

# BOSS COMPETENCE AND WORKER WELL-BEING

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Nearly all workers have a supervisor or “boss.” Yet little is known about how bosses influence the quality of employees’ lives. This study offers new evidence. First, the authors find that a boss’s technical competence is the single strongest predictor of a worker’s job satisfaction. Second, they demonstrate using longitudinal data, after controlling for fixed-effects, that even if a worker stays in the same job and workplace, a rise in the competence of a supervisor is associated with an improvement in the worker’s well-being. Third, the authors report a variety of robustness checks, including tentative instrumental variable results. These findings, which draw on U.S. and British data, contribute to an emerging literature on the role of “expert leaders” in organizations.

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Although bosses are ubiquitous in modern society, almost no research on how bosses affect the happiness and well-being of their workers has been done by industrial relations researchers and labor economists.<sup>1</sup> In this article, we cautiously offer new evidence. We suggest that the underlying technical competence of a boss may have major

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<sup>1</sup>A search through the standard labor textbook by Filer, Hamermesh, and Rees (1996), for example, finds only one mention of the word *boss* or *supervisor* in its 600 pages; a textbook such as Ehrenberg and Smith (2012) has a larger number of mentions but does not provide an analytical model or discuss data. As another illustration, a search on the Web of Science shows that in the whole history of the *Journal of Labor Economics* only one article mentioned in its keywords, abstract, or title the word *supervisors* and only one other article mentioned *bosses*. The same is true of the *Journal of Human Resources*. *ILR Review* has had a number of articles, the closest in spirit to ours perhaps being Heywood, Siebert, and Wei (2002), but none looked at links with job satisfaction. In the *Journal of Occupational and Organizational Psychology*, the closest article to ours appears to be Miles, Patrick, and King (1996), but that article did not make the same point as ours and was, instead, about supervisors’ communication. Large and important related literatures are available on procedural justice, by McFarlin and Sweeney (1992) and others; on citizenship, by authors such as Cappelli and Rogovsky (1998); and on group-payment systems by Freeman, Kruse, and Blasi (2008) and Green and Heywood (2010), but these also did not cover the issue tackled here.

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consequences for workers' job satisfaction and present a range of correlational findings. The article draws on cross sections and panels of data on job satisfaction from the United States and Britain; it reports seven different forms of evidence. Although the article's evidence is of a simple kind, and cannot have the persuasiveness of a randomized controlled trial, we hope the patterns and results may interest many different types of researchers. Job satisfaction is an indicator of worker well-being and is known to be a predictor of quit rates (e.g., Clark 2001; Levy-Garboua, Montmarquette, and Simmonet 2007).

In this study, we examine changes in supervisors within-person and within-firm, and the study thus relates to work on social capital in the workplace (e.g., Helliwell and Huang 2010), the economics of hierarchies (e.g., Garicano 2000), managerial attention (e.g., Halac and Prat 2014), and expert leaders (e.g., Goodall, Kahn, and Oswald 2011). We also consider issues of causality. Although we cannot resolve all the difficulties, we investigate a longitudinal sample of workplaces in which the identity of the employee remains the same and the only change is in the quality of the supervisor; we also tentatively provide some instrumental variable (IV) estimates. We find a significant role for variables that have been little-studied by labor researchers, such as 1) whether the supervisor worked his or her way up inside the company; 2) whether the supervisor could, in an emergency, do the employee's job; and 3) the supervisor's assessed level of competence. The first two of these are, in principle, indirect indicators of supervisor competence, but they also seem of independent interest as variables that have been rarely examined by labor-market researchers.

In this article, we follow in the footsteps of Freeman (1978) and Lazear, Shaw, and Stanton (2011). The article links to recent literature that, although not directly about the influence of bosses on well-being, has sought to understand the influence of bosses on productivity. Prominent among this recent literature are writings such as Lazear et al. (*ibid.*), Yukl (2008), Mackey (2008), and Branch, Hanushek, and Rivkin (2013). Our results are also consistent with new evidence in Brown, Gray, McHardy, and Taylor (2014) on links between employee trust (in managers) and good workplace outcomes. More broadly, this study fits within a growing research literature on well-being written by economists and psychologists (including Clark and Oswald 1996; Diener, Suh, Lucas, and Smith 1999; Di Tella, MacCulloch, and Oswald 2001; Hamermesh 2001; Frey and Stutzer 2002; Easterlin 2003; Senik 2004; Layard 2006; Booth and van Ours 2008; Powdthavee 2010; Graham 2011; Benjamin, Heffetz, Kimball, and Rees-Jones 2012).

Although the happiness and job satisfaction of workers might be believed to matter in themselves, they are now also thought to do so indirectly. Growing evidence has become available that happier workers are more productive (e.g., the work of Carol Graham, such as Graham, Eggers, and Sukhtankar 2004; many articles by the late Alice Isen, such as Isen 2000; and research by Argyle 1989; Tsai, Chen and Liu 2007; Bockerman, Bryson,

and Ilmakunnas 2012; Edmans 2012; De Neve and Oswald 2012; and Oswald, Proto and SgROI 2015). The broader background has been more general research on the effects of leaders on measures of organizational performance. One strand, to which this article is a contribution, has attempted to understand the role of expert leaders (Goodall 2009, 2011). Such research has largely been at a senior level; it has attempted to separate chief-executive-officer (CEO) effects from industry or firm effects to calculate the explanatory power of leaders and their characteristics (e.g., Thomas 1988; Finkelstein and Hambrick 1996; Waldman and Yammarino 1999; Souder, Simsek, and Johnson 2012; Dezso and Ross 2012; Bloom, Genakos, Sadun, and Van Reenen 2012). Literatures also exist on high-involvement management (Guthrie 2001; Bryson, Forth, and Kirby 2005; Bockerman et al. 2012; Boxall and Macky 2014), although those did not tackle the exact issue considered in this article, and on the influence of private equity (Agrawal and Tambe 2014).

### A Framework

Why would supervisors matter? No standard theory has been put forward on how a supervisor affects a workplace.<sup>2</sup> Our approach has been influenced by the innovative work of Lazear et al. (2011), which discussed the potential training, advising, and motivating functions of bosses. That channel is logical and almost certainly captures some of the activities of real-world bosses and supervisors (for some discussion of this in an elite sports setting, see Becker and Wisberg 2008; Goodall et al. 2011). Nevertheless, our conception differs in one way. Bosses are, in principle, special workers because they are in charge. They make a range of organizational decisions. Therefore, viewing a boss as just another factor of production, or as altering only the quality of an employee's input through greater marginal product in the production function, may not be desirable. Instead, we may find that viewing a boss as shaping the nature of the organization is more appropriate.

We designed this study as an empirical rather than theoretical contribution. Nevertheless, as one approach to possible thinking, we also describe a characterization of the equilibria of different kinds of efficiency and how supervisors might alter the outcome from one such equilibrium to another. We implicitly have in mind a wider set of supervisory functions than found in Lazear et al. (2011). One important conceptual challenge, on which our article is silent, is that real-world employees and supervisors are sorted into subtly different kinds of firms and specific job tasks; a weakness of our theoretical account is that it ignores much of such heterogeneity.

Consider a world in which three kinds of agents are to be understood: the worker, the supervisor, and the employer (i.e., the firm or

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<sup>2</sup>This might sound paradoxical because supervisors are all around us, but historically the implicit presumption in labor economics has been that supervisors can be treated (where they have been considered explicitly at all) as just another kind of input in the  $F(\dots)$  function.

organization). Imagine that a worker and a supervisor can be thought of as combining their efforts to produce some kind of output. For analytical simplicity, assume that the firm can be thought of as existing in the background rather than the foreground but that this employing firm has, ultimately, to receive a share of whatever is produced jointly by the worker and the supervisor. The worker and the supervisor must then decide how to behave. Let the worker take some kind of action, denoted  $a$ . Let the supervisor's action be denoted  $s$ . These could be thought of as effort levels, but they can also be viewed much more broadly (e.g.,  $s$  could be advice given to a worker by an experienced supervisor). The variables  $a$  and  $s$  can easily be generalized to vectors of actions; but for simplicity in the algebra here, they are not. They are instead viewed as single variables defined on the real line. Together, the two actions lead to the firm's output  $Q$ :

$$(1) \quad Q = q(a, s)$$

where both  $a$  and  $s$  contribute to output and have positive first derivatives.

Something also has to be assumed about incomes. Assume that the worker gets share  $\psi$  of the output and that the supervisor gets share  $\sigma$ . The remainder goes to the employer. Assume that the employee's utility function takes the general form:

$$(2) \quad \mu = \mu(a, s, \psi Q) - c(a)$$

Thus part of utility depends directly on the actions  $a$  and  $s$ ; another part depends on the share of the output that accrues to the worker; and a final part depends on the cost of action  $a$ , which is assumed to be captured by a convex increasing function  $c(a)$ . At this stage, no assumption needs to be made about the sign of the derivatives of the  $\mu$  function in Equation (2). For simplicity, the cost function is treated in Equation (2) as separable, but that can straightforwardly be dropped. If we desire,  $\mu$  here might be thought of approximately as the overall job satisfaction of a worker. It is a measure of the worker's total utility from the work environment.

Finally, we write the supervisor's utility function in a symmetric way:

$$(3) \quad v = v(a, s, \sigma Q) - k(s)$$

where the function  $k(s)$  captures the supervisor's cost of action.

