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Subjective Evaluation of Performance and Evaluation Interview
Empirical Evidence from France

Marc-Arthur Diaye, Nathalie Greenan,
and Michal W. Urdanivia

"If the economic organization meters poorly, with rewards and production only loosely correlated, then productivity will be smaller; but if the economic organization meters well productivity will be greater." —Alchian and Demsetz (1972, 779)

3.1 Introduction

A main contribution of linked longitudinal employer-employee data is to provide a decomposition of wage rates into components due to individual heterogeneity and to firm heterogeneity. In France, Abowd, Creecy, and Kramarz (2002) show that the person effect and firm effect account, respectively, for 70 percent and 20 percent of the variation of wages. The person-effect component is bigger in France than in the United States where it represents half of the wage variation.

This indicates that the devices used by firms to attract or select workers with specific characteristics play a central role in determining the firm's wage structure. However, these devices have not been investigated thoroughly by economic analysis. In this paper, we are going to assess individual evaluation

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interview, a human resource management (HRM) practice that could contribute to the two goals of selecting workers and stimulating their effort. In France, 52 percent of employees with more than one year of seniority in manufacturing had been evaluated at least once in 1997. At that time, evaluation interviews were not regulated at the national or at the industry level.

As an HRM practice, the function of evaluation interviews is not clear-cut. Sometimes viewed as formal performance appraisal systems, evaluation interviews often use complex evaluation grids referring to loosely defined behavioral characteristics as well as to precisely defined goals and measured criteria.

To assess evaluation interviews, it is useful to analyze them theoretically and to investigate empirically how they are implemented within firms. The theoretical framework we are going to use in this paper is the one (hereafter the DGU model) proposed by Diaye, Greenan, and Urdanivia (2007).

Intuitively, individual evaluation interviews are used to assess performance once the employee has undertaken her or his task. We will use here the term of ex post evaluation interviews. But, if we refer to a classic wage-setting mechanism, there is no need for evaluation. The incentive wages drives the employee toward the level of effort that is optimal for the employer. In the DGU model, ex post evaluation interviews insure risk adverse agent against technological or market uncertainty.

In the French context, Crifo, Diaye, and Greenan (2004) observe that evaluation interviews are significantly more frequent when the employee is involved in collective work. The model of ex post evaluation interviews is limited to give account of the function of evaluation interviews when employees work in teams because individual performance appraisal become difficult when the output cannot be separated between the members of a team (Alchian and Demsetz 1972). Diaye, Greenan, and Urdanivia (2007) propose a model of ex ante individual evaluation interviews specific to the teamwork context, where evaluation comes first, before the constitution of teams and aims at fostering a team spirit. They conclude their theoretical approach by establishing some predictions about drivers and outcomes of individual evaluation interviews.

In this paper, we want to assess empirically part of these predictions. Our empirical investigation rests on a matched employer-employee survey (section 3.2) on organizational change and information and communication technology (ICT) use (computerization and organizational change [COI]). In the labor force section of the survey, employees are asked whether they have been interviewed individually at least once in 1997. They also give information on work organization, on personal characteristics, and on outcomes. The business section of the survey gives a detailed set of firm-level characteristics reflecting technological and organizational choices implemented in French manufacturing at the end of the 1990s. We use a propen-

sity score methodology (section 3.3) to evaluate (section 3.4) the causal effect of individual evaluation interviews on effort, work overload, and wage setting. In section 3.5, we conclude.

3.2 The Data

We are going to use a matched employer-employee survey, the survey on computerization and organizational change (COI), to assess the DGU model of evaluation interviews. The information we have in the survey will not allow us to test all the predictions from their model. However, from the employee section of the survey, we have some information on the characteristics of work (whether individual or collective), on evaluation interviews, on effort, and on wages. This will allow us to cover the main features underlined by the DGU model. More precisely, we will be able to test whether evaluation interviews lead to higher levels of effort than classical incentive schemes (prediction 1). Our estimation strategy will also allow us to assess the existence of a selection effect associated with the implementation of evaluation interviews in individual and collective work organizations (prediction 2). Furthermore, using measures of work overload, we will check whether evaluation interviews drive workers toward an excessive work intensity leading to inefficiencies (prediction 3). Indeed, according to the DGU model, evaluation interviews in a context of supermodular technology (i.e., the conditional probability of success of the task is a strictly increasing convex function of the employees' level of effort) lead to an overintensification of work in the sense that the employees' level of effort will be higher than the one "required" by the firm. The reason is the selection effect regarding disutility of effort. Prediction 3 is a possible consequence of this result on overintensification. It is important to test this implication because work overload is a major factor of stress and has long-term implications on the health of the workforce, especially in a context of aging. Finally, we will be able to test our predictions on wage differentials and on the employees' knowledge of the rules driving wage setting between the scheme with evaluation interviews and the classical incentive scheme (prediction 4).

The COI survey was conducted at the end of 1997 by the French public statistical system.[1] We are going to work on a representative sample of

1. The conception and coordination of the COI survey has been directed by the Center for Labor Studies. The survey has been carried out in a consortium involving the Ministry of Labor (DARES), the Ministry of Industry (SESSI), the Ministry of Agriculture (SCEES), and the National Institute of Statistics and Economic Studies (INSEE). It benefited from very high response rates: 82 percent for employers and 75 percent for the employees. For a detailed description of the survey, see Greenan and Hamon-Cholet (2001) or http://www.enquetecoi.net.

manufacturing firms with more than fifty employees and on a sample of randomly selected employees within these firms. In matched employer-employee surveys, the budget constraint implies a trade-off between trying to capture the diversity of firms and trying to capture the diversity of the workforce within firms. By choosing to interview small sample of employees (one, two, or three) within each firm, COI chooses to favor the diversity of firms. As interviewed employees have at least one year of seniority within the firm, they belong to its core workforce.

In the full sample of the labor force section of the survey, there are 4,295 employees. However, in our analysis, we do not take into account employees with supervision activities (1,214 individuals) or employees working part time (177 individuals). Indeed, the former combine a position of Principal and of Agent that we have not investigated theoretically, while part time leads to badly measured effort and wages. We obtain a subsample of 2,904 employees.

