THE QUALITY OF WORK ENVIRONMENT:

WHAT CONSEQUENCES ON THE EMPLOYEES' EFFORT?

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According to research on the quality of employment, the work environment can have an impact on individuals' perception of their employment and thus influence their behavior. Therefore, a good atmosphere at work should positively affect the level of effort of employees. Our paper examines this hypothesis using the Computerization and Organizational Change survey (COI, 2006), but distinguishing quantitative effort and cognitive effort. We use methods of matching by propensity score to control for selection effects. We find a negative correlation between good working atmosphere and productive effort, and no link with cognitive effort.

KEYWORDS**:** good work environment, effort.

JEL CLASSIFICATION**:** M54, M55, C78

1. INTRODUCTION

There are many reasons to take an interest in the effects of work environment quality on the effort of employees. One of them is that the work environment can be seen as a non-monetary incentive scheme playing positively on the intrinsic motivation of employees.

Therefore, intrinsic motivation is the satisfaction a person gets from employment, which leads them to engage in this activity in the absence of any incentive or external threat (Ryan et al., 1996). Thus, unlike the conventional assumption that effort is source of disutility and must be

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looked at as exogenous by the carrot (compensation, delegation, promises), or the stick (surveillance, threats, punishment), the pride of accomplishing a particular task, the feeling of being useful or contributing something can make effort a positive argument for the utility of individuals (Kreps, 1997; Benabou and Tirole, 2003).

This method of addressing effort has opened up opportunities in terms of incentives policies in firms. It shows, in particular, that one cannot always base employees' effort on material considerations only. From this point of view, the employee effort can be sensitive to the non-monetary characteristics of the employment (such as the more or less pleasant character of the work, the ability of employees to express themselves, stress, or pride) and varies from one to the other depending on their perceptions of these characteristics. This is in fact Clark's position (2004), which attempts to identify aspects of employment other than wages and hours of work which could affect satisfaction as well as motivation. These aspects can actually allow us to distinguish "good jobs" from "bad jobs" and focus on the resulting working conditions and satisfaction. A good working environment, or one experienced as such, could be seen as a non-monetary incentive scheme playing positively on employees' intrinsic motivation. These intrinsically motivated employees would increase their voluntary effort.

Of course, the explanation, in terms of non-monetary incentive, is not exclusive. Another one in terms of organizational resource is possible. This organizational resource is part of the production function in the same way as the physical resource, and has a positive role in productive efficiency (Black and Lynch 2002, 2006; Capelli and Neumark, 1999; Bailey et al. 2001) and the employees' level of effort. But what is an organizational resource? It is the ability of the organization to mobilize skilled workers' knowledge in order to support the process of necessary change to improve work conditions. In other words, it corresponds to the organizational structures to promote new practices in human resource management (HRM), and would cover techniques allowing, for example, more autonomy at work, shortened hierarchical lines, team work (autonomous teams with cross disciplinary groups, or problem-solving groups), with total focus on quality and just in time production.

Referring to Prescott and Vissher (1980), the firm's knowledge of its employees allows for improvements in three dimensions. First, this knowledge should lead to a better match between employees and occupations. Second, it should improve the match between employees and teams. Third, knowing its employees competencies allows the firm to improve training and human capital embedded employees. Improving the match

between employees, occupations and work groups eventually increases the employees' effort within the firm.

The above analysis seems to indicate a positive relationship between good working environment and productive improvement. This relationship can be part of a more general perspective, based on the discussions held in the context of the economics of happiness. The latter can be defined broadly as a theory that strives to observe and analyze the determinants (economic and other) of subjective well-being or, in other words, happiness. Its study focuses on the analysis of the causes and consequences of happiness. Its primary objective is the search for correlations between "declared" satisfaction or "subjective well-being" and other aspects (income, living conditions, etc.). Its development can lead to a discussion on the criteria and indicators of employment quality (Layard, 2004, Frey and Stutzer, 2002).

However, this positive relationship has not always been proven. Indeed, it is possible that a good work environment is accompanied by a production efficiency decrease of employees. This is particularly the case when there are opportunities of collusion between employees. Developed within the framework of the tournament model, the problems of collusion are based on the idea that if the bonuses depend only on relative performance, then the expected profits of each individual are the same whether they shirk or work hard. In this context, shirking workers are saving effort and represent a tantalizing possibility (Milgrom and Roberts, 1992; Harbring and Irlenbusch, 2008). This approach is supported by workers who sustain a high effort cost (physical or psychological) and allows a system of confidence that attracts the worst workers.