For ease of notation, Equations (2) and (3) can be written in a more compressed way. We first define identities:

$$(4) \quad \mu(a, s, \psi Q) = u(a, s)$$

$$(5) \quad v(a, s, \sigma Q) = v(a, s)$$

From these, we write the two parties' net utilities as:

$$(6) \quad \text{Worker's utility} = u(a, s) - c(a)$$

$$(7) \quad \text{Supervisor's utility} = v(a, s) - k(s)$$

This framework is a very simple one, but it allows us to think of the different types of outcomes that might be expected to occur. Put more generally, simultaneous-move public-goods games with complementarities in the production function are known to have multiple equilibria in a wide range of cases, and this kind of conceptual background therefore offers one potential way of thinking about what supervisors do. Both communication and coordination (changing the order of moves) are ways that supervisors might increase the chances that better equilibria are reached.<sup>3</sup> As Brandts and Cooper put it: “in the absence of managerial intervention, subjects invariably slip into coordination failure. . . .we find that communication is a more effective tool than incentive changes for leading organizations out of performance traps” (2007: 1223).

Consider initially what might be called the case of the inexpert supervisor: Here a supervisor is relatively inexperienced in the nature of the work and the type of workplace. He or she thus lacks deep knowledge about the worker and the environment. Assume that the supervisor is able to observe the action of the worker but, beyond that, understands little about the work setting. In this case, because the supervisor is so inexpert, the two parties can be thought of as behaving in a non-cooperative rather than cooperative way. Then a Nash equilibrium potentially exists in which both the worker and the supervisor choose their actions  $(a, s)$  independently. This outcome is characterized by the usual first-order conditions:

$$(8) \quad u_a - c'(a) = 0$$

$$(9) \quad v_s - k'(s) = 0$$

Therefore, the outcome, which can be thought of as the intersection of two reaction functions, is, for the standard reasons, either strictly or weakly suboptimal for the worker-supervisor pair (intuitively, because each ignores the externalities imposed on the other party). Equations (8) and (9) define a self-reinforcing fixed point and thus one kind of equilibrium.

We might think that the supervisor in such a setup is behaving foolishly. But that reaction would not be an appropriate one. This kind of non-cooperative outcome is feasible and rational for a supervisor who has limited knowledge. It requires only that 1) the supervisor knows his or her own preferences, and 2) the supervisor can see the action chosen by the employee, even if the supervisor has little understanding of why the worker chose that action or how the workplace could be organized better.

Other supervisors may be different; let us call them expert supervisors. They are individuals who have a deep and expert knowledge of both the core business and the nature of the worker. In such a case, an expert

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<sup>3</sup>For earlier discussions of such ideas, see the interesting work of Brandts and Cooper (2007); Goerg, Kube, and Zultan (2010).

supervisor could, in principle, help guide the pair to a jointly efficient outcome (for the pair, and, by implication, for the employing firm in the background). This is not a minor variant on the previous outcome. The outcome is not a Nash equilibrium; rather, the expert supervisor helps to produce a cooperative equilibrium. The worker and the supervisor choose actions  $(a, s)$  jointly to solve:

$$\text{Maximize } u(a, s) - c(a, s) \quad \text{such that } v(a, s) - k \geq V$$

where  $V$  is an arbitrarily fixed level of net utility for the supervisor. Thus, this case is characterized by Pareto efficiency and:

$$(10) \quad u_a - c'(a) - \lambda v_a = 0$$

$$(11) \quad v_s - k'(s) - \lambda k_s = 0$$

where  $\lambda$  is the usual Lagrangean multiplier.

Here the defining aspect—and perhaps ultimately a testable one—is that the expert supervisor has to have an experienced understanding of the work setting and the character of the employees. The reason for this is simple. Such information is essential to achieve a cooperative equilibrium, whether by implicit negotiation or explicit negotiation. The expert supervisor leads the pair away from inefficient Nash equilibria. As can be seen, Equations (10) and (11) satisfy the requirements for Pareto efficiency. The worker and the supervisor will thus typically have higher utilities in this case. Expert bosses can offer workers the best outcomes. By contrast, to get to a Nash equilibrium in the first (inexpert) case, neither the supervisor nor the worker needs to know (almost) anything about the other side's preferences. An agent simply maximizes given what he or she sees the other side choose as the opposing side's action.

By such logic, workers can benefit from an expert supervisor, and not merely from any higher income level that such a supervisor might make possible. A supervisor's deep expertise may act to alter, and improve, the very nature of equilibrium outcomes. In this article, we do not attempt to test a narrow form of this framework because we are unable to do so using the type of data we have; nevertheless, this conception offers a potential way to think about the later empirical issues.

### Cross-Sectional Evidence

The data used<sup>4</sup> here are drawn from 1) a single cross section from the National Longitudinal Survey of Youth (NLSY) for 1990, 2) a cross section from the Working in Britain Survey (WIB) for 2000, and 3) a set of panel data from the NLSY 1979 to 1988. These data sets are statistically

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<sup>4</sup>Most surveys do not report information about the role of supervisors, so we have to use selected years for which such data are available.

representative of their chosen populations. Table 1 describes their key features, reporting the means and standard deviations.

Elementary evidence consistent with the possible importance of supervisors is visible in the regression equations of Table 2. Here the dependent variable is a measure of the job satisfaction<sup>5</sup> of approximately 6,000 randomly sampled young U.S. workers; the wording of the survey question is “Overall, how satisfied are you with your job?” with the responses on a four-point scale ranging from “I like it very much” to “I dislike it very much.”<sup>6</sup> For ease of reading, we report the findings using a simple ordinary least squares (OLS) estimator. The results are essentially unaffected when we use instead an ordered estimator.<sup>7</sup> The mean of the dependent variable in Table 2 is approximately 3.2 on a four-point scale; it has a standard deviation (driven by the across-person variation) of approximately 0.7 (see Table 1).

We are interested in the consequences of highly competent, or expert, supervisors. No single or conventional way to define *competence* is possible; hence, in this article we examine several different measures.

In Table 2, a dummy variable for the supervisor having worked his or her way up the ranks is used, and another dummy variable is used for the supervisor's having started or owning the company. After adjusting for a conventional set of covariates, we find a combined dummy variable for these two together (a form of either-or dummy) in column 1 of Table 2, which has a positive coefficient of 0.047. This coefficient is significantly different from 0 at the 95% level on a two-tailed test. It is substantial.

To get a sense for the estimated effect-size, we require some standard of comparison. A natural approach is to compare the coefficient on the supervisor competence variables against the coefficients on other variables in a regression equation. For example, when we compare our coefficient to the famously large coefficients in the job-satisfaction literature, the number 0.047 is close to the same size as the coefficient on Married, and approximately one-third the size of the extra satisfaction associated with working in the Public sector. Other variables also enter in ways familiar from the literature. For example, after controlling for income, we find that those with higher levels of education are less satisfied with their jobs (one of the early demonstrations of this was in Clark and Oswald 1996), the level of earnings enters positively, and black workers suffer a negative coefficient. Table 2, column (2), explores the effects of dividing the supervisor dummy variable into its two constituent parts. Here the two coefficients (0.044 and 0.059, respectively) are close in size, although, as might be expected after the

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<sup>5</sup>Most of the results in the article use job-satisfaction numbers as the variable measuring worker well-being. But we have replicated the spirit of these results using alternative measures, such as desire-to-quit information in the WIB data set and satisfaction with supervisor. The key finding remains the same. Those equations are available from the authors upon request.

<sup>6</sup>See the note in Table 2 for the full wording of the survey question.

<sup>7</sup>These versions of the equations are available from the authors upon request.

Table 1. Variable Definitions and Descriptive Statistics

Variable	Definition	Mean		
		Sample 1 <sup>a</sup>	Sample 2 <sup>b</sup>	Sample 3 <sup>c</sup>
Job satisfaction (NLSY data)	Global job satisfaction: from 1 = "Dislike very much" to 4 = "Like very much"	3.181 (0.749)	3.295 (0.728)	—
Job satisfaction (WIB data)	Global job satisfaction: from 1 = "Completely dissatisfied" to 7 = "Completely satisfied"	—	—	5.305 (1.101)
Supervisor competence	Supervisor is competent in doing the job: from 1 = "Not true at all" to 4 = "Very true"	3.489 (0.748)	—	—
Supervisor expertise	1 = supervisor "Worked way up through ranks" or "Started or owns company"; 0 otherwise	—	0.683 (0.465)	—
Supervisor knowledge	Supervisor "knows their own job well": from 1 = "Not at all true" to 4 = "Very true"	—	—	3.236 (0.904)
Supervisor replacement	Supervisor "could do [worker's] job if [worker] was away": from 1 = "Not true at all" to 4 = "Very true"	—	—	2.523 (1.216)
Friendly	Your coworkers are friendly: from 1 = "Not true at all" to 4 = "Very true"	3.630 (0.588)	—	—
Best	You are given a chance to do the things you do best: from 1 = "Not true at all" to 4 = "Very true"	3.085 (0.887)	—	—
Female	1 = worker is female; 0 = male	0.466 (0.499)	0.444 (0.497)	0.529 (0.499)
Hispanic	1 = worker is Hispanic; 0 otherwise	0.161 (0.368)	0.156 (0.363)	—
Black	1 = worker is black; 0 otherwise	0.217 (0.413)	0.245 (0.431)	—
High school	1 = worker has only a high school degree; 0 otherwise	0.445 (0.497)	0.429 (0.495)	—
Some college	1 = worker has more than a high school degree but not a four-year degree; 0 otherwise	0.196 (0.397)	0.223 (0.416)	—
College	1 = worker has at least a four-year degree; 0 otherwise	0.090 (0.286)	0.208 (0.406)	—
Degree or higher	1 = worker has a degree, equivalent or higher; 0 otherwise	—	—	0.302 (0.459)
A/AS-level	1 = worker has A-level or AS-level education; 0 otherwise	—	—	0.112 (0.316)
O-level	1 = worker has O-level education; 0 otherwise	—	—	0.252 (0.435)
CSE	1 = worker has CSE education; 0 otherwise	—	—	0.111 (0.314)
Married	1 = worker is married; 0 otherwise	0.283 (0.451)	0.523 (0.500)	0.653 (0.476)
Union	1 = worker is a member of a labor union; 0 otherwise	0.174 (0.379)	0.138 (0.345)	0.327 (0.469)
Public	1 = worker's employer is a government institution; 0 otherwise	0.111 (0.315)	0.131 (0.338)	0.300 (0.458)

