

Effect of Long-Term Absenteeism on the Operating Revenues, Productivity, and Employment of Enterprises

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Abstract: (1) Background: Previous studies have shown that absenteeism is negatively associated with employee-level performance, but we do not know how exactly absenteeism affects enterprise-level performance. To bridge this knowledge gap, we investigate how average long-term absenteeism affects Norwegian enterprises' operating revenues and productivity. Also, we investigate if absenteeism decreases employment and whether operating revenues mediate the association. (2) Methods: We performed an enterprise-level dynamic unconditional quasi-maximum likelihood fixed-effects panel regression. (3) Results: The average share of long-term absenteeism nonlinearly decreases operating revenues and overall productivity at an increasing rate. The nonlinear effect may indicate deteriorating value creation among the share of employees largely not absent, but their productivity actually increases at an increasing rate. Thus, the overall findings indicate that the least productive employees first tend to opt out of the workforce, and as absenteeism increases, those subsequently opting out are otherwise increasingly productive. In parallel, those remaining in the workforce are increasingly productive. Absenteeism, moreover, decreases employment the following year, which is partly explained by revenue losses. However, enterprises cut their workforce due to factors beyond the impact of absenteeism on revenues.

Keywords: instrumental variables; absenteeism; productivity; operating revenues



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1. Introduction

An increasing body of literature has shown that employee-level absenteeism is negatively associated with individual work performance (e.g., [Bycio 1992](#); [Lokke and Krotel 2020](#); [Stumpf and Dawley 1981](#); [Viswesvaran 2002](#)), but we have less knowledge about how absenteeism may affect enterprise-level performance. To bridge this knowledge gap, this study investigates how average long-term absenteeism is likely to affect enterprises' operating revenues and productivity. In addition, we aim to investigate if long-term absenteeism decreases employment and whether operating revenues explain and mediate the association between the concepts. Empirically, we study a panel of Norwegian enterprises.

1.1. Definition and Explanation of Concepts

Long-term absenteeism is measured as the average share of wage compensation an enterprise's full-time employees receive in government compensation compared to total wages in a given year. For example, if an enterprise in a given year had two employees, due to absenteeism, one received 10% government compensation of her/his total wages and the other received 5%, the average long-term absenteeism measure would be 7.5%. In Norway, the government compensates practically all wage losses when employees are absent for a long-term, making our empirical approach plausible. (Conversely, the employer largely compensates short-term absent employees' wages in full).

Operating revenues are the revenues that an enterprise generates from its core activities ([Malikov et al. 2018](#)). For example, a retailer's operating revenues are the revenues

generated from its sales of items to customers. In contrast, revenues from, e.g., interests earned from money in a bank account, are excluded.

According to [Hall and Jones \(1999\)](#), productivity is defined as output per employee. Despite that, productivity is not necessarily the same as profitability, as [Huselid \(1995\)](#) shows that human resource management practices generate similar results for the two measures. Our study includes two measures of productivity at an enterprise level. The first is operating revenues divided by the number of full-time employees independent of the extent to which they are long-term absent or not, and which other research has measured similarly (e.g., [Aarstad et al. 2016](#)). We label this concept as overall productivity. The second productivity measure, which is novel to our knowledge, divides operating revenues by the number of employees equivalent that are not long-term absent (i.e., assuming that the average long-term absenteeism is 7.5% for an enterprise with two employees, as described in our illustration above, the number of employees equivalents that are not long-term absent is $1.85 (2 \times (1 - 0.075))$). We label this concept as non-absent productivity. Taken together, the first productivity measure—overall productivity—captures the average output per employee in an enterprise, independent of whether long-term absenteeism is high or low. The second—non-absent productivity—captures the average output per employee relative to the average share that is not long-term absent.

Intuitively, operating revenues and overall productivity decrease due to long-term absenteeism because employees not working do not add to value creation in the enterprise. As a novel contribution, we take this argument a step further and elaborate on why it is likely that operating revenues and overall productivity will decrease due to long-term absenteeism at an *increasing* rate. Also, we argue why non-absent productivity increases due to long-term absenteeism. Finally, we argue that employment decreases in the following year due to long-term absenteeism and that operating revenues mediate the association.

