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# The Nonlinear Relationship Between Working Hours and Job Performance: A Meta-Analysis

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## Abstract

Based on 64 independent studies drawn from 42 articles, comprising data from 22,843 individuals, a meta-analysis was conducted on the nonlinear relationship between working hours and job performance. The results revealed: (1) a significant inverted U-shaped relationship exists between working hours and both task performance and contextual performance; (2) the moderating effect of country type is significant: compared to Western European and American countries, the inverted U-shaped relationship between working hours and task performance, as well as contextual performance, is more pronounced in China; (3) the moderating effect of industry type is significant: compared to labor- and capital-intensive industries, the inverted U-shaped relationship between working hours and task performance is more pronounced in knowledge-intensive industries; (4) the moderating effect of age is significant: compared to higher age levels, the inverted U-shaped relationship between working hours and task performance is more pronounced in lower age groups; (5) the moderating effect of gender is significant: compared to low male ratios, the inverted U-shaped relationship between working hours and contextual performance is more pronounced in groups with high male ratios. These findings not only clarify the inverted U-shaped relationship effect between working hours and job performance through meta-analysis, but also provide scientific evidence for the rationality of working hour regulations in labor law (e.g., weekly working hours not exceeding 44 hours), and caution organizations to be mindful of the “too much of a good thing” effect of working hours on job performance.

## Full Text

## Preamble

**Nonlinear Relationship Between Work Hours and Job Performance:  
A Meta-Analysis**

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**Abstract:** Based on data from 42 studies comprising 64 independent samples with a total sample size of 22,843 individuals, this meta-analysis examined the nonlinear relationship between work hours and job performance. The results revealed that: (1) Work hours exhibited a significant inverted U-shaped relationship with both task performance and contextual performance; (2) National context significantly moderated this relationship: compared with Western European and American countries, the inverted U-shaped relationship between work hours and both task and contextual performance was more pronounced in China; (3) Industry type significantly moderated the relationship: compared with labor- and capital-intensive industries, the inverted U-shaped relationship between work hours and task performance was stronger in knowledge-intensive industries; (4) Age significantly moderated the relationship: compared with older employee groups, the inverted U-shaped relationship between work hours and task performance was stronger among younger employees; (5) Gender composition significantly moderated the relationship: compared with samples with a lower proportion of males, the inverted U-shaped relationship between work hours and contextual performance was stronger in samples with a higher proportion of males. These findings not only clarify the inverted U-shaped effect of work hours on job performance through meta-analysis, but also provide scientific evidence for the rationality of working hour regulations in labor law (e.g., the 44-hour weekly maximum), warning organizations about the “too-much-of-a-good-thing” effect of extended work hours on performance.

**Keywords:** work hours, task performance, contextual performance, meta-analysis

## 1 Introduction

In recent years, news reports criticizing the “996” work schedule (9 a.m. to 9 p.m., six days per week) have become increasingly common. As market competition intensifies, many organizations compel employees to work overtime beyond their normal duties through high-pressure management practices. In August 2021, China’s Ministry of Human Resources and Social Security and the Supreme People’s Court jointly issued cases explicitly stating that excessive overtime practices like “996” are illegal. However, according to national economic performance data released by the National Bureau of Statistics, the average weekly work hours of enterprise employees nationwide still exceed the statutory maximum standard (44 hours/week) by 3 to 5 hours. Does simply extending work hours continuously enhance job performance? Theoretically, based on the premise that “work output = work productivity × work hours,” performance

should indeed increase continuously with extended work hours, assuming constant productivity (Zhao & Zhang, 2016). However, in practice, employers hire not cold machines but employees with subjective agency.

Once employees become physically and mentally exhausted from prolonged work hours and voluntarily reduce their work engagement, leading to continuously declining productivity—or even negative productivity—simply extending work hours may not only fail to enhance performance but could also result in a “lose-lose” situation for both employee rest rights and job performance. This contradicts China’s current high-quality development vision emphasizing efficient and sustainable growth (Zhang et al., 2019). Therefore, there is an urgent need to clarify the relationship between work hours and job performance and identify the warning threshold and underlying mechanisms at which work hours begin to negatively impact performance.

However, a review of existing research reveals that although work hours are a direct determinant of job performance, few studies have systematically examined their relationship effects and underlying mechanisms. Specifically, current research primarily uses qualitative analysis to critique long work hours and propose policy recommendations, or treats work hours as a control variable with simple descriptive and correlational analysis. These approaches not only lack deep theoretical examination of the relationship mechanism but also fail to reach consensus on whether the relationship is positive (Parent-Lamarche et al., 2020; Van de Brake et al., 2020; Yeh et al., 2020) or negative (Du et al., 2018; Nguyen & Giang, 2020; Webster et al., 2019), nor on the magnitude of the correlation. While existing research provides a foundation for understanding this relationship, it offers limited scientific theoretical logic and empirical evidence for thoroughly clarifying the relationship effects and mechanisms. Therefore, it is necessary to integrate existing studies through meta-analysis guided by a theoretical framework to more systematically and deeply examine the relationship between work hours and job performance.

