational strategies; hierarchical structures are appropriate when organisational success is based on the avoidance of mistakes (launching the wrong product). Flat structures are more appropriate when organisational success is based on the introduction of innovative goods or services. Flat hierarchical structures are more effective in ensuring that no viable product or service innovation is overlooked (Sah and Stiglitz 1986).

Consequently, the usefulness of organisational hierarchies is contingent on market and organisational characteristics (Anderson and Brown 2010). That is, the business environment in which organisations operate, their product market strategies, and the design adopted for their jobs all influence the type of hierarchical structure adopted by organisations.

[1] Interestingly, the intensity of monitoring is affected by the position held by the manager in the hierarchy. Managers higher up in the hierarchy tend to use a more democratic leadership style compared to managers down in the hierarchy who tend to adopt a more autocratic leadership style (Jago and Vroom 1977; Oshagbemi 2004).

In the present article, we focus on the role of hierarchies in the provision of incentives. Companies have different ways to motivate employees; broadly speaking, organisations can use monetary and non-monetary incentives (the latter based on the provision of jobs with rewarding job design features). Briefly, organisations that are able to leverage job design characteristics to motivate workers may adopt flatter organisational structures than similar companies that are not able to do so. We will investigate the relationship between hierarchies and job characteristics empirically using the latest wave of the European Company Survey (ECS 2019).

The approach to providing work incentives, job design choices and hierarchical structure are interrelated. A job, with the same job title, but placed in a different organisational context, a flat or a tall hierarchy, will consist of different tasks and will require different skill sets.

For example, the wave of corporate downsizing that took place in the 1980s delivered leaner and flatter organisations. The layers above middle management, which were tasked with the coordination of middle managers, disappeared. The role of middle managers had to change accordingly. Middle managers experienced an increase in coordination tasks as they now had to ensure the coordination of their decisions with that of other middle managers. Similarly, the flatter hierarchy provided less opportunities for promotions and consequently middle managers experienced an increase in the tasks directed at sustaining their subordinates' motivation (Osterman 2008).

The structure of the article is the following: Section 2 discusses the expected relationship between hierarchies and the provision of incentives to work, Section 3 describes the data, Section 4 contains the main results and robustness analysis. Finally, Section 5 provides concluding remarks.

2. Levels of Hierarchy and Job Design Features

The trend towards flatter hierarchies continued during the 1990s,as firms eliminated layers of management and correspondingly increased the span of control of managerial positions (Rajan and Wulf 2006). The drive to reduce the number of layers in corporate hierarchies originates in an attempt to remain competitive by streamlining the organisation, by pushing decisions down the hierarchy, to respond more quickly to customers and to increase market responsiveness (Wulf 2012).

Focusing on the role of hierarchies in providing incentives to stimulate work effort, a flat hierarchy is a less effective incentive mechanism than a tall hierarchy since the smaller number of layers limits promotion opportunities. However, organisations that went further in providing autonomy and problem-solving responsibility to the lower echelons of the hierarchy may not need to rely on promotions for motivation. This is because work itself, when appropriately designed, can be a powerful motivational lever. This is recognised by two important motivational theories: the job design theory (Hackman and Oldham 1976; Oldham and Hackman 2010) and the self-determination theory (Deci, Olafsen et al. 2017; Gagné 2018). Workers' autonomy has been found to be positively associated with measures of engagement (Crawford, Lepine et al. 2010; Parker, Morgeson et al. 2017). At the same time, decision-making and (successful) problem-solving are linked to the satisfaction of the need for mastery, which in turn leads to engagement and job satisfaction (Morgeson and Humphrey 2006; Humphrey, Nahrgang et al. 2007; Morgeson and Humphrey 2008; Parker, Morgeson et al. 2017).

Jobs allowing for higher levels of autonomy and problem-solving are more complex and cognitively more demanding. Since both autonomy and problem-solving lead to similar motivational states we will

conflate autonomy and problem solving under the term of job complexity. So, a complex job design is a job design allowing for autonomy and problem solving.

In fact, while delayering took place across the board, not all companies endorsed complex job design to the same extent. Some organisations fully embraced the adoption of complex job design and the consequent decentralisation of discretion, whereas in other organisations delayering implied a larger involvement of senior management in day-to-day business; that is, delayering resulted in an increase in centralisation and a less widespread adoption of complex job design (Wulf 2012).

Companies that went further in the adoption of complex job design would have benefitted from these motivational drivers and would not have needed to use hierarchical layers and promotions to motivate their workers. Consequently, our working hypothesis is that the higher the degree of adoption of complex job design the fewer the number of layers in the hierarchy.

Another way in which companies can grant autonomy and provide incentives through job design is by adopting autonomous, self-directed teams instead of the more traditional management led teams. In fact, the adoption of self-directed teams begun in the same period during which companies were actively delayering (Appelbaum, Bethune et al. 1999). Self-directed teams are complex work environments since team members need to go over and beyond their role to perform managerial tasks. As such they share many of features of complex jobs: they involve problem solving and autonomy (de Sitter, den Hertog et al. 1997; Powell and Pazos 2017). As such they will tend to produce the same motivational effects of complex jobs. Companies adopting self-directed teams would have benefitted from their motivational drive they provide and so could have avoided to use the hierarchical layers for providing motivation through promotion opportunities. Consequently, our working hypothesis is that the adoption of self-directed team work is associated with fewer number of layers in the hierarchy compared to the adoption of management led teams.

3. Data

The European Company Survey 2019 (ECS 2019) is an EU-wide establishment survey, commissioned by the European Foundation for the Improvement of Living and Working Conditions (Eurofound) and the European Centre for the Development of Vocational Training (CEDEFOP).[2] It covers European establishments with at least 10 employees carrying out "market activities", excluding agriculture.[3] The survey is addressed to two respondents: a (human resource) manager and a member of the employee representative body (if present).