(continued)



Table 1. Continued

Variable	Definition	Mean		
		Sample 1 <sup>a</sup>	Sample 2 <sup>b</sup>	Sample 3 <sup>c</sup>
Age	Age in years	22.160 (3.842)	29.038 (2.254)	38.501 (10.584)
Age squared	Age in years × Age in years	505.81 (178.14)	848.31 (131.60)	1,594.29 (840.39)
Tenure	Tenure at employer in weeks	78.21 (96.31)	177.15 (172.64)	386.71 (389.09)
Tenure squared	Tenure at employer × Tenure at employer	153.91 (416.83)	611.82 (101.907)	3,008.42 (567.750)
Log hours	Natural log of weekly hours worked	3.555 (0.400)	3.731 (0.150)	3.454 (0.427)
Log earnings	Natural log of weekly earnings at job	5.141 (0.763)	5.918 (0.622)	5.553 (0.775)

Notes: Standard deviations appear in parentheses. CSE, certificate of secondary education; NLSY, National Longitudinal Survey of Youth; WIB, Working in Britain Survey.

<sup>a</sup>Number of observations = 27,537 using data from five NLSY waves (1979, 1980, 1981, 1982, and 1988). Includes 10 occupation categories and 13 industry categories.

<sup>b</sup>Number of observations = 6,298 using data from the NLSY 1990 wave. Includes 10 occupation categories, 13 industry categories, and 4 firm-size categories.

<sup>c</sup>Number of observations = 1,604 using data from WIB 2000. Includes 9 occupation categories, 9 industry categories and 3 firm-size categories.

reduction in statistical power, the individual *t*-statistics become weaker at approximately 1.8 and 1.6.

Table 3 is in the same spirit but uses a British data set, the WIB 2000. This provides a randomly selected sample of approximately 1,600 individuals. Here the wording used to construct the dependent variable is similar to the NLSY, but workers now answered on a seven-point scale from “I am completely satisfied” to “I am completely dissatisfied.” The mean of the dependent variable in Table 3 is approximately 5.3, with a standard deviation of approximately 1.1 (see Table 1).

In Table 3, the questions workers were asked were “Could your supervisor do your job if you were away?” and “Does the supervisor know their own job well?” Both of these allow the construction of a banded dummy variable for competence. This is because they are coded on a four-point scale from “Yes, very true” to “No, not true at all.” For the first question, the mean of workers’ answers is 2.5, and for the second, the mean is 3.2 (see Table 1; apparently a large number of workers do not believe the supervisor could fill in for the worker if the worker were away, but workers give supervisors higher grades for the ability to do their supervisory role). We might reasonably argue that different interpretations are possible. Nevertheless, the two questions seem independently interesting and apparently have not been studied before.

The coefficient in Table 3 on the variable Supervisor could do the worker’s job is positive, large, and statistically well determined. Its estimate is

Table 2. Regression Equations for Job Satisfaction in the United States:  
OLS Cross-Sectional Estimates

Variable	Job satisfaction <sup>a</sup>	
	(1)	(2)
Supervisor “worked way up in the ranks” or “started or owns company” <sup>b</sup>	0.047** (2.009)	— —
Supervisor “worked way up in the ranks”	—	0.044* (1.782)
Supervisor “started or owns company”	—	0.059 (1.612)
Female	0.031 (1.143)	0.030 (1.120)
Hispanic	0.075*** (2.663)	0.075*** (2.668)
Black	-0.062** (-2.413)	-0.062** (-2.382)
Age	0.064 (0.479)	0.064 (0.478)
Age squared	-0.001 (-0.473)	-0.001 (-0.473)
High school degree	-0.031 (-0.836)	-0.031 (-0.837)
Some college education	-0.046 (-1.105)	-0.046 (-1.099)
Four-year college degree	-0.084* (-1.789)	-0.083* (-1.780)
Married	0.062*** (2.761)	0.062*** (2.778)
Union	-0.049 (-1.498)	-0.048 (-1.453)
Public sector	0.136*** (3.279)	0.137*** (3.300)
Log weekly earnings	0.115*** (4.568)	0.115*** (4.550)
Log weekly hours worked	0.230*** (2.893)	0.230*** (2.892)
Tenure	$-4.9 \times 10^{-4}$ ** (-2.417)	$-4.9 \times 10^{-4}$ ** (-2.412)
Tenure squared	$2.80 \times 10^{-7}$ (0.846)	$2.79 \times 10^{-7}$ (0.844)
Firm sizes (4)	Yes	Yes
Industries (13)	Yes	Yes
Occupations (10)	Yes	Yes
Constant	0.973 (0.498)	0.972 (0.497)
Number of observations	6,298	6,298

Source: NLSY 1990 data.

Notes: *t*-statistics are in parentheses. Survey weights are used throughout. NLSY, National Longitudinal Survey of Youth; OLS, ordinary least squares.

<sup>a</sup>“How do/did you feel about the job you have now / your most recent job?” 1 = “Dislike very much”; 2 = “Dislike somewhat”; 3 = “Like fairly well”; 4 = “Like very much.”

<sup>b</sup>“To the best of your knowledge, what reason on this card best explains how he/she came to occupy his/her position?” 1 = “Worked way up through ranks” or “Started or owns company”; 0 = otherwise.

\*\*\*, \*\*, and \* represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 3. Results of Regression Equations for Job Satisfaction in Great Britain:  
OLS Cross-Sectional Estimates

Variable	Job satisfaction <sup>a</sup>		
	(1)	(2)	(3)
Supervisor "could do [worker's] job" <sup>b</sup>	0.132*** (5.321)	— —	0.055** (2.086)
Supervisor "knows own job" <sup>c</sup>	—	0.305*** (8.633)	0.279*** (7.371)
Female	0.227*** (3.193)	0.212*** (3.065)	0.213*** (3.074)
Age	-0.033 (-1.526)	-0.047** (-2.237)	-0.044** (-2.125)
Age squared	$4.47 \times 10^{-4}$ * (1.657)	0.001** (2.382)	0.001** (2.284)
Degree or higher	-0.142 (-1.349)	-0.182* (-1.762)	-0.178* (-1.727)
A-level or AS-level	-0.175 (-1.506)	-0.210* (-1.836)	-0.206* (-1.802)
O-level	-0.212** (-2.243)	-0.222** (-2.368)	-0.223** (-2.385)
CSE	-0.052 (-0.489)	-0.058 (-0.552)	-0.065 (-0.622)
Married	0.106 (1.621)	0.123* (1.943)	0.118* (1.847)
Union	-0.183** (-2.484)	-0.146** (-2.040)	-0.147** (-2.058)
Public sector	0.117 (1.413)	0.149* (1.842)	0.146* (1.815)
Log weekly hours worked	-0.237*** (-2.693)	-0.207** (-2.414)	-0.204** (-2.383)
Log annual salary	0.211*** (3.456)	0.192*** (3.124)	0.201*** (3.304)
Tenure	$1.84 \times 10^{-4}$ (0.816)	$1.92 \times 10^{-4}$ (0.834)	$2.30 \times 10^{-4}$ (1.003)
Tenure squared	$-1.41 \times 10^{-7}$ (-0.863)	$-1.38 \times 10^{-7}$ (-0.796)	$-1.59 \times 10^{-7}$ (-0.924)
Firm sizes (3)	Yes	Yes	Yes
Industries (9)	Yes	Yes	Yes
Occupations (9)	Yes	Yes	Yes
Constant	5.239*** (9.746)	4.814*** (9.197)	4.634*** (8.867)
Number of observations	1,604	1,604	1,604

Source: Working in Britain Survey 2000 data.

Notes: *t*-statistics are in parentheses. Survey weights are used throughout. CSE, certificate of secondary education; OLS, ordinary least squares.

<sup>a</sup>"All in all, how satisfied would you say you are with your job?" Range from 1 = "Completely dissatisfied" to 7 = "Completely satisfied."

<sup>b</sup>"How true is it that your supervisor could do your job if you were away?" 1 = "Not at all true"; 2 = "Somewhat true"; 3 = "True"; 4 = "Very true."

<sup>c</sup>"How true is it that your supervisor or manager knows their own job well?" 1 = "Not at all true"; 2 = "Somewhat true"; 3 = "True"; 4 = "Very true."

\*\*\*, \*\*, and \* represent statistical significance at the 1%, 5%, and 10% levels, respectively.

approximately 0.13, with a *t*-statistic in excess of 5. Employees enjoy their jobs far more when the supervisor is assessed as technically competent. To get a sense of the size of the coefficient, recall that the variable runs from 1 to 4. Hence, a movement from “Not true at all” (that the supervisor could do the worker’s job) to “Very true” would be associated with a quadrupling of the level of job satisfaction from this source. The first column of Table 3 therefore points to a striking pattern in the data. Here the existence of a highly competent supervisor implies 0.4 extra point (on a seven-point scale) on the worker’s job satisfaction. This is almost double the combined coefficients for Married and working in the Public sector. (We return later to what might account for this strength.)