Furthermore, beyond examining individual characteristics such as achievement motivation and organizational trust as moderators (Ko & Choi, 2019; Lu et al., 2020), existing research has rarely explored other boundary conditions. However, studies on the work hours-performance relationship are dispersed across different national contexts and industry types, with substantial variation in sample demographic characteristics such as mean age, gender ratio, and education level. These different research contexts and sample characteristics may be important sources of heterogeneity in existing findings. Therefore, through meta-analysis, it is necessary to integrate study characteristics and examine the moderating effects of national context, industry type, and demographic characteristics on the work hours-performance relationship from macro, meso, and micro levels, thereby expanding the research scope and levels of boundary conditions.

Finally, existing research has primarily adopted a linear perspective to examine the relationship or explained the negative effects of work hours from a physiological resource depletion perspective (Flinn & Armstrong, 2011). However,

based on the limited self-control resource theory, employees must also consume psychological self-control resources to regulate their behavior to meet organizational norms and job requirements (Lian et al., 2017). Moreover, given that self-control resources can recover quickly after short-term depletion but generally fail to recover after long-term depletion (Baumeister et al., 2000), when work hours remain within a moderate range, employees may not easily fall into a state of ego depletion and can maintain relatively stable productivity, leading to performance improvements with extended hours. Once work hours exceed a certain threshold, causing long-term depletion of self-control resources that cannot be recovered, employees may enter a state of ego depletion, resulting in continuously declining productivity and even negative productivity. Consequently, performance will no longer increase with work hours but will instead show a gradual decline. Therefore, it is necessary to integrate relevant research through meta-analysis to examine the inverted U-shaped relationship between work hours and job performance, identify the critical point of this relationship, and reveal the nonlinear pattern of changing from positive to negative effects as work hours increase.

In summary, to comprehensively reveal and characterize the nonlinear relationship between work hours and job performance, this study constructs a theoretical framework for the inverted U-shaped relationship based on limited self-control resource theory. Through meta-analysis, we examine the inverted U-shaped relationship effect from a nonlinear perspective and investigate the moderating effects of national context, industry type, and demographic characteristics from macro, meso, and micro levels.

## 2.1 Conceptualization and Measurement of Work Hours

Work hours can be conceptualized from two primary perspectives: labor law and organizational management. From a labor law perspective, work hours refer to the time during which legally employable workers engage in legal labor and fulfill their employment obligations according to labor contracts (Li, 2007). From an organizational management perspective, work hours refer to the time employees devote to work-related behaviors as required by the organization (Iwasaki et al., 2006). Some studies have provided more specific definitions from both workplace and work content perspectives, suggesting that work hours include not only time spent at the workplace but also time devoted to work-related tasks in other locations (Lu et al., 2020). This study adopts the organizational management perspective, conceptualizing work hours as the total time employees devote to work-related tasks across all settings. Regarding measurement, given that existing studies have relatively consistent measures of work hours—primarily through self-reported average weekly work hours (Nohe et al., 2014; Zhang & Seo, 2018)—this study uses average weekly work hours as the measurement indicator, coding terms such as “average weekly work duration” and “weekly work hours” as work hours.

## 2.2 Conceptualization and Measurement of Job Performance

Job performance can be conceptualized from three perspectives: results, behavior, and integration. Early research primarily adopted a results perspective, defining job performance as the quantity, quality, and goal achievement of employees' work tasks (Berdardin & Beatty, 1984). Subsequent research argued that focusing solely on results might not fully capture individual work effort and should conceptualize performance from a behavioral perspective. For example, Williams & Anderson (1991) divided job performance into task performance and contextual performance, where task performance refers to work behaviors directly related to job description requirements, and contextual performance refers to extra-role behaviors voluntarily performed by employees that contribute to organizational performance but are not required by their roles. Finally, some research from an integrative perspective suggests that both behaviors and results related to work goal achievement should be included in job performance (Paul & Jane, 2004). This study adopts the integrative perspective, using task performance and contextual performance as measurement indicators based on existing research (Rudolph et al., 2018; Young et al., 2021). Terms such as "in-role performance" and "objective/subjective performance" were coded as task performance, while "extra-role performance," "organizational citizenship behavior," and "peripheral performance" were coded as contextual performance.

