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A double-edged sword: Digitalization of listed companies and employee overtime

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Abstract

Current research on enterprise digitalization examines predominantly performance enhancement and technological transformation while largely overlooking its effects on employees' number of working hours. This study uses nighttime satellite light data to examine the impact and mechanism of the digitalization of listed companies on employees' amount of overtime work and further discusses the issue of income compensation for such work. The results show that digitalization increases employees' amount of overtime work through the market expansion mechanism and the technological innovation mechanism. In addition, digitalization can increase the total revenue and average wage of enterprises; that is, there is an income compensation effect for overtime work. This study also reveals that listed companies' more positive attitudes toward digitalization can effectively weaken the overtime work problem caused by digitalization. This study advocates optimizing the operational efficiency of digitalization while safeguarding employee rights, thus fostering sustainable synergy between organizations and workforces during digital transformation.

Introduction

In the contemporary global economic landscape, overtime work has emerged as a prevalent and concerning issue across various countries and industries (Autor, et al., 2024, Grigsby, et al., 2021). A multitude of factors, including intensifying global competition, the rapid pace of technological innovation, and ever-changing market demands, have contributed to the widespread occurrence of overtime work (Qin, et al., 2022, Wang, et al., 2025, Yu, et al., 2025). With the continuous promotion of high-quality development in China, in recent years, work systems such as "007" (working around the clock, seven days a week) and "996" (working from 9 am to 9 pm, six days a week) have emerged. The phenomenon of overtime work is gradually becoming more prominent and serious and has already become a core issue of wide focused among all sectors of society. Overtime work has become a widely adopted work model in enterprises. Such a model involves not only the physical and mental health and rights protection of many workers but also the promotion of China's high-quality development strategy (Wang and Zhao, 2024).

Moreover, as an important aspect influencing human social life, digitalization has received widespread attention from all sectors of society (Brynjolfsson, et al., 2025, Gornick, 2016, Hu, 2025). Digitalization usually brings about changes in business models and the application of new technologies (Norton and Shapiro, 2023, Xu, et al., 2024). Employees need to adapt to these changes and continuously learn and become accustomed to new technologies and tools, thus strengthening their work burden (Du and Li, 2025). Therefore, it is necessary to organically combine research on the digitalization of listed companies and employees' amount of overtime work to open the "black box" of the rights and interests of enterprise workers under digitalization. Will the digitalization of enterprises increase employees' amount of overtime work? If so, what is the underlying mechanism of this impact? Can this overtime work be effectively compensated? To answer the above questions, this article uses the matching data of listed companies and nighttime lights. Through microeconometric analysis, this study examines the

impact mechanisms and compensation effects of digitalization on employees' amount of overtime work. Clarifying these issues can help enterprises better balance the efficiency of transformation and the protection of employees' rights and interests and contribute to the construction of a more reasonable pattern of labor relations during the digitalization period.

This study has several innovative aspects. Methodologically, instead of relying on conventional research data, nighttime satellite light data are used to measure employees' overtime work, which overcomes the limitations of subjective biases in questionnaires. Moreover, this work combines Python-based text recognition technology with annual report data to measure the level of enterprise digitalization. This data measurement approach, paired with microeconometric models, ensures more objective and accurate research results. In terms of research content, existing studies focus mostly on the influence of enterprise digitalization on performance and technology. In contrast, this work explores its influence on employees' number of working hours, delving into the scale expansion and technological innovation mechanisms behind the increase in the amount of overtime work. Furthermore, this study takes a new approach to the moderating function of corporate executives' digital attitudes, offering a more complete understanding of the interaction among digitalization, management, and employees.

The remainder of this article are organized as follows. Section 2 defines enterprise digitalization and proposes hypotheses about its impact on employees' amount of overtime work. Section 3 designs the research by constructing an econometric model and selecting relevant variables, with data sourced from multiple channels. Section 4 presents empirical estimations, including benchmark analysis, endogeneity analysis, and mechanism analysis. Section 5 further discusses wage compensation for overtime work and the influence of corporate executives' digital attitudes. The final section draws conclusions and presents policy implications.