Collusion problems provide a first theoretical explanation of the negative relationship between good working environment and productive efficiency. Another explanation could come from so-called selections effects. Indeed, it is possible that employees who are working in a good environment are in fact with companies that implement new management practices. In this context, the good working environment perceived by employees results from the implementation of the new work organization. However, as shown in the economic literature on organizational change, the spread of such practices does not necessarily improve the level of effort of employees. The reason is that the practices based on increase of responsibility for workers, greater versatility and both more qualified and qualifying work are associated with increased stress and work intensification (Paoli and Merlie, 2001). This means greater difficulty in achieving the same workload in an environment where the work content becomes more complex. These practices are directly correlated to the occurrence of stress (Kompier and Levy, 1994, Dhondt,

1997) and musculoskeletal disorders (MSD), and an increase in accidents (Askenazy and Caroli, 2010).

Finally, if we recognize that the good working environment can positively affect the employee's level of effort, particularly through its influence on intrinsic motivation, we cannot leave out the idea that this same environment can reduce productivity. Our goal is then to empirically examine this relationship. We do so based on the Computerization and Organizational Change (COI 2006) survey. Its advantage is that we can just use the data at employee and firm level. The originality of this work is that the work environment, as well as the level of effort, are assessed at the employee level, but by controlling business characteristics and of course employee characteristics. There is a distinction between productive effort and cognitive effort (Diaye et al., 2007). The first is the level of effort as we usually understand, it is the disutility of effort. The second is the measure of job involvement. This can be an important distinction, since cognitive effort has an impact on productive efficiency, so we can observe both a constant productive effort and increase in productive efficiency of the firm if there is an improvement of the cognitive effort of employees.

This paper is organized in the following manner. In section two, we present the empirical approach. The third section is committed to the econometric method and the estimation of results, while section four concludes.

2. THE EMPIRICAL APPROACH

2.1. Data and variables

The data used come from the 2006 COI survey, which is an employer/employees survey of organizational and computerization changes. It was conducted in 2006 by several institutions including the EEC, DARES, DGAFP the DREES and INSEE[1]. The characteristic of this survey is the coupling of questions to the employer as well as a small samples of employees (two or three) randomly selected in companies. This survey was conducted with a sample of employees related to companies using a double

[1] The conception and coordination of the COI survey has been directed by the Centre d'Etudes de l'Emploi. The survey has been carried out in a consortium involving the French Ministry of Labour (DARES), the Ministry of Industry (SESSI), the Ministry of Agriculture (SCEES) and the National Institute of Statistics and Economic Studies (INSEE). For a detailed description of the survey, see www.enquetecoi.net.

sampling in the Annual Survey of Companies and in the Annual Statements of Corporate Data. It refers to companies with ten employees or more in market sectors (including financial and insurance services). The employer side of the survey seeks to identify how the companies mobilize management tools, organizational forms and their recent changes, and technical tools, especially ICT. Data collection from employees provides additional information on the work organization and their use of ICT. In addition, the employee side provides information on the conditions and the pace of work, and the integration of employees in teamwork, acquisition and use of skills and wage compensation. In total there are 12 984 employees in our sample.

2.1.1. The Treatment variable

To assess the work environment quality, we choose the following two questions:

- Question 1: "How do you find the overall atmosphere in your company: rather good, (2) relatively bad, (3) neither good nor bad. "
- Question 2: "How do you find the working atmosphere with your colleagues: rather good, (2) relatively bad, (3) neither good nor bad. "

Table 1: Distribution of work environment quality

	Firm environment		**Colleagues environment**	
	Frequency	**Percent**	**Frequency**	**Percent**
Good	7 397	56.97	10 422	80.27
Neither good nor bad	3 927	30.24	2 025	15.60
Bad	1 660	12.78	537	4.14
Total	12 984	100.00	12 984	100.00

From these two questions we create two binary variables: one considering only the "general atmosphere in the company" (first question) that takes the value 0 if the answer is "bad environment or neither good nor bad "and the value 1 otherwise; another variable considering only the "colleague environment "(second question). These two variables are then added together to give a score ranging from 0 to 2.

The treatment variable "quality of the work environment" is then built as follows. It is 0 if the score is 0 or 1, and is 1 if the score is 2. If the value of this variable is 1, this means that the employee works in a good environment.