## 2.3 The Inverted U-Shaped Relationship Between Work Hours and Job Performance

Limited self-control resource theory posits that individuals consume self-control resources when executing any type of self-control (cognitive, emotional, or behavioral), and these resources are limited. Once excessively depleted, individuals fall into a state of ego depletion, making it difficult to successfully execute subsequent self-control behaviors (Baumeister et al., 2007). However, given that self-control resources can be restored through rest after short-term depletion (Tyler & Burns, 2008) but become persistently depleted after long-term depletion (Diestel & Schmidt, 2011), individuals are less likely to fall into ego depletion in short-term self-control situations but more likely to experience stronger ego depletion in long-term situations, leading to subsequent self-control failure.

Based on limited self-control resource theory, employees must overcome instinctive impulses or habitual responses during work to align their behavior with organizational norms and job requirements (Clinton et al., 2020). Therefore, as work hours increase, employees must consume increasingly more self-control resources to regulate their behavior. When work hours are relatively short, employees can regain self-control resources through sleep or micro-breaks at work, making them less susceptible to ego depletion. Thus, when work hours remain within a short-term, moderate range, employees can successfully execute self-control as required by the organization, provide effective labor supply, and

their job performance improves with extended work hours. However, once work hours exceed a certain threshold, employees fall into a state of ego depletion due to long-term, continuous consumption of self-control resources, leading to subsequent self-control failure. They not only fail to provide effective labor supply per unit of time as required but may also engage in negative work behaviors such as shirking, non-compliance with procedures, or even sabotage, causing work productivity to drop to zero or become negative. At this point, further increases in work hours will not enhance performance but will instead lead to a gradual decline. Therefore, we propose the following hypothesis:

**Hypothesis 1:** Work hours have an inverted U-shaped relationship with job performance (a. task performance, b. contextual performance), with a positive relationship before the critical point and a negative relationship after.

## 2.4 Moderating Effect of National Context

Existing research indicates that employees' motivations and reasons for working long hours differ between Chinese and Western contexts. In Western European and American labor markets, labor laws generally impose strict restrictions on overtime, and workers have strong rights awareness and often have the choice to work overtime (Lowisch, 2003). In contrast, in China's labor market, due to imperfect labor law regulations and enforcement, selective law enforcement in some regions, and relatively weak workers' rights awareness (Cheng et al., 2016), most companies—except for some state-owned and foreign enterprises—have not yet achieved compliant labor relations management in terms of work hours. They often use high-pressure management to force employees into passive and even unpaid overtime (Wang & Yang, 2016). Consequently, compared with Western countries, Chinese employees are more likely to develop complaints and dissatisfaction as work hours increase, while also needing to consume more self-control resources to cope with cognitive dissonance, accelerating the onset of ego depletion. This causes the critical point of the inverted U-shaped relationship between work hours and job performance to arrive sooner and the negative relationship after the critical point to be stronger. Therefore, we propose:

**Hypothesis 2:** National context significantly moderates the inverted U-shaped relationship between work hours and job performance (a. task performance, b. contextual performance), such that the inverted U-shaped relationship is stronger in China than in Western European and American countries.

## 2.5 Moderating Effect of Industry Type

Existing research classifies industries into three types based on their reliance on different production factors: labor-intensive, capital-intensive, and knowledge-technology-intensive. Unlike labor- and capital-intensive industries that rely primarily on cheap labor or capital as core production factors, knowledge-technology-intensive industries pursue high-quality innovation and rely on advanced knowledge and technology as core production factors (Muller

& Doloreux, 2009). Accordingly, this leads to differences in workflow and content complexity and autonomy across industry types, which may cause heterogeneity in the inverted U-shaped relationship between work hours and job performance.

First, regarding work complexity, knowledge-technology-intensive industries feature faster knowledge and technology updates and more complex and refined work content (Mudambi, 2008) compared with labor- and capital-intensive industries that have lower dependence on high-tech knowledge and more routine work processes. Consequently, employees in knowledge-technology-intensive industries must consume more self-control resources to execute cognitive and volitional control, making them more susceptible to ego depletion as work hours increase and causing the critical point of the inverted U-shaped relationship to arrive earlier.

Second, regarding work autonomy, employees in labor- and capital-intensive industries generally perform standardized operations according to work division, with workflows that are relatively easy to de-skill and monitor (Chu & Liu, 2021; Jones, 1982). In contrast, employees in knowledge-technology-intensive industries primarily engage in complex, intangible mental labor, making knowledge and technology difficult to separate from workers and work processes harder to monitor (Afsar et al., 2017). Therefore, once employees fall into ego depletion due to extended work hours, those in knowledge-intensive industries may more easily engage in negative work behaviors, while employees in labor- and capital-intensive industries may suppress negative behaviors due to the risk costs of external monitoring.