Table 3, columns (2) and (3), report coefficients on a variable that codes answers to the question “How true is it that your supervisor or manager knows their own job well?” Because of its directness, this question might be thought to have special appeal.<sup>8</sup> In column (2), the coefficient on this variable is 0.305, with a *t*-statistic greater than 8 (the values of the variable run from 1 to 4). Thus a statistically representative worker whose supervisor knows his or her own job very well is markedly more contented than other workers. The difference in job satisfaction is approximately one full point on a seven-point scale. Table 3, column (3) shows that both these independent variables (Supervisor could do my job and Supervisor knows own job well) are significant when entered together in the specification. As would be expected, the individual coefficients in column (3) are slightly lower, 0.055 and 0.279, respectively, than in columns (1) and (2).

### Pooled Equations and Longitudinal Evidence

Table 4 contains evidence from a larger data set. It gives pooled cross-sectional estimates from the NLSY for the years 1979, 1980, 1981, 1982, and 1988. Here we have used all the years in which a particular supervisor question was included in the survey: “Is your supervisor competent in doing the job?” The responses were on a four-point scale from “Not true at all” to “Very true.” The sample size in these regression equations is approximately 27,000 employees.

The coefficients on the supervisor variable are now very substantial. In Table 4, column (1), of the job satisfaction equations, for example, the estimated coefficient is 0.303, with a *t*-statistic of approximately 35. This implies that a move from having the least-competent category of supervisor to the most-competent category of supervisor would be associated with a difference in job satisfaction of nearly one full point on a four-point scale.

In Table 4, column (1), we exclude a large number of the potentially relevant influences on the job satisfaction of the workers who are being supervised. The other columns gradually introduce more and more of these

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<sup>8</sup>We thank a referee for pointing this out.

Table 4. Results of Regression Equations for Job Satisfaction in the United States: Pooled Cross-Sectional Estimates

Variable	Job satisfaction <sup>a</sup>				
	(1)	(2)	(3)	(4)	(5)
Supervisor competence <sup>b</sup>	0.303*** (35.187)	0.303*** (35.155)	0.301*** (34.890)	0.293*** (34.057)	0.238*** (26.616)
Coworkers are friendly <sup>c</sup>	—	—	—	—	0.225*** (20.243)
Female	0.039*** (3.026)	0.037*** (2.814)	0.065*** (4.896)	0.057*** (3.837)	0.062*** (4.274)
Hispanic	0.004 (0.277)	0.003 (0.200)	-0.004 (-0.243)	0.002 (0.129)	0.010 (0.710)
Black	-0.110*** (-7.600)	-0.102*** (-6.993)	-0.097*** (-6.551)	-0.081*** (-5.472)	-0.054*** (-3.704)
Age	0.033** (2.274)	0.034** (2.121)	-0.031* (-1.739)	-0.024 (-1.360)	-0.023 (-1.330)
Age squared	-3.83 × 10 <sup>-4</sup> (-1.232)	-4.59 × 10 <sup>-4</sup> (-1.353)	0.001* (1.885)	0.001 (1.378)	4.89 × 10 <sup>-4</sup> (1.334)
High school degree	—	-0.017 (-1.074)	-0.039** (-2.384)	-0.060*** (-3.641)	-0.055*** (-3.456)
Some college education	—	-0.014 (-0.690)	-0.026 (-1.265)	-0.084*** (-3.894)	-0.081*** (-3.861)
Four-year degree	—	0.009 (0.361)	-0.057** (-2.214)	-0.196*** (-7.017)	-0.201*** (-7.332)
Married	—	0.049*** (3.488)	0.042*** (2.993)	0.043*** (3.094)	0.044*** (3.170)
Union	—	—	-0.066*** (-4.001)	-0.039** (-2.370)	-0.031** (-1.964)
Public sector	—	—	0.137*** (6.877)	0.051** (2.024)	0.052** (2.116)
Log weekly earnings	—	—	0.110*** (8.065)	0.093*** (6.719)	0.092*** (6.834)
Log weekly hours worked	—	—	0.038* (1.862)	0.052** (2.502)	0.051** (2.472)
Tenure	—	—	-9.10 × 10 <sup>-5</sup> (-0.655)	-1.76 × 10 <sup>-4</sup> (-1.265)	-1.74 × 10 <sup>-4</sup> (-1.269)
Tenure squared	—	—	4.19 × 10 <sup>-9</sup> (0.015)	1.41 × 10 <sup>-7</sup> (0.501)	1.52 × 10 <sup>-7</sup> (0.547)
Industries (13)	No	No	No	Yes	Yes
Occupations (10)	No	No	No	Yes	Yes
Year dummies	No	No	No	Yes	Yes
Constant	1.592*** (9.385)	1.598*** (8.528)	1.771*** (9.295)	2.086*** (10.415)	1.441*** (7.214)
Number of observations	27,537	27,537	27,537	27,537	27,537

Source: NLSY 1979–1982, 1988 data.

Notes: *t*-statistics are in parentheses. Survey weights are used throughout. Standard errors are clustered by individual respondent. NLSY, National Longitudinal Survey of Youth.

<sup>a</sup>“How do/did you feel about the job you have now / your most recent job?” 1 = “Dislike very much”; 2 = “Dislike somewhat”; 3 = “Like fairly well”; 4 = “Like very much.”

<sup>b</sup>“Your supervisor is competent in doing the job.” 1 = “Not true at all”; 2 = “Not too true”;

3 = “Somewhat true”; 4 = “Very true.”

<sup>c</sup>“Your coworkers are friendly.” 1 = “Not true at all”; 2 = “Not too true”; 3 = “Somewhat true”;

4 = “Very true.”

\*\*\*, \*\*, and \* represent statistical significance at the 1%, 5%, and 10% levels, respectively.

influences. Nevertheless, only minor changes are observed in the estimated coefficient on the Supervisor competence variable. By the fourth column of Table 4, the coefficient is still approximately 0.3.

A coherent objection to the estimates in Table 4 is that they are biased because the personality of the worker is an omitted variable. That is, possibly inherently “cheerful” people tend both to report high levels of job satisfaction and to give favorable assessments of their supervisor (they simply have a sunny outlook about everything). In that case, the association between the worker’s well-being and the assessment of the supervisor might be spurious. One way to probe this possibility is to include another variable for the inherent cheerfulness of the employee and to see whether that largely eliminates the significance of the Supervisor competence variable. The final column of Table 4 does so. It includes a variable for whether the individual reported that his or her coworkers are friendly. The friendliness variable is positive in Table 4, column (5). Nevertheless, once this inclusion is done the coefficient on the Supervisor competence variable is barely affected. It falls by only approximately 0.05 point to 0.238. This result is consistent with the existence of a genuine role for supervisor competence in job satisfaction.

Table 5 reports another form of evidence. In these fixed-effects regression equations, we are able to confirm that the positive correlation between Job satisfaction and a Supervisor competence variable is not spurious and merely attributable to other factors, such as omitted personality factors. Table 5 also gives results similar to those earlier tables, which establishes that such an interpretation cannot explain the patterns in the data.

Once again, the columns of Table 5 build up to fuller specifications. The Supervisor competence coefficient remains highly stable, at approximately 0.23, across the first four columns of the table. This value is not far from the estimate size from cross-sectional estimates. This fact itself suggests comparatively little bias exists from omitted person fixed-effects in the cross-sectional equations. Once again, the addition of the Coworkers are friendly variable has only a minor effect on the supervisor coefficient, and the variable itself is positive and well determined (which, because this is in a fixed-effects equation, is arguably suggestive of the idea that the friendliness of coworkers genuinely matters). In Table 5, column (5), the variable for Supervisor competence remains at approximately 0.2, with a *t*-statistic of approximately 23.

The other variables in these fixed-effects specifications of Table 5 are of interest. Even in the fullest specification, evidence exists that job satisfaction depends on education, whether the person works in the public sector, weekly earnings, and tenure. The coefficients of these variables are necessarily estimated from the “switchers” (people who moved to different workplaces) in the data set.

An illustration of effect-sizes is provided in the histogram in Figure 1. Here, we need to standardize the data in some way so that the quantitative

Table 5. Results of Regression Equations for Job Satisfaction in the United States: Fixed-Effects Estimates

Variable	Job satisfaction <sup>a</sup>				
	(1)	(2)	(3)	(4)	(5)
Supervisor competence <sup>b</sup>	0.243*** (28.790)	0.243*** (28.767)	0.239*** (28.183)	0.233*** (27.647)	0.198*** (22.951)
Coworkers are friendly <sup>c</sup>	—	—	—	—	0.165*** (14.993)
Age	0.039*** (2.789)	0.040** (2.374)	-0.001 (-0.064)	-0.028 (-1.192)	-0.025 (-1.078)
Age squared	$-4.75 \times 10^{-4}$ * (-1.618)	-0.001 (-1.530)	$2.55 \times 10^{-4}$ (0.696)	$4.37 \times 10^{-4}$ (1.169)	$3.74 \times 10^{-4}$ (1.007)
High school degree	—	-0.017 (-0.745)	-0.065*** (-2.800)	-0.074*** (-3.235)	-0.066*** (-2.911)
Some college education	—	-0.011 (-0.339)	-0.079** (-2.473)	-0.114*** (-3.594)	-0.105*** (-3.342)
Four-year degree	—	0.035 (0.892)	-0.142*** (-3.398)	-0.242*** (-5.699)	-0.239*** (-5.688)
Married	—	0.014 (0.883)	0.018 (1.147)	0.015 (0.975)	0.016 (1.059)
Union	—	—	-0.004 (-0.264)	0.007 (0.459)	0.011 (0.742)
Public sector	—	—	0.149*** (7.115)	0.059** (2.367)	0.061** (2.471)
Log weekly earnings	—	—	0.123*** (7.709)	0.118*** (7.325)	0.117*** (7.366)
Log weekly hours worked	—	—	-0.004 (-0.194)	-0.003 (-0.148)	-0.004 (-0.190)
Tenure	—	—	-0.001*** (-4.879)	-0.001*** (-5.439)	-0.001*** (-5.243)
Tenure squared	—	—	$4.60 \times 10^{-7}$ * (1.715)	$6.13 \times 10^{-7}$ ** (2.276)	$5.93 \times 10^{-7}$ ** (2.212)
Industries (13)	No	No	No	Yes	Yes
Occupations (10)	No	No	No	Yes	Yes
Year dummies	No	No	No	Yes	Yes
Constant	1.718*** (10.514)	1.710*** (8.772)	1.708*** (8.600)	2.361*** (6.684)	1.853*** (5.261)
Number of observations	27,537	27,537	27,537	27,537	27,537

Source: NLSY 1979–1982, 1988 data.