1.2. Operating Revenues and Productivity as a Function of Long-Term Absenteeism

Absenteeism has individual costs related to income losses in most countries, and those absent workers may further lose self-esteem, working skills, and fellowship opportunities with colleagues. At an individual level, absenteeism is negatively associated with different facets of performance, according to numerous studies. For example, [Bycio \(1992, p. 193\)](#), in a meta-study, found “a modest but significant tendency for frequently absent employees to be poor performers on many rating and non-rating indices.” [Lokke and Krotel \(2020\)](#), analyzing Danish longitudinal data, showed that the lower a superior’s rating of a leader’s performance, the more the absent frequency rate increased. Similarly, [Stumpf and Dawley \(1981\)](#) revealed that absenteeism correlated negatively with performance rating, work accuracy, and work promotion. Finally, in another meta-study, [Viswesvaran \(2002\)](#) concluded that absenteeism was inversely associated with the quality of work, supervisory ratings of effort and interpersonal behavior, and productivity. Granted, the empirical data we have referred to do not necessarily assess causality between the concepts, i.e., absenteeism may induce lower performance due to loss of skills or experience, or low-performing employees may have a relatively high probability of being absent, or the causality may go in both directions. Also, the association between the concepts may be due to a common underlying factor; e.g., poor physical or mental health likely induces both absenteeism and low work performance. However, independent of these potential explanations, there seems to be a consensus in the literature that employees with high absenteeism perform lower than less absent colleagues.

Previously, we have argued that operating revenues and overall productivity decrease due to long-term absenteeism because employees not working do not contribute to value creation in the enterprise. Relating this argument with the negative association between absenteeism and individual performance at the workplace, to which we have referred (e.g., [Bycio 1992](#); [Lokke and Krotel 2020](#); [Stumpf and Dawley 1981](#); [Viswesvaran 2002](#)), one can further argue that operating revenues and overall productivity decrease at an *increasing* rate. According to our literature review, the reason for this potential nonlinear

association is that the least productive employees have the highest probability of being absent. Therefore, it is fair to assume that they have the highest probability of being long-term absent. Suppose an enterprise at one point in time has very low long-term absenteeism, it is then likely to assume that those few long-term absent, *ceteris paribus*, are the least productive employees (when present at work), i.e., they are less productive than those with a lower probability of being long-term absent. Secondly, assuming that the long-term absenteeism increases marginally, those subsequently becoming long-term absent, *ceteris paribus*, tend to be marginally more productive than those long-term absent at the outset but less productive than those not (yet) long-term absent. The argument hinges on the assumption that those least productive first opt out and become long-term absent. Subsequently, those “second least” productive opt out. A further marginal increase in long-term absence, therefore, *ceteris paribus*, implies that those now opting out are the “third least” productive employees. In other words, the most productive employees are the least to opt out and become long-term absent. This reasoning implies that operating revenues and overall productivity decrease at an increasing rate when long-term absenteeism increases because those subsequently becoming absent are increasingly productive. Let us assume an enterprise of four employees where the individual productivity of the employee most likely to become long-term absent is 1.1, the individual productivity of the second most likely to become long-term absent is 1.2, the third is 1.3, and the fourth is 1.4. If the long-term absenteeism is zero at the outset, the overall productivity is 1.25 $((1.1 + 1.2 + 1.3 + 1.4)/4)$. If the least productive employee first becomes long-term absent, the overall productivity decreases to 0.975 $((1.2 + 1.3 + 1.4)/4)$, and if the second least productive becomes long-term absent, it further decreases to 0.675 $((1.3 + 1.4)/4)$, i.e., operating revenues and overall productivity decrease at an increasing rate as a function of long-term absenteeism, which motivates the following hypothesis:

Hypothesis 1a (H1a). *Operating revenues decrease at an increasing rate as enterprises’ average long-term absenteeism increases.*

Hypothesis 1b (H1b). *The overall productivity decreases at an increasing rate as enterprises’ average long-term absenteeism increases.*

Following the above reasoning that the least productive employees first tend to opt out and become long-term absent, and those subsequently opting out are increasingly productive, an implication is that the non-absent productivity increases as a function of long-term absenteeism, i.e., referring to the above example, the non-absent productivity is 1.25 $((1.1 + 1.2 + 1.3 + 1.4)/4)$ if the long-term absenteeism is zero, 1.3 $((1.2 + 1.3 + 1.4)/3)$ if the least productive employee becomes long-term absent, and 1.35 $((1.3 + 1.4)/2)$ if the second least productive becomes long-term absent. Therefore, we conclude and hypothesize that non-absent productivity increases linearly as enterprises’ long-term absenteeism increases.¹