The available information on the practice of individual evaluation interviews stems from the following question: Do you have at least one evaluation interview per year (yes / no)? Because of their seniority in the firm, we know that all interviewed employees had the opportunity of being evaluated at least once.

The labor force section of the COI survey describes in detail work organization. It includes a whole set of questions capturing whether work is structured around group activities. From these questions, we build up five different measures of interaction between employees in the course of the work process: being part of a team, time spent in teamwork, intensity of communication with other workers, level of support from other workers, participation in meetings (see appendix A for detailed questions). These five measure are positively correlated, with correlations ranging between 0.04 (intensity of communication with time spent in team work) and 0.18 (being part of a team and level of support from other workers). Thus, they measure different dimensions of collective work. We derive from these five measures a synthetic binary indicator of collective work. When it takes the value 1, the employee is considered as being a "collective" worker, when it takes the value 0, he or she is considered as being an individual worker. According to this variable, our sample of employees breaks down into 1,537 individual workers and 1,367 collective workers.

Table 3.1 gives the distribution of individual evaluation interviews according to our synthetic binary indicator of collective work. In 1997, 37.2% of the employees have been interviewed at least once. Evaluation interviews are positively correlated with collective work: 47 percent of collective workers have been evaluated against 29 percent of individual employees.

The COI survey also measures different effort indicators. Productive effort is measured through two questions indicating if the employee works

Table 3.1 **Evaluation among individual workers and collective workers**

Evaluation	Individual workers	Collective workers
Yes	445 (29%)	637 (47%)
No	1,092 (71%)[a]	730 (53%)
Total	1,537 (53%)	1,367 (47%)

[a]Percentage with respect to the analyzed subsample of 2,904 employees.

longer than the usual hours some days or some weeks. Productive effort is considered as *very high* if the employee sometimes increases hours worked for personal reasons, as *high* if he or she sometimes increases hours worked in response to the firm's demand, and as *low* if longer hours never happen. According to these three situations, the productive effort indicator, respectively, takes a value of 2, 1, or 0. The cognitive effort indicator is a binary variable indicating if the employee makes propositions to improve his or her workstations, the production process, or the machines. It measures an involvement in collective knowledge building about the productive activity, allowing continuous improvement of the production process.

Two additional measures are included in the analysis to identify if effort is going beyond reasonable levels, creating an overload that could be detrimental for work efficiency and for the employee's health. A first variable indicates how often an employee has to hurry in the course of his or her work. Four states are taken into account: hurrying almost all the time, hurrying for one quarter of the time or more, hurrying for less than a quarter of the time, and never. The hurry variable, respectively, takes the value 4, 3, 2, and 1 according to the intensity of the pressure. Work overload is also measured through a binary indicator telling whether the employee often has to interrupt one task to carry out another urgent and nonanticipated one.

Finally, we measure the employee's annualized net wage in euros. As it comes from an administrative data file used to compute social contributions, it is precisely measured and includes all bonuses, taxed allowances, and compensations in kind. We also build up an indicator of the employees' ability to predict their wages. It rests on a question about the elements that have a big influence on the employee's wage or promotion, followed by a list of eight items. We compute the ratio of the number of yes responses to the list of items, on the number of yes and no, which gives an indicator taking its value between 0 and 1. Zero means that the employee has no idea of how to increase his or her wage or chance of promotion, 1 means that the employee knows that he or she can improve his or her situation and is aware of what to do to obtain this outcome.

3.3 Estimation Strategy

We want to measure the impact of evaluation interviews on effort, work overload, and wages, but we know from the DGU model that evaluation interviews induce a selection process. Employees with a low disutility of effort and, in the case on teamwork, with a team spirit are going to be attracted by jobs where evaluation interviews are conducted periodically. A possible way to measure outcomes related to evaluation interviews, taking into account the selection effect, is to consider evaluation interviews as treatments and to apply a propensity score method to match each treated individual with a nontreated individual with the same characteristics in order to turn our nonexperimental data into a quasi experiment.

A simple way to test the predictions of the DGU model is to consider evaluation interviews as treatments and to evaluate the effect of this treatment on the chosen variables for measuring effort, wages, and beliefs about wages. More precisely, let t be a dummy variable equal to 1 if the employee declares being evaluated and 0 otherwise. Three quantities are of interest to us. The first is the average treatment effect over the whole population, written C; the second is the average treatment effect over the treated individuals, written C_1; and the third is the average treatment effect over the nontreated individuals, written C_0. More precisely, let Y be the chosen variables for measuring effort, wages, and beliefs about wages. Then C measures the variation of Y that would be observed if the whole population was treated; C_1 is an evaluation of the effect of the treatment in the usual sense because it concerns the treated population; and C_0 is a prospective evaluation in the sense that it measures what would happen if the nontreated population was treated. We have:

$$C = E(Y_1 - Y_0)$$

$$C_1 = E(Y_1 - Y_0 \mid \mathrm{t} = 1)$$

$$C_0 = E(Y_1 - Y_0 \mid \mathrm{t} = 0),$$

where Y_1 is the observed value of Y that results when receiving treatment (that is, when being evaluated), Y_0 is the observed value of Y that results when not receiving treatment (that is, when not being evaluated), and $E(.)$ denotes expectation in the population. Intuitively, an estimate of an average treatment effect could be the difference between the average of Y over the population of treated individuals and its average over the population of nontreated individuals, that is,

$$\overline{Y}_1 - \overline{Y}_0,$$

where $\overline{Y}_1$ and $\overline{Y}_0$ are, respectively, the average of Y for treated (evaluated employees) and the nontreated (nonevaluated employees).

However, broadly speaking, the main problem when evaluating the effect of a treatment is that for each individual we only observe

$$Y = \mathrm{t} \times Y_1 + (1 - \mathrm{t}) \times Y_0 = \begin{cases} Y_1 & \text{if } \mathrm{t} = 1 \\ Y_0 & \text{if } \mathrm{t} = 0 \end{cases}.$$

Then it can be shown that the average difference between treated and nontreated individuals can be the cause of a selection bias because the data does not result from a randomized experiment. And when testing evaluation effects (on effort, overload, and wages), there is a need to control for naturally occurring systematic differences in background characteristics between the treated population and the nontreated population, which would not occur in the context of a randomized experiment. Moreover, according to prediction 2, individual evaluation interviews affect employees' efforts through a selection effect associated to disutility or to team spirit, an incentive effect that in our case is estimated by the average treatment (evaluation) effect. Therefore, in order to estimate the average treatment (evaluation) effect, it is also necessary to control for the selection bias due to disutility. Although it seems difficult to control "directly" for this selection effect because disutility or team spirit are not observable characteristics, we can assume that they are grounded on observable background characteristics of the employee and of the employer, and, hence, controlling for them allows to control for the selection.