Combining these two reasons, compared with labor- and capital-intensive industries, employees in knowledge-technology-intensive industries not only fall into ego depletion more easily as work hours increase—causing the critical point of the inverted U-shaped relationship to arrive sooner—but also engage in more negative work behaviors when ego-depleted, leading to stronger negative effects of work hours on job performance after the critical point. Therefore, we propose:

**Hypothesis 3:** Industry type significantly moderates the inverted U-shaped relationship between work hours and job performance (a. task performance, b. contextual performance), such that the inverted U-shaped relationship is stronger in knowledge-intensive industries than in labor- and capital-intensive industries.

## 2.6 Moderating Effects of Demographic Characteristics

Existing research indicates that as individuals age, they accumulate more work experience and show changes in impulsivity and risk decision-making (Henninger et al., 2010). Compared with younger employees who have less experience and may make risky decisions and impulsive behaviors without considering consequences, older employees, with increased maturity and experience, exhibit reduced impulsivity in attention, behavior, and non-planning, and tend to make

risk-averse decisions after careful consideration (Rolison et al., 2012; Yu et al., 2019). Therefore, when work hours extend to employees' energy limits and cause ego depletion, older employees may consider the work risks associated with negative behaviors and suppress the ego depletion-driven impulse, thereby delaying the arrival of the critical point and mitigating the negative impact of work hours on performance after the critical point. Conversely, younger employees may more easily engage in negative work behaviors driven by ego depletion, causing stronger negative effects after the critical point. Therefore, we propose:

**Hypothesis 4:** Age significantly moderates the inverted U-shaped relationship between work hours and job performance (a. task performance, b. contextual performance), such that the inverted U-shaped relationship weakens as age increases.

Existing research indicates gender differences in stress coping strategies and aggressive behavior tendencies (Eagly & Steffen, 1986). When facing stress or conflict, men tend to choose aggressive coping strategies, while women prefer avoidance and prosocial strategies to maintain relatively harmonious relationships (Rose & Asher, 1999; Zhang & Zhang, 2003). Therefore, when work hours extend to employees' energy limits and cause ego depletion, female employees may consider the potential conflict risks of negative behaviors and suppress ego depletion-driven impulses, reducing the likelihood of negative behaviors, delaying the arrival of the critical point, and mitigating the negative impact after the critical point. Conversely, male employees are more susceptible to negative emotional and physiological reactions driven by ego depletion, leading to counterproductive work behaviors and stronger negative effects after the critical point. Therefore, we propose:

**Hypothesis 5:** Gender significantly moderates the inverted U-shaped relationship between work hours and job performance (a. task performance, b. contextual performance), such that the inverted U-shaped relationship strengthens as the proportion of males increases.

Existing research indicates that education level significantly influences employees' work hour preferences (Li & Zhu, 2017). Specifically, highly educated employees often work in primary labor markets with relatively high compensation and do not need to rely on long work hours for essential income, generally preferring shorter hours to achieve work-life balance. In contrast, less-educated employees mostly work in secondary labor markets with lower average wages and tend to rely on long work hours for more income (Sun & Huang, 2021). Therefore, less-educated employees may have less resistance to long work hours and, even when ego-depleted, will suppress negative impulses to continue working as required to earn more income, thereby delaying the arrival of the critical point and mitigating the negative impact after the critical point. Conversely, highly educated employees may be more reluctant to work long hours, strengthening cognitive dissonance and ego depletion, causing the critical point to arrive sooner and strengthening negative effects after the critical point. Therefore, we propose:

**Hypothesis 6:** Education level significantly moderates the inverted U-shaped relationship between work hours and job performance (a. task performance, b. contextual performance), such that the inverted U-shaped relationship strengthens as the proportion of highly educated employees increases.

The theoretical model of this study is shown in Figure 1 [Figure 1: see original paper].

### 3.1 Literature Search and Screening

This study comprehensively searched empirical literature on the relationship between work hours and job performance in both Chinese and English databases. Chinese databases included CNKI, VIP, and Wanfang, while English databases included Web of Science, Wiley, Proquest, EBSCO-Academic Search Premier, and Science Direct. Given that work hours may appear as either an independent or control variable in studies, we conducted full-text searches (in CNKI and Wanfang) or all-field searches (in VIP and other English databases) for terms including “工作时间,” “工作时长,” “working time,” “working hours,” “work time,” “work hours,” “hours employed,” “job hours,” and “hours worked.” We searched titles and keywords for performance-related terms including “员工绩效,” “个体绩效,” “工作绩效,” “任务绩效,” “关系绩效,” “周边绩效,” “角色内绩效,” “角色外绩效,” “employee performance,” “staff performance,” “job performance,” “task performance,” “role performance,” “in-role performance,” “contextual performance,” “relationship performance,” “out-role performance,” “periphery performance,” and “organizational citizenship behavior.” We also manually searched major management and psychology journals for potentially missed studies and used backward citation searching to identify additional relevant literature. The search covered publications from each database’s inception to May 2022.