Hypothesis 2 (H2). *The non-absent productivity increases linearly as enterprises’ average long-term absenteeism increases.*

A counterargument to our above reasoning is that the non-absent productivity may increase at a decreasing rate, not increase at all, or even decrease as long-term absenteeism can preclude the work for those present due to the loss of key personnel. We do not rule out such associations, but our empirical data will assess the more plausible one.

Another issue we want to emphasize is that long-term absenteeism is not always associated with low individual performance, as health issues unrelated to abilities or issues unrelated to health can induce employees to be out of the workforce. For instance, we regard long-term absenteeism due to maternity leave to be unrelated to inherent work performance. Consequently, we control for the percentage of female employees. Similarly, work conditions can affect absenteeism (Dale-Olsen 2012), and to amend this issue, we explain later how we control for time-invariant enterprise heterogeneity. In addition, we control for average education as employees with low education often have work conditions

challenging to their health, thereby inducing long-term absenteeism. Finally, we control for average age, average education, and employment in the current and the past year.

1.3. Employment as a Function of Long-Term Absenteeism and the Mediating Role of Operating Revenues

Concerning our second research question to investigate how long-term absenteeism affects employment the following year and how a change in operating revenues mediates the association, we have not found studies tapping into the topics that can help us craft arguments. Instead, research has largely emphasized factors that affect absenteeism (e.g., Block et al. 2014; Chen et al. 2020; Dale-Olsen 2012; Markussen et al. 2011; and Winkelmann 1999) or, as noted, on the association between absenteeism and individual performance (e.g., Bycio 1992; Lokke and Krotel 2020; Stumpf and Dawley 1981; and Viswesvaran 2002). That said, we do not rule out that average long-term absenteeism may have a temporary positive employment effect as enterprises need to maintain a relatively large workforce to substitute for those absent. One year later, on the other hand, we assume that the effect is negative, the reason being that long-term absenteeism precludes value creation, which the enterprise, one way or another, needs to account for. For many enterprises, their highest costs are employee wages. Therefore, it is not farfetched to assume that an implication of long-term absenteeism is to reduce the number of employees the following year. This argument further implies that operating revenues mediate the suggested association between long-term absenteeism and employment reduction the following year because an inherent consequence of long-term absenteeism is reduced operating revenues due to lower value creation in the enterprise. Consequently, we conclude and hypothesize that full-time employment decreases the following year as a function of average long-term absenteeism and that operating revenues mediate the association.

Hypothesis 3 (H3). *As enterprises' average long-term absenteeism increases, full-time employment decreases the following year.*

Hypothesis 4 (H4). *Operating revenues mediate the association between enterprises' average long-term absenteeism and full-time employment the following year.*

2. Methodology

2.1. Data and Context

To study our research questions, we analyze a panel of Norwegian private-sector enterprises operating across numerous industries between 2008 and 2014. The data for the panel is collected and registered by Statistics Norway and The Brønnøysund Register Centre, a government body under the Ministry of Trade, Industry and Fisheries.

To model the panel, we used person-level data merged with enterprise-level data. We identified employees at year t as those working full-time in the same enterprise at year t and $t-1$. Using these criteria, we included enterprises having at least 20 employees the first year and they were identified as panel candidates. For each following year, we included observations of those same enterprises if they had at least ten employees. Our motive for this approach was to exclude too small enterprises but include observations of those smallest that may decrease in size below 20 full-time employees after the first year included in the data.

We excluded enterprises having operations at more than one plant from the data. Our motive for this approach was to avoid possible disturbances in the data due to potential mergers, acquisitions, and demergers.

2.2. Variables

As described above, enterprise size in the number of full-time employees is the dependent variable when testing H3 and H4. Also, we include enterprise size in the number of full-time employees as a control variable when testing H1a, H1b, and H2, which we address below.