We will discuss in the next section the background characteristics we will take into account to estimate the effect of individual evaluation interviews. We choose to use the propensity score methodology introduced by Rosenbaum and Rubin (1983). This method reduces the entire collection of background characteristics to a single composite characteristic that appropriately summarizes the collection. Propensity score technology allows to correct the selection bias by matching individuals according to their propensity score, which is the estimated probability of receiving the treatment (of being evaluated) given background characteristics. We are going to use a nonparametric kernel matching estimator proposed by Heckman, Ichimura, and Todd (1997, 1998), which under some regularity assumptions is convergent and asymptotically normal.

3.4 The Results

3.4.1 Determinants of Individual Evaluation Interviews

The first step of the propensity score method is to analyze the determinants of evaluation interviews, taking into account background characteristics that influence the employee's probability of receiving a periodical

evaluation interview and the three categories of outcomes we consider: effort, work overload, and wages.

In this step, it is very important to take into account individual effects as well as contextual effects. As we have pointed out, personal characteristics of the employee like team spirit or disutility of effort are going to play a crucial role in influencing both the chances of being evaluated and the outcomes we consider. These characteristics are not directly observable, but we are going to take into account observables that are possibly correlated with them: gender, age, seniority, education level, and occupation. It is clear that these personal characteristics have impacts on effort levels, work overload, and wages.

The fact that our employee sample is matched with a survey describing the characteristics of firms is an important advantage in our estimation strategy. The DGU model has stressed that the production technology plays a role in the diffusion of evaluation interviews. A supermodular technology is more favorable than a submodular technology. In order to control for the technology, we are going to include the regression size and sector dummies. Stemming from an employer database, information on size and sector is much more precise than the information usually included in labor force surveys. We also include a measure of the firm's computerization intensity. We choose to build up a variable describing the intensity of numerical data transfers within and outside the firm. Moreover, evaluation interviews could be complementary to other organizational practices, and these practices could also have an influence on outcomes. Eight new organizational practices are considered in the logistic regression: quality certification, total quality management, methods to analyze products and processes (value analysis; functional analysis; Failure Mode, Effects, and Criticality Analysis [FMECA]), total productive maintenance (TPM), organization in profit center, formal in-house customer/supplier contracts, system of just-in-time delivery, and system of just-in-time production. We also detail different teamwork practices: self-managed teams, problem solving groups, and project teams. Finally, we take into account the evolution of the number of hierarchical layers in the firm and variables indicating difficulties connected with the implementation of organizational changes.

Appendix C presents the parameters estimated of the logistic models explaining individual evaluation interviews for individual workers and for collective workers. In the case of individual workers, we find that employee characteristics have higher explanatory power than employer characteristics. More precisely, male workers in executive or middle management positions with either low seniority (one or two years) or intermediate seniority (seven to ten years) have a higher probability of being evaluated. We have to keep in mind that even though some of the interviewed workers have management positions, they have no formal hierarchical authority as they declare no subordinates. Among the employer characteristics, the

only variables with significant influence are size, with a positive impact of the highest size cluster; sector, with a positive impact of five sectors (pharmaceutical, perfumes, and cleaning products; chemicals, rubber, and plastic products; electrical and electronic equipment; electrical and electronic components; and shipbuilding, aircraft, and railway); and quality certification (ISO 9001, ISO 9002, and EAQF).

In contrast, in the case of collective workers, employer characteristics tend to explain more than employee characteristics. Indeed, for team workers the only personal characteristic that influences the probability of being evaluated is the level of education: a second or third level of education is associated with a coefficient that is positive and significant. On the employer side, size, sector, computer intensity, use of new organizational devices, and use of teamwork have a significant impact on the probability of being evaluated. Employers with medium size (between 100 and 999 employees) and belonging to pharmaceutical, perfumes, and cleaning products or to chemicals, rubber, and plastic products use evaluation interviews more frequently. Employers from printing, press, and publishing and shipbuilding, aircraft, and railways have a lower probability of being interviewed. The intensity of computerization favors evaluation interviews of collective workers as well as quality certification and total productive maintenance. Conversely, employers using just-in-time delivery are less oriented toward evaluation interviews for collective workers. Having a nonmarginal fraction of production workers in problem solving groups favors evaluation interviews, while having a small fraction of nonproduction workers participating in self-managed teams and having management involved in project teams has a negative impact on evaluation interviews. In total, evaluation interviews for collective workers seem complementary with information technologies and new organizational practices. These managerial tools could support a supermodular production technology, where the employer has a preference for higher levels of effort.

3.4.2 Observing the Outcomes of Individual Evaluation

We are now going to discuss the matching evaluation of the effect of individual evaluation interviews on individual and collective workers on effort (table 3.2), work overload (table 3.3), and wages (table 3.4). In each table, we first compute as a benchmark the average outcome for individual and collective workers. Second, we compute the average difference in outcome between workers that have been individually evaluated and workers that have not been evaluated. This estimator is often designated as the naive estimator of the treatment effect. Then we compute the three causal effects: the effect on the treated (C1), the effect on the nontreated (C0), and the global effect (C). The first effect is the matching evaluation strictly speaking, the second one represents the effect that evaluation interviews would have if they were implemented on the nonevaluated population of

workers, and the last one is the effect that would be obtained if evaluation interviews were extended to the entire population.

Effort

We observe higher levels of productive and cognitive efforts when work is collective rather than individual (table 3.2). This was not entirely expected because our model underlined that one of the advantage of collective work was to share the burden of higher levels of effort between workers. However, other effects might play a role here. The DGU model (as well as the analysis of determinants of evaluation interviews) suggests that collective work is positively correlated with supermodular production technologies. Another explanation could lie in synergy and peer pressure effects connected with collective work.