The ECS 2019 is the first pan-European establishment survey carried out using a push-to-web approach. The approach consists of a short telephone screener interview to assess eligibility, talk to the management respondent to secure cooperation and obtain the contact details of an employee representative (where present). These target respondents were subsequently invited to complete the

[2] https://www.eurofound.europa.eu/surveys/2019/european-company-survey-2019

[3] NACE Rev 2 categories B to N, R and S (see https://ec.europa.eu/competition/mergers/cases/index/nace_all.html). The public sector has been excluded for lack of suitable sample frames. Due to an error in the sampling that was discovered after data collection, NACE categories M, N, R and S were excluded from the Slovenian sample.

questionnaire online.[4] The response rate for the management interviews, as in other business survey, was low; 8% overall, and varying between 2% in Poland and 16% in Lithuania.[5] The total achieved sample of management interviews is 21,869, and varies between 122 cases in Cyprus, and 1498 cases in Italy. We use only the management data set in the current analysis, and the estimation sample is reduced to 18,287 observations after the deletion of missing cases.

2.1 Operationalisation: dependent variable and controls

The dependent variable – the number of hierarchical layers - is derived by the following question: Counting in the same way as is done in the examples below, how many hierarchical levels do you have in this establishment?

The question was accompanied by two examples showing organigrams, with three and four levels of reporting.

Answers ranging between 1 and 10 levels were kept and considered valid.[6] Only about 1% of establishments reported to have 6 hierarchical levels or more. The dependent variable has been recoded into five categories, with the first 4 categories corresponding with the reported number of hierarchical layers and the last category containing all establishments where the number of layers was five or more. Most establishments have three or four levels; 60% and 18%% of the sample, respectively.

To capture the extent to which establishments have adopted complex job design we have used the percentages of workers (non-managerial employees) whose job includes independently organising their time and scheduling their tasks and whose job includes finding solutions for unfamiliar problems.

Table 1 shows that the majority of establishments only offer work autonomy and problem solving to a minority of employees, in 53% of establishments less than 40% of employees are in jobs offering work autonomy and in 62% of establishments less than 40% of employees are in jobs allowing for problem solving.

Table 1: Proportion of establishments by fraction of employees in jobs with autonomy and problem solving, weighted (N=18,287).

Proportion of employees	Autonomy	Problem Solving
Less than 20%	0.3384	0.3902
20% - 39%	0.1978	0.2344

[4] This approach resulted into three different types of outcomes: establishments where only a management interview was completed, establishments where both a management and an employee representative interview were completed, and establishments where consisting an employee representative interview was completed.
[5] Additional technical information on the quality of the data can be found in the technical report (hyperlink). The quality of the data collection process and the resulting dataset was also assessed by an external contractor (see HYPERLINK).
[6] In 24 cases an answer was provided that was considered out of range and was coded to missing; in seven of these cases the answer was “0” in the other 17 it was (much) greater than 10.

40% - 59%	0.1343	0.1498
60% - 79%	0.1206	0.0979
80% or more	0.2089	0.1277

The variables measuring the incidence of work autonomy and problem solving were combined into a scale to measure the incidence of complex job design (Cronbach alpha = 0.66%). The scale ranges from 1 (less than 20% of employees) to 5 (80% or more of employees) with higher values indicating a larger incidence of complex job design.

A second dimension of complex job design is captured by the presence of autonomous self-directed teams. The ECS 2019 shows that autonomous teams are utilised only by 15% of establishments, most establishments have management led teams, while 29% of establishments do not utilise teamwork at all.

Prima facie evidence of the negative relationship between the degree of delegation of decision-making and the number of layers in the hierarchy is presented in Table 2: establishments with one or two hierarchical levels have a larger incidence of workers in jobs with complex job design.

Table 2: The relationship between job complexity and the depth of the hierarchy at the establishment, weighted (N=18,287).

Number of hierarchical levels	Average job complexity
1	2.5449
2	2.7471
3	2.4741
4	2.3175
5 or more	2.3547

The empirical analysis in the next section will focus on two variables: the extent of adoption of complex job design and on the adoption of autonomous teams. To control for confounding factors a large number of control variables will be included in the empirical model (Angrist and Pischke 2017). These include the percentage of workers in jobs requiring continuous training, and the percentage of workers in jobs not requiring learning new skills, the percentage of workers in jobs in which a computer is used, if data analytics are used to improve the production process or to monitor workers' performance. Finally, establishments will be characterised by the incidence of workers with permanent and with part-time contracts.

Managerial attitudes towards employees will be captured by three variables: whether managers control if employees follow the tasks assigned to them or rather facilitate employees' work, and the extent to which employee involvement is reported to cause delays or to give a competitive advantage.

The investment in skills is captured by a variable characterising the speed with which skill requirements change at the establishment and by the percentage of workers participating in training during paid working time and the percentage of workers receiving on-the-job training.

The data includes information on whether or not an employee representation body is present at the establishment, the establishment size[7], the establishment age (10 years or less, 11 to 20 years, 21 to 30 years, and more than 30 years), the type of establishment (single establishment, headquarters, or a subsidiary site), and whether or not innovations (new to the market and new to the establishment) were introduced.

The conditions in which establishments operate are captured by the predictability of product demand, the intensity of competition in the product market, product market strategy (whether the emphasis is on price, quality, customisation, product/service innovation or a combination of those). The analyses also control for the presence of certain activities at the establishment: the production or service provision, and the design and development of new product and services. The questionnaire also explored the way the above activities are most often organised: internally, in collaboration (with other establishments within the same company or with other companies) or contracted out.[8]

Controlling for the environment (volatility of demand, degree of competition, approach to the product market and the speed at which skill requirements change) and for many establishment characteristics we are thus able to focus on the relationship between job design features and the number of hierarchical levels.

The descriptive statistics in the estimation sample for all the variables used in the empirical analysis are shown in Appendix A.

4. The empirical model

4.1 Main model

Given the ordinal nature of hierarchies, we used an ordered logit model to investigate the relationship between the numbers of layers in the hierarchy (Y) and the degree of adoption of complex job design in establishments:

$$Y_i^* = \beta_1 X_i + \epsilon_i$$

$$\begin{cases} Y_i = 1 \; if \; Y_i^* \leq \alpha_1 \\ Y_i = 2 \; if \; \alpha_1 < Y_i^* \leq \alpha_2 \\ Y_i = 3 \; if \; \alpha_2 < Y_i^* \leq \alpha_3 \\ Y_i = 4 \; if \; \alpha_3 < Y_i^* \leq \alpha_4 \\ Y_i = 5 \; if \; \alpha_4 < Y_i^* \end{cases}$$

Where X is a matrix of explanatory variables, β a vector of parameters to be estimated, α a vector of ancillary parameters to be estimated, and ϵ an error term i.i.d. according to a type 1 extreme value distribution. Since the coefficients in ordered logit models are difficult to compare across models

[7] The number of employees, in 3 categories: small (10 - 49), medium (50 - 249), and large (250 and more).
[8] In addition, country dummies and 1-digit NACE industry dummies will be used in the empirical models.