Notes: *t*-statistics are in parentheses. Standard errors are clustered by individual respondent. NLSY, National Longitudinal Survey of Youth.

<sup>a</sup>“How do/did you feel about the job you have now / your most recent job?” 1 = “Dislike very much”; 2 = “Dislike somewhat”; 3 = “Like fairly well”; 4 = “Like very much.”

<sup>b</sup>“Your supervisor is competent in doing the job.” 1 = “Not true at all”; 2 = “Not too true”; 3 = “Somewhat true”; 4 = “Very true.”

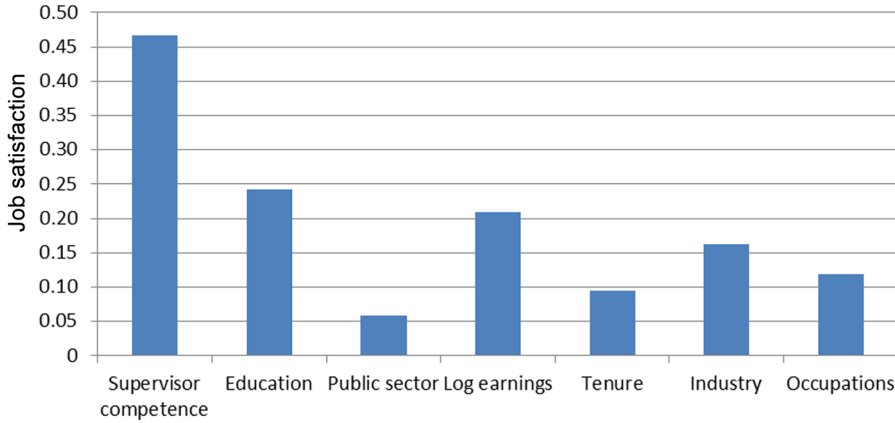
<sup>c</sup>“Your coworkers are friendly.” 1 = “Not true at all”; 2 = “Not too true”; 3 = “Somewhat true”; 4 = “Very true.”

\*\*\*, \*\*, and \* represent statistical significance at the 1%, 5%, and 10% levels, respectively.

role of different explanatory variables can be compared appropriately. We do so here by using 90th percentile to 10th percentile movements in the main independent variables (except, necessarily, the 0 or 1 Public sector dummy variable). The size of the estimated supervisor effect, in the first

Figure 1. The Major Role of Supervisor Competence on Job Satisfaction

**Effect of significant independent variables on job satisfaction**



Notes: Using standardized effect sizes and the fixed-effects estimates of Table 5, column (4). Values are computed by differencing the effects at the 10th percentile from the 90th percentile of each variable. The Public sector value is the difference in the effect between the public sector and the private sector, the Tenure value corresponds to difference between the 90th percentile and the 10th percentile, and the Education value is the difference in the effect between having a college degree and not finishing high school.

column of Figure 1, is strikingly large. It dominates any of the more conventional influences on workers' job satisfaction, including the role of worker remuneration.<sup>9</sup> Here the 10th percentile for the Supervisor competence variable is the second-lowest rating of Supervisor competence and the 90th percentile is the highest of the four possible ratings. Thus, this change corresponds to a two-point movement in the independent variable that measures Supervisor competence.

Table 6 reveals that our principal finding is robust to an important form of correction. A potential objection to Table 5 is that, in the whole sample used there, the switchers might have moved disproportionately to workplaces with (unobserved) better characteristics; this, we might argue, could lead to an upward bias on the coefficient on the Supervisor competence variable. We show that this is not what is driving the study's key finding. Table 6, columns (1) to (3), reveal that even in the final column, where we study only those who remained in the same job and same workplace, we

<sup>9</sup>A referee has asked us for a back-of-the-envelope calculation of the required monetary compensating variation for having a much poorer supervisor. That number is large. Although we would wish to view this kind of calculation as illustrative rather than as causal, the arithmetical answer, taking the Table 5 estimates, is that around the mean of earnings a one standard-deviation worsening of supervisor competence (admittedly, a substantial worsening) would have to be offset by approximately a 150% increase in the worker's pay. This conclusion, and the largeness of the estimate, is consistent with the spirit of the ideas of Brandts and Cooper (2007).



Table 6. Results of Regression Equations for Job Satisfaction in the United States: Alternative Groupings Fixed-Effects Estimates

Variable	Job satisfaction <sup>a</sup>		
	Narrow sample 1 <sup>b</sup>	Narrower sample 2 <sup>c</sup>	Narrowest sample 3 <sup>d</sup>
Supervisor competence <sup>e</sup>	0.179*** (16.420)	0.149*** (10.375)	0.121*** (4.926)
Coworkers are friendly <sup>f</sup>	0.160*** (11.800)	0.100*** (5.965)	0.064** (2.485)
Age	-0.138** (-1.979)	-0.129 (-1.294)	-0.046 (-0.223)
Age squared	0.004** (2.534)	0.004* (1.653)	0.001 (0.185)
High school degree	-0.084*** (-2.890)	-0.057 (-1.364)	-0.051 (-0.749)
Some college education	-0.162*** (-3.618)	-0.118* (-1.755)	-0.102 (-0.939)
Four-year degree	-0.446*** (-6.040)	-0.432*** (-3.396)	-0.839*** (-4.288)
Married	0.002 (0.102)	-0.037 (-1.185)	0.022 (0.382)
Union	-0.003 (-0.144)	0.019 (0.722)	0.004 (0.095)
Public sector	0.093*** (2.712)	0.158*** (2.754)	0.171* (1.930)
Log weekly earnings	0.126*** (5.564)	0.042 (1.490)	0.048 (1.011)
Log weekly hours worked	0.006 (0.191)	0.029 (0.586)	0.000 (0.005)
Tenure	-0.002*** (-5.062)	-0.004*** (-8.198)	-0.006*** (-4.238)
Tenure squared	$7.11 \times 10^{-7}$ (0.502)	$6.47 \times 10^{-6}$ *** (4.085)	$9.65 \times 10^{-6}$ *** (3.359)
Industries (13)	Yes	Yes	No
Occupations (10)	Yes	Yes	No
Year dummies	Yes	Yes	Yes
Constant	2.828*** (3.499)	3.484*** (3.104)	3.180 (1.437)
Number of observations	19,587	9,361	3,275

Source: NLSY 1979–1982 data.

Notes: This table gradually restricts the sample to show, in the final column, that the fixed-effect results hold even when the sample consists of only those workers who remained in the same job and workplace, that is, when only supervision altered. *t*-statistics are in parentheses. Standard errors are clustered by each cluster type in the corresponding columns. NLSY, National Longitudinal Survey of Youth.

<sup>a</sup>“How do/did you feel about the job you have now / your most recent job?” 1 = “Dislike very much”; 2 = “Dislike somewhat”; 3 = “Like fairly well”; 4 = “Like very much.”

<sup>b</sup>Includes all observations from 1979 to 1982.

<sup>c</sup>Includes only observations of workers in the same employer.

<sup>d</sup>Includes only observations of workers in same employer, occupation, and industry. The number of observations is reduced (i.e., groupings are large) because we use three-digit occupations and industries to generate the sample/groupings. This corresponds to very close job matches across the waves.

<sup>e</sup>“Your supervisor is competent in doing the job.” 1 = “Not true at all”; 2 = “Not too true”;

3 = “Somewhat true”; 4 = “Very true.”

<sup>f</sup>“Your coworkers are friendly.” 1 = “Not true at all”; 2 = “Not too true”; 3 = “Somewhat true”;

4 = “Very true.”

\*\*\*, \*\*, and \* represent statistical significance at the 1%, 5%, and 10% levels, respectively.

again find an influential role for the Supervisor competence variable. As we would expect, the coefficient is slightly lower, at 0.121, but it remains well determined, with a *t*-statistic of approximately 5.

