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Estimating the Effect and Economic Impact of Absenteeism, Presenteeism, and Work Environment–Related Problems on Reductions in Productivity from a Managerial Perspective

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ABSTRACT

Objectives: The aim of this study was to propose wage multipliers that can be used to estimate the costs of productivity loss for employers in economic evaluations, using detailed information from managers. **Methods:** Data were collected in a survey panel of 758 managers from different sectors of the labor market. Based on assumed scenarios of a period of absenteeism due to sickness, presenteeism and work environment–related problem episodes, and specified job characteristics (i.e., explanatory variables), managers assessed their impact on group productivity and cost (i.e., the dependent variable). In an ordered probit model, the extent of productivity loss resulting from job characteristics is predicted. The predicted values are used to derive wage multipliers based on the cost of productivity estimates provided by the managers. **Results:** The results indicate that job characteristics (i.e., degree of time sensitivity of output, teamwork, or difficulty in replacing a worker) are linked to productivity loss as a result of health-related and work environment–related problems. The impact of impaired performance on productivity differs among various occupations. The mean wage multiplier is 1.97 for absenteeism, 1.70 for acute presenteeism, 1.54 for chronic presenteeism, and 1.72 for problems related to the work environment. This implies that the costs of health-related and work environment–related problems to organizations can exceed the worker's wage. **Conclusions:** The use of wage multipliers is recommended for calculating the cost of health-related and work environment–related productivity loss to properly account for actual costs.
Keywords: costs of absenteeism, job characteristics, presenteeism, productivity, wage multipliers, work environment.

Introduction

Reduced work performance, which can be a consequence of absenteeism or presenteeism (i.e., at work despite being sick), can contribute substantially to productivity costs for employers [1]. The economic impact of reduced performance as a result of absenteeism is relatively simple to estimate unlike that of presenteeism. Productivity losses resulting from presenteeism have been shown to be significantly higher than such losses resulting from absenteeism [2], yet these costs are not recognized by employers. As yet, there is no general reference that employers can use to measure or monetize the impact of impaired performance on their organization's productivity [3].

In previous research, productivity loss has been estimated by counting the number of days individuals are absent and the amount of reduction in performance as a result of health-related problems [4]. This reduction is then multiplied by a relevant value of production per time unit (e.g., hours), translated into productivity costs by using the minimum wage rate [3]. It has been suggested that productivity losses are underestimated when the minimum wage is used because of discrepancies between wage and marginal productivity [5,6]. This implies that the value of the worker's contribution is generally higher than the wage. However, this depends on, for example, whether it is possible to postpone the deadline without economic consequences and how easy it is to make substitutions, if needed. Another argument for productivity costs being underestimated when wages are used has been that a reduction in worker performance affects the performance not only of the specific worker in question but also of coworkers. These job-specific factors could make the value of productivity costs to employers significantly higher than the cost of wages. To deal with this challenge in estimating the cost of lost productivity and to show its relevance for the employer [7], the impact of certain job-specific characteristics, particularly the extent of loss in teamwork, has been studied in a number of occupations [5,8]. The cited studies have

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generated hypotheses about the impact of absenteeism and presenteeism on the degree of reduction in performance. Accordingly, Pauly et al. [5] have suggested the use of wage multipliers based on job-specific contexts to estimate actual productivity loss from the employer's perspective. The multiplier is the cost in excess of the wage caused by a reduction of the affected worker's performance resulting from absenteeism or presenteeism [5,8].

Productivity loss is not only a consequence of absenteeism or presenteeism, but it has also been shown that work environment–related problems are associated with productivity loss, and thus these problems need to be taken into account to estimate the total cost of productivity loss [9,10]. Earlier research has shown that work environment–related problems may not always be as prevalent as those related to presenteeism but that they have a greater impact on productivity compared with problems related to presenteeism [10]. As in the case of absenteeism and presenteeism, there is reason to believe that the cost of lost productivity resulting from work environment–related problems may be higher than the cost of wages. Therefore, wage multipliers that take into consideration the effect of work environment–related problems on the total cost of lost productivity can be of value. Findings from previous research on the cost of productivity loss are largely generalizable only to study-specific contexts (with differing economic systems, including the labor market and insurance regulations). It is therefore desirable to identify wage multipliers that can be applied to a variety of settings.