(Greene 2010; Norton and Dowd 2018) we will use the more intuitive regression model to test the robustness of the estimated coefficients in different subsamples.

The estimation results for the key coefficients are shown in Table 3: Model 1 reports the results for the ordered logit model while Model 2 concerns the results from the linear probability model (a regression model) that will be used for robustness checks.

The results in Table 3, Model 1, show that the extent of adoption of complex job design is negatively associated with the number of hierarchical layers. Establishments that go further in the adoption of complex job design tend to adopt hierarchical structure with fewer levels of hierarchy than establishments that were more conservative in the adoption of complex job design. Similarly, establishments organising teamwork in autonomous teams have flatter hierarchies than establishments adopting management led teams (or establishments that do not use teamwork at all).

Table 3: Regression estimates of team autonomy and extent of the adoption of complex job design on the number of hierarchical levels, standard errors in parenthesis, weighted (*: significant at α = .05).

	Model 1 Ordered Logit		Model 2 Regression	
% of workers in complex jobs	-0.121	*	-0.038	*
	(0.025)		(0.009)	
Teamwork				
No teams	-0.602	*	-0.194	*
	(0.071)		(0.019)	
Autonomous teams	-0.461	*	-0.148	*
	(0.040)		(0.019)	

The regressions include all variables in Appendix B. The reference group of the variables is in parenthesis: Teamwork (management led teams), Establishment size (small, 10 – 49 employees), managers create an environment in which employees can autonomously carry out their tasks, no innovation introduced (innovation introduced), Establishment age (10 years or less), Design and development of new product and services (carried out in house), Production of goods, assembly of parts, delivery of services (carried out in house), Product market strategy (price), Type of establishment (single establishment), Sector (mining and Quarrying), and Country (Austria).

The results are robust to a different model specification. Table 3, model 2, shows the result of a linear regression model[9]. The extent of the adoption of complex job design is associated with flat hierarchical structures also in this specification. Similarly, establishments relying on autonomous teams have fewer levels of hierarchy than establishments adopting management led teams.

The provision of incentives through job design might be only weakly (or not at all) associated with the number of hierarchical layers in establishments relying heavily on hierarchies for coordination purposes. The importance of hierarchies for the purpose of coordination varies from establishment to establishment. Some establishments will rely a lot on their hierarchy to coordinate production activities

[9] This model specification is similar to a linear probability model. None of the predicted values falls outside the range [1,5].

while others will adopt more flexible structures. The importance of coordination role of hierarchies for establishments is not directly observable. However, it is plausible to hypothesize that hierarchies would have a larger coordination role in large establishment than in small ones.[10] In large establishments employees are likely to be organised in a greater variety of functions, so the coordination function of hierarchical layers could be of particular importance. Consequently, the strength of the association between the provision of incentive through job design and the number of hierarchical layers may be stronger among small establishment that among large ones.

Table 4 shows the estimates of the regression model broken down by establishment size class based on the number of employees. The adoption of complex job design is accompanied by a reduction in the number of hierarchical levels in small establishments. In medium and large establishments, the coefficient on the extent of adoption of complex job design is not too dissimilar from the one found in the small establishment group, but the relationship is imprecisely estimated. On the one hand, this result could arise because hierarchies play an important coordination role in medium and large establishments and this effect could offset the impact of the adoption of work incentive through job design. On the other hand, it may also be the consequence of the dramatic drop in sample size across the subgroups; the group of small establishments is twice as big than the subsample of medium sized establishments and it is 7 times larger than that of large establishments.

Finally, across all size groups establishments adopting management led teamwork tend to have taller than establishments adopting autonomous teamwork.[11]

Table 4: Regression estimates of team autonomy and extent of the adoption of complex job design on the number of hierarchical levels by establishment size, standard errors in parenthesis, weighted (*: significant at $\alpha = .05$).

	Small (10 - 49)	Medium (50- 249)	Large (250 or more)
% of workers in complex jobs	-0.039 *	-0.021	-0.032
	(0.009)	(0.013)	(0.024)
Teamwork			
No teams			
Management led teams	-0.196 *	-0.196 *	-0.115
	(0.022)	(0.032)	(0.081)
Autonomous teams	-0.159 *	-0.084 *	-0.215 *
	(0.021)	(0.031)	(0.095)

[10] The size of the establishment is associated with the number of hierarchical layers. The coefficient on the medium (large) size dummy in Table 3, Model 2 is 0.492 (0.900) with a standard error of 0.037 (0.044).

[11] The negative correlation between the extent of the adoption of complex job design and the number of hierarchical levels is present, albeit imprecisely estimated, in most countries. The largest standard errors can be found in Malta and Cyprus, the countries in which the samples are particularly small, see Figure B1 in Appendix B. Since the sample size is not large enough to allow to meaningfully estimate the regression model in the one-digit industries separately; we collapsed industries into 5 sector groups. The negative relationship between the adoption of complex job design and the number of hierarchical levels can be found across groups of sectors (5), See Figure B2 in Appendix B.

N	11,507	5,203	1,579

The regressions include all variables in Appendix B. The reference group of the variables is in parenthesis: Teamwork (no teamwork), managers create an environment in which employees can autonomously carry out their tasks, no innovation introduced (innovation introduced), Establishment age (10 years or less), Design and development of new product and services (carried out in house), Production of goods, assembly of parts, delivery of services (carried out in house), Product market strategy (price), Type of establishment (single establishment), Sector (mining and Quarrying), and Country (Austria).

The subsamples by establishment size are very imbalanced as most establishments belong to the small group. The unequal size of the subsamples has led to an increase of the standard errors associated to the coefficient estimated and leading to non-significant estimates. Therefore, we have pooled the large and medium establishment together and re-run the regression analysis in Table 3 Model 2. The coefficient on the extent of adoption of job complexity is -0.026 (with a standard error of 0.009). The coefficient on the autonomous team dummy is 0.107 (with a standard error 0.030). Even among larger establishments, the trade-off between a more extensive adoption of jobs with complex job design and the adoption of autonomous teams and the number of hierarchical layers can be observed.