Theoretical analysis and hypotheses

Enterprise digitalization refers to the use of digital technologies to break down data barriers between different levels and industries, thereby creating new businesses, business forms, and business models (Chen, et al., 2024, Shao, et al., 2024). Enterprises rely on digital technology for modernization, with data as the core element and data empowerment as the main line, with the goal of increasing production volume and efficiency (Li, et al., 2025, Li, et al., 2025, Yu, et al., 2024). Enterprise digitalization has a continuous and profound effect on the enterprise’s organizational structure (Mustafa, et al., 2022, Zhang, et al., 2025), business scope (Kohtamäki, et al., 2024), and employment model (Cirillo, et al., 2021). All these changes in factors are likely to lead to overtime work among enterprise employees (Fang, et al., 2025, Norden and Ribeiro, 2025).

Digitalization can increase employees' number of working hours by facilitating the expansion of enterprise scale (Franco and Suppressa, 2025, Zhang, et al., 2025). Digital technology provides firms with more efficient management tools and greater market reach (Du, et al., 2025, Liu, et al., 2025). Through big data analysis, companies can better understand market demand, optimize production processes, and

thus make more informed decisions about business expansion (Boerner, et al., 2025, Wu, et al., 2025). This expansion often leads to increased workloads. Moreover, digitalization also heightens competition (Yan, et al., 2024, Zhang, et al., 2025). To maintain a competitive edge in the digitally driven market, enterprises may push employees to work longer hours to ensure faster product development, more responsive customer service, and more efficient operations (He and Yi, 2023, Liu, et al., 2025, Shen, et al., 2025). This competitive pressure further contributes to the increase in employees' number of working hours as an enterprise expands under the influence of digitalization (Aránega, et al., 2025, Martindale and Lehdonvirta, 2023).

Digitalization can lead to an increase in employees' number of working hours by promoting corporate technological innovation. Digitalization offers enterprises abundant resources and tools for technological innovation (Andres, et al., 2025, Chen, et al., 2024, Yan, et al., 2025). Advanced digital research and development (R&D) platforms allow companies to conduct in-depth R&D more quickly (Wang and Wei, 2025, Zheng, et al., 2025). Big data analytics helps in identifying market trends and customer needs precisely, which in turn guides targeted innovation (Magistretti, et al., 2025). When enterprises are engaged in technological innovation spurred by digitalization, they often face several situations that drive up employees' number of working hours (Mao, et al., 2025, Neumann, 2025). During the process of technological innovation, new product or service development requires a high degree of concentration and continuous effort (Affandi, et al., 2024, Ma and Lin, 2025). Employees in R&D departments, in particular, need to spend extra time testing, debugging, and optimizing new technologies. Furthermore, after the successful implementation of technological innovation, enterprises usually need to rapidly integrate new technologies into their operations (Çela, et al., 2024, Zhang, et al., 2025). This integration phase also demands considerable time and effort from employees (Maione, et al., 2024). As digitalization accelerates the pace of technological innovation, the frequency and intensity of these situations increase, ultimately resulting in more overtime for employees.

Therefore, two hypotheses are presented as follows:

Hypotheses 1: The digitalization of enterprises increases the amount of overtime work among enterprise workers.

Hypotheses 2: The scale expansion effect and technological innovation effect are the internal mechanisms through which digitalization leads to employees' overtime.

Research design

Econometric model. To investigate the influence of digitalization on overtime work, this benchmark study adopts the following panel two-way fixed effects model:

$$OW_{it} = \alpha + \beta DT_{it} + \gamma X_{it} + \eta_i + \nu_t + \varepsilon_{it}$$

1

where i denotes individual enterprises and t represents periods. OW_{it} is the dependent variable, operationalized by quantifying the brightness of corporate nighttime lighting data from listed companies. DT_{it} serves as the core explanatory variable, measured through the automated text analysis of annual reports to calculate digitalization-related word frequencies. X_{it} consists of control variables that incorporate key production/operation characteristics. η_i captures unobserved time-invariant firm-specific fixed effects, and v_t accounts for macroeconomic and policy-related year fixed effects. ε_{it} represents the idiosyncratic error term with standard assumptions.