Are some kinds of employees more sensitive to bosses' actions? What about certain kinds of workplaces? Further robustness checks are reported in Table 7. Column (1) tests for an interaction between the age of the worker and a variable for Supervisor competence. The level of Supervisor competence continues to be highly significant. An interaction term, however, shows a coefficient of 0.004 and a *t*-statistic of approximately 1.8. This implies there is mild evidence that the marginal effect of supervisor competence on the job satisfaction of the worker may be larger for older employees. One possible interpretation of this is that young workers are highly mobile and, thus, less susceptible to good or bad supervisors; another is that the old hold more senior positions in the job hierarchy and that their bosses are therefore fewer and individually more influential. Table 7, columns (2) and (3), then, show that in a fixed-effects job satisfaction equation a Supervisor competence variable works powerfully both for the large establishments and small establishments (where the cut-off chosen for *small* is having fewer than 50 employees). The variable's coefficient is slightly greater in column (2) for the group of small establishments. In each of the two columns, its *t*-statistic exceeds 4. Table 7, columns (4) and (5), alter the dependent variable. They use not a Job satisfaction variable but, instead, a variable for how the worker answered "You are given the chance to do the things you do best?" with responses ranging from "Not true at all" to "Very true." The aim is to probe whether supervisors might have effects through such a channel. The coefficients on the Supervisor competence variable for this are 0.207 and 0.183, respectively. Hence, these findings are consistent with the view that this channel is important. Competent supervisors may assign their workers particularly effectively. Further issues related to the gender of bosses were taken up in Artz and Taengnoi (2014), and we do not pursue those here.

### Further Issues

Several issues and concerns remain. Given the article's length constraints, we review them briefly next.

**Issue 1:** Although we have found that the results cannot be explained by omitted fixed-effects, they could, in principle, be the spurious result of exogenous mood swings.

Consider a worker who becomes happier for some external reason. Then he or she might see the world as a rosier place and thus might both report higher levels of job satisfaction and view the supervisor more favorably.

Such a criticism, although a cogent one, cannot account for all of our findings. It is unable to explain, for example, why the "Supervisor worked his way up through the company" variable is statistically significant in

Table 7. Results of Regression Equations for Job Satisfaction and “You Are Given the Chance to Do What You Do Best” in the United States: Robustness Checks

Variable	Job satisfaction <sup>a</sup> fixed-effects		Can do what you do best <sup>b</sup>	
	Whole sample	NLSY 1979, 1980, 1988	Pooled cross-sectional estimate	Fixed-effects estimates
	(1)	Small firm <sup>c</sup> (2)	(4)	(5)
		Big firm <sup>d</sup> (3)		
Supervisor competence <sup>e</sup>	0.110** (2.299)	0.194*** (7.784)	0.207*** (20.818)	0.183*** (19.291)
Coworkers are friendly <sup>f</sup>	0.165*** (15.011)	0.150*** (4.868)	0.162*** (13.315)	0.135*** (11.215)
Female	—	—	0.123 (-7.030)	—
Hispanic	—	—	0.043 (-2.347)	—
Black	—	—	-0.006 (-0.352)	—
Age × Supervisor competence	0.004* (1.846)	—	—	—
Age	-0.040 (-1.604)	-0.007 (-0.131)	0.076*** (3.702)	0.015 (0.554)
Age squared	3.91 × 10 <sup>-4</sup> (1.055)	0.001 (0.606)	-0.001*** (-3.185)	-0.001 (-1.258)
High school degree	-0.067*** (-2.941)	0.019 (0.317)	-0.081*** (-4.019)	-0.051* (-1.868)
Some college education	-0.106*** (-3.372)	0.045 (0.521)	-0.179*** (-6.890)	-0.073* (-1.934)
Four-year degree	-0.242*** (-5.742)	-0.065 (-0.594)	-0.224*** (-7.077)	0.032 (0.637)
Married	0.016 (1.053)	-0.011 (-0.270)	0.021 (1.365)	0.019 (1.097)

(continued)

Table 7. Continued

Variable	Job satisfaction <sup>a</sup> fixed-effects			Can do what you do best <sup>b</sup>	
	Whole sample	NLSY 1979, 1980, 1988	Big firm <sup>d</sup>	Pooled cross-sectional estimate	Fixed-effects estimates
	(1)	Small firm <sup>c</sup>	(3)	(4)	(5)
Union	0.012 (0.796)	0.035 (0.713)	-0.077 (-1.577)	-0.096*** (-4.943)	-0.027 (-1.474)
Public sector	0.062** (2.508)	0.207** (2.152)	0.354*** (2.634)	-0.016 (-0.535)	-0.036 (-1.181)
Log weekly earnings	0.117*** (7.346)	0.042 (0.979)	0.061 (1.370)	0.105*** (7.087)	0.116*** (6.661)
Log weekly hours worked	-0.004 (-0.162)	0.113** (2.093)	0.073 (0.978)	0.160*** (6.557)	0.071*** (2.756)
Tenure	-0.001*** (-5.192)	-0.001 (-1.397)	-0.001 (-1.505)	0.001*** (6.912)	0.001*** (3.209)
Tenure squared	$5.92 \times 10^{-7}$ ** (2.205)	$4.50 \times 10^{-7}$ (0.698)	$8.09 \times 10^{-7}$ (0.968)	$-1.76 \times 10^{-6}$ *** (-5.364)	$-1.21 \times 10^{-6}$ *** (-3.925)
Industries (13)	Yes	Yes	Yes	Yes	Yes
Occupations (10)	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes
Constant	2.163*** (5.520)	1.431* (1.740)	1.504 (1.286)	-0.072 (-0.301)	1.177*** (2.943)
Number of observations	27,537	8,009	6,339	27,537	27,537

Notes: *t*-statistics are in parentheses. Survey weights are used throughout. Standard errors are clustered by individual respondent.

<sup>a</sup>How do/did you feel about the job you have now / your most recent job? 1 = "Dislike very much"; 2 = "Dislike somewhat"; 3 = "Like fairly well"; 4 = "Like very much."

<sup>b</sup>You are given the chance to do the things you do best." 1 = "Not at all true"; 2 = "Not too true"; 3 = "Somewhat true"; 4 = "Very true."

<sup>c</sup>Small firms have fewer than 50 employees.

<sup>d</sup>Big firms have more than 49 employees.

<sup>e</sup>Your supervisor is competent in doing the job." 1 = "Not true at all"; 2 = "Not too true"; 3 = "Somewhat true"; 4 = "Very true."

<sup>f</sup>Your coworkers are friendly." 1 = "Not true at all"; 2 = "Not too true"; 3 = "Somewhat true"; 4 = "Very true."

\*\*\*, \*\*, and \* represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 2. And arguing that it could explain the statistical significance of the “Supervisor could do my job if I were away” variable in Table 3 would be difficult. It also does not explain why, in Table 4, the addition of a variable for perceived coworker friendliness (which should absorb most of a temporary mood-swing effect) leaves the coefficient on the Supervisor competence variable largely unchanged.

We could also argue that we cannot be certain what a variable for “Supervisor worked his way up . . .” literally meant to the respondents. It might even act as a proxy for social friendships between the worker and supervisor.<sup>10</sup> Nevertheless, we hope the results are interesting enough to stand as they are.

**Issue 2:** Supervisors in these data sets are not randomly assigned, so causality is moot.

This is an important point, and no perfect reply to it is possible. Relatively little is known in this research area. The econometric work points to an interesting and persistent type of correlation, so these early patterns seem intriguing. We have taken a number of steps here to explore endogeneity. Perhaps most interestingly, Table 6 reveals that, even when the worker stayed put so that the nature of the supervisor is the only thing that was altered, the study’s key result continues to hold in the longitudinal data. This finding is not plausibly viewed as unexplained reverse causality.

**Issue 3:** The dependent variables in the empirical work use subjective data, so they are not reliable.

If readers reach this point in the article, they have perhaps accepted the principle that subjective data can be of value. Nevertheless, as explained earlier, evidence exists that subjective scores are correlated with, and predictive of, objective and observable phenomena. Examples include Oswald and Wu (2010), which also reviewed the literature on this issue. Note also that corporations around the world make use of subjective satisfaction data, in market research and their human resources divisions, so such data might be said to have passed a key Chicago-esque market test.

**Issue 4:** Assessing whether the data support the conceptual framework sketched earlier in the article is not easy.

Such a view is fair. Nevertheless, the conceptual section (A Framework) offers one way to think that is different from treating supervisors mechanically as just another input in a standard concave production function. Once explicit functional forms are assumed, it may generate testable predictions for future research.

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<sup>10</sup>We thank a referee for pointing this out.

**Issue 5:** In principle, a valid instrument is needed for supervisor competence.

We are extremely sympathetic to, and cognizant of, such arguments. Given the data available to us, we cannot answer this concern in a truly persuasive way. In the spirit of inquiry, and although we would not wish to emphasize them, we have done some IV estimates. Obtaining an instrument that satisfies the exclusion restriction is intrinsically difficult. Nevertheless, our attempted IV results are reported in Table A.1 (in the Appendix). For this, a variable is needed that influences the competence of the supervisor and satisfies the necessary exclusion restriction in the second-stage equation. We exploit two possibilities. The first is whether the supervisor has a college degree; we view this as a likely shifter in the competence equation and as a priori excludable from a worker-satisfaction equation that includes industry and occupation dummies. The second possibility is a simple instrument, the earlier variable on whether the supervisor worked his or her way up in the organization (or owned or started the company), which could be viewed as a proxy for individual knowledge of, and detailed experience in, the company. We might view this not as a direct variable (as earlier) but, instead, as a candidate for inclusion in a competence equation and one that is excludable from the satisfaction equation as long as industry dummies are included. We can estimate such a model using the 1988 data. Table A.1, columns (1) and (4), which are for different subsamples, report OLS estimates as a baseline. Column (2) is the first-stage equation, namely, the equation for whether the supervisor was assessed as competent. The variable for the instrument (coded 0, 1, or 2) works positively with a coefficient of 0.171 and a *t*-statistic of approximately 7. In Table A.1, column (3), the instrumented job-satisfaction equation has a well-determined coefficient of 0.381 on the variable for Supervisor competence. The same pattern is found in columns (5) and (6). We argue, however, that these IV estimates should be treated cautiously.