Table 2: Distribution of work environment quality

	Frequency	**Percent**
Good	7 021	54.07
Not good (Bad)	5 963	45.96
Total	12 984	100.00

In other words, we assume that there is a good quality of work environment if there is both a pleasant environment and a good atmosphere between colleagues. Otherwise, it is not of good quality. To explain this reasoning, we believe that when there is a good working environment there is rarely a bad atmosphere between colleagues (see Table 3). But the opposite can be true.

Table 3: Cross tabulation, firm working environment and colleagues environment

	Colleagues environment						**Total**
Firm environment	**Good**		**Neither good nor bad**		**Bad**		
	Frequency	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**	
Good	7 021	67.37	309	15.26	67	12.48	7 397
Neither good nor bad	2 386	22.89	1 447	71.46	94	17.50	3 927
Bad	1 015	9.74	269	13.28	376	70.02	1 660
Total	10 422	100.00	2 025	100.00	537	100.00	12 984

2.1.2. Variables of productive and cognitive effort

There is a distinction between productive effort and cognitive effort. The productive effort is built from the answer to the two following questions:

- Question 1: "Working beyond regular hours: (1) frequently, (2) occasionally, (3) never".
- Question 2: "Compensation in money or days off: (1) yes, (2) no".

We identified five different levels of effort: a very high level if the employee frequently works beyond the regular hours without compensation, a high level if the employee works occasionally beyond the regular hours without receiving compensation, a medium level if the employee works frequently beyond the regular hours and receives compensation, a low level if the employee works occasionally beyond the regular hours and receive compensation, level zero if the employee does not work beyond the regular hours.

Table 4: Distribution of productive effort

		Frequency	**Percent**
Nil	0	3 686	28.39
Low	1	3 927	30.24
Medium	2	2 076	15.99
High	3	1 333	10.42
Very High	4	1 419	10.93
Total		12 984	100.00

Regarding the level of cognitive effort or, more precisely the degree of implication into collective knowledge building about the production 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 work station, the production process, the machines...?" (response is either "yes" or "no").

Table 5: Distribution of cognitive effort

		Frequency	**Percent**
No	0	6 089	46.90
Yes	1	6 895	53.10
Total		12 984	100.00

2.1.3. Others variables

For research purposes, we also retain standard individual variables such as age and gender, to the extent that these characteristics can be correlated with activity behavior and the perception of the quality of the work environment. The richness of the COI survey also allows us to estimate firm variables: firm size, business sector and organizational practices. We also use job characteristics such as seniority in the current firm and level of education. These variables, which affect the level of job satisfaction, are also likely to affect the effort of the employee.

2.2. Descriptive analysis

Table 6 shows some socio-demographic characteristics using the environment quality variable. We notice that there are more men than women among the employees reporting working in a bad environment. The proportion of women, among all employees, reporting working in a bad environment (approximately 38.7%) is higher than that of women reporting working in a good environment.

Figure 1 shows the distribution of employees' productive effort according to the quality of working environment perceived. In general, we observe that employees who work in a good environment provide less productive effort than those who do not. For example, those employees at a "very high" level of effort represent about 12% in companies with bad environment against 10% in those with a good environment.