The explained variable is the overtime work variable OW_{it} of listed companies. In the literature (Barentine, 2022, Xuan and Wu, 2023), the criterion for determining whether an enterprise is in a state of overtime work is based on comparison standards in terms of time and space dimensions. The reason for this is due to, unlike questionnaires, which are easily interfered with by factors such as subjective cognitive biases and personal willingness tendencies, satellite nighttime light data are obtained via remote sensing technology. Such technology can continuously collect information over a long time span and covers a vast geographical area. These characteristics are more in line with the needs of empirical research on large samples than are those of other approaches. The building method is as follows: on the one hand, the nighttime light brightness of listed company i during legal holidays is taken as the comparison benchmark in the time dimension. When the nighttime light brightness of listed company i is greater than that during legal holidays, the high light brightness may not be an inherent characteristic of the grid where the listed company is located but rather caused by the company's nighttime overtime work. On the other hand, the nighttime light brightness of the district or county where listed firm i is located is used as the comparison benchmark in the spatial dimension. When the nighttime light brightness of listed company i is greater than that of the district or county where it is located, it may also reflect the company's nighttime overtime work situation rather than the spillover effect generated by the surrounding infrastructure construction. In summary, when listed company i meets both the time and spatial dimension criteria simultaneously, it is defined as being in a state of overtime work. The overtime work variable OW_{it} of the listed company then counts the number of overtime work days of listed firm i in year t.

The explanatory variable is digitalization DT_{it}. In the literature (Bao, et al., 2023, Wu, et al., 2021), which is based on the text recognition function of Python crawlers, and taking the annual reports of listed firms in the Shanghai and Shenzhen stock markets as the basis, a specific keyword set for digitalization is selected, and keywords with negative words and those that do not belong to the company itself are excluded. The method of searching, matching, and summing keywords is adopted to depict the level of digitalization of enterprises.

The control variable is X_{it}, which incorporates key enterprise-level production and operation characteristics to account for potential confounding effects. These variables are selected on the basis of their theoretical relevance to both overtime work patterns and digitalization adoption. Specifically, the firm scale variable *Scale* is operationalized as the natural logarithm of total assets, which captures

economies of scale and resource endowment effects; the capital structure variable *CS* is measured by the total debt-to-assets ratio, reflecting financial leverage and risk management strategies; the capital intensity variable *CI* is calculated as fixed assets per employee, representing the technology-intensive nature of production processes; the profitability variable *Profit* is operationalized as return on assets, capturing the efficiency of asset utilization and overall financial performance; and the ownership concentration variable *OC* is measured by the percentage of shares held by the largest shareholder, reflecting governance structures and agency costs.

Data sources. Overtime work indicators for listed firms are derived mostly from nighttime light data provided by the Visible Infrared Imaging Radiometer Suite (VIIRS) sensor on the National Polar-orbiting Partnership (NPP) satellite in the United States. This data product has provided daily frequency nighttime light data since January 19, 2012. The Python programming language is used to analyze and process the relevant data. Specifically, through the longitude and latitude coordinate information of the office address disclosed in the annual report of the listed company, the company is mapped to the corresponding grid position with the help of a specific positioning algorithm, and then, the operation of reading the nighttime light brightness data of the grid where the enterprise is located is realized, providing data support for subsequent research and analysis. Digitalization data for listed companies are derived from annual reports of all A-share firms listed on the Shanghai and Shenzhen Stock Exchanges. A Python-based web crawler is employed to systematically collect and organize these reports, which are then processed using the Java-based *PDFbox* library to extract full-text content. This forms the textual database for subsequent text mining analysis to identify digitalization-related keywords. Firm characteristic data are obtained from three primary sources—the China Stock Market & Accounting Research (CSMAR) database, which is a core dataset for financial and operational metrics; the Wind Database, which includes supplementary data on market indices and corporate governance; and the China Research Data Service Platform (CNRDS), which includes additional macroeconomic and industry-level variables. The final sample spans an 11-year period (2012–2022) with annual observations. The descriptive statistics for key variables are presented in Table 1, providing a foundational overview of the dataset characteristics.

Table 1
Descriptive statistics of key variables.