Literature inclusion criteria were: (1) empirical studies only, excluding literature reviews, theoretical papers, and interview-based qualitative studies; (2) studies must include complete information on measuring both work hours and job performance and report correlation coefficients or statistics convertible to correlations ( $d$ -values,  $F$ -values,  $t$ -values,  $r^2$  values, etc.); (3) studies must be conducted in organizational settings; (4) studies must clearly report sample size; (5) individual-level analysis; (6) each independent sample corresponds to one effect size, with multiple independent samples from the same article coded separately. After screening, 42 articles were included in the meta-analysis, comprising 64 effect sizes (22 Chinese articles, 20 English articles; 23 published journal articles, 19 unpublished dissertations), with a total sample size of 22,843. The literature screening process is shown in Figure 2 [Figure 2: see original paper].

### 3.2 Literature Coding

Following Lipsey and Wilson’s (2001) recommended procedures, we coded the included studies. Sample characteristic codes included author, publication year, journal source, sample size, measurement instruments, demographic characteris-

tics (mean age, proportion of males, proportion with bachelor's degree or higher), and contextual information such as national context and industry type. National context included two categories: China and Western European/American countries (e.g., United States, Germany). Industry type included two categories: labor- and capital-intensive industries (e.g., service, construction) and knowledge-technology-intensive industries (e.g., education, healthcare). Effect size statistics included reliability coefficients ( $\alpha$ ), correlation coefficients ( $r$ ), and statistics convertible to  $r$  ( $d$ ,  $F$ ,  $t$ ,  $\eta^2$  values). During variable coding, terms such as "average weekly work duration" and "weekly work hours" were coded as work hours; "in-role performance" and "objective/subjective performance" were coded as task performance; and "organizational citizenship behavior," "extra-role performance," and "contextual performance" were coded as contextual performance. Two PhD-level researchers in management independently coded the literature following standardized coding procedures, achieving 93.75% initial agreement. Discrepancies were resolved through discussion, literature review, and consensus.

### 3.3.1 Effect Size Conversion

We used correlation coefficient  $r$  as the effect size to integrate the relationship between variables. For studies reporting  $d$ ,  $F$ ,  $t$ , or  $\eta^2$  values instead of  $r$ , we converted them using appropriate formulas. Additionally, to avoid attenuation bias from subjective measurement error, we corrected the original sample correlation coefficients  $r$  for measurement error to obtain the true correlation between variables using the formula:  $r_{\text{true}} = r / \sqrt{\alpha_1 \alpha_2}$ , where  $r_{\text{true}}$  represents the true correlation after measurement error correction,  $r$  is the original sample correlation, and  $\alpha_1$  and  $\alpha_2$  are the Cronbach's alpha reliability coefficients for the independent and dependent variables, respectively. For objective measures of work hours or job performance, reliability was set to 1.

### 3.3.2 Publication Bias Tests

We examined publication bias using funnel plots, Egger's regression test, and Begg's rank correlation test. Funnel plots provide a visual method for qualitatively assessing publication bias through scatterplot symmetry, with well-distributed meta-analytic literature yielding a symmetrical inverted funnel distribution (Rothstein et al., 2006). Egger's regression and Begg's rank correlation tests provide quantitative statistical assessment, with non-significant intercepts or rank correlation coefficients indicating no significant publication bias (Egger et al., 1997). Additionally, given that researchers may engage in p-hacking behaviors (e.g., stopping data collection, selective variable reporting) to increase publication likelihood, we also used p-curve analysis (conducted at <http://www.p-curve.com/>) to test for publication bias. P-curve analysis examines the distribution of p-values in published studies; a significantly right-skewed p-curve (with far more p-values between 0-0.025 than between 0.025-0.050) suggests no significant publication bias (Vogel & Homberg, 2021).

### 3.3.3 Heterogeneity Tests

We examined heterogeneity among effect sizes using  $Q$  and  $I^2$  statistics. The  $Q$  statistic is the weighted sum of squared deviations of effect sizes; a significant  $p$ -value indicates significant differences among study effect sizes.  $I^2$  reflects the proportion of between-study variance in total variance, with thresholds of 25%, 50%, and 75% representing low, moderate, and high heterogeneity (Higgins & Thompson, 2002). Higher  $I^2$  values indicate greater heterogeneity. Significant heterogeneity suggests the need to explore moderating variables and informs model selection: high heterogeneity warrants use of random-effects models for meta-analysis estimation.