The aim of this study was to establish wage multipliers that can be used to estimate the costs of productivity loss for employers in economic evaluations by using detailed information from managers. The present study replicates and further advances discussions about the cost of impaired performance by raising the issue of problems related to the work environment in the labor market. To establish multipliers, the first step is to examine the effect of job characteristics on group productivity in relation to health and work environment–related problems.

Theoretical Framework

Production Model

According to economic theory, *productivity* is assessed as output, which is a function of capital and labor input. *Productivity loss* is associated with reduced labor input as a result of absenteeism and presenteeism [11]. To clarify, *absenteeism* refers to a short period of absence from work because of ill-health. *Presenteeism* refers to attending work despite illness (i.e., acute or chronic) which would normally justify absence. *Work environment–related productivity loss*, which is introduced into the model later, refers to any physical, psychological, or social problems that might arise in the work environment and impair work performance.

Let us assume that there is a competitive market where labor can be contracted for a wage in return for the output produced [5]. Let us also assume that different jobs require workers to carry out different tasks such that the output of organization *i* would be different from that of organization *j*. Let us adopt a production function similar to Pauly et al. [5], where organizations can combine capital (K) and labor (L) to produce output Q (K, L). Capital is held constant across organizations. Further, assume that if the available labor (L) is greater or equal to the labor requirement (L'), such that $L > L'$, then $Q > 0$ [5]. Suppose also that different jobs have different labor requirements. This implies that wages (W) in jobs with $L' = 1$ will be equal to the marginal product value of labor added by the work of that single person in the job, which is W(1).

At the same time, any job-specific characteristics, such as the amount of teamwork, the ease of substitution of workers, and time sensitivity of output, can implicitly affect how much productivity loss incurred by an organization [5].

Teamwork

Suppose that output is dependent on the extent of teamwork, then the labor requirement would be greater than unity, or $L' > 1$ such that $L \geq L'$ to achieve $Q > 0$. Thus, a reduction of labor by one unit below L', will immediately reduce the output to zero. Put simply, if one unit of output requires $L' = 2$, but instead, $L < 2$, then $Q = 0$. Thus, if the organization experiences health-related or work environment–related problems, productivity loss is expected to increase by the extent of team production.

Ease of Substitution of Workers

Suppose also that a worker was absent for a number of days because of illness, implying that $L < L'$ labor, then the marginal product of the team $Q' = 0$. If substitution is possible but imperfect, the marginal product of the team will be the difference between regular team production levels and the lower team production levels with a replacement. If the employer should find a replacement of similar quality for the absent worker (i.e., ease of substitution) then $L \geq L'$, and $Q > 0$. Hence, the health-related or work environment–related productivity loss is expected to increase in proportion to how difficult it is to replace a worker.

Time Sensitivity of Output

Time sensitivity of the organization's output relates to the entire production process and what consequences may be incurred should part of the process be postponed. Accordingly, it is assumed that output revenue is highest in a situation where the output is not delayed. The revenue falls when production is postponed to another period. The marginal effect of time sensitivity of output is the difference between the value of the period in which there are no delays in production and the period in which production is delayed. Thus, if the organization experiences health-related or work environment–related problems, productivity loss is expected to increase if the output is time sensitive.

Wage Multipliers

As a function of job-specific characteristics (i.e., the extent of teamwork [TW], the ease of substitution of workers [S] and time sensitivity [TS] of output), the wage multiplier can be generalized as, $m(W) = 1 + c$, where c represents the additional costs paid in excess of the wage (W) by a particular organization because of health-related or work environment–related problems. If one assumes that an organization hires a perfect substitute for an absent worker at the same wage, then the additional cost (c) paid in excess of the wage as a result of absenteeism is zero. In this case, the wage multiplier will be equal to 1. If it is difficult to find a perfect replacement for the absent worker at a wage (W), the multiplier may exceed unity, $m(W) = 1 + c$. For the multiplier to exceed unity, the absenteeism must cause one or a combination of the following: other team members will not be able to perform their work as expected; the organization will pay overtime to a coworker to cover the workload of the absent worker; and there will be delays in sales leading to losses.