**Issue 6:** A central role in the analysis is played by subjective assessments of the level of Supervisor competence, and these are used to define the key independent variable, so the evidence depends on the validity of such data.

Employees seem to be in a good position to answer truthfully and fairly objectively to, for example, an inherently factual question of the kind: “Did your supervisor work his or her way up in this company/start the company?” To answer this in the positive does not require the worker to like, or admire the behavior of, the supervisor. Such factual questions are routine in social science surveys and are widely used in almost all econometric research. Insofar as people’s answers contain measurement error (perhaps because they are new to the office or factory and are thus not certain about the job history of their supervisor), then regression coefficients will be biased downward, and that will typically make finding statistically significant results in the earlier equations harder, not easier.

## Conclusion

Bosses are found everywhere in working life, but their activities have provoked relatively little empirical interest among labor-market researchers. In this article, we offer evidence consistent with the belief that the qualities of supervisors—particularly their technical competence—may have significant and currently underappreciated consequences for workers' well-being. To the best of our knowledge, these results are the first of their kind.

Seven forms of empirical support have been documented here; some are particularly simple. These seven have different (perhaps complementary) strengths and weaknesses, but each is consistent with the broad idea that the quality of workers' lives is higher if the supervisor is highly competent, in a technical sense, at his or her job.<sup>11</sup> The size of the estimates varies from fairly substantial to strikingly large. In the results of some equations, such as those in Table 5, the assessed competence of the boss is the strongest predictor of employee well-being.<sup>12</sup> One weakness of our analysis should be noted: Information on an even wider range of supervisors' characteristics would be desirable (on supervisor age see, e.g., Artz 2013), but that must largely await future data sets.

Boss competence is, admittedly, a subtle concept. No conventional method is available for assessing it. For this reason, we have explored here a variety of empirical proxies for technical competence and expertise.<sup>13</sup> First, in a cross section of 6,000 young U.S. workers, the job satisfaction of employees is positively correlated with whether the supervisor worked his or her way up in the company (or in fact started the company). Second, in a cross section of 1,600 British workers, satisfaction levels are higher among individuals whose supervisor could, if necessary, step in competently to do that job and whose supervisor knows his or her own job extremely well. Third, in pooled cross sections totaling 27,000 workers, a variable for assessed Supervisor competence has a large positive coefficient in a job satisfaction equation. Fourth, the key conclusion continues to hold, with an only marginally reduced coefficient, in a fixed-effects estimation. Fifth, the conclusion is also unaffected in fixed-effects equations by the inclusion of an extra control variable that is a proxy for fluctuations in the underlying cheerfulness of individuals. Sixth, the conclusion is robust, with an only fractionally reduced effect-size, in estimates that restrict the sample solely to workers who remain in the same job in the same workplace and thus who are the employees who experience only a change in the quality of their

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<sup>11</sup>As mentioned earlier, we have obtained the same kinds of results using other measures.

<sup>12</sup>Figure 1 is one nontechnical way to convey this.

<sup>13</sup>Although, for simplicity, we have in some cases used a cardinalized measure of competence, Table A.2 shows that the findings are the same when the equations are re-estimated using a set of competence dummies. In further tests, Table A.3 reveals 1) that, as a check against attrition bias, the supervisor effect is equally strong in a sample of workers who recently left the employer, and 2) that some sign of asymmetry appears in the supervisor effect, in the sense that the absolute value of the coefficient is larger when the worker acquired a bad supervisor rather than a good one.

supervisor. Seventh, tentative IV estimates are reported in the Appendix Table A.1 and broadly support the conclusion.

Lazear et al. (2011) argued, in an appealing way, that bosses act to raise workers' productivity. We agree with this. In this article, however, we have considered a wider remit for bosses. They are trainers and advisors; nevertheless, they also make organizational decisions about how workplaces actually run. Future research will no doubt examine explicit models of supervisory behavior. Quasi-experimental inquiries into the effects that stem from poor, mediocre, and talented bosses will also be important. True randomized trials, in which different kinds of team leaders are allocated to work teams in some form of otherwise standardized productivity setting, will teach us much about the size of leaders' effects. In the world of practice, moreover, our results could one day be helpful to CEOs and human resources managers when making promotion decisions. Such issues merit future attention.



## Appendix

*Table A.1. Results of Regression Equations for Job Satisfaction in the United States: Instrumental Variable Estimates*

<i>Variable</i>	<i>Inclusive sample</i>		<i>Exclusive sample</i>		
	<i>OLS</i>	<i>IV OLS</i>	<i>OLS</i>	<i>IV OLS</i>	
	<i>Job satisfaction<sup>a</sup></i> (1)	<i>First-stage equation</i> (2)	<i>Job satisfaction<sup>a</sup></i> (4)	<i>First-stage equation</i> (5)	
		<i>Second-stage equation</i> (3)		<i>Second-stage equation</i> (6)	
Supervisor competence <sup>b</sup>	0.286*** (16.053)	— —	0.381*** (13.048)	— —	0.493*** (2.235)
Instrument <sup>c</sup>	0.016 (0.742)	0.171*** (6.922)	0.022 (0.709)	0.142*** (3.966)	— —
Female	0.014 (0.451)	-0.005 (-0.152)	0.014 (0.468)	0.031 (0.605)	0.018 (0.388)
Hispanic	0.075** (2.017)	-0.053 (-1.250)	0.080** (2.124)	0.026 (0.428)	0.082 (1.572)
Black	-0.054* (-1.660)	-0.049 (-1.322)	-0.049 (-1.483)	0.004 (0.071)	-0.172*** (-3.825)
Age	0.154 (1.092)	-0.154 (-0.959)	0.169 (1.189)	0.107 (0.477)	0.218 (1.102)
Age squared	-0.003 (-1.135)	0.003 (0.931)	-0.003 (-1.230)	-0.004 (-0.493)	-0.004 (-1.122)
High school degree	-0.010 (-0.232)	-0.077 (-1.501)	0.030 (-0.069)	0.033 (-0.452)	0.035 (0.546)
Some college education	-0.079 (-1.561)	-0.035 (-0.615)	-0.042 (-1.500)	0.011 (0.136)	-0.044 (-0.596)
Four-year degree	-0.053 (-0.943)	-0.062 (-0.955)	-0.048 (-0.852)	-0.042 (-0.450)	-0.001 (-0.008)
Married	0.057** (2.198)	0.010 (0.327)	0.066** (2.167)	0.038 (0.895)	0.056 (1.484)
Union	-0.016 (-0.467)	-0.164*** (-4.292)	-0.053 (-0.004)	-0.133** (-2.486)	-0.032 (-0.574)

*(continued)*

Table A.1. Continued

Variable	Inclusive sample			Exclusive sample		
	OLS	IV OLS	OLS	IV OLS	OLS	IV OLS
	Job satisfaction <sup>a</sup> (1)	First-stage equation (2)	Second-stage equation (3)	Job satisfaction <sup>a</sup> (4)	First-stage equation (5)	Second-stage equation (6)
Public sector	0.066 (1.346)	-0.087 (-1.561)	0.075 (1.493)	0.161** (2.418)	-0.073 (-0.959)	0.172** (2.529)
Log weekly earnings	0.020 (0.694)	-0.035 (-1.062)	0.023 (0.804)	0.027 (0.634)	0.015 (0.321)	0.024 (0.572)
Log weekly hours worked	0.101 (1.289)	-0.092 (-1.042)	0.109 (1.387)	0.054 (0.507)	-0.027 (-0.219)	0.059 (0.546)
Tenure	-0.001** (-2.471)	-0.001*** (-3.783)	-0.001* (-1.813)	-0.001 (-1.336)	-0.001*** (-3.123)	-0.001 (-0.604)
Tenure squared	$8.35 \times 10^{-7}$ (1.621)	$1.6 \times 10^{-6}$ *** (2.796)	$6.8 \times 10^{-7}$ (1.223)	$2.8 \times 10^{-7}$ (0.381)	$2.0 \times 10^{-6}$ ** (2.404)	$-3.2 \times 10^{-4}$ (-0.043)
Industries (13)	Yes	Yes	Yes	Yes	Yes	Yes
Occupations (10)	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.023 (0.012)	6.190*** (2.814)	-0.566 (-0.272)	-1.109 (-0.412)	2.093 (0.681)	-1.439 (-0.528)
Number of observations	2,469	2,469	2,469	1,197	1,197	1,197

Source: NLSY 1988 data.

Notes: *t*-statistics are in parentheses. On a Hausman test, the null hypothesis of the exogeneity of the instrument is not close to rejection (the test statistic has a *p* value of approximately 0.5 in each of the instrumental columns of the table). The count variable enters significantly in the first-stage equations. Further test statistics are available on request. IV, instrumental variable; NLSY, National Longitudinal Survey of Youth; OLS, ordinary least squares.

<sup>a</sup>How do/did you feel about the job you have now / your most recent job? 1 = "Dislike very much"; 2 = "Dislike somewhat"; 3 = "Like fairly well"; 4 = "Like very much."

<sup>b</sup>Your supervisor is competent in doing the job." 1 = "Not true at all"; 2 = "Somewhat true"; 3 = "Somewhat true"; 4 = "Very true."

<sup>c</sup>Count variable: 0 = worker's supervisor did not have at least a college degree and did not work his/her way up through the ranks or owned/started the company; 1 = one of these is true; 2 = both of these are true.