4.2 Additional analyses to check the robustness to the importance of the coordination role

To further probe the robustness of the relationship between the provision of incentives through job design and the number of hierarchical levels that does not rely on splitting the sample according to establishment size we have standardised the dependent variable within quantiles of the establishment size distribution.

First, we divided the sample into quantiles (5, 10, and 20) based on the distribution of establishment size. In each of the quantile group we have computed the average number of hierarchical layers; this could be considered as the number of layers in the typical establishment in the quantile group, accounting for the need for coordination. The average number of layers clearly increases with establishment size. Figure 1 shows the increase in the average number of hierarchical levels across deciles of establishment size.

FIGURE 1 ABOUT HERE

The average number of hierarchical layers increases smoothly from about 2.5 in the first decile to about 3.9 in the tenth decile.

Second, in each quantile we have standardised the hierarchical levels, by computing z-scores. That is, in each quantile, the average number of layers of the quantile was subtracted from the observed number of each individual establishment and the difference was subsequently divided by the standard deviation of the number of hierarchical layers in the quantile.

Third, the standardised number of hierarchical layers was used as the dependent variable in Figure 3, Model 2. The results of these analyses when establishments are separated in 5, 10, and 20 quantiles on the basis of their number of employees are shown in Table 5.

Table 5: Regression estimates of team autonomy and extent of the adoption of complex job design on the standardised number of hierarchical layers by number of quantiles used in the standardisation procedure, standard errors in parenthesis, weighted (*: significant at $\alpha = .05$).

	Ventiles	Deciles	Quintiles
Workers in complex jobs	-0.016	-0.017	-0.020 *
	(0.009)	(0.009)	(0.010)
Teamwork			
No teams	-0.161 *	-0.162 *	-0.168 *
	(0.017)	(0.017)	(0.017)
Autonomous teams	-0.142 *	-0.140 *	-0.141
	(0.016)	(0.015)	(0.015)
N	18,287	18,287	18,287

The regressions include all variables in Appendix B. See Table 3 for the reference group of the variables.

The coefficient on the extent of adoption of complex job design is negative and just significant in two out of three models in Table 5. In the model in which the standardisation of the hierarchy is based on ten groups (the deciles of the establishment size distribution) the coefficient is of the same magnitude of the coefficients in the other models and it is very close to being significant.

The coefficient on the adoption of autonomous team work is significantly smaller than the coefficient on the adoption of management led team across all models; establishment adopting autonomous teamwork tend to have less hierarchical layers than establishments in which teams are led by managers.

As a final robustness check we note that establishments of similar size would have roughly the same difficulties in coordinating activities it is plausible that in these establishments, hierarchies would have an equally important role in coordinating production activities. This variable, the need for coordination, is not observable to the econometrician and it is therefore included in the error term. If establishments in the same quantile have (roughly) similar "needs for coordination", and we acknowledge that this is a big if, the within quantile de-meaning of dependent and independent variables would also remove the "need for coordination" from the error term. We do not claim that this is what happens. We acknowledge that using establishment size as a proxy for need for coordination is a rather coarse way to assess the importance of the coordination role of hierarchies. However, if the procedure captures at least part of the importance of the coordination role of hierarchies, the relationship between the provision of incentive through job design and the number of hierarchical levels should be affected.

The results of this analysis, based on the division of the establishment size distribution in 5, 10 and 20 quantiles are shown in Table 6.[12]

Table 6: Regression estimates of team autonomy and extent of the adoption of complex job design on the number of hierarchical layers by number of quantiles used in the de-meaning procedure, standard errors in parenthesis, weighted (*: significant at $\alpha = .05$).

	Ventiles	Deciles	Quintiles
Workers in complex jobs	-0.016	-0.017	-0.020 *
	(0.009)	(0.009)	(0.010)
Teamwork			

[12] The de-meaning procedure results in a loss of 794 cases.

No teams	-0.161 *	-0.162 *	-0.168 *
	(0.017)	(0.017)	(0.017)
Autonomous teams	-0.142 *	-0.140 *	-0.141 *
	(0.016)	(0.015)	(0.015)
N	17,493	17,493	17,493

The regressions include all variables in Appendix B. See Table 3 for the reference group of the variables.

The coefficient on the extent of adoption of complex job design is negative but not significant, across all model specifications (5, 10 and 20 quantiles). In addition, the coefficient on the extent of the adoption of complex job design in Table 6 (20 quantiles) is significantly smaller than the coefficient on the same variable in Table 3, Model 2.[13] Our analyses suggest that, to the extent that establishment size correlates with the need for coordination, the negative association between incentives offered through complex job design and the number of hierarchical layers is drastically reduced so that its size is not significant among establishments heavily relying on hierarchies to coordinate production activities.

Across all three model specifications, establishment adopting autonomous teamwork tend to have fewer hierarchical layers than establishments in which teams are led by managers. The difference in the coefficients on management lead teams and autonomous teams in Table 6 (specification with 20 quantiles) is not different from the one on the same variables in Table 3, model 2. In other words, the "need for coordination" does not appear to affect the negative relationship between the adoption of autonomous team work and the number of hierarchical layers.

To sum up, the provision of incentives through job design is negatively associated with the number of hierarchical layers. The adoption of autonomous teams is robustly associated with a reduction in the number of hierarchical layers. Our analyses suggest that the strength of the association between the extent of adoption of complex job design and the number of hierarchical layers is affected by the importance of the coordination role played by hierarchies in establishments.

5. Conclusions

Organisational hierarchies serve multiple purposes: coordinate activities, allocate talent, monitor effort, and provide incentives to contribute to the success of the organisation. There are many ways in which organisations can provide work incentives other than promotions. One case in point is the utilisation of two job design features – autonomy and problem solving –, which are a source of motivation. At the individual job level, these two features combine in complex job design; i.e., jobs requiring workers to solve production problems and providing them with a certain degree of autonomy on how to organise their work. Autonomy and problem solving are also prominent features in autonomous and self-directed teams. The central idea we investigate in this paper is that workplaces providing incentives through job design can offer rewarding jobs and rely less on promotions for motivating employees.