Figure 1: Distribution of productive effort according to the environment quality

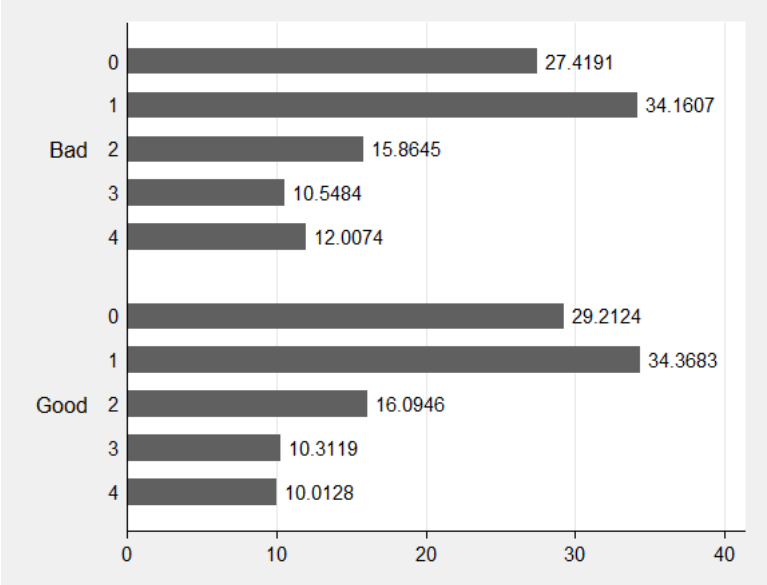


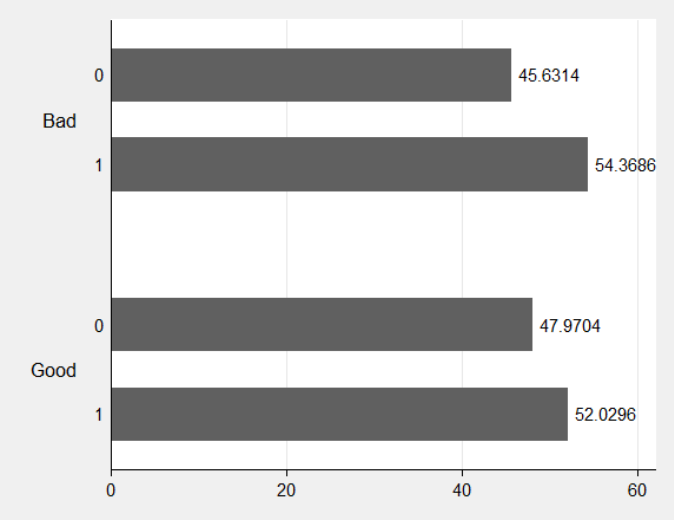
Table 6: employee's characteristics according to the quality of work environment

Socio-demographic characteristics of the employee		**Not good (Bad)**	**Good**
Gender			
	Women	38.77[a]	35.79
Age			
	[16-24]	4.06	6.00
	[25-39]	44.66	44.40
	[40-49]	30.22	30.61
	49 +	21.06	19.00
Seniority in the current firm			
	[1-2 years]	12.16	12.18
	[3-6]	38.72	35.84
	[7-10]	17.88	17.49
	10 +	31.24	34.50
Level of education			
	Below A level or below NVQ level 3	9.83	12.79
	Youth training (NVQ levels 1, 2)	25.07	27.63
	A level or NVQ level 3	15.58	15.10
	Above A level or above NVQ level 3	49.52	44.48
Professional type			
	Executives	13.43	16.95
	Middle Management	24.60	25.77
	Clerk	19.15	18.79
	Skilled blue collar	42.81	38.50
General characteristics of the firm			
Firm size			
	[0-99]	28.01	34.00
	[100-499]	23.73	21.79
	[500-999]	18.83	17.12
	1000 +	29.43	27.09
Business sector			
	Agrifood	7.28	6.41
	Consumption goods	2.23	1.97
	Cars	3.84	3.33
	Equipment goods	9.73	7.39
	Intermediate goods	21.52	17.06
	Power	0.69	1.04
	Construction	5.38	7.43
	Sales and reparation	15.86	19.36
	Transport	6.71	7.96
	Finance	6.07	6.08
	Real estate	2.67	3.23
	Service for firms	14.56	14.50
	Service for individuals	3.47	4.23
Organizational devices			
	ISO 9001, ISO 9002, or EAQF certification	60.71	55.42
	ISO 14001	28.86	26.29
	Value analysis , Functional analysis, or FMEA method	41.62	35.72
	Independent work groups or teams	51.55	49.42
	System of Just in time production	53.46	47.51
Number of observations		**5 963**	**7 021**

Note: (a) 38.77 % of employees who declare working in a bad environment are women.

Regarding the change in cognitive effort depending on the quality of the work environment (Figure 2), we note that the same proportion of employees who provide cognitive effort is higher in firms with a bad working environment. For example, 54.37% of employees who say they work in a bad environment provide a cognitive effort, against 52.03% for those who reported working in a good environment.

Figure 2: Distribution of cognitive effort by the quality of the environment



Finally, it seems that the effort (productive or cognitive) is less when the employee reports working in a good environment. This observation, purely descriptive, seems to indicate a negative relationship between the working environment quality and the effort.

3. THE ECONOMETRIC METHOD AND ITS RESULTS

3.1. The econometric method

We want to estimate the effect of the work environment, which we will now call treatment variable, on both types of stress previously defined. The treatment variable is binary and allows two groups of sample: those who have treatment and those who do not. The treatment variable is for an employee working in a good environment.