As predicted by the DGU model, we observe that the level of effort, whether productive or cognitive, is higher when workers are individually evaluated than in the classical incentive scheme (prediction 1).

The causal treatment effect on productive effort is stronger for individual workers than for collective workers. And the selection effect has an opposite sign. Individual workers displaying higher level of effort are selected in the population of evaluated workers, when they are selected out in the

Table 3.2 Individual evaluation interviews and effort

	Individual workers[a]	Collective workers[b]
Productive effort[c]		
Average productive effort	0.564	0.720
Average difference E/NE	0.127***	0.092***
Effect on the treated (C1)	0.084**	0.120**
Effect on the nontreated (Co)	0.093**	0.100**
Global effect (C)	0.091**	0.110**
Cognitive effort[c]		
Average cognitive effort	0.507	0.722
Average difference E/NE	0.143***	0.140***
Effect on the treated (C1)	0.099**	0.110**
Effect on the nontreated (Co)	0.120**	0.110**
Global effect (C)	0.114**	0.110**

[a]The standard deviation of the treatment effect is computed using bootstrap with 300 simulations. The characteristics of the support over 300 simulations are min = 1,352; max = 1,501; mean = 1,426.48.

[b]The standard deviation of the treatment effect is computed using bootstrap with 300 simulations. The characteristics of the support over 300 simulations are min = 1,124; max = 1,304; mean = 1,229.03

[c]See section B of appendix A for a description of these variables.

***p-value < 0.01.

**$0.01 \geq p$-value < 0.05.

*$0.05 \geq p$-value < 0.1.

case of collective work. This result corroborates prediction 2 although the DGU model gives no specific clue to understand our surprising result on collective workers. The extension of evaluation interviews to the whole population of collective workers would consequently increase productive effort although it is already high in this case.

The observed effects on cognitive effort are more straightforward. Evaluation interviews similarly affect cognitive effort for individual and collective workers: they increase by 14 percent the propensity to make propositions for improving the production process. In the case of cognitive effort, the selection effect has an identic sign among individual and collective workers, but it is stronger in the first case.

Work Overload

Individual and collective workers work with a similar time pressure: the average need to hurry is 2.67 in the first case, 2.64 in the second (table 3.3), indicating that workers have to hurry a little more than a quarter of their time. Our second indicator of work overload is higher for collective workers: 65 percent of collective workers experience task interruptions in the course of their work, whereas 53 percent of individual workers face interruptions.

However, it is in the case of individual workers that evaluation interviews have a significant impact as it appears to mitigate work overload. Individual workers that are periodically evaluated work under lower time pressure

Table 3.3 Individual evaluation interviews and work overload

	Individual workers[a]	Collective workers[b]
Hurry[c]		
Average overload	2.666	2.640
Average difference E/NE	–0.143**	–0.110*
Effect on the treated (C1)	–0.142 (ns)	–0.108 (ns)
Effect on the nontreated (Co)	–0.189**	–0.073 (ns)
Global effect (C)	–0.176**	–0.089 (ns)
Interrupt[c]		
Average overload	0.526	0.650
Average difference E/NE	–0.053*	0.009 (ns)
Effect on the treated (C1)	–0.065**	0.002 (ns)
Effect on the nontreated (Co)	–0.066**	–0.003 (ns)
Global effect (C)	–0.066**	–0.000 (ns)

[a]See table 3.2 footnote.

[b]See table 3.2 footnote.

[c]See section C of appendix A for a description of these variables.

***p-value < 0.01.

**$0.01 \geq p$-value < 0.05.

*$0.05 \geq p$-value < 0.1.

and are less exposed to task interruptions. In the case of time pressure, the selection effect seems to play an important role as the causal effect on the treated is not significant. But evaluation interviews also seem to have a protective effect on their own because the effect on the nontreated is negative, significant, and stronger than the naive estimator. Individual workers who have been selected out from evaluation interviews would benefit from their implementation. As far as task interruptions are concerned, the protective effect of evaluation interviews is not explained by a selection effect; it is a pure outcome of this managerial device.

Evaluation interviews do not protect collective workers from work overload, but they do not increase their risk of exposition either. It is also an interesting result, knowing that collective workers produce higher levels of productive and cognitive efforts.

These results could be evidence of prediction 3. Evaluation interviews in a context of supermodular technology lead to an overintensification of work, but not to work overload. On the contrary, they seem to mitigate work overload, either through a selection effect as described in the DGU model, or through a pure effect.

Wage Setting

Collective workers earn more, on average, than individual workers (table 3.4). We also observe that, on average, evaluated employees earn more

Table 3.4 Individual evaluation interviews and wage setting

	Individual workers[a]	Collective workers[b]
Annualized net wage (in euros)[c]		
Average net wage	15,003	16,586
Average difference E/NE	1,654***	1,925***
Effect on the treated (C1)	198 (ns)	1,310**
Effect on the nontreated (Co)	275 (ns)	1,062**
Global effect (C)	253 (ns)	1,174**
Employee's ability to predict his or her wage[c]		
Average ability to predict	0.491	0.597
Average difference E/NE	0.164***	0.136***
Effect on the treated (C1)	0.145***	0.110***
Effect on the nontreated (Co)	0.147***	0.100***
Global effect (C)	0.146***	0.100***

[a]See table 3.2 footnote.

[b]See table 3.2 footnote.

[c]See sections D and E of appendix A for a description of these variables.

***p-value < 0.01.

**$0.01 \geq p$-value < 0.05.

*$0.05 \geq p$-value < 0.1.

than employees in a classical incentive scheme, confirming prediction 4. These monetary gains are higher for collective than for individual workers: 1,925 euros per year, on average, against 1,654 euros per year. For individual workers, this difference is entirely explained by the selection effect: the causal effects on the treated is not significantly different from zero, and the causal effect on the nontreated is also nonsignificant. Contrary to individual workers, the monetary gain of collective workers is only slightly lower when selection is taken into account: the gain falls from 1,925 euros to 1,310 euros if we consider the causal effect on the treated, to 1,062 if we consider the causal effect on the nontreated, and to 1,174 if we consider the global effect.