### 3.3.4 Analysis Procedures

We conducted heterogeneity tests, publication bias tests, and main and moderating effect analyses using the metafor package (version 4.2.0) in R (Viechtbauer, 2010). To test the inverted U-shaped relationship between work hours and job performance, we used weighted least squares regression with work hours as the independent variable and the true correlation between work hours and job performance as the dependent variable, following previous research (Kooij et al., 2018; Zhao et al., 2021). A significant negative regression coefficient indicates that the relationship effect size decreases as work hours increase. We then calculated the overall correlation by converting each independent study's correlation coefficient using Fisher's  $Z$  transformation ( $Z = 0.5 \times \ln[(1+r)/(1-r)]$ ), computing the weighted mean of transformed  $Z$  values, and back-transforming to obtain the overall correlation. If the 95% confidence interval of the overall correlation includes 0, this indicates a complete inverted U-shaped relationship. To test the moderating effects of demographic characteristics (age, gender, education), industry type, and national context, we followed previous research (Sturman, 2003) by constructing meta-regression equations with the work hours-performance relationship as the outcome, and work hours, moderators, and their interaction terms as predictors. Significant interaction coefficients indicate significant moderation, which we further examined through subgroup analysis.

## 4.1 Publication Bias Tests

Funnel plot results showed that studies of work hours with task performance and contextual performance were relatively symmetrically distributed around the mean effect size, suggesting low likelihood of publication bias. As shown in Table 1, Egger's regression and Begg's rank correlation tests were non-significant for both relationships, indicating no publication bias. P-curve analysis also showed right-skewed distributions for both relationships, with significant  $Z$ -values for the 10 significant effect sizes in the work hours-task performance relationship ( $Z = -4.94$ ,  $p = 0.000$ ) and the 7 significant effect sizes in the work hours-contextual performance relationship ( $Z = -6.31$ ,  $p = 0.000$ ), confirming evidential value.

**Table 1: Publication Bias Test Results**

Test	Task Performance	Contextual Performance
Egger' s test intercept	-1.31, 95% CI [-2.71, 0.09]	-2.87, 95% CI [-5.75, 0.01]
Begg' s test	Non-significant	Non-significant

## 4.2 Heterogeneity Tests

Q tests revealed significant heterogeneity in effect sizes for work hours-task performance ( $Q = 126.81$ ,  $p = 0.000$ ) and work hours-contextual performance ( $Q = 128.10$ ,  $p = 0.000$ ).  $I^2$  statistics were 70.03% and 81.26%, respectively, indicating high heterogeneity. Therefore, random-effects models were appropriate, and further examination of moderating variables was warranted.

## 4.3 Main Effect Tests

**First**, we tested the inverted U-shaped relationship between work hours and task performance. Meta-regression with the work hours-task performance relationship as the outcome and work hours as the predictor showed a significant positive intercept (Intercept = 0.24, 95% CI = [0.15, 0.32]) and a significant negative coefficient ( $\beta = -0.01$ , 95% CI = [-0.01, -0.00]), indicating that the relationship started positive and gradually weakened as work hours increased. Using Hedges and Olkin' s (1985) random-effects model, the overall correlation was 0.01 with a 95% CI of [-0.02, 0.04], which includes 0, indicating a complete inverted U-shaped relationship. As shown in Figure 3 [Figure 3: see original paper], the relationship effect size followed a “positive  $\rightarrow$  zero  $\rightarrow$  negative” pattern, approaching zero at 44.43 hours/week, after which the relationship became negative and strengthened with further increases in work hours. Thus, Hypothesis 1a was supported.

**Second**, we tested the inverted U-shaped relationship between work hours and contextual performance. Meta-regression showed a significant positive intercept (Intercept = 0.28, 95% CI = [0.12, 0.44]) and a significant negative coefficient ( $\beta = -0.01$ , 95% CI = [-0.01, -0.00]). The overall correlation was 0.04 with a 95% CI of [-0.02, 0.10], which includes 0, indicating a complete inverted U-shaped relationship. As shown in Figure 4 [Figure 4: see original paper], the relationship effect size started positive, gradually weakened as work hours increased, approached zero at 47.88 hours/week, and then became negative and strengthened with further increases. Thus, Hypothesis 1b was supported.