If an enterprise in a given year had two employees and due to absenteeism, one received 10% government compensation of her/his total wages and the other received 5%, the average long-term absenteeism would be 7.5%.² Thus, when measuring an enterprise's share of long-term absenteeism, each employee from which we measure the number is not necessarily either 100% absent or present in a given year but somewhere between these extremes. When testing H1a, H1b, and H2, we include long-term absenteeism as a linear and squared independent variable. We include the square term to assess eventual nonlinearity.

Overall productivity as a dependent variable when testing H1b is operating revenues divided by the number of full-time employees independent of the absent share. We measure operating revenues in 2014 prices using Statistics Norway's consumer price index inflator. Also, we use operating revenues as a dependent variable when testing H1a and as a mediating variable when testing H4.

To model non-absent productivity as a dependent variable when testing H2, we divide the overall productivity by the not long-term absent share, i.e., following our previous example of 7.5% long-term absenteeism in a given year, the share of *not* long-term absent is $1 - 0.075 = 0.925$.

The Norwegian government compensates practically all wage losses when an employee is absent long-term due to sickness, childbearing, or adoption. Absenteeism related to adoption is marginal, and the largest share of long-term absenteeism compensation related to childbearing is allocated to the mother during her maternity leave. To account for this issue, we control for the employees' gender when testing H1a, H1b, and H2. Specifically, we measure the variable as the average share of female employees. Also, we include it as a square term. To further account for potential heterogeneity in the data when testing H1a, H1b, and H2, we similarly control for average education, theoretically taking values from 1 (no elementary education) to 9 (doctorate or equivalent), and the average age in years. These variables, too, we include as both linear and squared terms.

As noted above, we control for enterprise size in the number of full-time employees when testing H1a, H1b, and H2. We include it at year t and $t-1$ as it may have an immediate and lagged effect on the dependent variables. We log-transform all continuous variables for this study using the natural logarithm. Finally, we control for potential time heterogeneity in the data by including year dummies.

3. Results

Largely, we apply the dynamic unconditional quasi-maximum likelihood fixed-effects panel regressions with robust standard errors and one lagged time period of the dependent variable. An advantage of fixed-effects regression is that it controls for time-invariant enterprise heterogeneity (Cameron and Trivedi 2010; Wooldridge 2010, 2019). An advantage of including the lagged dependent variable is that it accounts for last year's unobserved heterogeneity in the data, but the approach is prone to "Nickell bias" by generating biased estimates or standard errors (Nickell 1981). However, the dynamic unconditional quasi-maximum likelihood fixed-effects panel regression technique avoids this bias when including the lagged dependent variable (for further details on this regression technique, see, e.g., Kripfganz 2016; Leszczensky and Wolbring 2019; Williams et al. 2019).

3.1. Testing H1a, H1b, and H2

Operating revenues and overall productivity (all employees) decrease at an increasing rate as a function of long-term absenteeism (Table 1, Models 1 and 2), which implies that H1a and H1b gain empirical support, i.e., the dependent variables are a negative function of the proportion of long-term absenteeism as both linear and squared (second-degree polynomial) terms.

Non-absent productivity increases at an increasing rate as a function of long-term absenteeism (Table 1, Model 3), which implies that H2 gains partial empirical support, i.e., the dependent variable is a positive function of the proportion of long-term absenteeism as

both linear and squared nonlinear (second-degree polynomial) terms. We hypothesized a linear but not a nonlinear effect, and the finding implies that the individual productivity of employees subsequently becoming absent long-term increases, not at a linear, but at an exponential rate.³

Average age as a control variable has an increasing effect at a decreasing rate on both the productivity measures and operating revenues. It implies that average age up to a certain point positively affects these performance measures but eventually turns negative when reaching a high value. The findings are in line with previous research (Aarstad et al. 2021; Bell et al. 2011) and indicate that the accumulated experience and skills reflected in age have a positive performance effect, which eventually turns negative, possibly due to outdated competence or other related issues (Aarstad et al. 2021).⁴

Table 1. Dynamic unconditional quasi-maximum likelihood fixed-effects panels.