Methods

Sample

The data used in this cross-sectional study were collected on two different occasions in 2014 and 2015. The first data collection was conducted 2014 among all managers (n = 24) in a small government agency. The response rate was 83%. A larger data collection was conducted in the spring of 2015 using an experienced market research company (TNS Sifo). To include a variety of job categories in the sample, 30 occupations with approximately 15 respondents in each category were targeted. A random sample of subjects who had previously identified themselves as managers (n = 3753), stratified by gender and region, was obtained from a larger survey panel. From this sample, 1721 managers responded to the survey (46 % response rate).

From the screening process in the questionnaire, only managers who fulfilled the following inclusion criteria were included: 1) managers in medium to large organizations; and 2) managers with operational responsibility for five to 50 employees. Managers in medium and large organizations were included and requested to report on as many workers with homogeneous job characteristics in teamwork. It was considered that at least five employees could constitute a team, but >50 employees were too many for a manager to properly assess their productivity because of less supervision contact with the employees.

In the second sample, 738 managers answered the questionnaire. In all, the final study sample included 758 managers from a variety of occupations.

Questionnaire

The questions asked were related to job characteristics and the impact of absenteeism, presenteeism, and work environment–related problems on group productivity.

On job characteristics, managers assessed the extent to which the job in question was characterized by the following: time sensitivity of output; teamwork; ease of substitution of a worker in the case of unexpected (i.e., 3 days) absenteeism resulting from sickness. Ease of substitution of a worker with an acute or chronic health problem (presenteeism) or work environment–related problem was also reported. Response options ranged from 1 to 5 on a Likert scale, with "1" indicating that the employees work independently, that work can easily be postponed, or that it is easy for a manager to find a substitute of equal quality for a worker who is absent, present yet ill, or is affected by problems related to the work environment and "5" indicating that the employee's work is critical to the team, output is highly time sensitive, or worker substitution is difficult.

With regard to the impact of absenteeism, managers assessed the extent to which a short unexpected absence affected group productivity. The impact of presenteeism or work environment–related problems on group productivity was also assessed. Response options were on a 5-point Likert scale, with "1" indicating that the organization was not affected at all and "5" indicating a total shutdown.

Productivity loss is expressed as a percentage reduction of the affected worker's performance during a working day if she or he is at work despite suffering from acute or chronic health problems or work environment–related ones compared with a worker without any such problems. The response options for the productivity loss question range from 0 to 10, with "0" indicating that the worker's performance was completely reduced and "10" indicating that the worker's performance was not affected at all. The managers also reported costs per day to the organization in excess of the worker's wage for absenteeism, presenteeism (acute or chronic), and work environment–related problems. To improve the accuracy of responses, managers were allowed to report excess costs either in monetary terms or as a percentage of the hourly wage. They also provided information about employees' work tasks.

All of the questions except those about the work environment–related problems were used in the studies by Pauly et al. and Nicholson et al. [5,12]. The questionnaire was translated into Swedish by two bilingual experts, who used the Beaton et al. translation guidelines [13]. Experts familiar with the terminology suggested improvements, where necessary. The questionnaire was pretested, and some modifications were made. The final version of the questionnaire in Swedish was used in this study.

Statistical Analysis

Before the analysis was carried out, the job categories were cross-checked with the short task description provided by each manager. Adjustments to the job categories were made, where necessary, and agreed upon by three researchers. Wage multipliers were derived for absenteeism, for acute and chronic presenteeism, and for problems related to the work environment. Multiple steps were used to estimate the impact of these problems as a proportion of the worker's wage, in accordance with previous work by Nicholson et al. [12] and Pauly et al. [5].