A simple way to estimate the effect of this treatment on the employees' stress level is to calculate a difference in the averages for the two groups of employees. That means we calculate the average level of effort for each group and we do an equality test. If the effort level is significantly higher in the group of employees who work in a good environment (in the statistical sense) than the effort level in the group of employees who work in a bad environment, then we can say that the good working environment has a (positive) impact on the employees' effort.

The resulting estimator is however seen as naive because it does not take into account the effects of selection. What is that? For example, suppose that there is a difference of stress level between the employees working in a good environment and those who do not, we cannot be sure that this difference in effort level is due to the quality of the environment. It is possible that the difference is due to the fact that the employees of both groups are not alike. The bias in the estimates caused by such phenomena is called selection bias. We use the matching method with Kernel Matching Function to control selection bias. This method is described in Appendix 2. The general idea is to build a group of untreated individuals (control group) comparable to individuals of the treated group, to allow an unbiased estimate of the effect of treatment on the treated individuals, correcting for bias selection.

The propensity score matching method involves two steps. First, the propensity score is estimated using a logistic model (see Appendix 3). Second, we attribute to each treated employee untreated employees by assigning an inversely proportional weight to their "distance" with the treated employee. Once we get the two similar groups, the estimated coefficient is determined by the average causal effect from treated employees. This quantity, known as ATT (Average Treatment Effect on the Treated) is defined as the mathematical expectation of the conditional causal treatment. The standard deviations are then calculated by bootstrap.

3.2. Results

The complete results of the estimates are given below in table 7.

Table 7: Estimated effect of working in a good environment on effort

	Treated	**Controls**	**Average difference**
Productive effort			
Naive	1.375	1.455	-0.080*** (0.022)
ATT	1.374	1.569	-0.157*** (0.035)
Cognitive effort			
Naive	0.520	0.543	-0.023*** (0.008)
ATT	0.519	0.530	-0.010 (0.013)

The standard deviation of the treatment effect is in parenthesis. It is computed using bootstrap with 999 simulations.
***, **, * : significant respectively at 1%, 5% and 10%.

First, we notice that employees who report working in a good environment have a lower average productive effort level (about 12%) than those who report working in a bad environment. However, we do not notice any significant difference regarding the cognitive effort. We get the following result 1.

Result 1. Good working environment has a negative impact on employees' productive effort but has no impact on cognitive effort.

Moreover, the estimates obtained before and after matching by propensity score are different, which shows the existence of an important bias selection. This is shown in result 2.

Result 2. The effects of selection weaken the real impact of good environment on the employees' productive effort.

In conclusion of this analysis, it appears that there is a negative correlation between productive effort and good working environment, and there is no link with cognitive effort. In the introduction we gave two main ideas that may explain the link between negative working environment and productive effort. The first refers to the fact that the good working environment may facilitate an explicit or tacit collusion (via correlated equilibrium) between certain employees and their level of productive effort, and also encourage behavior in which good employees cover for the less productive. The second refers to selection effects. The idea in this case is that employees who perceive a good working environment are often concentrated in firms that have implemented new organizational practices. However, some of these practices may by increasing stress and workload negatively affect the productive efficiency of employees. They could be the cause of a decrease of effort quality more than the working environment quality.

The second seems less plausible because, if so, then we would expect a positive impact of these practices on both the work environment and the level of effort. However, this is not the case since out of the five organizational practices that we consider, three (ISO 9001 certification, value analysis, just in time) reduce the likelihood of an employee working in a good environment (see table 10 in appendix 3). For the other two organizational practices positively correlated to a good working environment, one (Independent work groups or teams) has a positive influence on the productive effort of employees and the other (ISO 14001 certification) has a negative influence (see table 13 in appendix 5).

4. CONCLUSION

The topic of employment quality has been the subject of growing interest since the late' 90s. The idea behind the development of this concept is that jobs of "better" quality can have an impact on the employment perception of individuals and therefore influence their activity behavior. In this context, we focus on studying the effect of the work environment quality on employee effort. In particular, we try to examine pragmatically the effect of a good work environment on employee effort level. We use the data from the Organizational Change and Computerization (COI, 2006) survey because it allows us to use employee data coupled with those of companies. The originality of this work is that employee work environment is assessed at the same level as effort, but by controlling the employees' and companies' characteristics. We can sometimes see a distinction between productive effort and cognitive effort. The first is the effort level, as we usually understand it, entering the disutility function of effort. The second measures job involvement. This distinction may be important since cognitive effort has an impact on productive efficiency. We can observe both a productive effort and constant increase of productive efficiency of the firm if there is an improvement of the employees' cognitive effort. We used the matching by propensity score method.