	Model 1	Model 2	Model 3
Dependent variable at t	Operating revenues	Productivity, all empl.	Productivity, non-abs. ekv.
Dependent variable at t_{-1}	0.396 *** (0.075)	0.396 *** (0.075)	0.391 *** (0.075)
Prop. of absenteeism at t	−0.040 *** (0.011)	−0.040 *** (0.011)	0.057 *** (0.011)
Prop. of absenteeism sq. at t	−0.003 ** (0.001)	−0.003 ** (0.001)	0.005 *** (0.001)
Prop. of fem. empl. at t	−0.032 (0.054)	−0.032 (0.054)	−0.032 (0.054)
Prop. of fem. empl. sq. at t	−0.003 (0.009)	−0.003 (0.009)	−0.003 (0.009)
Av. education at t	−10.37 (10.19)	−10.37 (10.19)	−10.50 (10.20)
Av. education sq. at t	0.506 (0.391)	0.506 (0.391)	0.544 (0.392)
Av. age at t	70.27 * (30.34)	70.27 * (30.34)	70.02 * (30.32)
Av. age sq. at t	−0.949 * (0.455)	−0.949 * (0.455)	−0.914 * (0.453)
Enterprise size in empl. at t	0.400 *** (0.049)	−0.600 *** (0.049)	−0.600 *** (0.049)
Enterprise size in empl. at t_{-1}	−0.013 ** (0.004)	0.308 *** (0.077)	0.304 *** (0.076)
Year dummies included	Yes	Yes	Yes

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Two-tailed tests for regressors and robust standard errors in parentheses. The number of enterprise-year observations is 18,534. The number of enterprises is 4809. The minimum, average, and maximum observations per enterprise are 2, 3.85, and 5, respectively.

Enterprise size in the number of employees as a control variable at year t has an immediate negative effect on productivity measures and an immediate positive effect on operating revenues. The findings make sense as increasing the number of employees will immediately decrease revenues per employee due to the time it takes to train the new staff, but they nonetheless increase operating revenues. At year t_{-1} , i.e., the following year, the effects are the opposite but not as strong in absolute terms. The opposite effects may be due to the training effect of new staff and regression towards the mean (Barnett et al. 2004; Nesselroade et al. 1980).

3.2. Testing H3 and H4

To test H3 and H4, we include the independent and mediating variables at year t_{-1} . Full-time employment decreases the following year as a function of long-term absenteeism (Table 2, Model 1), which implies that H3 gains empirical support.⁵ Compared to Model

1, the effect of long-term absenteeism on operating revenues decreased when including operating revenues at t_{-1} as a mediating variable in Model 2. As the long-term absenteeism effect is still significant, the mediating effect is partial at best. To further address the issue of partiality, we estimate whether the *difference* between the estimates of long-term absenteeism in Model 1 and 2 is significant using the following equation $Z = \frac{E1-E2}{\sqrt{(SE1)^2+(SE2)^2}}$ (for further details, see [Altman and Bland 2003](#)). E1 is the regression estimate of absenteeism in Model 1, and E2 is the regression estimate in Model 2. SE1 and SE2 are the estimates' standard error (reported in parentheses in Table 2). Z takes a value of -1.11 , which generates a non-significant p -value of 0.266 (two-tailed test), i.e., the estimates of long-term absenteeism in Models 1 and 2 (Table 2) are not significantly different from each other. Therefore, we conclude that including operating revenues as a mediating variable does not significantly mediate the association between long-term absenteeism and employment the following year. In other words, operating revenues neither fully nor partially mediated the association between long-term absenteeism and full-time employment the following year. Hence, H4 did not gain empirical support.

Table 2. Dynamic unconditional quasi-maximum likelihood fixed-effects panels. Enterprise size in employment at t is the dependent variable.

	Model 1	Model 2
Dependent variable at t_{-1}	0.922 *** (0.047)	0.699 *** (0.027)
Prop. of absenteeism at t_{-1}	-0.013 *** (0.002)	-0.009 *** (0.002)
Operating revenues at t_{-1}		0.170 *** (0.024)
Year dummies included	Yes	Yes

*** $p < 0.001$. Two-tailed tests for regressors and robust standard errors in parentheses. The number of enterprise-year observations is 19,945. The number of enterprises is 5124. The minimum, average, and maximum observations per enterprise are 2, 3.89, and 5, respectively.

Unsurprisingly, operating revenues have a significant positive effect on employment the following year, i.e., decreasing operating revenues induce a decrease in employment the following year, and vice versa.