Using an ordered probit regression, job-specific characteristics —TW, S, and TS—were regressed on the reported impact of absenteeism, presenteeism (acute and chronic), or work environment–related problems on group productivity. Separate regressions were made for each dependent variable such that:

$$\pi^{*}=\alpha+\beta_{1,j}TW+\beta_{2,j}S+\beta_{3,j}TS+\varepsilon_{i},\ j=1,2,3 \text{ and } i=1\ldots n \quad (1)$$

where α is the intercept and π^* is the latent variable. By checking the distribution of data for both dependent and independent variables, very few responses were on the tails of the Likert scales. Thus, the observations were recategorized as follows: responses "1" and "2" were grouped together, response "3" stayed the same, and responses "4" and "5" were grouped together. The new scale on the extent of productivity loss assessed was between 1 and 3.

A latent dependent variable π^* is predicted by a regression of the explanatory variables on the dependent variable to obtain a robust and reliable estimate of Y such that:

$$\begin{aligned}\pi &= 0 \text{ if } \pi^{*}\le 0\\ &= 1 \text{ if } 0\le \pi^{*}\le \mu_1\\ &= 2 \text{ if } \mu_1\le \pi^{*}\le \mu_2\\ &= 3 \text{ if } \mu_2\le \pi^{*}\le \mu_3\end{aligned}$$

where the μ's are unknown parameters to be estimated with β. The standard ordered probit model assumes that the error term ε has a normal distribution with zero mean and unit variance. In this study, the applied model utilized a robust error term that allowed for the relation of the assumption of unit variance. The coefficients, β, were then used to extract the mean predicted latent value π^* for each job category in the survey.

In the last step, the predicted value of the latent variable was linked to the reported cost in excess of the wage (Y) for each outcome respectively. Costs reported as monetary values were transformed into percentages by using the median salary data from Statistics Sweden. To adjust for the large standard deviation in the manager-reported costs for absenteeism, presenteeism, and work environment–related problems and to have the value of Y at least as large as the value of X, the latent variable π^* was rescaled in two ways. First, each manager's reported Y was set equal to X if Y < X, where X was the percentage reduction of the affected worker's performance as a result of acute or chronic presenteeism and work environment–related problems compared with another worker without such problems. Second, the 90th percentile value of the difference (X–Y) was added to Y. The rescaling enhances the robustness and reliability of the reported values of Y [5].

Results

Twenty-four job categories were identified in the sample, each with at least 10 managers with similar job descriptions. The largest groups (i.e., 46 observations each) were engineers and craftsmen (Table 1). Jobs for which <10 managers responded to the survey or managers who gave unclear job descriptions were combined to form "Group n <10" and "Other," respectively.

Table 2 presents sample statistics for job characteristics S, TS, and TW. About 55% of the managers responded that it would be relatively difficult to impossible to find a replacement of equal productivity for a worker who was absent from the group. This percentage was lower for presenteeism and work environment–related problems (i.e., 34% and 38%, respectively). The majority (67%) responded that jobs were characterized by high time sensitivity, which implied that it was relatively difficult or nearly impossible to postpone the work without serious consequences. Managers rated individuals as being moderately to highly important to group production in the majority of cases (68%), which implied that employees often worked in teams.

Table 1 – Sample statistics on type of occupations (n = 758).

Occupations	*n*	%
Engineers	46	6.07
Information technology workers	46	6.07
Carpenters, masons, construction workers, roofers	45	5.94
Doctors, registered nurses, pharmacists, dentists	44	5.80
Nurse's assistants and auxiliary nurses	44	5.80
Teachers (primary/secondary level)	38	5.01
Insurance brokers, salesmen, purchasers, and supply managers	34	4.49
Business administrators (private)	25	3.30
Workers in mass media, communications, public relations, and advertising	23	3.03
Shop assistants and cashiers	22	2.90
Administrators (public service)	22	2.90
Workers in heavy industry and manufacturing	20	2.64
Analysts and investigators	18	2.37
Transport workers, couriers	18	2.37
Janitors/real estate maintenance workers	17	2.24
Service and maintenance (machinery) workers	15	1.98
Chefs, Maître d'hôtel, waiters	14	1.85
Crop producers, livestock breeders, fishermen	14	1.85
Professors and researchers (tertiary level)	13	1.72
Priests, deacons, and pastors	13	1.72
Concrete casters, welders, and tinsmiths	12	1.58
Social service workers	12	1.58
Military staff	10	1.32
Child care workers	10	1.32
Other*	65	8.58
Groups, n <10	118	16
Total	758	100

* Noncategorizable observations.