Our main result shows a negative correlation between a good work environment and employees' productive effort, and no connection with cognitive effort.

However, our study is limited on one hand by the method used to construct our treatment variable "quality of the work environment" and on the other,

by the pragmatic approach used. Indeed, we have only considered two aspects to define work environment, the general atmosphere in the firm and the atmosphere between colleagues. We could, as suggested by some studies on work psychology, take into consideration interpersonal relationships, including social interaction among employees. Also, to monitor the effects of selection, we use an econometric method and not a parametric one, which has a different approach.

To resume, our results emphasize that a good work environment does not necessarily mean better economic efficiency.

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Appendix 1: Robust analysis with other variable processes

Reminder of the two main questions:

- Question 1: "How do you find the overall atmosphere in your company: rather good, (2) relatively bad, (3) neither good nor bad. "
- Question 2: "How do you find the working atmosphere with your colleagues: rather good, (2) relatively bad, (3) neither good nor bad. "

We build four other variable processes using a two-step process. First, we divide each question in order to create binary variables. Two divisions are possible. The first is to assign a score of 1 "if the quality is rather good" and a score of 0 otherwise. The second gives a score of 1 to "a quality rather good and neither good nor bad" and 0 to "quality relatively bad." In the end, we get four treatment variables whose distribution is given in table 8.

Table 8: Distribution of treatment variable

	Division 1				**Division 2**			
	Treatment 1		**Treatment 2**		**Treatment 3**		**Treatment4**	
	Firm environment		**Colleagues environment**		**Firm environment**		**Colleagues environment**	
	Frequency	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**
0	5 587	43.03	2 562	19.73	1 660	12.78	537	4.14
1	7 397	56.97	10 422	80.27	11 324	87.22	12 447	95.86
Total	12 984	100.00	12 984	100.00	12 984	100.00	12 984	100.00

Table 9 represents the estimated effects of working in a good environment on effort. Overall it seems that the expected effects of the four estimates indicate the same feature, which is a very narrow correlation between effort and a good environment. The division does not seem to affect the results.

Table 9: Estimated effects of working in a good environment on effort

	Treatment 1	**Treatment 2**	**Treatment 3**	**Treatment 4**
Productive effort				
Naive estimator	-0.081****	0.065***	-0.147***	-0.024
ATT	-0.1120***	-0.068**	-0.198***	-0.153**
Cognitive effort				
Naive estimator	-0.021***	0.041***	-0.054***	-0.003
ATT	0.0006	0.010	-0.045***	-0.020

***, **, * : significant respectively at 1%, 5% and 10%.

Appendix 2: Matching method by propensity score

Our goal is to measure the effect of the environment quality on the employees' effort. We recall that the idea is to compare the effects of a good working environment on the level of effort of two groups of employees, all things being equal. One, working in a good environment and the other in a bad environment. Thus, $Di = 1$ for employees working in a good working environment and $Di = 0$ for employees not working in a good working environment. Yi is the variable of interest, in our case, the employees' effort. The effect of treatment, which is a good working environment, on the interest variable is equal to:

$$\Delta_i = Y_{i1} - Y_{i0} \quad (1)$$

As it is impossible to observe the same person in both situations, we measure the average treatment effect on the treated population (in our case it is the population of employees working in a good environment) and we note:

$$\Delta_{ATT} = E(Y_{i1}|D_i = 1) - E(Y_{i0}|D_i = 1) \quad (2)$$

The second part of the equality (2) can't be observed. By adding and subtracting in the second part of the above equation, we get:

$$E(Y_{i1}|D_i = 1) - E(Y_{i0}|D_i = 0) + E(Y_{i0}|D_i = 1) - E(Y_{i0}|D_i = 1) = (Y_{i1} - Y_{i0}|D_i = 1) + E(Y_{i0}|D_i = 1) - E(Y_{i0}|D_i = 0) \quad (3)$$

The first expression $E(Y_{i1} - Y_{i0}|D_i = 1)$ is the effect of the good environment that we are trying to isolate, the effect of good environment on the employees' level of effort. The difference $E(Y_{i0}|D_i = 1)$ - $E(Y_{i0}|D_i = 0)$ corresponds to bias selection. We only get the real value of the treatment impact when bias selection equals zero, that is to say when:

$$E(Y_{i0}|D_i = 1) = E(Y_{i0}|D_i = 0) \quad (4)$$

This equality is valid only if Y_i and D_i are independents. Econometrically, this means that the treatment variable is independent of the outcome variable. The treatment is then considered to be randomly distributed conditionally on the matrix of observable characteristics X.