4. Discussion

Previous research has indicated that absenteeism is negatively correlated with employees' performance at work (e.g., [Bycio 1992](#); [Lokke and Krotel 2020](#); [Stumpf and Dawley 1981](#); [Viswesvaran 2002](#)), but to date, studies have not investigated how it may affect enterprise-level performance. To bridge this knowledge gap, we investigated how average long-term absenteeism affected enterprises' operating revenues and productivity. Also, we investigated if long-term absenteeism decreased employment and whether operating revenues explained and mediated the association between the concepts. Taken together, this study adds to the literature about long-term absenteeism, as there is limited knowledge on how it affects productivity, operating revenues, and employment.

The findings showed that the portion of enterprises' long-term absenteeism negatively affects overall productivity and operating revenues at an increasing rate. The nonlinear effect may indicate decreasing value creation among those that are not absent, but their productivity actually increases at an increasing rate. From these findings, we infer that low-productive employees first opt out of the workforce as long-term absent. As long-term absenteeism increases, those later opting out are otherwise increasingly productive. At the same time, employees that remain in the active workforce are also similarly, increasingly productive. Furthermore, long-term absenteeism negatively affects enterprises' employment the following year, which is explained partially by revenue losses. But having said

that, enterprises reduce the number of employees because of factors that go beyond the impact of long-term absenteeism on revenue losses.

A contribution of this study is that it theoretically, through hypothesis development, and empirically, through econometric analyses, illuminates how long-term absenteeism affects enterprises' operating revenues, productivity, and employment decisions, which have not been addressed in previous research. In other words, this study increases our knowledge about enterprises' outcomes and decisions as a function of employees' long-term absenteeism. A further contribution is that it practically informs managers, employees, and other enterprise stakeholders about how long-term absenteeism affects crucial aspects of performance and future employment. A social implication of this study is our finding that enterprises reduce the number of employees due to factors beyond the negative effect that long-term absenteeism has on operating revenues. This may indicate that enterprises use the opportunity of long-term absenteeism as a vehicle to lay off workers not only due to reduced revenues but also to make the organization leaner.

A limitation of this study is that we do not know the reasons for long-term absenteeism. Despite controlling for the proportion of female employees, average age, and average education, the effect of long-term absenteeism on operating revenues and productivity may therefore partially reflect other underlying factors which this study has not uncovered. Accordingly, future research should aim to model different genuine reasons for long-term absenteeism as potential carriers for enterprise performance, which we did not do in our analyses. A further limitation is that we do not know whether enterprises lay off those most absent, which is a topic for future research. A final limitation is that we did not address other estimation techniques described in the literature concerning mediation effects (Aglér and De Boeck 2017; Preacher and Hayes 2008), which is also yet another topic to address further in future research.

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Notes

- ¹ We cannot rule out the suggested positive association between long-term absenteeism and non-absent productivity because capital investment output in the short term may be constant or decrease at a lower rate than the share of employees not long-term absent. However, if this were the case, the above reasoning concerning decreasing overall productivity at an increasing rate as a function of absenteeism would be unlikely, but shortly we show that the empirics are consistent with what we argued. Also, we later show that the non-absent productivity increases at an increasing rate due to long-term absenteeism. It rules out the argument concerning capital investments output in the short term being constant or decreasing at a lower rate than the share of employees not being long-term absent.
- ² Assuming one employee received 50k NOK in government compensation due to long-term absenteeism and the wages apart from that were 450k NOK, and the other received 30k NOK in government compensation and the wages apart from that were 570k, the average share of long-term absenteeism would be $((50k/(50k + 450k)) + (30k/(30k + 570k)))/2 = (0.10 + 0.05)/2 = 0.075$, i.e., 7.5%.
- ³ When testing H1a, H1b, and H2, we cannot rule out reverse causality. To account for this, we applied in unreported models the dynamic two-step Arellano-Bover/Blundell-Bond GMM panel regression with instrumental variables reporting heteroscedasticity bias-corrected (wc) robust standard errors (Arellano and Bover 1995; Blundell and Bond 1998; Windmeijer 2005). Stata code used to test H1a, H1b, and H2, is `xtabond2 L(0/2).y x1 x1_sq L(0/1).x2 i.year, gmm(L2.y x1 x1_sq L.x2 z1 z1_sq z2 Z2_sq, lag(1 .) collapse) two robust` (for details, see Li et al. 2021; Roodman 2009). *y* is the dependent variable, *x1* the share of absenteeism, *x2* enterprise size in employees, *i.year*, year dummies, *z1* the share of female employees, and *z2* the average education level. *_sq means squared values. The code shows that the independent- and control variables are treated as endogenous regressors. The statistical conclusions concerning H1a, H1b, and H2 are the same as we report in Table 1. The model