We find that, indeed, the more extensive the adoption of complex job design – the higher the percentage of employees in complex jobs (jobs providing work autonomy and opportunities for problem solving) – the flatter the hierarchical structure. Also, establishments adopting autonomous teamwork

[13] The coefficient on the extent of adoption of complex job design is 0.018 also when 50, 100, and 200 quantiles are used.

have flatter hierarchies (consisting of fewer hierarchical layers) than otherwise similar establishments adopting management led teams.

In establishments with a strong need for coordination, in which hierarchies play mainly a coordination role, the provision of incentives through job design may only be weakly (or not at all) associated with the number of layers. It is plausible to assume that the need for coordination is bigger in large establishments than in small ones. We acknowledge that this strategy is a crude way to proceed.

The robustness of the relationship between the provision of incentives through job design and the number of hierarchical levels to the importance of the coordination role of hierarchies has been investigated by using different model specifications derived from transformations based on the establishment size variable.

We have performed various types of analyses: first we have run the original models separately among small, medium, and large establishments. Second, on the assumption that hierarchies play a similar coordination role in establishments of similar size, the establishment size distribution has been divided into quantiles and then two within quantile transformations have been applied: the within-quantile standardisation of the dependent variables, and the demeaning of the dependent and independent variables.

These robustness analyses show that the coefficient on the extent of the adoption of complex job design, albeit negative and significant, is reduced in size and turn not significant when hierarchies have an important coordination role. The adoption of autonomous teams is robustly linked to short hierarchies. Establishments adopting of autonomous team work tend to have fewer hierarchical layers than establishments in which teams are management led across all subsamples of small, medium, and large establishments and in all models based on the within quantile transformations.

All in all, our results suggest that the provision of incentives through job design are associated with short hierarchies. Establishments going further in the extent of adoption of complex job design have fewer hierarchical layers than establishments that were more conservative in the adoption of complex job design elements. However, the trade-off is likely to disappear in establishments in which hierarchies play a strong coordination role. On the other hand, the adoption of autonomous teams is robustly linked to a reduced number of hierarchical layers, also in establishments with a strong need for coordination.

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Appedix A: Descriptive statistics

Table A: Descriptive statistics (unweighted)

	Mean	Std. Dev.	Min	Max
Number of hierarchical levels	3.058	0.815	1	5
Workers in complex jobs	2.317	1.241	1	5
Workers in jobs in which the pace of work set by machines	1.889	1.359	1	5
Workers in jobs in which there is needs of continuous training	2.265	1.472	1	5
Workers in jobs in which there is no need to learn new skills	1.955	1.281	1	5
Workers in jobs in which computer is used	2.908	1.640	1	5

Workers with permanent contracts	4.483	1.131	1	5
Workers on part-time contracts	1.491	1.055	1	5
Teamwork				
No teams	0.257	0.437	0	1
Management led teams	0.590	0.492	0	1
Autonomous teams	0.152	0.359	0	1
Establishment size (number of employees)				
Small (10 - 49)	0.629	0.483	0	1
Medium (50 - 249)	0.284	0.451	0	1
Large (250 and more)	0.086	0.281	0	1
Data analytics to improve production process	0.500	0.500	0	1
Data analytics to monitor workers' performance	0.321	0.467	0	1
Managers control if employees follow the tasks assigned to them	0.709	0.454	0	1
No innovation introduced	0.460	0.498	0	1
Skills requirements change	2.371	0.634	1	4
Workers in training during paid work time	2.764	1.574	1	5
Workers in jobs in on-the-job learning	2.852	1.490	1	5
Employee representation body present	0.378	0.485	0	1
Employee involvement causes delay	2.149	0.858	1	4
Employee involvement is a source of competitive advantage	2.878	0.893	1	4
Product demand (very stable to very volatile)	2.725	0.648	1	4
Intensity of competition in the product market	3.192	0.741	1	4
Establishment age				
10 years or less	0.141	0.348	0	1
11 to 20 years	0.235	0.424	0	1
21 to 30 years	0.257	0.437	0	1
more than 30 years	0.367	0.482	0	1
Design and development of new product and services				
Carried out internally	0.307	0.461	0	1
Carried out in cooperation with other establishments same company	0.037	0.188	0	1
in collaboration with other companies	0.089	0.285	0	1
Contracted out	0.020	0.141	0	1
No	0.547	0.498	0	1
Production of goods, assembly of parts, delivery of services				
Carried out internally	0.463	0.499	0	1
Carried out in cooperation with other establishments same company	0.051	0.220	0	1
in collaboration with other companies	0.121	0.326	0	1
Contracted out	0.043	0.204	0	1
No	0.322	0.467	0	1
Product market strategy				
Price	0.116	0.320	0	1
Quality	0.357	0.479	0	1
Customisation	0.287	0.452	0	1

Innovation	0.085	0.279	0	1
All equally important	0.046	0.209	0	1
Customisation, innovation, and quality	0.028	0.164	0	1
Customisation and quality	0.033	0.178	0	1
Customisation and innovation	0.006	0.076	0	1
Innovation and quality	0.007	0.082	0	1
Price and quality	0.010	0.097	0	1
Price and customisation	0.003	0.058	0	1
Price and innovation	0.005	0.069	0	1
Price, quality, and customisation	0.013	0.115	0	1
Price, quality, and innovation	0.003	0.059	0	1
Price, innovation, and customisation	0.001	0.038	0	1
Type of Establishment				
Single establishment	0.728	0.445	0	1
Headquarter	0.171	0.376	0	1
Subsidiary	0.101	0.301	0	1
Industry (NACE)				
Mining and quarrying	0.004	0.064	0	1
Manufacturing	0.247	0.431	0	1
Electricity, gas, steam and air conditioning supply	0.008	0.090	0	1
Water supply sewerage waste management and remediation activities	0.015	0.121	0	1
Construction	0.103	0.304	0	1
Wholesale and retail trade , reparation of motor vehicles	0.201	0.401	0	1
Transportation and storage	0.059	0.236	0	1
Accommodation and food services activities	0.059	0.235	0	1
Information and communication	0.040	0.196	0	1
Financial and insurance activities	0.020	0.140	0	1
Real estate activities	0.013	0.114	0	1
Professional, scientific, and technical activities	0.067	0.250	0	1
Administrative and support services activities	0.031	0.174	0	1
Arts, entertainment, and recreation	0.029	0.169	0	1
Other service activities	0.103	0.304	0	1
Country				
Austria	0.047	0.211	0	1
Belgium	0.047	0.212	0	1
Bulgaria	0.045	0.207	0	1
Croatia	0.024	0.154	0	1
Cyprus	0.005	0.071	0	1
Czechia	0.040	0.196	0	1
Denmark	0.049	0.216	0	1
Estonia	0.023	0.149	0	1
Finland	0.051	0.220	0	1
France	0.062	0.241	0	1