Concerning the employee's ability to predict his or her wage, we first note that this ability is greater, on average, for collective workers than for individual workers, and in both cases the average difference between evaluated and nonevaluated workers is significantly different from zero. Moreover, this effect of evaluation interview still remains significant when one corrects for the selection effect. As stated by prediction 4, evaluated workers have a better knowledge of the rules driving wage setting.

3.5 Conclusion

Diaye, Greenan, and Urdanivia (2007) have proposed a theoretical framework based on a Principal-Agent model to analyze the underlying mechanisms of individual evaluation interviews in the case of individual production and of team production (DGU model). They distinguish an ex post evaluation interview that builds a subjective evaluation of employees' effort and an ex ante evaluation interview which, in the case of team production, works as a coordination device through the fostering of a team spirit. Their theoretical analysis allows deriving testable predictions regarding the effect of individual evaluation interviews on productive and cognitive effort, on work overload, and on wage setting.

Using a matched employer-employee survey on computerization and organizational change (COI), we are able to test part of these predictions and to corroborate them. First, evaluation interviews have a positive impact on productive and cognitive effort. Second, evaluation interviews increase effort through two effects: the classical incentive effect and also a selection effect. Third, the selection effect is stronger in the case of individual production compared with the case of team production. Fourth, evaluated employees earn more than employees in a classical incentive scheme, and fifth, evaluated workers have a better knowledge of the rules driving wage setting.

The DGU model also suggests a higher propensity to evaluate workers in firms when the production technology is of a supermodular type and an overintensification of work in such a technological context. Our empirical

results tend to indicate that collective work is positively correlated with supermodular technologies as collective workers are more frequently evaluated and provide a higher level of effort than individual workers. However, evaluation interviews are not associated with work overload. On the contrary, individual workers seem to be protected from work overload when they are evaluated, and collective workers do not register a higher exposure to work overload even though they provide higher levels of effort. This could be an indirect evidence of the selection effect already stressed. Evaluated workers produce higher levels of effort, but their personal characteristics or the characteristics of their employers allow them to better cope with it.

Appendix A

Variables Constructed from the Labor Force Section of the COI Survey

A. Measures of Collective Work

In the COI survey, a sample of randomly selected employees within interviewed firms (one, two, or three per firm) are asked to describe in detail the way they work at the time when they are being surveyed.

Measure 1: Teamwork

This measure is associated to the following question: "Do you sometimes do your work in group or collectively?"

Response is either "yes" or "no."

Measure 2: Time Spent in Teamwork

This measure is constructed from the following question asked to employees who declared working in group or collectively: "How much of your working time do you work in group or collectively?"

Responses are "Almost all the time," "More than a quarter of your time," "Less than a quarter of your time."

Measure 3: Communication in the Firm

This measure is constructed from the following four questions:

"Apart from your superiors, are there other persons who give you indications on what you have to do?" (Responses are either "yes" or "no," or "it does not apply.")

1. "Colleagues you usually work with?"
2. "Other persons or departments in the firm?"

"Apart from your subordinates, do you give indications to other persons on what they have to do?" (Responses are either "yes" or "no" or "it does not apply.")

3. "Colleagues you usually work with?"
4. "Other persons or departments in the firm?"

Then a *low* intensity of communication corresponds to 0 or 1 positive answer among these four questions, and a *high* intensity of communication to at least two positive answers among the four questions.

Measure 4: Support from Other Workers

The measure is constructed from the following three questions:

"If you have a temporary excess workload or if you are uneasy with a difficult task, are you helped by . . ." (Responses are either "yes" or "no" or "it does not apply.")

1. "your superiors?"
2. "colleagues you usually work with?"
3. "other persons or departments in the firm?"

Then a *low* level of support from other workers corresponds to 0 or 1 positive answer, and a *high* level of support corresponds to at least two positive answers among the three questions.

Measure 5: Participation in Meetings

The measure is constructed from the following question: "How many times a year do you participate in meetings in the context of your work?" Then a *low* participation in meetings corresponds to 0 or only one meeting a year, and a *high* participation in meetings corresponds to at least two meetings a year. (See tables 3A.1 and 3A.2.)

B. Measures of Effort

Two dimensions of effort are captured in the COI survey.

The first one describes the **level of productive effort.** It is built from the answers to the two following questions: (1) "Do you work more than ordinarily?" (Response is either "yes" or "no"); (2) If yes, "Do you work more than ordinarily for personals reasons?" (Response is either "yes" or "no.")

Employee's effort is a variable with three levels: 0 when the answer to question (1) is "no," 1 when the answer to question (1) is "yes" and the answer to question (2) is "no," 2 when both the answers to questions (1) and (2) are "yes."

The second one describes the **level of cognitive effort** or, more precisely, the degree of implication into collective knowledge building about the pro-

Table 3A.1 Five measures of interaction between employees in the work process

	Frequency	Percent
Measure 1: Teamwork		
No (0)	1,422	48.97
Yes (1)	1,482	51.03
Measure 2: Teamwork intensity		
Less than 1/4 of time (0)	2,045	70.42
1/4 of time or more (1)	859	29.58
Measure 3: Communication intensity		
Low (0)	1,019	35.09
High (1)	1,885	64.91
Measure 4: Level of support		
Low (0)	1,537	52.93
High (1)	1,367	47.07
Measure 5: Participation in meetings		
Low (0)	1,557	53.62
High (1)	1,347	46.38

Table 3A.2 Correlation coefficients between the five measures of interaction between employees

	Measure 1	Measure 2	Measure 3	Measure 4	Measure 5
Measure 1	1.00000				
Measure 2	0.63486	1.00000			
Measure 3	0.15159	0.04493	1.00000		
Measure 4	0.17993	0.11736	0.14987	1.00000	
Measure 5	0.13480	0.04775	0.17168	0.08567	1.00000

duction process. It is built from the answers to the following questions: (1) "In the context of your work, do you make propositions to improve your workstation, the production process, the machines . . . ?" (Response is either "yes" or "no.")