Table 3 shows that a majority of the managers reported that absenteeism, acute or chronic presenteeism, and work environment–related problems had a moderate or major effect on group productivity.

The average costs incurred, in excess of the worker's wage, as a result of absenteeism, presenteeism, and work environment–related problems are shown in monetary terms and percentages in Table 4. The highest costs were for productivity loss as a result of absenteeism, followed by work environment–related problems and presenteeism.

Effects of Job Characteristics on Group Productivity

Table 5 presents the marginal effects of job characteristics on productivity loss resulting from absenteeism, presenteeism, and work environment problems. The results, in general, revealed significant marginal effects of increasing magnitude for the levels

Table 2 – Sample statistics of managers reporting the extent to which jobs are characterized by ease of substitution of worker, time sensitivity of output, and teamwork (N = 758).

	n	%
Ease of substitution – presenteeism		
1 = Easy to replace worker with maintained quality or production	35	4.6
2 = Relatively easy to replace worker	162	21.4
3 = Moderately easy to replace worker	301	39.7
4 = Relatively difficult to replace worker	222	29.3
5 = Impossible to replace worker	38	5.0
Total	758	100.0
Ease of substitution – absenteeism	*n*	%
1 = Easy to replace worker with maintained quality or production	21	2.8
2 = Relatively easy to replace worker	87	11.5
3 = Moderately easy to replace worker	233	30.7
4 = Relatively difficult to replace	332	43.8
5 = Impossible to replace worker	85	11.2
Total	758	100.0
Ease of substitution – work environment–related problems	*n*	%
1 = Easy to replace worker with maintained quality or production	49	6.5
2 = Relatively easy to replace worker	122	16.1
3 = Moderately easy to replace worker	281	37.1
4 = Relatively difficult to replace	239	31.5
5 = Impossible to replace worker	47	6.2
Do not know	20	2.6
Total	758	100.0
Time sensitivity of output	*n*	%
1 = Job has no time sensitivity	20	2.6
2 = Job has low time sensitivity	47	6.2
3 = Job has moderate time sensitivity	178	23.5
4 = Job has high time sensitivity	281	37.1
5 = Job cannot be postponed without serious consequences	232	30.6
Total	758	100.0
Teamwork	*n*	%
1 = Employee works independently of others	70	9.2
2 = Worker somewhat important to team	124	16.4
3 = Worker moderately important to team	332	43.8
4 = Worker highly important to team	181	23.9
5 = Worker critical to team	51	6.7
Total	758	100.0

Table 3 – Proportion of managers reporting on the effect of a worker's absenteeism, presenteeism, or work environment–related problems on group productivity (n = 758).

	Sickness-related absenteeism	Presenteeism		Work Environment problems
		Acute	Chronic	
1 = No effect at all	3.7	9.0	2.5	1.2
2 = Minor effect	23.4	36.0	16.1	22.2
3 = Moderate effect	41.8	37.1	38.9	48.2
4 = Major effect	25.5	15.4	34.3	23.4
5 = Work cannot be done	5.7	2.5	8.2	0.8
Do not know	—	—	—	4.4
	100%	100%	100%	100%

of job characteristics. This indicated the probable effects of absenteeism, presenteeism, or work environment–related problems on the organization's productivity.

The baseline probability (i.e., the reference category) represented a job with low time-sensitive output, fairly easy substitution, and low degree of teamwork. The results of our study showed that relative to this baseline job situation, where productivity was highly affected by a worker's absence, the probability that the effect was even higher increased by 8.8% and 13.9% if it was either moderately difficult or difficult to replace the worker, and the values for the impact of chronic presenteeism were higher by 8.2% and 11.2%, respectively. The values for acute presenteeism were higher by 5.4% or 6%, respectively, if it was either moderately difficult or difficult to find a substitute, compared with a baseline situation in which it was relatively easy to replace a worker. Compared with a worker easy to replace in a situation where productivity was highly affected by problems related to the work environment, the effect was probably higher by 21.4% and 32.7% if it was either moderately difficult or difficult to replace the worker.