Germany	0.033	0.178	0	1
Greece	0.023	0.149	0	1
Hungary	0.049	0.217	0	1
Ireland	0.013	0.112	0	1
Italy	0.068	0.252	0	1
Latvia	0.023	0.151	0	1
Lithuania	0.022	0.148	0	1
Luxembourg	0.011	0.103	0	1
Malta	0.006	0.078	0	1
Netherlands	0.051	0.220	0	1
Poland	0.036	0.187	0	1
Portugal	0.046	0.209	0	1
Romania	0.034	0.182	0	1
Slovakia	0.016	0.125	0	1
Slovenia	0.026	0.158	0	1
Spain	0.067	0.250	0	1
Sweden	0.050	0.218	0	1
United Kingdom	0.032	0.177	0	1
Number of cases	18,287			

Appendix B: Estimation Results

Table B: Estimation results, standard error between brackets (*: significant at 5%), weighted.

	Ordered Logit Model 1		Regression Model 2	
% workers in complex jobs	-0.121	*	-0.038	*
	(0.025)		(0.009)	
% workers in jobs in which the pace of work set by machines	-0.016		-0.008	
	(0.036)		(0.013)	
% workers in jobs in which there is needs of continuous training	0.007		0.003	
	(0.023)		(0.007)	
% workers in jobs in which there is no need to learn new skills	0.028		0.011	
	(0.020)		(0.006)	
% workers in jobs in which computer is used	0.048	*	0.017	*
	(0.018)		(0.006)	
% workers with permanent contracts	0.012		0.005	
	(0.020)		(0.006)	
% workers in part-time contracts	-0.063	*	-0.025	*
	(0.023)		(0.007)	
Teamwork				
No teams	-0.602	*	-0.194	*
	(0.071)		(0.019)	
Autonomous teams	-0.461	*	-0.148	*
	(0.040)		(0.019)	
Establishment size (number of employees)				
Medium (50 - 249)	1.540	*	0.492	*
	(0.076)		(0.037)	
Large (250 and more)	2.715	*	0.900	*
	(0.117)		(0.044)	
Data analytics to improve production process	0.230	*	0.069	*
	(0.052)		(0.019)	
Data analytics to monitor workers' performance	0.159	*	0.054	*
	(0.070)		(0.026)	
Managers control if employees follow the tasks assigned to them	-0.034		-0.010	
	(0.084)		(0.030)	
No innovation introduced	-0.130		-0.045	
	(0.092)		(0.031)	
Skills requirements change	-0.042		-0.012	
	(0.035)		(0.010)	
Workers enrolled in training during paid time	0.012		0.000	
	(0.014)		(0.004)	
Workers who received on-the-job learning	0.061	*	0.022	*
	(0.022)		(0.007)	
Employee representation body present	0.434	*	0.138	*

	(0.079)		(0.024)	
Employee involvement causes delay	0.090		0.030	
	(0.063)		(0.021)	
Employee involvement is a source of competitive advantage	0.072	*	0.022	*
	(0.025)		(0.008)	
Product demand conditions (very stable to very volatile)	0.066		0.023	
	(0.040)		(0.013)	
Intensity of competition in the product market	-0.051		-0.023	
	(0.058)		(0.022)	
Establishment age				
11 to 20 years	0.191	*	0.073	*
	(0.047)		(0.014)	
21 to 30 years	0.063		0.028	
	(0.047)		(0.017)	
More than 30 years	-0.023		-0.001	
	(0.070)		(0.018)	
Design and development of new product and services				
Carried out in cooperation with other establishments same company	0.119		0.045	
	(0.154)		(0.044)	
In collaboration with other companies	0.084		0.028	
	(0.066)		(0.019)	
Contracted out	0.031		0.008	
	(0.147)		(0.045)	
No	-0.026		-0.019	
	(0.041)		(0.014)	
Production of goods, assembly of parts, delivery of services				
Carried out in cooperation with other establishments same company	0.083		0.025	
	(0.192)		(0.058)	
In collaboration with other companies	0.023		0.022	
	(0.060)		(0.021)	
Contracted out	-0.194	*	-0.067	*
	(0.078)		(0.030)	
No	-0.065		-0.014	
	(0.046)		(0.016)	
Product market strategy				
Quality	0.032		0.019	
	(0.051)		(0.017)	
Customisation	0.100		0.035	
	(0.078)		(0.022)	
Innovation	-0.019		-0.001	
	(0.064)		(0.020)	
All equally important	-0.130		-0.066	

	(0.181)		(0.064)	
Customisation, innovation, and quality	-0.302	*	-0.112	*
	(0.135)		(0.046)	
Customisation and quality	-0.131		-0.049	
	(0.123)		(0.053)	
Customisation and innovation	-0.250		-0.081	
	(0.222)		(0.070)	
Innovation and quality	-0.405		-0.141	
	(0.271)		(0.071)	
Price and quality	-0.105		-0.085	
	(0.245)		(0.082)	
Price and customisation	-0.684	*	-0.222	*
	(0.308)		(0.098)	
Price and innovation	-1.299	*	-0.453	*
	(0.330)		(0.123)	
Price, quality, and customisation	-0.372		-0.138	
	(0.198)		(0.084)	
Price, quality, and innovation	-1.160	*	-0.374	*
	(0.325)		(0.103)	
Price, innovation, and customisation	0.033		0.016	
	(0.395)		(0.121)	
Type of Establishment				
Headquarter	0.129	*	0.047	*
	(0.061)		(0.019)	
Subsidiary	0.086		0.034	
	(0.110)		(0.037)	
Industry (NACE)				
Manufacturing	0.463		0.124	
	(0.259)		(0.082)	
Electricity, gas, steam and air conditioning supply	0.660	*	0.223	*
	(0.300)		(0.102)	
Water supply sewerage waste management and remediation activities	0.494		0.128	
	(0.368)		(0.125)	
Construction	0.543	*	0.143	*
	(0.184)		(0.062)	
Wholesale and retail trade , reparation of motor vehicles	0.322		0.081	
	(0.245)		(0.083)	
Transportation and storage	0.109		0.017	
	(0.339)		(0.111)	
Accommodation and food services activities	0.557	*	0.155	*
	(0.205)		(0.067)	
Information and communication	-0.191		-0.090	
	(0.315)		(0.113)	