C. Measures of Work Overload

Two indicators measure work overload:

- *Hurry* is a discrete variable. It is equal to 1 if the employee states that he or she never has to hurry to do his work. It is equal to 2 if he or she states that it is the case for less than one quarter of the time. It is equal to 3 if he or she states that it is the case for one quarter of the time or more. And it is equal to 4 if he or she states that he or she has to hurry almost all the time.
- *Interrupt* is a dummy variable equal to 1 when the employee states that

he or she often has interrupt one task to carry out another urgent and nonanticipated one. It is equal to 0 otherwise.

D. Measure of Monetary Incentives

Monetary incentives are captured through annualized **net wage** (in euros). It comes from the annual declarations of social data (DADS), which is an administrative file used to compute the tax on wages. It groups all earnings paid in cash or kind between the 1st of January and the 31st of December 1996, less social contributions (social security, pensions, and unemployment benefit).

This compensation includes base wage, all bonuses, taxed allowances, and compensations in kind. Bonuses associated with the two French profit sharing regimes (participation and *intéressement*) are not included when they are not taxed. However, bonuses connected to participation schemes are generally not taxed when the reverse is true for bonuses connected to intéressement schemes. It is the length of the period during which bonuses remain unavailable that determines taxation. In the case of participation, when this unavailability period is shortened to three years, the bonuses become partly eligible to taxation. In the case of intéressement, bonuses are partly exonerated from taxes when they are blocked for a while in a company saving scheme.

If we except bonuses connected with participation, compulsory in firms with more than fifty employees, most of the earnings that contribute to an individualization of compensations are taken into account in our variable. Thus, we may interpret it as an output of the wage policy of the firm.

Last, compensations correspond to employment periods that vary from one employee to the other. We have annualized the information we had, taking into account the number of days worked. This does not correct for part time, but only 6 percent of the employees in our sample declare working part time.

E. Employee's Ability to Predict His or Her Wage

This variable is built from the answers to the eight following questions: "Which of the following elements have a big influence on your wage or on your promotion" (for each element, response is either "yes" or "no" or "it does not apply"): (1) "To do a high-quality work?"; (2) "To carry assignments to the letter?"; (3) "To be on good terms with the boss (bosses)?"; (4) "To be on good terms with the colleague(s)?"; (5) "To take up training courses?"; (6) "To learn how to use new technologies?"; (7) "The firm's performances?"; (8) "Other reasons?"

The employee's ability to predict his or her wage is then the ratio of number of "yes" answers to the number of "yes" or "no."

Appendix B

Variables Constructed from the Firm Section of the COI Survey

A. Firms' Computerization Intensity

This variable in constructed from the following question:

"Did/Does your firm realize data transfers by means of a computer interface . . ." (Response is either "yes" or "no"):

1. "within the management service?"
2. "between management and production service?"
3. "between management and suppliers, subcontractors?"
4. "between management and client firms?"
5. "between management and social organisms public power?"
6. "between conception services and production?"
7. "between conception and suppliers, subcontractors?"
8. "within the production services or between manufacturer unities?"
9. "between production and suppliers, subcontractors?"
10. "between production and client firms?"

Computerization intensity is equal to 1 if there is 0 or 1 "yes"; intensity 2 corresponds to two or three "yes"; intensity 3 corresponds to four or five "yes"; and intensity 4 corresponds to five and more "yes."

B. Average Number of Tasks That Each Type of Worker Is Responsible for (NMT)

This variable is constructed from the question (responses are "Management"/"Production Worker"/"Specialist": more than one answer is possible for each subquestion). "In general, who is/was authorized in 1997 to . . .":

1. adjust installations?
2. perform first level maintenance?
3. allocate tasks to production workers?
4. inspect quality of supplies?
5. inspect quality of production?
6. participate in performance improvements?
7. participate in project teams?
8. stop production in case of an incident?
9. troubleshoot in case of an incident?
10. start production again in case of an incident?

The qualitative variable NMT with four items is constructed as follows:

NMT ≥ 1.7 (High responsibility sharing between the three types of workers: Management, Production Worker, and Specialist)
1.4 ≤ NMT < 1.7 (Medium responsibility sharing)
1 < NMT ≤ 1.4 (Low responsibility sharing)
NTM ≤ 1 (No responsibility sharing)

Appendix C

Logistic Regression Results for the Binary Outcome "Evaluated/Not Evaluated"

Table 3C.1 The case of individual production

Parameter	Estimate	Standard error	Wald χ^2	Pr > χ^2
Intercept	–2.0329	0.3485	34.0305	<.0001
Sociodemographic characteristics of employee				
Gender[a]	–0.2524	0.1519	2.7595	0.0967
Age[b]				
15–24	–0.1760	0.4762	0.1366	0.7116
25–39	–0.0446	0.1963	0.0515	0.8205
40–49	0.2130	0.1865	1.3044	0.2534
Years in the firm[c]				
1–2	0.6301	0.2374	7.0452	0.0079
3–6	0.2496	0.1952	1.6355	0.2010
7–10	0.3229	0.1756	3.3827	0.0659
Level of education[d]				
Vocational training (CAP and BEP)	–0.0175	0.1503	0.0135	0.9074
Second-level education (BAC)	–0.0885	0.2581	0.1177	0.7316
Third-level education	–0.0496	0.2607	0.0363	0.8489
Professional type[e]				
Executives	0.6554	0.3603	3.3089	0.0689
Middle management	0.7697	0.2356	10.6728	0.0011
Clerk	0.3463	0.2461	1.9801	0.1594
Skilled blue collar	–0.0568	0.1670	0.1156	0.7339
General characteristics of the firm				
Firm size[f]				
100–499	–0.0328	0.1744	0.0355	0.8506
500–999	0.0294	0.2264	0.0168	0.8968
1000 and more	0.6202	0.2525	6.0334	0.0140
Industry sector[g]				
Mineral products	0.4561	0.3481	1.7165	0.1901
Textile	0.4668	0.3269	2.0391	0.1533
Clothing and leather	–0.2872	0.4127	0.4845	0.4864
Wood and paper	0.1410	0.3348	0.1773	0.6737
Printing, press, publishing	0.2648	0.3902	0.4605	0.4974

(*continued*)

Table 3C.1 (continued)