Table 4 – Average reported costs per day to the organization in excess of the worker's wage for an absence, acute or chronic presenteeism and work environment-related problems. Presented in percentages and monetary terms. (n = 758).

Costs	Mean	Median	Standard deviation
Cost of absenteeism (%)	47.9	30	46.4
Cost of absenteeism (EUR)	6676	189	82051
Cost of presenteeism (%)	25.4	20	27.0
Cost of presenteeism (EUR)	198	53	476
Cost of work environment–related problems (%)	38.0	25	106.5
Cost of work environment–related problems (EUR)	320	106	1133

EUR = euros.

Health and Work Environment–Related Wage Multipliers

Wage multipliers by type of occupation are presented in Table 6. The mean wage multiplier for was 1.97 for absenteeism, 1.70 for acute presenteeism, 1.54 for chronic presenteeism, and 1.72 for problems related to the work environment. The adjusted wage multipliers (i.e., the 90th percentile of [X–Y]) indicated that the costs of health and work environment problems to organizations could exceed the worker's wage.

Discussion

The purpose of this study was to establish wage multipliers for estimating the costs of health and work environment–related productivity loss from the employer's perspective by considering the effect of job characteristics on group productivity. The wage multipliers could possibly also be used for economic evaluations with a broader perspective. To the best of our knowledge, this study is the first to identify wage multipliers of work environment–related problems.

Both the mean and median multipliers indicate that absenteeism is costliest per employee, followed by work environment–related problems, acute presenteeism, and chronic presenteeism. However, the total cost of work environment–related problems or presenteeism could be higher than that of absenteeism because those issues are more common. For jobs characterized by time-sensitive output, a high degree of teamwork, and difficulty in finding substitutes, the probability is high because even a short period of health-related or work environment–related problems will cause productivity loss, all else being equal. This finding corroborates the results of previous studies that had suggested that the costs of health-related and work environment–related problems to an organization can, indeed, exceed the cost of the worker's wage [5,6].

Some previous studies that had measured presenteeism and its consequences argued that the overall cost of presenteeism is higher than that of absenteeism [14,15]. Other studies have also found higher productivity loss resulting from work environment–related problems compared with that resulting from presenteeism [9,10]. This result is further supported in the present study of managers, in which it appears that work environment–related problems could, in fact, be more costly than episodes of presenteeism when job characteristics are taken into consideration. The wage multipliers for work environment–related problems exceed those of acute and chronic presenteeism in the majority of cases (i.e., 52% and 72%, respectively).

The wage multipliers that were high in this study were also high for almost identical jobs in previous studies [5]. However, the magnitude of the multipliers differed. The reason for the discrepancies could potentially be explained by differences in educational and social insurance systems as well as cultural differences. This suggests a need for region-specific multipliers

Table 5 – Marginal effects of ordered probit model*.

	Absenteeism			Presenteeism						Work environment–related problems		
				Acute			Chronic					
	Low effect	Moderate effect	High effect	Low effect	Moderate effect	High effect	Low effect	Moderate effect	High effect	Low effect	Moderate effect	High effect
Baseline probability	0.27	0.418	0.311	0.450	0.371	0.179	0.186	0.389	0.425	0.12	0.232	0.756
Time sensitivity												
2 = Moderate	**–0.179**	**0.047**	**0.132**	–0.073	0.030	0.043	–0.083	–0.022	0.105	0.003	0.044	–0.047
3 = High	**–0.246**	0.042	**0.204**	–0.090	0.035	0.054	–0.090	**–0.026**	**0.115**	0.004	0.054	–0.058
Team work												
2 = Moderate	0.032	–0.001	–0.030	–0.035	0.015	0.020	0.004	0.001	–0.006	**–0.010**	**–0.092**	**0.102**
3 = High	**–0.101**	**–0.022**	**0.123**	**–0.152**	**0.048**	**0.104**	**–0.088**	**–0.053**	**0.141**	**–0.012**	**–0.123**	**0.134**
Replace worker												
2 = Moderate	**–0.099**	0.012	**0.088**	**–0.088**	**0.034**	**0.054**	**–0.061**	**–0.021**	**0.082**	**–0.022**	**–0.192**	**0.214**
3 = Difficult	**–0.145**	0.007	**0.139**	**–0.096**	**0.036**	**0.060**	**–0.080**	**–0.032**	**0.112**	**–0.027**	**–0.301**	**0.327**

Bold font represents significance at 5% significance level. Probabilities are presented as percentages. Baseline probability is the reference case (i.e., low time-sensitive output, low degree of teamwork, and easy to replace a worker).