Financial and insurance activities	0.202		0.028	
	(0.230)		(0.082)	
Real estate activities	0.357		0.106	
	(0.397)		(0.119)	
Professional, scientific, and technical activities	-0.065		-0.026	
	(0.225)		(0.070)	
Administrative and support services activities	0.088		0.014	
	(0.472)		(0.145)	
Arts, entertainment, and recreation	0.538	*	0.154	*
	(0.228)		(0.073)	
Other service activities	0.494	*	0.132	
	(0.222)		(0.075)	
Country				
Belgium	-0.065		-0.017	
	(0.039)		(0.013)	
Bulgaria	0.027		-0.010	
	(0.022)		(0.008)	
Croatia	0.180	*	0.039	
	(0.068)		(0.021)	
Cyprus	0.910	*	0.254	*
	(0.055)		(0.011)	
Czechia	0.449	*	0.137	*
	(0.071)		(0.018)	
Denmark	-0.801	*	-0.286	*
	(0.034)		(0.016)	
Estonia	-0.027		-0.033	*
	(0.026)		(0.009)	
Finland	-0.061		-0.029	
	(0.055)		(0.018)	
France	0.620	*	0.202	*
	(0.077)		(0.020)	
Germany	-0.052		-0.037	*
	(0.034)		(0.013)	
Greece	0.118	*	0.019	
	(0.040)		(0.015)	
Hungary	0.479	*	0.163	*
	(0.076)		(0.021)	
Ireland	0.604	*	0.184	*
	(0.069)		(0.016)	
Italy	0.033		0.006	
	(0.039)		(0.015)	
Latvia	-0.054		-0.037	
	(0.054)		(0.018)	
Lithuania	-0.303	*	-0.127	*

	(0.021)		(0.007)	
Luxembourg	0.200	*	0.053	*
	(0.052)		(0.014)	
Malta	1.435	*	0.442	*
	(0.075)		(0.013)	
Netherlands	-0.012		-0.000	
	(0.031)		(0.010)	
Poland	0.314	*	0.100	*
	(0.053)		(0.016)	
Portugal	0.329	*	0.097	*
	(0.055)		(0.017)	
Romania	-0.047		-0.021	*
	(0.025)		(0.010)	
Slovakia	0.342	*	0.112	*
	(0.041)		(0.010)	
Slovenia	0.289	*	0.084	*
	(0.061)		(0.015)	
Spain	0.510	*	0.152	*
	(0.054)		(0.012)	
Sweden	-0.360	*	-0.133	*
	(0.068)		(0.025)	
United Kingdom	0.918	*	0.290	*
	(0.080)		(0.013)	
Constant			2.369	*
			(0.123)	
Ancillary parameters				
Alpha 2	-1.735	*		
	(0.386)			
Alpha3	0.338			
	(0.384)			
Alpha 4	3.740	*		
	(0.469)			
Alpha 5	6.294	*		
	(0.515)			
R2			0.211	
Log likelihood restricted model	-2223811.0			
Log likelihood full model	-1975774.9			
Chi squared test	496072.20	*		
N	18,289		18,289	

The reference group of the variables is in parenthesis: Teamwork (no teamwork), Establishment size (small, 10 – 49 employees), managers, no innovation introduced (innovation introduced), Establishment age (10 years or less), Design and development of new product and services (carried out in house), Production of goods, assembly of parts, delivery of services (carried out in house), Product market strategy (price), Type of establishment (single establishment), Sector (mining and Quarrying), and Country (Austria).

Figure B1 ABOUT HERE

Figure B2 ABOUT HERE

Figure 1: The average number of hierarchical levels (and 95% confidence band) by decile of establishment size