Parameter	Estimate	Standard error	Wald χ^2	Pr > χ^2
Production of propellants and fuels	1.0360	1.4831	0.4880	0.4848
Chemicals, rubber, and plastic products	0.6593	0.2753	5.7342	0.0166
Pharmaceutical, perfumes, and cleaning products	1.7797	0.3673	23.4742	<.0001
Foundry and metal work products	–0.0104	0.2843	0.0013	0.9709
Mechanical engineering	0.1636	0.2718	0.3625	0.5471
Household equipment	0.0894	0.3122	0.0821	0.7745
Electrical and electronic equipment	0.9187	0.4546	4.0840	0.0433
Electrical and electronic components	0.6605	0.2988	4.8870	0.0271
Automobile	0.3523	0.3630	0.9420	0.3318
Shipbuilding, aircraft, and railway	0.6672	0.3829	3.0367	0.0814
Firms' computerization intensity[h]				
Intensity 2	0.0295	0.1914	0.0238	0.8773
Intensity 3	0.1274	0.2034	0.3923	0.5311
Intensity 4	0.0664	0.2266	0.0860	0.7694
Obstacles to the organizational changes[i]				
Tensions between the services	–0.2390	0.1760	1.8428	0.1746
Tensions with the shareholders	0.0501	0.2123	0.0558	0.8133
Difficulties in the relations with the other firms	0.0393	0.1899	0.0429	0.8359
Difficulties to school or to reclassify the staff	–0.0221	0.1621	0.0186	0.8915
Nonexecutive staff adaptations and establishment problems	–0.0908	0.1751	0.2688	0.6041
Executive staff adaptations and establishment problems	0.2754	0.1679	2.6886	0.1011
Clashes with the staff (petitions, strikes, etc.)	–0.0970	0.2035	0.2271	0.6337
Use of new organizational devices[j]				
ISO 9001, ISO 9002, EAQF certification	0.4734	0.1616	8.5854	0.0034
Other certification or total quality management	0.0457	0.1394	0.1073	0.7432
Value analysis, functional analysis, or FMECA method	0.00832	0.1633	0.0026	0.9593
5S method or Total Productive Maintenance (TPM) method	0.2457	0.1768	1.9307	0.1647
Organization in profit centers	0.1212	0.1398	0.7517	0.3859
Formal in-house customer/supplier contracts	0.0257	0.1402	0.0335	0.8547
System of "Just-in-time" delivery	0.1323	0.1786	0.5483	0.4590
System of "Just-in-time" production	–0.0757	0.1793	0.1785	0.6727
Evolution in hierarchical layers between 1994 and 1997[k]				
1 and more	–0.0725	0.2648	0.0750	0.7842
–1	–0.1617	0.1748	0.8556	0.3550
–2 and less	0.1750	0.2874	0.3707	0.5426
Teamwork				
Share of production workers participating in self-managed teams[l]				
10% to less than 50%	–0.1373	0.1965	0.4879	0.4849
50% and more	0.1451	0.2585	0.3149	0.5747
Share of production workers participating in problem solving groups[l]				
10% to less than 50%	0.3005	0.1927	2.4314	0.1189
50% and more	0.5594	0.3928	2.0281	0.1544

Table 3C.1 (continued)

Parameter	Estimate	Standard error	Wald χ^2	Pr > χ^2
Share of production workers participating in project teams[l]				
10% to less than 50%	0.1398	0.1958	0.5101	0.4751
50% and more	–0.9496	0.5843	2.6415	0.1041
Share of other workers participating in self-managed teams[l]				
10% to less than 50%	0.1439	0.2051	0.4921	0.4830
50% and more	–0.1158	0.3478	0.1108	0.7392
Share of other workers participating in problem solving groups[l]				
10% to less than 50%	–0.1922	0.2010	0.9143	0.3390
50% and more	–0.0789	0.3770	0.0438	0.8343
Share of other workers participating in project teams[l]				
10% to less than 50%	–0.2005	0.1941	1.0673	0.3016
50% and more	0.3645	0.3384	1.1598	0.2815
Who is/was authorized in 1997 to participate in project teams?[m]				
Management	–0.2209	0.1608	1.8877	0.1695
Production worker	0.0596	0.1448	0.1694	0.6806
Specialist	–0.2073	0.1627	1.6232	0.2027
Average number of tasks that each type of worker is responsible for[n]				
1.1–1.4	–0.0469	0.1864	0.0635	0.8011
1.5–1.7	0.1619	0.2226	0.5292	0.4669
1.8 and more	0.3439	0.2386	2.0764	0.1496

[a]Reference is "men."

[b]Reference is "50 and more."

[c]Reference is "11 and more."

[d]Reference is "with no degree except CEP or BEPC."

[e]Reference is "unskilled blue collar."

[f]Reference is "99 and less."

[g]Reference is "food industries."

[h]Reference is "intensity 1." See section A of appendix B for the construction of this variable.

[i]The variable is equal to 1 when the firms states that such an obstacle has been either "quite important," "important," or "very important," and 0 when she states that it has been "unimportant."

[j]Response is either "yes" or "no."

[k]Reference is "0."

[l]Reference is "less than 10%."

[m]Response is either "yes" or "no."

[n]Reference is "≤ 1." See section B of appendix B for the construction of the variable.