Main Variable	Observation	Mean	Standard Deviation	Minimum	Maximum
OW	37,095	186.87	66.97	0	364
DT	37,095	0.0811	0.1934	0	3.5077
Scale	37,018	22.20	1.5605	14.94	3.13E + 01
CS	37,092	0.4364	1.0431	-0.1947	1.78E + 02
CI	37,082	0.0030	0.3587	7.19E-06	6.77E + 01
Profit	37,091	0.0427	0.1667	-1.46E + 01	1.22E + 01
OC	36,234	34.01	15.19	0.29	100

Empirical estimation and result analysis

Benchmark analysis. On the basis of the benchmark equation, a panel two-way fixed effects model is employed to control for individual and year fixed effects. In addition, considering the possible problem of heteroscedasticity, during the regression process, logarithmic transformation is carried out on variables with relatively large data fluctuations. The findings are reported in Table 2. In Column (1) of Table 2, the overtime work variable of listed companies is used as the dependent variable, and only the digitalization variable is introduced as the explanatory variable. Column (2) further introduces the production, operation, and management characteristics at the company level. Moreover, Columns (3) and (4) use overtime work on working days and overtime work on weekends, respectively, as the dependent variables to further examine the influence of digitalization on the overtime work of firms.

The findings in Columns (1) and (2) of Table 2 reveal that the coefficient of the digitalization variable is positive, indicating that the increased digitalization of listed companies increases employees' overtime work. A possible explanation for this is that digitalization usually brings about changes in business models and applications of new technologies. Moreover, digitalization may lead to adjustments in the company's organizational structure and the optimization of business processes. Employees need to adapt to these changes and continuously learn and become accustomed to new technologies and tools, thus resulting in an increase in employees' work burden and the need to work overtime to complete corresponding tasks. A comparison of the digital variables of listed companies in Columns (1) and (2) reveals that if the production and management characteristics of a company are not considered, then the impact of digitalization on employees' amount of overtime work will be overestimated. In addition, the findings in Columns (3) and (4) show that the digitalization variable is also positive, indicating that the digitalization of the company increases employees' amount of overtime work both on weekends and nonweekends.

The control variables produce outcomes that are consistent with expectations. The regression coefficients for the firm scale are all significantly negative, showing that the larger the company scale is, the less overtime work. Large-scale companies usually have more complete management systems and resource allocations, enabling them to arrange work more reasonably, than do small-scale companies. The regression coefficients of capital intensity are all significantly positive, suggesting that the stronger the capital intensity is, the more serious the overtime work situation. Capital-intensive enterprises require more human input and technical support during the production or operation process, leading to increased levels of work pressure on employees and longer overtime hours. The regression coefficient for ownership concentration is negative, implying that a higher level of ownership concentration may diminish the likelihood of overtime work. The regression coefficients of capital structure and profitability are not significant in all columns, indicating that the impacts of capital structure and profitability on overtime work are not obvious within the sample interval.

Table 2
Benchmark analysis.

	(1)	(2)	(3) *Weekends*	(4) *Nonweekends*
	OW	***OW***	***OW***	***OW***
DT	0.0868***	0.0793***	0.0775***	0.0781***
	(0.0240)	(0.0246)	(0.0241)	(0.0249)
Scale		-0.0095***	-0.0094***	-0.0102***
		(0.0026)	(0.0025)	(0.0026)
CS		-0.0005	-0.0005	-0.0002
		(0.0024)	(0.0023)	(0.0024)
CI		0.0068***	0.0069***	0.0063***
		(0.0002)	(0.0002)	(0.0002)
Profit		0.0143	0.0148	0.0150
		(0.0134)	(0.0134)	(0.0131)
OC		-0.0005	-0.0005	-0.0005*
		(0.0003)	(0.0003)	(0.0003)
Constant	5.0730***	5.2990***	4.9681***	4.0618***
	(0.0099)	(0.0553)	(0.0542)	(0.0551)
Observation	37,095	36,223	36,223	36,223
R^2	0.0125	0.0139	0.0149	0.0130

Note: Significance thresholds are denoted hierarchically: * p < 0.10, ** p < 0.05, and *** p < 0.01. Robust standard errors appear in parentheses.