* Predicting productivity loss as a result of sickness-related absence, presenteeism, and work environment–related problems by job characteristics (n = 758).

Table 6 – Wage multipliers by type of occupation.

		Unadjusted				Y rescaled Y ≥ X				Y rescaled w/90th percentile of (X–Y)			
Occupation	n	Absence	Acute	Chronic	WE	Absence	Acute	Chronic	WE	Absence	Acute	Chronic	WE
Engineers	46	0.92	0.51	0.33	0.81	1.63	1.44	1.08	1.44	2.44	2.13	1.58	2.11
Information technology workers	46	0.86	0.47	0.37	0.62	1.46	1.28	1.17	1.24	2.17	1.87	1.68	1.86
Carpenters, masons, construction workers, roofers	45	0.63	0.26	0.23	0.42	1.20	0.92	0.93	1.10	1.79	1.50	1.35	1.70
Doctors, nurses, pharmacists, dentists	44	0.83	0.43	0.38	0.62	1.33	1.15	1.18	1.20	1.98	1.66	1.70	1.79
Nurse's assistants and auxiliary nurses	44	0.50	0.35	0.33	0.29	0.99	1.03	1.07	0.92	1.61	1.54	1.59	1.45
Teachers (primary/ secondary level)	38	0.70	0.39	0.34	0.54	1.26	1.09	1.10	1.12	1.87	1.64	1.61	1.74
Insurance brokers, salesmen, purchasers, and supply managers	34	0.45	0.10	0.10	0.40	1.15	0.82	0.89	1.04	1.90	1.65	1.34	1.64
Business administrators (private)	25	0.86	0.37	0.30	0.46	1.36	1.09	1.00	1.19	2.07	1.67	1.47	1.88
Workers in mass media, communications, public relations, and advertising	23	0.91	0.53	0.46	0.36	1.40	1.31	1.22	0.94	2.13	1.83	1.73	1.46
Shop assistants and cashiers	22	0.69	0.30	0.21	0.44	1.26	0.99	0.92	0.95	1.89	1.58	1.33	1.51
Administrators (public)	22	0.54	0.32	0.23	0.69	1.04	0.96	1.05	1.42	1.66	1.52	1.51	2.14
Workers in heavy industry and manufacturing	20	0.44	0.37	0.34	0.63	0.96	1.07	1.06	1.19	1.54	1.55	1.57	1.78
Analysts and investigators	18	0.73	0.43	0.34	0.68	1.32	1.23	1.05	1.21	1.98	1.77	1.52	1.77
Transport workers, couriers	18	1.35	0.49	0.38	0.22	1.80	1.39	1.12	1.10	2.81	2.06	1.60	1.74
Janitors/real estate maintenance workers	17	0.41	0.16	0.15	0.59	1.01	0.89	0.96	1.16	1.60	1.43	1.38	1.77
Service and maintenance (machinery) workers	15	1.10	0.39	0.27	0.76	1.69	1.22	1.05	1.44	2.54	1.92	1.53	2.17
Chefs, Maître d'hôtel, waiters	14	0.44	0.41	0.40	0.53	0.88	1.02	1.18	1.07	1.40	1.43	1.66	1.66
Crop producers, livestock breeders, fishermen	14	0.62	0.23	0.18	0.39	1.21	0.93	0.83	1.06	1.85	1.54	1.23	1.67
Professors and researchers (tertiary level)	13	0.55	0.28	0.38	0.52	1.09	0.93	1.17	1.09	1.67	1.47	1.72	1.65
Priests, deacons, and pastors	13	0.67	0.49	0.39	0.52	1.29	1.31	1.14	1.00	1.93	1.84	1.59	1.43
Concrete casters, welders, and tinsmiths	12	0.35	0.16	0.13	0.47	0.89	0.85	0.84	0.99	1.50	1.39	1.24	1.54
Social service workers	12	0.68	0.25	0.24	0.61	1.30	0.98	1.06	1.14	1.98	1.64	1.59	1.64
Military staff	10	1.49	0.75	0.57	0.50	1.90	1.67	1.35	1.06	2.90	2.27	1.84	1.64
Child care workers	10	0.95	0.52	0.43	0.26	1.37	1.25	1.12	0.87	2.11	1.76	1.57	1.32
Other*	65	0.67	0.42	0.36	0.63	1.29	1.17	1.10	1.26	1.92	1.75	1.62	1.88
Groups with n <10	118												
Observations, total	758												
Mean	758	0.73	0.38	0.31	0.52	1.28	1.12	1.07	1.13	1.97	1.70	1.54	1.72
Median	758	0.68	0.39	0.34	0.52	1.29	1.09	1.07	1.10	1.92	1.65	1.58	1.70