specification, however, is different, and the reason is because of the “trial and error” procedure to identify models with valid instrumental variables that generate non-significant post-estimation tests (for a practical discussion, please see Li et al. 2021). Also, the statistical conclusion concerning H3 is the same when using the dynamic two-step Arellano-Bover/Blundell-Bond GMM panel regression with instrumental variables. Still, we had to omit the $z1$ $z1_sq$ $z2$ $z2_sq$ instruments as the model otherwise failed to generate non-significant postestimation tests. Upon request, we can provide statistical details that also include post-estimation tests.

- 4 The high absolute values of the average age variable may indicate an issue with multicollinearity, and omitting the square term returns a positive linear effect taking the value of 0.330 ($p < 0.01$) in Models 1 and 2 and 0.348 ($p < 0.01$) in Model 3. Omitting the square term of average education similarly induces a positive linear effect taking the value of 0.331 ($p < 0.01$) in Models 1 and 2 and 0.334 ($p < 0.01$) in Model 3. The hypothesized effects are not altered when removing these mentioned square terms.
- 5 Replicating Model 1 (Table 2) using the dynamic two-step Arellano-Bover/Blundell-Bond GMM panel regression with instrumental variables reporting heteroscedasticity bias-corrected (wc) robust standard errors gives a substantially similar result concerning long-term absenteeism at t_{-1} as an independent variable. The Stata code we use is `xtabond2 L(0/2).y L.x1 i.year, gmm(L2.y L.(x1 z1 z2), lag(1 .) collapse) two robust`, which generates valid non-significant post estimates. Upon request, we can provide statistical details that also include post-estimation tests.