Endogeneity analysis. Because the two-way causal link between variables and omitted factors can cause endogeneity difficulties, we adjust for endogeneity bias by identifying relevant instrumental variables. Columns (1) and (2) of Table 3 introduce the digital attention of the government and the public in the cities where listed firms are situated as instrumental variables. The government's digital attention is assessed using official work reports and the frequency of digital-related terms, whereas the Baidu search index is used to measure the public's digital attention. On the one hand, when the government in the region where a listed business is based is more concerned with digital concerns, the firm is more likely to gain government backing and advantageous policies if it actively participates in digitalization. On the other hand, when the public in the region where a listed business is based is more concerned with

digital concerns and the firm actively pursues digitalization, then its corporate reputation and product impacts are more likely to be recognized and preferred by customers. As a result, if the government and the general public in the region where a listed firm is based pay more attention to digitalization, then the listed company is more likely to improve its digitalization efforts, achieving the correlation criterion. Furthermore, macroeconomic variables are less likely to be influenced by company overtime work, hence satisfying the condition of instrumental variable exogeneity. Columns (3) and (4) of Table 3 introduce digitalization at the regional and industry levels, respectively, as instrumental variables. On the basis of the digitalization situations of listed companies in the respective cities and industries, the digitalization situations of the cities and industries where the listed companies are located are aggregated, and the digitalization situation of the company itself is deducted. The results in Table 3 reveal that when endogeneity is controlled for, all of the coefficients of digitalization are considerably positive, implying that digitalization will increase the amount of enterprise employee overtime. In addition, weak instrumental variable tests and overidentification tests are used for the instrumental variables. The test findings reject the null hypothesis, demonstrating the efficiency of the instrumental variables.

Table 3
Endogeneity analysis.

DT	(1) *Government*	(2) *Public*	(3) *Region*	(4) *Industry*
	1.9314**	**1.7541*****	**0.5735*****	**0.3098*****
	(0.7861)	(0.2459)	(0.1116)	(0.0579)
Constant	5.2113***	5.2231***	5.2770***	5.2911***
	(0.0767)	(0.0693)	(0.0571)	(0.0558)
Control variables	YES	YES	YES	YES
Kleibergen–Paap rk	57.89	733.14	3822.19	1.1e + 04
LM statistic	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Kleibergen–Paap rk	60.68	63.80	67.46	93.68
Wald F statistic	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Observations	31,259	36,208	36,223	36,092
R^2	0.2297	0.1959	0.0044	0.0097

Note: The LM statistic detects the underidentification of instrumental variables, whereas the Wald F statistic determines if instrumental variables are poorly recognized. The p values for the statistics are indicated in parentheses.

Mechanism analysis. It has been verified earlier that digitalization leads to employees' overtime work, and further exploration of its mechanisms is necessary. First, digital development leads to the expansion of the enterprise's business scale and business transformation, thereby generating a greater workload.

The scale expansion effect prompts employees to work overtime. Second, with the implementation of the enterprise's digitalization strategy, the enterprise's R&D and innovation activities tend to increase. Moreover, R&D investment has obvious characteristics of skill bias, which generate greater demand for highly skilled labor in the enterprise. Through the technological innovation effect, this situation prompts employees to work overtime. On this basis, the market expansion mechanism and technological innovation mechanism are tested. The market expansion mechanism is assessed according to the rate of increase in operating revenue and inventory turnover, whereas the technical innovation mechanism is measured by the number of digital patent applications and R&D workers.

The findings are shown in Table 4. Columns (1) and (2) show the market expansion mechanism. The impacts of digitalization on a company's revenue growth and inventory turnover are significantly positive. That is, digitalization usually leads to the expansion of the market scale. Employees need to continuously learn and adapt to new businesses, which increases their work burden and makes them need to work overtime to complete corresponding tasks. Columns (3) and (4) report the technological innovation mechanism. The impacts of digitalization on the numbers of patent applications and R&D personnel of enterprises are significantly positive. That is, intelligent development can promote innovative collaboration and knowledge sharing and generate greater demand for highly skilled labor. Compared with routine and repetitive low-skilled jobs, highly skilled jobs are more likely to involve overtime work.

Table 4
Mechanism analysis.

	Market expansion mechanism		*Technological innovation mechanism*	
	(1) *Revenue growth*	(2) *Inventory turnover*	(3) *Patent application*	(4) *R&D personnel*
DT	0.0473**	0.7341***	2.2429***	2.0297***
	(0.0200)	(0.1488)	(0.1614)	(0.1151)
Constant	-0.0512	0.0320	-1.4890***	-6.4302***
	(0.0399)	(0.3706)	(0.3433)	(0.4525)
Control variables	YES	YES	YES	YES
Observations	36,195	34,965	36,223	20,691
R^2	0.0461	0.0143	0.1000	0.3351

Further discussion

Discussion on wage compensation for overtime work. Digitalization leads to the expansion of enterprise scale and technological innovation. Employees need to continuously learn and adapt to new

technologies and tools, which increases their work burden and requires them to work overtime to complete corresponding tasks. Thus, whether the overtime work brought about by digitalization is compensated through income is a question that still needs further verification. In Columns (1) and (3) of Table 5, the employee compensation payable by listed companies and the average wage are introduced as the explained variables, respectively. The results show that the coefficients of the digitalization variables are all significantly positive, indicating that the digitalization of listed companies can increase the overall income and average wage of employees, resulting in an increase in employees' income.