Y is the assessment of the costs per day to the organization in excess of the worker's wage for absenteeism, acute or chronic presenteeism, and work environment–related problems.

X is the percentage reduction of the affected worker's performance as a result of acute or chronic presenteeism and work environment–related problems.

The rescaled value, Y rescaled w/90th percentile of (X-Y), is the final multipliers.

* Noncategorizable observations.

because the use of multipliers from other settings may lead to over- or underestimation of the actual costs of productivity.

Only short-term absence was looked at because employers were not likely to replace or find a worker of equal quality immediately during this period in a group production process. Again, the precision levels of the estimated cost are good because of the short-term (retrospective) self-reported questionnaire used.

The study has some limitations. The survey did not obtain any information about the nature of the work environment–related problems. Hence, psychosocial factors are clustered with purely facility-related and organization-related factors as well as physical ones. It is possible that different types of work environment–related problems may affect productivity differently and would therefore give different multipliers. The same can be said for health-related problems, even though the survey questions did distinguish between acute and more chronic problems.

Some managers found it too difficult to grasp the concept of work environment–related problems —and, to some extent, presenteeism—to make a proper assessment of productivity loss and its related costs. To reduce the potential effect of reporting unreliable cost data, a clarification of the concepts and an "open response" option was included in the questionnaire for managers who were not comfortable with responding on the provided scales. The questionnaire used in this study has not been extensively psychometrically tested, but it was, nevertheless, tested for concept and face validity in the development process. We would encourage future research to psychometrically test the questionnaire to determine the accuracy of this self-reported data.

In summary, the wage multipliers developed in this study can be used to calculate productivity loss resulting from health-related and work environment–related problems to properly account for their actual costs. In the present study, the cost of the team production problems for the employer exceeds the wage cost because of the impact of these problems on the marginal product of the team. This means that the total cost of short-term absenteeism during team production in heavy industry and the manufacturing sector is the average labor cost per day, including salaries, payroll taxes, and other personnel costs (euros [EUR] 288 = EUR 36 $\times$ 8 hours) multiplied by the multiplier (1.54), which gives EUR 443.5 as productivity lost. If the calculation does not allow for use of job-specific multipliers, we recommend that the median value of the multiplier be used. The use of multipliers in economic evaluations is an effective way of identifying the cost of health-related and work environment–related problems, which, in turn, improves the benchmark for making decisions about occupational safety and health interventions.

Conclusions

Using wages to value the cost of lost productivity resulting from absenteeism, presenteeism, and work environment–related problems from the employer's perspective will most likely underestimate the cost in the case of jobs characterized by time-sensitive output, a high degree of teamwork, and difficulty in finding substitutes. To help value this burden, multipliers to adjust wages to estimate productivity loss are proposed here. Both the mean and median multipliers indicate that absenteeism is the costliest per employee, followed by work environment–related problems, acute presenteeism, and chronic presenteeism. However, the total cost of work environment–related problems or presenteeism could be higher than that of absenteeism because the former are more common.

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Supplemental Materials

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