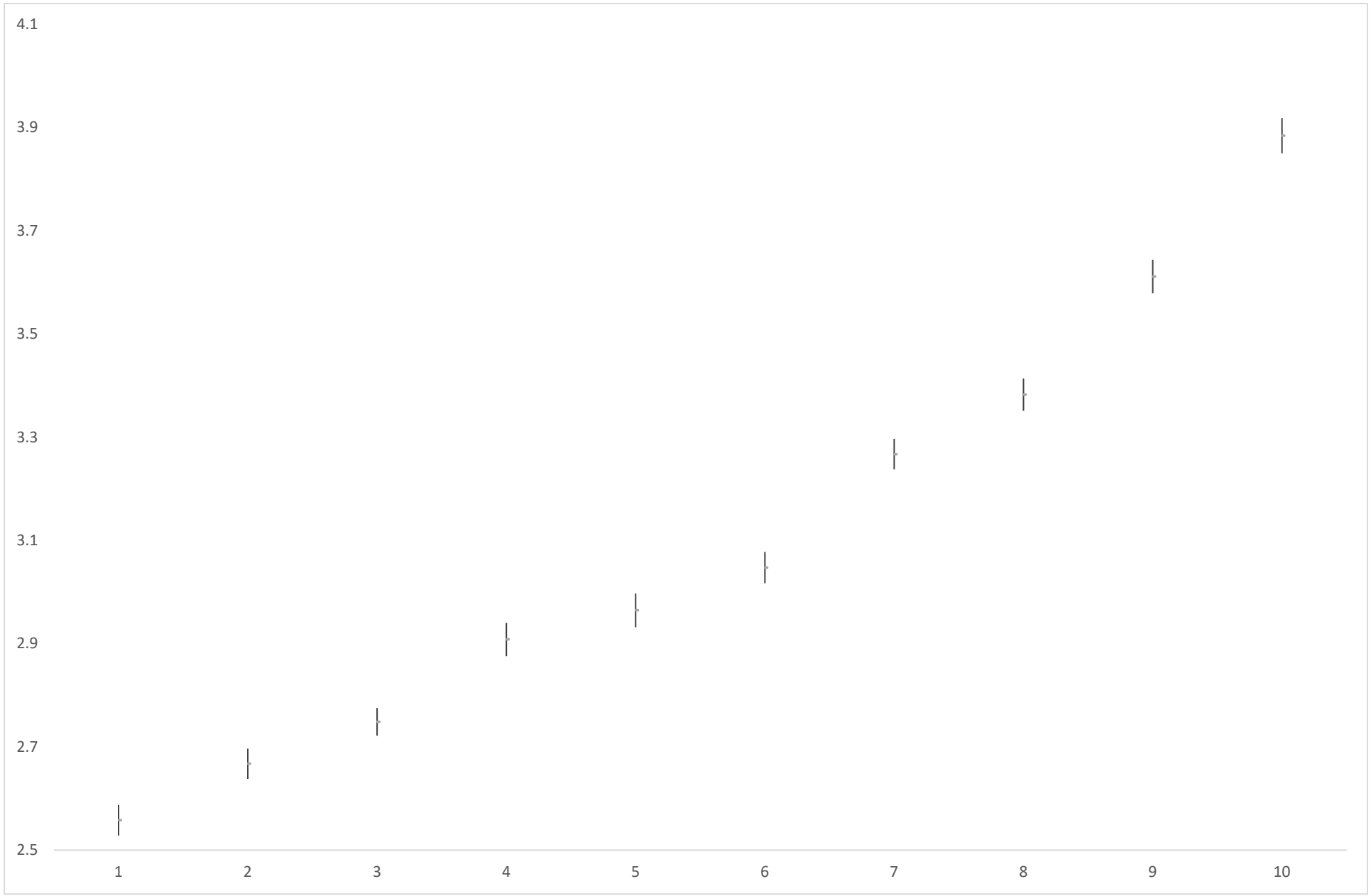

Figure B1: The coefficient on the extent of the adoption of complex job design (diamond) and its confidence interval in the whole sample (solid horizontal lines) and by country (vertical lines)

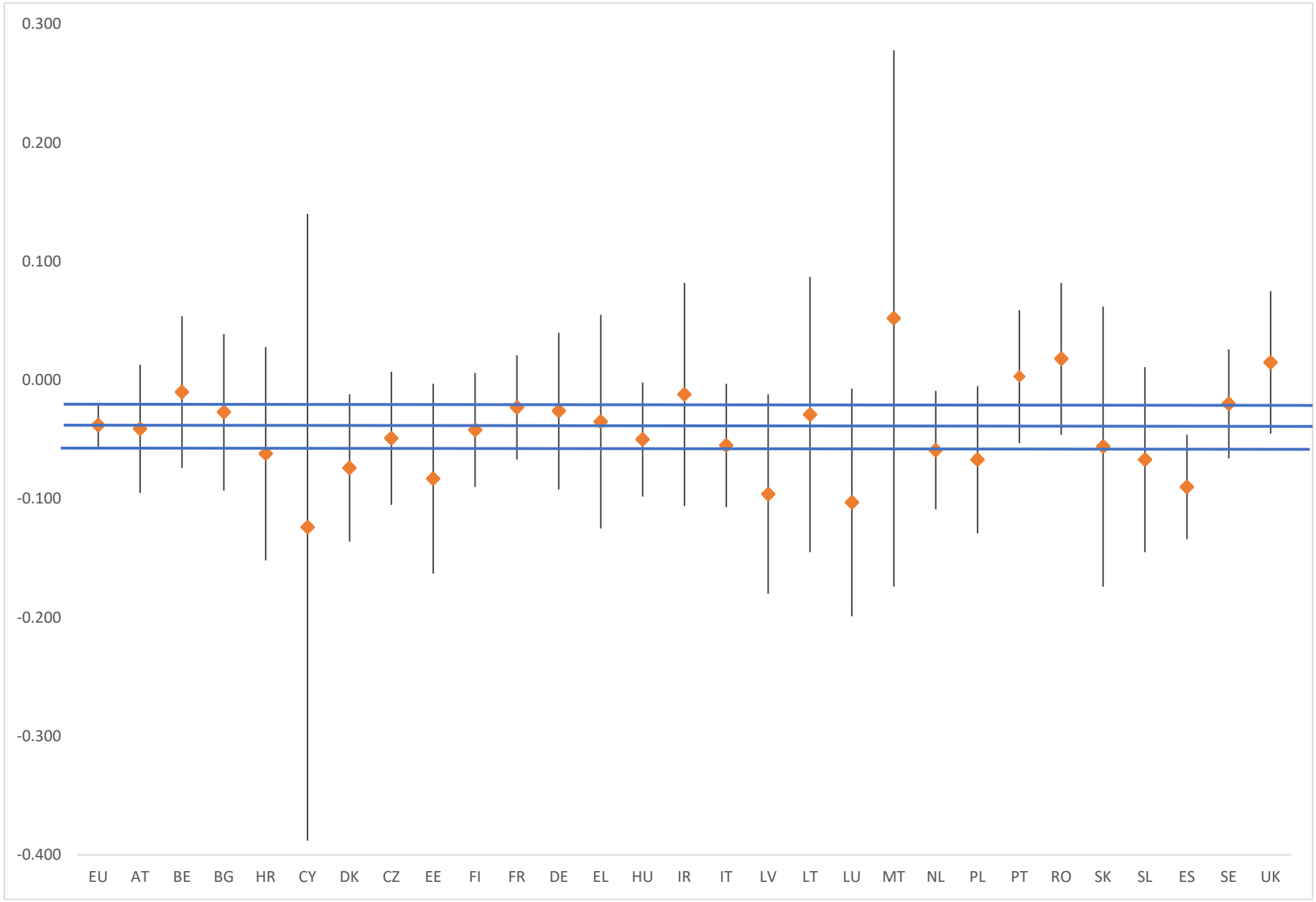

Figure B2: The coefficient on the extent of the adoption of complex job design (diamond) and its confidence interval in the whole sample (solid horizontal lines) and by sector group (vertical lines)