## 4.4 Moderation Effect Tests

**First**, we tested the moderating effect of national context. As shown in Table 2, meta-regression with the work hours-performance relationship as the

outcome and work hours, national context, and their interaction as predictors showed significant interaction effects for both task performance ( $\beta = 0.01$ ,  $p = 0.095$ ) and contextual performance ( $\beta = 0.02$ ,  $p = 0.000$ ). Subgroup analysis revealed that in the Chinese context, both relationships showed complete inverted U-shapes with critical points at 46.19 hours/week for task performance and 49.29 hours/week for contextual performance. In Western contexts, the inverted U-shaped relationships were not significant; instead, work hours showed a significant linear positive correlation with task performance ( $r = 0.05$ , 95% CI = [0.01, 0.09]) but no significant relationship with contextual performance. Thus, Hypotheses 2a and 2b were supported.

**Second**, we tested the moderating effect of industry type. As shown in Table 3, the interaction between work hours and industry type was significant for task performance ( $\beta = -0.01$ ,  $p = 0.003$ ) but not for contextual performance ( $\beta = -0.01$ ,  $p = 0.445$ ). In knowledge-intensive industries, work hours showed a complete inverted U-shaped relationship with task performance (critical point = 44.61 hours/week). In labor- and capital-intensive industries, the relationship was not significant. Thus, Hypothesis 3a was supported, but Hypothesis 3b was not.

**Third**, we tested the moderating effect of age. As shown in Table 4, the interaction between work hours and age was significant for task performance ( $\beta = 0.00$ ,  $p = 0.083$ ) but not for contextual performance ( $\beta = -0.00$ ,  $p = 0.470$ ). In younger groups, work hours showed a complete inverted U-shaped relationship with task performance (critical point = 42.98 hours/week). In older groups, the inverted U-shaped relationship was not significant, but a significant linear positive correlation emerged ( $r = 0.06$ , 95% CI = [0.02, 0.09]). Thus, Hypothesis 4a was supported, but Hypothesis 4b was not.

**Fourth**, we tested the moderating effect of gender composition. As shown in Table 5, the interaction between work hours and proportion of males was not significant for task performance ( $\beta = 0.00$ ,  $p = 0.827$ ) but was significant for contextual performance ( $\beta = -0.04$ ,  $p = 0.022$ ). In high male proportion groups, work hours showed a complete inverted U-shaped relationship with contextual performance (critical point = 47.65 hours/week). In low male proportion groups, the relationship was not significant. Thus, Hypothesis 5a was not supported, but Hypothesis 5b was supported.

**Fifth**, we tested the moderating effect of education level. As shown in Table 6, the interaction between work hours and proportion of highly educated employees was not significant for either task performance ( $\beta = 0.01$ ,  $p = 0.410$ ) or contextual performance ( $\beta = -0.02$ ,  $p = 0.199$ ). Thus, Hypotheses 6a and 6b were not supported.

## 5.1 Research Findings

This study examined the relationship between work hours and job performance from a nonlinear perspective using meta-analysis based on limited self-control

resource theory. The results showed: (1) Work hours have a significant inverted U-shaped relationship with task performance, with a positive relationship before the critical point and a negative relationship after; (2) Work hours have a significant inverted U-shaped relationship with contextual performance, with a positive relationship before the critical point and a negative relationship after; (3) National context significantly moderates the relationship: compared with Western countries, the inverted U-shaped relationships are stronger in China; (4) Industry type significantly moderates the relationship: compared with labor- and capital-intensive industries, the inverted U-shaped relationship with task performance is stronger in knowledge-intensive industries; (5) Age significantly moderates the relationship: compared with older employees, the inverted U-shaped relationship with task performance is stronger among younger employees; (6) Gender composition significantly moderates the relationship: compared with samples with lower male proportions, the inverted U-shaped relationship with contextual performance is stronger in samples with higher male proportions.

## 5.2 Theoretical Implications

**First**, this study integrates existing research to clarify the relationship between work hours and job performance. Previous studies have often treated work hours as a control variable and have not reached consensus on the direction, significance, or magnitude of the relationship (Du et al., 2020; Yeh et al., 2020; Zhang & Seo, 2018). Through meta-analysis, this study not only reduces sampling limitations and measurement errors inherent in single studies (Harari et al., 2020) to provide more stable and reliable effect estimates, but also clarifies the relationship pattern by comparing linear and inverted U-shaped effects. The findings reveal that the linear relationship is not significant, while the dynamic inverted U-shaped relationship is significant. This revelation of the inverted U-shaped pattern presents the double-edged sword effect of work hours on performance and helps integrate heterogeneous findings: the inconsistent positive and negative results in previous research may be due to the dynamic, complex inverted U-shaped relationship, where the specific work hour range determines whether the relationship appears positive or negative.