In addition, although digitalization can increase the employee compensation payable and the average wage of listed companies, is it compensation for overtime work? Columns (2) and (4) introduce the interaction terms between digitalization and overtime work, respectively. The findings show that the interaction terms are positive and significant and that the coefficients of the digitalization variables are no longer significant. This finding indicates that overtime work is an important reason for the increase in employee compensation payable and the average wage of listed companies due to digitalization. That is, digitalization leads to employees' overtime work, but it also provides certain income compensation to employees for such work.

Table 5
Digitalization, overtime work and employee compensation.

	Employee compensation payable		*Average wage*	
	(1)	**(2)**	**(3)**	**(4)**
DT	0.9145***	0.0293	0.5860***	0.0997
	(0.1158)	(0.1443)	(0.0939)	(0.1286)
DT×OW		0.0905***		0.0601***
		(0.0134)		(0.0124)
Constant	-2.1028***	-1.8209***	4.9581***	4.6540***
	(0.2527)	(0.2559)	(0.2468)	(0.2527)
Control variables	YES	YES	YES	YES
Observations	36,165	25,345	35,818	25,059
R^2	0.4940	0.5653	0.1650	0.1731

Discussion on the digital attitudes of corporate executives. As the microsubjects of economic activities, the digital attitude of a firm's managers directly affects the effectiveness of its digitalization. The annual report texts of the management issued by the company contain incremental information and can reflect the details, logic, and evidence that cannot be reflected in quantitative information. When the digital attitude of the company's management is more positive, it presents positive expectations for the firm's

digitalization in the annual report. Therefore, this article takes the annual report texts of the management of listed firms as the carrier. The sentiment analysis dictionary of *CNKI HowNet* differentiates positive and negative emotion words, automatically segments texts using Python's Chinese word segmentation package, and counts word frequencies. Then, the indicators of the proportion of digital positive word frequencies and the proportion of digital negative word frequencies of listed companies are constructed.

The findings are reported in Table 6. When the degree of digitalization of listed companies is fixed, if the management of a company holds a more positive attitude toward digitalization, then the extent to which digitalization leads to an increase in employees' amount of overtime work in listed companies will be weakened. When management holds a positive digital attitude, during the digitalization process, the enterprise pays more attention to improving efficiency through reasonable planning and efficient process design rather than simply relying on increasing employees' number of working hours. For listed companies whose management holds a negative attitude toward digitalization, the extent to which digitalization leads to an increase in employees' amount of overtime work in listed companies will be strengthened. A negative digital attitude may manifest as a company's lack of clear strategies and plans during the digitalization process, resulting in chaos and inefficiency. As a result, employees need to spend more time solving these problems, thus increasing their number of overtime hours.

Table 6
Digitalization, attitudes of upper management and overtime work.

	(1)	(2)	(3)	(4)
	OW	*OW*	*OW*	*OW*
DT	0.0647**	0.0562**	0.0671***	0.0579**
	(0.0251)	(0.0255)	(0.0250)	(0.0253)
Positive attitude	-0.0018**	-0.0016**		
	(0.0008)	(0.0008)		
Negative attitude			0.0246***	0.0255***
			(0.0080)	(0.0079)
Constant	5.1511***	5.4028***	5.1361***	5.3966***
	(0.0145)	(0.0628)	(0.0136)	(0.0632)
Control variables	NO	YES	NO	YES
Observations	25,433	25,425	25,433	25,425
R^2	0.0111	0.0127	0.0111	0.0128