\*\*\*, \*\*, and \* represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Table A.2. Results of Regression Equations for Job Satisfaction in the United States with Banded Supervisor Dummies

Variable	Job satisfaction <sup>a</sup>			
	Pooled cross-sectional estimates	Fixed-effects estimates		
		Narrower sample 1 <sup>b</sup>	Narrower sample 2 <sup>c</sup>	Narrowest sample 3 <sup>d</sup>
Supervisor not too competent <sup>e</sup>	0.130*** (2.898)	0.167*** (3.020)	0.162** (2.342)	-0.004 (-0.032)
Supervisor somewhat competent <sup>f</sup>	0.368*** (9.064)	0.328*** (6.581)	0.255*** (3.987)	0.063 (0.578)
Supervisor very competent <sup>g</sup>	0.633*** (15.614)	0.520*** (10.374)	0.433*** (6.685)	0.245** (2.203)
Coworkers are friendly <sup>h</sup>	0.223*** (20.003)	0.159*** (11.736)	0.099*** (5.873)	0.061** (2.408)
Female	0.061*** (4.208)	—	—	—
Hispanic	0.011 (0.749)	—	—	—
Black	-0.052*** (-3.596)	—	—	—
Age	-0.024 (-1.360)	-0.137** (-1.971)	-0.126 (-1.264)	-0.024 (-0.120)
Age squared	0.001 (1.370)	0.004** (2.532)	0.004 (1.635)	4.335 × 10 <sup>-4</sup> (0.094)
High school degree	-0.055*** (-3.422)	-0.085*** (-2.900)	-0.056 (-1.353)	-0.051 (-0.759)
Some college education	-0.081*** (-3.835)	-0.163*** (-3.635)	-0.119* (-1.764)	-0.106 (-0.970)
Four-year degree	-0.200*** (-7.293)	-0.445*** (-6.031)	-0.431*** (-3.378)	-0.828*** (-4.307)
Married	0.043*** (3.146)	0.002 (0.094)	-0.037 (-1.201)	0.022 (0.382)
Union	-0.031* (-1.947)	-0.002 (-0.128)	0.020 (0.742)	0.005 (0.099)
Public sector	0.052** (2.085)	0.093*** (2.710)	0.158*** (2.753)	0.178** (1.979)
Log weekly earnings	0.093*** (6.889)	0.126*** (5.576)	0.042 (1.498)	0.051 (1.095)
Log weekly hours worked	0.050** (2.447)	0.006 (0.187)	0.028 (0.559)	-0.002 (-0.022)
Tenure	-1.60 × 10 <sup>-4</sup> (-1.167)	-0.002*** (-5.051)	-0.004*** (-8.239)	-0.006*** (-4.263)
Tenure squared	1.34 × 10 <sup>-7</sup> (0.484)	7.29 × 10 <sup>-7</sup> (0.514)	6.55 × 10 <sup>-6</sup> *** (4.150)	9.8 × 10 <sup>-6</sup> *** (3.450)
Industries (13)	Yes	Yes	Yes	No
Occupations (10)	Yes	Yes	Yes	No
Year dummies	Yes	Yes	Yes	Yes
Constant	1.775*** (8.795)	3.019*** (3.735)	3.619*** (3.229)	3.183 (1.438)
Number of observations	27,537	19,587	9,361	3,275

Sources: Pooled cross-sectional estimates, NLSY 1979–1982, 1988 data; fixed-effects estimates, NLSY 1979–1982 data.

Notes: *t*-statistics are in parentheses: Standard errors are clustered by each cluster type in the corresponding columns. NLSY, National Longitudinal Survey of Youth.

<sup>a</sup>“How do/did you feel about the job you have now / your most recent job?” 1 = “Dislike very much”; 2 = “Dislike somewhat”; 3 = “Like fairly well”; 4 = “Like very much.”

<sup>b</sup>Includes all observations from 1979 to 1982.

<sup>c</sup>Includes only observations of workers in the same employer.

<sup>d</sup>Includes only observations of workers in same employer, occupation, and industry. The number of observations is reduced (i.e., groupings are large) because we use three-digit occupations and industries to generate the sample/groupings. This corresponds to very close job matches across the waves.

<sup>e</sup>“Your supervisor is [not too] competent in doing the job.” Base category is “not competent at all.”

<sup>f</sup>“Your supervisor is [somewhat] competent in doing the job.” Base category is “not competent at all.”

<sup>g</sup>“Your supervisor is [very] competent in doing the job.” Base category is “not competent at all.”

<sup>h</sup>“Your coworkers are friendly.” 1 = “Not true at all”; 2 = “Not too true”; 3 = “Somewhat true”; 4 = “Very true.”

\*\*\*, \*\*, and \* represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Table A.3. Results of Regression Equations for Job Satisfaction in the United States: Robustness Checks

Variable	Job satisfaction <sup>a</sup>		
	Pooled cross-sectional estimates		Fixed-effects estimates
	Job is current	Recently left job	Narrower sample 2 <sup>c</sup>
Supervisor competence <sup>c</sup>	0.229*** (24.147)	0.248*** (10.749)	—
Positive change in supervisor competence <sup>f</sup>	—	—	0.081*** (3.312)
Negative change in supervisor competence <sup>g</sup>	—	—	-0.176*** (-9.330)
Coworkers are friendly <sup>h</sup>	0.225*** (19.155)	0.192*** (5.944)	0.124*** (7.461)
Female	0.063*** (4.137)	0.100** (2.458)	—
Hispanic	0.013 (0.807)	0.024 (0.551)	—
Black	-0.063*** (-4.084)	0.027 (0.716)	—
Age	-0.034* (-1.846)	0.028 (0.478)	-0.140 (-1.412)
Age squared	0.001* (1.723)	-3.5 × 10 <sup>-4</sup> (-0.280)	0.004* (2.399)
High school degree	-0.049*** (-2.930)	-0.118*** (-2.697)	-0.049 (-1.190)
Some college education	-0.066*** (-2.942)	-0.178*** (-3.229)	-0.109 (-1.615)
Four-year degree	-0.187*** (-6.495)	-0.362*** (-4.323)	-0.428*** (-3.308)
Married	0.049*** (3.423)	-0.003 (-0.065)	-0.038 (-1.194)
Union	-0.024 (-1.437)	-0.116** (-2.165)	0.021 (0.780)
			-0.001 (-0.002)
			-1.1 × 10 <sup>-4</sup> (-0.023)
			-0.054 (-0.812)
			-0.114 (-1.050)
			-0.810*** (-4.245)
			0.017 (0.297)
			0.007 (0.148)

(continued)

Table A.3. Continued

Variable	Pooled cross-sectional estimates		Job satisfaction <sup>a</sup>		Fixed-effects estimates	
	Job is current	Recently left job	Narrow sample 1 <sup>b</sup>	Narrower sample 2 <sup>c</sup>	Narrowest sample 3 <sup>d</sup>	
Public sector	0.050* (1.939)	0.089 (1.289)	0.095*** (2.750)	0.161*** (2.793)	0.202** (2.214)	
Log weekly earnings	0.081*** (5.621)	0.096** (2.575)	0.125*** (5.400)	0.039 (1.371)	0.042 (0.891)	
Log weekly hours worked	0.059*** (2.677)	0.041 (0.750)	0.008 (0.240)	0.032 (0.627)	0.003 (0.034)	
Tenure	-5.0 × 10 <sup>-4</sup> ** (-3.480)	0.001** (2.393)	-0.002*** (-5.398)	-0.005*** (-8.331)	-0.006*** (-4.567)	
Tenure squared	6.6 × 10 <sup>-7</sup> ** (2.323)	-2.5 × 10 <sup>-6</sup> * (-1.677)	1.2 × 10 <sup>-6</sup> (0.773)	6.8 × 10 <sup>-6</sup> ** (4.207)	1.0 × 10 <sup>-5</sup> *** (3.464)	
Industries (13)	Yes	Yes	Yes	Yes	No	
Occupations (10)	Yes	Yes	Yes	Yes	No	
Year dummies	Yes	Yes	Yes	Yes	Yes	
Constant	1.640*** (7.864)	0.652 (1.001)	3.221*** (3.981)	4.056*** (3.631)	3.085 (1.403)	
Number of observations	24,196	3,341	19,587	9,361	3,275	

Sources: Pooled cross-sectional estimates, NLSY 1979–1982, 1988 data; fixed-effects estimates, NLSY 1979–1982 data.

Notes: *t*-statistics are in parentheses. Standard errors are clustered by each cluster type in the corresponding columns. NLSY, National Longitudinal Survey of Youth.

<sup>a</sup>“How do/did you feel about the job you have now / your most recent job?” 1 = “Dislike very much”; 2 = “Dislike somewhat”; 3 = “Like fairly well”; 4 = “Like very much.”

<sup>b</sup>Includes all observations from 1979 to 1982.

<sup>c</sup>Includes only observations of workers in the same employer.

<sup>d</sup>Includes only observations of workers in same employer, occupation, and industry. The number of observations is reduced (i.e., groupings are large) because we use three-digit occupations and industries to generate the sample/groupings. This corresponds to very close job matches across the waves.

<sup>e</sup>Your supervisor is competent in doing the job.” 1 = “Not true at all”; 2 = “Not too true”; 3 = “Somewhat true”; 4 = “Very true.”

<sup>f</sup>Worker experienced a change in supervisor competence from the lowest three competence categories to the highest competence category.

<sup>g</sup>Worker experienced a change in supervisor competence from the highest competence category to the lowest three competence categories.

<sup>h</sup>Your coworkers are friendly.” 1 = “Not true at all”; 2 = “Not too true”; 3 = “Somewhat true”; 4 = “Very true.”

\*\*\*, \*\*, and \* represent statistical significance at the 1%, 5%, and 10% levels, respectively.

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