Table 3C.2 The case of team production

Parameter	Estimate	Standard error	Wald χ^2	Pr > χ^2
Intercept	–1.7432	0.3745	21.6633	<.0001
Sociodemographic characteristics of the employee				
Gender[a]	–0.1403	0.1523	0.8481	0.3571
Age[b]				
15–24	0.5015	0.4257	1.3880	0.2387
25–39	0.2781	0.2295	1.4691	0.2255
40–49	0.2781	0.2295	1.4691	0.2255
Years in the firm[c]				
1–2	–0.2096	0.2443	0.7363	0.3908
3–6	0.1818	0.1820	0.9972	0.3180
7–10	0.0170	0.1730	0.0097	0.9217
Level of education[d]				
Vocational training (CAP and BEP)	0.1829	0.1567	1.3621	0.2432
Second-level education (BAC)	0.4481	0.2421	3.4263	0.0642
Third-level education	0.5279	0.2645	3.9823	0.0460
Professional type[e]				
Executives	0.5416	0.3485	2.4147	0.1202
Middle management	0.1200	0.2284	0.2761	0.5993
Clerk	–0.0121	0.2972	0.0017	0.9675
Skilled blue collar	–0.1469	0.1743	0.7101	0.3994
General characteristics of the firm				
Firm size[f]				
100–499	0.3510	0.1765	3.9524	0.0468
500–999	0.7059	0.2080	11.5179	0.0007
1000 and more	0.1941	0.2422	0.6426	0.4228
Industry sector[g]				
Mineral products	–0.2853	0.3202	0.7942	0.3728
Textile	0.3355	0.4096	0.6708	0.4128
Clothing and leather	–0.1220	0.3734	0.1068	0.7439
Wood and paper	–0.4769	0.3661	1.6974	0.1926
Printing, press, publishing	–0.8333	0.4390	3.6032	0.0577
Production of propellants and fuels	1.2745	0.9040	1.9877	0.1586
Chemicals, rubber, and plastic products	0.6759	0.2593	6.7962	0.0091
Pharmaceutical, perfumes, and cleaning products	1.2302	0.3578	11.8237	0.0006
Foundry and metal work products	–0.2956	0.2752	1.1535	0.2828
Mechanical engineering	–0.0338	0.2637	0.0164	0.8980
Household equipment	0.1161	0.3083	0.1418	0.7065
Electrical and electronic equipment	0.3344	0.3679	0.8263	0.3633
Electrical and electronic components	0.1719	0.2950	0.3396	0.5601
Automobile	–0.2314	0.3329	0.4832	0.4870
Shipbuilding, aircraft, and railway	–0.6255	0.3706	2.8479	0.0915
Firms' computerization intensity[h]				
Intensity 2	0.3321	0.1888	3.0940	0.0786
Intensity 3	0.4203	0.1960	4.5997	0.0320
Intensity 4	0.3323	0.2140	2.4118	0.1204

Table 3C.2 (continued)

Parameter	Estimate	Standard error	Wald χ^2	Pr > χ^2
Obstacles to the organizational changes[i]				
Tensions between the services	–0.0540	0.1773	0.0927	0.7608
Tensions with the shareholders	–0.2445	0.2312	1.1179	0.2904
Difficulties in the relations with the other firms	–0.0976	0.1999	0.2382	0.6255
Difficulties to school or to reclassify the staff	0.0598	0.1538	0.1513	0.6973
Nonexecutive staff adaptations and establishment problems	0.0411	0.1639	0.0629	0.8020
Executive staff adaptations and establishment problems	0.1569	0.1589	0.9750	0.3234
Clashes with the staff (petitions, strikes, etc.)	–0.1195	0.1930	0.3833	0.5358
Use of new organizational devices[j]				
ISO 9001, ISO 9002, EAQF Certification	0.4089	0.1604	6.4964	0.0108
Other certification or total quality management	0.1545	0.1389	1.2379	0.2659
Value analysis, functional analysis, or FMECA method	–0.0932	0.1582	0.3470	0.5558
5S method or Total Productive Maintenance (TPM) method	0.4285	0.1631	6.8979	0.0086
Organization in profit centers	0.1763	0.1351	1.7015	0.1921
Formal in-house customer/supplier contracts	0.1045	0.1380	0.5728	0.4492
System of "Just-in-time" delivery	–0.3277	0.1778	3.3980	0.0653
System of "Just-in-time" production	0.1577	0.1781	0.7846	0.3757
Evolution in hierarchical layers between 1994 and 1997[k]				
1 and more	–0.0279	0.2610	0.0114	0.9150
1	–0.0204	0.1629	0.0156	0.9005
2 and less	–0.3818	0.2959	1.6652	0.1969
Teamwork				
Share of production workers participating in self-managed teams[l]				
10% to less than 50%	0.0247	0.1780	0.0193	0.8895
50% and more	0.0651	0.2613	0.0620	0.8033
Share of production workers participating in problem solving groups[l]				
10% to less than 50%	0.4672	0.1863	6.2869	0.0122
50% and more	0.8599	0.3590	5.7362	0.0166
Share of production workers participating in project teams[l]				
10% to less than 50%	–0.0944	0.1838	0.2640	0.6074
50% and more	–0.0239	0.4492	0.0028	0.9575
Share of other workers participating in self-managed teams[l]				
10% to less than 50%	–0.3616	0.1983	3.3244	0.0683
50% and more	–0.2979	0.3314	0.8082	0.3687
Share of other workers participating in problem solving groups[l]				
10% to less than 50%	0.1016	0.2065	0.2419	0.6229
50% and more	0.2644	0.3815	0.4801	0.4884

(continued)

Table 3C.2 (continued)

Parameter	Estimate	Standard error	Wald χ^2	Pr > χ^2
Share of other workers participating in project teams[l]				
10% to less than 50%	0.1084	0.1851	0.3428	0.5582
50% and more	0.0786	0.3393	0.0537	0.8168
Who is/was authorized in 1997 to participate in project teams?[m]				
Management	–0.3374	0.1701	3.9368	0.0472
Production worker	–0.1134	0.1475	0.5912	0.4420
Specialist	0.1610	0.1591	1.0239	0.3116
Average number of tasks that each type of worker is responsible for[n]				
1.1–1.4	0.0988	0.1917	0.2656	0.6063
1.5–1.7	0.1538	0.2221	0.4796	0.4886
1.8 and more	–0.1319	0.2414	0.2984	0.5849

[a]Reference is "men."

[b]Reference is "50 and more."

[c]Reference is "11 and more."

[d]Reference is "with no degree except CEP or BEPC."

[e]Reference is "unskilled blue collar."

[f]Reference is "99 and less."

[g]Reference is "food industries."

[h]Reference is "intensity 1." See section A of appendix B for the construction of this variable.

[i]The variable is equal to 1 when the firms states that such an obstacle has been either "quite important," "important," or "very important," and 0 when he or she states that it has been "unimportant."

[j]Response is either "yes" or "no."

[k]Reference is "0."

[l]Reference is "less than 10%."

[m]Response is either "yes" or "no."

[n]Reference is " ≤ 1." See section B of appendix B for the construction of the variable.

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