Conclusions and policy implications

This study empirically tests the degree and action mechanism of the impact of digitalization on the amount of overtime work of listed companies by using a microeconometric model and further discusses whether the resulting overtime work can be compensated with income. The results show that with the digitalization of listed companies, employees' amount of overtime work will increase to a certain extent, and this conclusion still holds after controlling for the endogeneity problem. The analysis of the mechanism shows that digitalization affects employees' amount of overtime work through the market expansion mechanism and the technological innovation mechanism. Further discussion shows that the digitalization of listed companies can increase the total income and average salary of employees and that overtime work is an important reason for the increase in income compensation brought about by digitalization. In addition, when the degree of digitalization of listed companies is certain, if the management of the company holds a positive attitude toward digitalization, then it can reduce the amount of employees' overtime work caused by digitalization. If the management of a company holds a negative attitude toward digitalization, then it can increase the amount of employees' overtime work caused by digitalization. On the basis of the research findings, this study proposes the below policy suggestions.

First, governments advancing enterprise digitalization must enact regulatory frameworks for monitoring labor practices. While acknowledging the productivity benefits of digitalization, mandatory measures should prevent exploitative overtime as a digitalization driver. Legislative initiatives must define the maximum number of working hours during digital transitions, curbing corporate tendencies to prioritize transformation velocity over workforce well-being. Second, governments must implement sector-specific regulations that steer corporate strategies through industrial policies. This curbs innovation arbitrage, where market share competition drives exploitative overtime practices. Legislative frameworks should establish legally binding overtime thresholds with premium compensation during R&D cycles, mandating phased innovation roadmaps aligned with workforce sustainability metrics. Enterprises are obligated to synchronize project timelines with human resource capacities and implement task distribution algorithms to prevent workload clustering. Finally, the issue of excessive overtime in digital transformation requires structural adjustment through organizational culture building. Governments should employ policy incentives and public advocacy to guide enterprises in integrating humanistic considerations into digitalization strategies. Enterprises must cultivate digital organizational cultures that emphasize bidirectional empowerment. This stratified governance model enhances organizational resilience, achieving synergistic evolution between technological adoption and labor rights protection.

Declarations

Data availability

The data that support the findings of this study are available within the supplementary files of this article. The shared datasets include the foundational data on the overtime work of listed companies and their digital transformation. Furthermore, the databases containing the instrumental variables and

mechanism variables used in the analysis, as well as the variable data utilized for the extended analyses, are also provided directly in the supplementary files.

Ethical statement

This article does not contain any studies with human participants performed by any of the authors.

References

1. Affandi Y, Ridhwan MM, Trinugroho I et al (2024) Digital adoption, business performance, and financial literacy in ultra-micro, micro, and small enterprises in indonesia. Res Int Bus Finance 70. ttp://10.1016/j.ribaf.2024.102376
2. Andres R, Niebel T, Sack R (2025) Big data and firm-level productivity – a cross-country comparison. Inf Econ Policy 71:101147. ttp://https://doi.org/10.1016/j.infoecopol.2025.101147
3. Aránega AY, Montesinos CG, Urueña RC et al (2025) Digitalization intention in entrepreneurs and smes: A structural equation model of digital behavior and work-life balance. Int Entrepreneurship Manage J 21. ttp://10.1007/s11365-024-01049-2
4. Autor D, Chin C, Salomons A et al (2024) New frontiers: The origins and content of new work, 1940–2018. Quart J Econ 139:1399–1465. ttp://10.1093/qje/qjae008
5. Bao Q, Dang J, Wang Y (2023) Domestic trade network, geographical distance and localization of suppliers. Econ Res J 102–118
6. Barentine JC (2022) Night sky brightness measurement, quality assessment and monitoring. Nat Astronomy 6:1120–1132. ttp://10.1038/s41550-022-01756-2
7. Boerner X, Wiener M, Guenther TW (2025) Controllership effectiveness and digitalization: Shedding light on the importance of business analytics capabilities and the business partner role. Manage Acc Res 66. ttp://10.1016/j.mar.2024.100904
8. Brynjolfsson E, Li D, Raymond L (2025) Generative ai at work*. Quart J Econ. ttp://10.1093/qje/qjae044
9. Çela A, Mansi E, Morina F (2024) Young adults' pathway to digital entrepreneurship: From ideas to innovation. Eur J Innov Manage. ttp://10.1108/ejim-04-2024-0486
10. Chen Y, Wang YD, Zhao CY (2024) From riches to digitalization: The role of amc in overcoming challenges of digital transformation in resource-rich regions. Technol Forecast Soc Chang 200. ttp://10.1016/j.techfore.2023.123153
11. Chen ZG, Gong YF, Meng QY et al (2024) Can digital finance boost regional innovation? From the perspective of resource mismatch in china. Technol Anal Strateg Manag. ttp://10.1080/09537325.2024.2426046
12. Cirillo V, Evangelista R, Guarascio D et al (2021) Digitalization, routineness and employment: An exploration on italian task-based data. Res Policy 50. ttp://10.1016/j.respol.2020.104079