**Second**, this study deepens the theoretical mechanism of the work hours-performance relationship. While previous research has primarily treated work hours as a control variable (Inness et al., 2010) or explained negative relationships from physiological resource depletion (Flinn & Armstrong, 2011; Shimizu et al., 2004), this study positions work hours as a core independent variable, reveals the inverted U-shaped relationship and its double-edged effects, and constructs a theoretical framework based on limited self-control resource theory. This provides a deeper psychological resource-based explanation for the relationship mechanism, enriching and supplementing the theoretical foundation and perspective.

**Third**, this study expands the boundary conditions of the work hours-performance relationship. Beyond examining individual characteristics like

achievement motivation (Ko & Choi, 2019; Lu et al., 2020), this study reveals moderating effects of national context, industry type, and demographic characteristics (age, gender, education) from macro, meso, and micro levels. These findings not only build a clearer boundary framework for understanding the inverted U-shaped relationship and the application of self-control resource theory, but also expand the research levels and content of boundary conditions. Additionally, the significant differences in inverted U-shaped effects across different national contexts, industries, age groups, and gender compositions provide an alternative explanation for heterogeneous findings in previous research.

### 5.3 Practical Implications

Although Article 36 of China's Labor Law stipulates that "average weekly work hours shall not exceed 44 hours," many organizations violate this provision, leading to the prevalence of "996" overtime culture (Nie & Feng, 2020). This study's findings indicate that work schedules sacrificing employee rest rights do not necessarily enhance performance. For example, work hours promote task performance before the critical point (approximately 44.43 hours/week) but negatively affect it afterward. Therefore, the 44-hour weekly limit in labor law is not only legally mandatory but also managerially rational. Organizations should thoroughly understand and implement working hour regulations, remaining vigilant about the "too-much-of-a-good-thing" effect. Additionally, the non-significant inverted U-shaped relationship in Western countries but significant effect in China may relate to the prevalence of forced and unpaid overtime in China, suggesting that organizations should strengthen compliance in work hour management. Furthermore, the stronger inverted U-shaped effect in knowledge-intensive industries highlights that high-tech enterprises should pay particular attention to the negative performance effects of long work hours and optimize work hour management to sustain performance improvements. Finally, the stronger effects in younger and male-dominated groups suggest that organizations should be particularly attentive to these employees to mitigate stronger negative impacts of long work hours.

### 5.4 Limitations and Future Directions

This study has several limitations. **First**, meta-analytic stability and reliability depend on comprehensive literature coverage. Limited by language, tools, and capacity, this study primarily included Chinese and English literature, potentially introducing selection bias. Future research should include more comprehensive literature to enhance meta-analytic validity. **Second**, due to insufficient studies on average daily work hours with task performance ( $k=11$ ) and contextual performance ( $k=7$ ) and limited moderator information, this meta-analysis did not include daily work hour studies. However, preliminary analysis shows significant inverted U-shaped relationships with critical points at 6.77 hours/day for task performance and 8.32 hours/day for contextual performance. Future re-

search should examine these relationships as more studies accumulate. **Third**, following previous research (Kooij et al., 2018; Zhao et al., 2021), this study used meta-regression with work hours predicting the work hours-performance correlation to test the inverted U-shaped relationship. However, recent research suggests examining correlations between the squared term of the independent variable and the dependent variable (Mackey et al., 2020). Since few original studies provided correlations between squared work hours and performance, this method was not used. Future research should compare these methods as more data become available. **Fourth**, most included studies were cross-sectional, precluding causal inferences. Future research should use longitudinal or experimental designs to clarify causality. **Fifth**, this study focused on individual-level relationships. Given the prevalence of overtime, future research should examine team- or organizational-level effects. **Sixth**, this study only examined national context, industry type, age, gender, and education as moderators. Given substantial heterogeneity, future research should explore additional moderators at macro, meso, and micro levels.

## 6 Conclusion

This meta-analysis examined the relationship between work hours and job performance. The findings indicate: (1) Work hours have significant inverted U-shaped relationships with both task and contextual performance; (2) National context significantly moderates these relationships: the inverted U-shaped relationships are stronger in China than in Western countries; (3) Industry type significantly moderates the relationship: the inverted U-shaped relationship with task performance is stronger in knowledge-intensive industries than in labor- and capital-intensive industries; (4) Age significantly moderates the relationship: the inverted U-shaped relationship with task performance is stronger among younger than older employees; (5) Gender composition significantly moderates the relationship: the inverted U-shaped relationship with contextual performance is stronger in samples with higher male proportions.

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**Note:** References marked with \* indicate studies included in the meta-analysis.

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