$$Y_{i1}, Y_{i0} \perp\!\!\!\perp D \mid X, \forall X \quad (5)$$

We can write the following:

$$E(Y_{i1}|X, D = 1) - E(Y_{i0}|X, D = 1) =$$

$$E_{(x|D=1)}\{E(Y_i \mid X, D = 1) - E(Y_i|X, D = 0)\} \quad (6)$$

When the number of characteristics is high, it is difficult to make a match on all of them. One solution would be to make a match on the propensity score $\pi(x)$, and not on all X. The latter corresponds to the probability that a person with characteristic X, to be assigned to the treatment : $\pi(x) = Pr(D = 1|X)$. We can then write:

$$Y_{i1}, Y_{i0} \perp\!\!\!\perp D \mid \pi(x), \forall X \quad (7)$$

The matching can then be written:

$$\Delta_{ATT} = E_{(x|D=1)}\{E(Y_i|D = 1, P(X)) - E(Y_i|D = 0, P(X))\} \quad (8)$$

However, it is essential that there is a common interval to both propensity score distribution between the two groups. In other terms, the following condition of common support must be met:

$$0 < Pr(D = 1|X) < 1 \quad (9)$$

In summary, the goal of the matching method is to create a control group comparable to the treated group to allow an unbiased estimate of the treatment effect on the treated, by correcting for bias selection. The propensity score matching method is in two steps. After estimating the propensity score using a logistic model (logistic regression results are found in appendix 3), we proceed to an estimation by matching. There are several methods. We retain the one with the Kernel Matching function. This estimation method was developed by Hackman, Ichimura and Todd (1998). It consists of holding for each treated employee all the untreated employees, but by assigning an inversely proportional value to their "distance" with the employee treated. The simplest of these estimators can be written:

$$E[\,Y_0|\,P(x)\;=\;p(x_i)]\;=\;\frac{1}{N_0}\;\sum_{j\epsilon I_0}\frac{K\left(\frac{\left(P(x_j)\;-\;P(x_i)\right)}{h}\right)}{\sum_{j\epsilon I_0}K\left(\frac{P(x_j)\;-\;P(x_i)}{h}\right)}\quad Y_j\quad (10)$$

I_0 is the set of untreated people defined $I_0 = \{i|D_i = 0\}$, I_1 is the set of treated people, N_0 is the number of untreated people, N_1 is the number of treated people, K is a Kernel Function, continuously differentiable, symmetric with respect to 0 and such as: $\int_{+\infty}^{-\infty} K(u)du = 1$, and h is the estimation window (bandwidth function). The average treatment effect estimator on treated employees is then given by:

$$\Delta_{ATT}\;=\;\frac{1}{N_1}\sum_{i\epsilon I_1}\{\,Y_i\;-\;\sum_{j\epsilon I_0}\frac{K\left(\frac{\left(P(x_j)\;-\;P(x_i)\right)}{h}\right)}{\sum_{j\epsilon I_0}K\left(\frac{P(x_j)\;-\;P(x_i)}{h}\right)}\quad Y_j\,\}\quad (11)$$

Since we assume that the conditional independence is important, we must check that it is respected. This test is called Balancing Property test. We apply Dehejia and Wahba tests (2002). The variables used in determining the propensity score are, in theory, the variables that best explain the treatment variable. In practice (and this is what we do), the included variables are chosen in a way to respect the Balancing Property (see Appendix 4).