References

- Aarstad, Jarle, Olav Andreas Kvitastein, and Marte C. W. Solheim. 2021. External shocks and enterprises’ dynamic capabilities in a time of regional distress. *Growth and Change* 52: 2342–63. [\[CrossRef\]](#)
- Aarstad, Jarle, Olav Andreas Kvitastein, and Stig-Erik Jakobsen. 2016. Related and unrelated variety in a tourism context. *Annals of Tourism Research* 57: 254–56. [\[CrossRef\]](#)
- Agler, Robert, and Paul De Boeck. 2017. On the Interpretation and Use of Mediation: Multiple Perspectives on Mediation Analysis. *Frontiers in Psychology* 8: 1984. [\[CrossRef\]](#) [\[PubMed\]](#)
- Altman, Douglas G., and J. Martin Bland. 2003. Interaction revisited: The difference between two estimates. *BMJ* 326: 219. [\[CrossRef\]](#) [\[PubMed\]](#)
- Arellano, Manuel, and Olympia Bover. 1995. Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics* 68: 29–51. [\[CrossRef\]](#)
- Barnett, Adrian G., Jolieke C. van der Pols, and Annette J. Dobson. 2004. Regression to the mean: What it is and how to deal with it. *International Journal of Epidemiology* 34: 215–20. [\[CrossRef\]](#) [\[PubMed\]](#)
- Bell, Suzanne T., Anton J. Villado, Marc A. Lukasik, Larisa Belau, and Andrea L. Briggs. 2011. Getting specific about demographic diversity variable and team performance relationships: A meta-analysis. *Journal of Management* 37: 709–43. [\[CrossRef\]](#)
- Block, Jörn, Laszlo Goerke, José María Milian, and Concepción Roman. 2014. Family employees and absenteeism. *Economics Letters* 123: 94–99. [\[CrossRef\]](#)
- Blundell, Richard, and Stephen Bond. 1998. Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics* 87: 115–43. [\[CrossRef\]](#)
- Bycio, Peter. 1992. Job-Performance and Absenteeism—A Review and Metaanalysis. *Human Relations* 45: 193–220. [\[CrossRef\]](#)
- Cameron, A. Colin, and Pravin K. Trivedi. 2010. *Microeconometrics Using Stata*. College Station: Stata Press.
- Chen, Jie, Chad D. Meyerhoefer, and Lizhong Peng. 2020. The effects of paid sick leave on worker absenteeism and health care utilization. *Health Economics* 29: 1062–70. [\[CrossRef\]](#) [\[PubMed\]](#)
- Dale-Olsen, Harald. 2012. Sickness absence, performance pay and teams. *International Journal of Manpower* 33: 284–300. [\[CrossRef\]](#)
- Hall, Robert E., and Charles I. Jones. 1999. Why do Some Countries Produce So Much More Output Per Worker than Others? *The Quarterly Journal of Economics* 114: 83–116. [\[CrossRef\]](#)
- Huselid, Mark A. 1995. The Impact Of Human Resource Management Practices On Turnover, Productivity, And Corporate Financial Performance. *Academy of Management Journal* 38: 635–72. [\[CrossRef\]](#)
- Kripfganz, Sebastian. 2016. Quasi-maximum likelihood estimation of linear dynamic short-T panel-data models. *The Stata Journal* 16: 1013–38. [\[CrossRef\]](#)
- Leszczensky, Lars, and Tobias Wolbring. 2019. How to Deal with Reverse Causality Using Panel Data? Recommendations for Researchers Based on a Simulation Study. *Sociological Methods & Research* 1–29, in press. [\[CrossRef\]](#)
- Li, Jiatao, Haoyuan Ding, Yichuan Hu, and Guoguang Wan. 2021. Dealing with dynamic endogeneity in international business research. *Journal of International Business Studies* 52: 339–62. [\[CrossRef\]](#)
- Lokke, Ann-Kristina, and Sarah M. L. Krotel. 2020. Performance evaluations of leadership quality and public sector leaders’ absenteeism. *Public Management Review* 22: 96–117. [\[CrossRef\]](#)
- Malikov, Kamran, Stuart Manson, and Jerry Coakley. 2018. Earnings management using classification shifting of revenues. *British Accounting Review* 50: 291–305. [\[CrossRef\]](#)
- Markussen, Simen, Knut Røed, Ole J. Røgeberg, and Simen Gaure. 2011. The anatomy of absenteeism. *Journal of Health Economics* 30: 277–92. [\[CrossRef\]](#)
- Nesselroade, John R., Stephen M. Stigler, and Paul B. Baltes. 1980. Regression toward the mean and the study of change. *Psychological Bulletin* 88: 622–37. [\[CrossRef\]](#)
- Nickell, Stephen. 1981. Biases in Dynamic Models with Fixed Effects. *Econometrica* 49: 1417–26. [\[CrossRef\]](#)

- Preacher, Kristopher J., and Andrew F. Hayes. 2008. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods* 40: 879–91. [[CrossRef](#)]
- Roodman, David. 2009. How to do Xtabond2: An Introduction to Difference and System GMM in Stata. *The Stata Journal* 9: 86–136. [[CrossRef](#)]
- Stumpf, Stephen A., and Patricia Kelly Dawley. 1981. Predicting Voluntary and Involuntary Turnover Using Absenteeism and Performance Indexes. *Academy of Management Journal* 24: 148–63. [[CrossRef](#)]
- Viswesvaran, Chockalingam. 2002. Absenteeism and measures of job performance: A meta-analysis. *International Journal of Selection and Assessment* 10: 12–17. [[CrossRef](#)]
- Williams, Richard, Paul Allison, and Enrique Moral-Benito. 2019. *XTDPDML: Stata Module to Estimate Dynamic Panel Data Models Using Maximum Likelihood*. College Station: Stata Press.
- Windmeijer, Frank. 2005. A finite sample correction for the variance of linear efficient two-step GMM estimators. *Journal of Econometrics* 126: 25–51. [[CrossRef](#)]
- Winkelmann, Rainer. 1999. Wages, firm size and absenteeism. *Applied Economics Letters* 6: 337–41. [[CrossRef](#)]
- Wooldridge, J. M. 2010. *Econometric Analysis of Cross Section and Panel Data*, 2nd ed. Cambridge: MIT Press.
- Wooldridge, J. M. 2019. *Introductory Econometrics: A Modern Approach*, 7th ed. UK: Cengage.

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