Appendix 3: Probability of working in a good working environment

Table 10: *Logit* model of the probability of working in a good environment

Socio-demographic characteristics of the employee		**Estimate**	**St. Dev**
Gender			
	women	-0.138***	0.041
Age			
	[16-24]	Ref	
	[25-39]	-0.284**	0.090
	[40-49]	-0.211**	0.097
	49 +	-0.336***	0.103
Seniority in the current firm			
	[1-2 years]	Ref	
	[3-6]	-0.100	0.065
	[7-10]	-0.190***	0.073
	10 +	-0.252***	0.068
Level of education			
	Below A level or below NVQ level 3	Ref	
	Youth training (NVQ levels 1, 2)	-0.147***	0.060
	A level or NVQ level 3	-0.150	0.071
	Above A level or above NVQ level 3	-0.125**	0.073
Professional type			
	Executives	Ref	
	Middle Management	-0.191***	0.061
	Clerk	-0.374***	0.071
	Skilled blue collar	-0.403***	0.068
General Characteristics of the firm			
Firm size			
	[0-99]	0.205***	0.056
	[100-499]	0.018	0.056
	[500-999]	Ref	
	1000 +	0.004	0.04
Business sector			
	Agrifood	0.164	0.142
	Consumption goods	Ref	
	Cars	0.142	0.159
	Equipment goods	-0.018	0.140
	Intermediate goods	-0.003*	0.131
	Power	0.570***	0.235
	Construction	0.413***	0.145
	Sales and reparation	0.318***	0.131
	Transport	0.323***	0.140
	Finance	0.142	0.145
	Real estate	0.277*	0.162
	Service for firms	0.079	0.133
	Service for individuals	0.256	0.155
Organizational devices			
	ISO 9001, ISO9002, or EAQF certification	-0.105***	0.043
	ISO 14001	0.085**	0.047
	Value analysis, functional analysis, or FMEA method	-0.115***	0.046
	Independent work groups or teams	0.077**	0.041
	System of Just in time production	-0.098***	0.041
Intercept		0.0899***	0.182
Pseudo R2	0.0164		
LR chi2	294.37		

Ref= reference

***, **, * : significant respectively at 1%, 5% and 10%.

Appendix 4: Balancing test property

Table 11: T-test results and standardized differences

		T-test	Stand. Diff.
Socio-demographic characteristics of the employee			
Gender			
	women	Ns	<20
Age			
	[16-24]	Ref	
	[25-39]	Ns	<20
	[40-49]	Ns	<20
	49 +	Ns	<20
Seniority in the current firm			
	[1-2 years]	Ref	
	[3-6]	Ns	<20
	[7-10]	Ns	<20
	10 +	***	<20
Level of education			
	Below A level or below NVQ level 3	Ref	
	Youth training (NVQ levels 1, 2)	Ns	<20
	A level or NVQ level 3	Ns	<20
	Above A level or above NVQ level 3	Ns	<20
Professional type			
	Executives	Ref	
	Middle Management	*	<20
	Clerk	*	<20
	Skilled blue collar	***	<20
General Characteristics of the firm			
Firm size			<20
	[0-99]	***	<20
	[100-499]	***	<20
	[500-999]	Ref	
	1000 +	***	<20
Business sector			
	Agrifood	***	<20
	Consumption goods	Ref	
	Cars	Ns	<20
	Equipment goods	Ns	<20
	Intermediate goods	Ns	<20
	Power	Ns	<20
	Construction	Ns	<20
	Sales and reparation	***	<20
	Transport	***	<20
	Finance	Ns	<20
	Real estate	***	<20
	Service for firms	Ns	<20
	Service for individuals	***	<20
Organizational devices			
	ISO 9001, ISO9002, or EAQF certification	***	<20
	ISO 14001	***	<20
	Value analysis , Functional analysis, or FMEA method	Ns	<20
	Independent work groups or teams	***	<20
	System of Just in time production	***	<20

Ns : Not significant.
***, **, * : significant respectively at 1%, 5% and 10%.

Appendix 5: Logistic Regression of productive effort

We recall that our productive effort variable has five categories: 0 for no effort level, 1 for a low effort level, 2 for a medium effort level, 3 for a significant effort level and 4 for effort at a very high level. From this method, we create a new dichotomous effort variable which we call "Variable 2", whose value is 1 if the effort level is medium, or very high and 0 otherwise.

Table 12: Distribution of the new productive effort variable

Productive effort	**Variable 2**	**Frequency**	**Percent**
Nil Low	0	8 136	62.66
Medium High Very high	1	4 848	37.34
Total		12 984	100.00

We then regress this effort variable relative to organizational practices. The following table shows the results of the *logit* models.

Table 13: *Logit* modeling of productive effort

Organization practice	**Estimate**	**St. Dev**
ISO 9001, ISO 9002 or EAQF certification	-0.028	0.042
ISO 14001	-0.085*	0.068
Value analysis, Functional analysis or FMEA method	0.067	0.045
Independent work groups or teams	0.122***	0.041
System of Just in time production	-0.171***	0.040
Intercept	-0.507***	0.031
Pseudo R2 LR chi2	0.0019 32.87	

***, **, * : significant respectively at 1%, 5% and 10%.