13. Du WJ, Cheng C, Li MJ (2025) Can listed company digitization reduce the risk of export failure? Evidence from multisource heterogeneous data in china. Int Rev Econ Finance 103. ttp://10.1016/j.iref.2025.104573
14. Du WJ, Li MJ (2025) Corporations' digital attitude and digital technology innovation: Are the heart and mouth in agreement or not? Finance Res Lett 75. ttp://10.1016/j.frl.2025.106910
15. Fang X, Zhang Y, Lv SQ et al (2025) Does digital finance spatial correlation drive income convergence? Econ Model 153. ttp://10.1016/j.econmod.2025.107308
16. Franco C, Suppressa F (2025) Robot, trade and employment: Unravelling the relationship within the european context. Struct Change Econ Dyn 73:407–422. ttp://10.1016/j.strueco.2025.02.004
17. Gornick J (2016) Finding time the economics of work-life confict. Science 352:299–299. ttp://10.1126/science.aaf3924
18. Grigsby J, Hurst E, Yildirmaz A (2021) Aggregate nominal wage adjustments: New evidence from administrative payroll data. Am Econ Rev 111:428–471. ttp://10.1257/aer.20190318
19. He YH, Yi Y (2023) Digitalization of tax administration and corporate performance: Evidence from china. Int Rev Financial Anal 90. ttp://10.1016/j.irfa.2023.102859
20. Hu ZG (2025) How digital economy and green and low carbon policies affect non-agricultural employment?-evidence from china. Humanit Social Sci Commun 12. ttp://10.1057/s41599-025-05398-3
21. Kohtamäki M, Leminen S, Parida V (2024) Conceptualizing digital business models (dbm): Framing the interplay between digitalization and business models. Technovation 133. ttp://10.1016/j.technovation.2024.103013
22. Li MJ, Yuan NN, Du WJ (2025) Artificial intelligence and firm green innovation: Empirical evidence from the application of robots in china. Econ Anal Policy 87:2239–2253. ttp://10.1016/j.eap.2025.08.022
23. Li ZY, Hu BQ, Bao YF et al (2025) Supply chain digitalization, green technology innovation and corporate energy efficiency. Energy Econ 142. ttp://10.1016/j.eneco.2024.108153
24. Liu BF, Guo RF, Shi HQ (2025) Digital government and corporate investment: Effects and mechanisms. Econ Model 151. ttp://10.1016/j.econmod.2025.107189
25. Liu ZK, Jiang CX, Jin H et al (2025) Digital innovation diffusion of local government under public crisis: An event history analysis based on the city brain. Cities 160. ttp://10.1016/j.cities.2025.105811
26. Ma RY, Lin BQ (2025) The impact of digital technology innovation on energy-saving and emission reduction based on the urban innovation environment. J Environ Manage 375. ttp://10.1016/j.jenvman.2025.124176
27. Magistretti S, Dell'Era C, Candi M et al (2025) Unpacking experimentation in design thinking: Contributions to innovation performance and the moderating role of digital technologies. Technovation 141. ttp://10.1016/j.technovation.2025.103187

28. Maione G, Leoni G, Magliacani M (2024) Unpacking the knowledge dimensions of digital innovation: Implications for accountability in public and private sectors during extraordinary times. J Knowl Manage. ttp://10.1108/jkm-01-2024-0047
29. Mao JH, Yu B, Guan C (2025) Digital economy, official promotion pressure, and firm innovation. Glob Financ J 64. ttp://10.1016/j.gfj.2025.101078
30. Martindale N, Lehdonvirta V (2023) Labour market digitalization and social class: Evidence of mobility and reproduction from a european survey of online platform workers. Socio-Economic Rev 21:1945–1965. ttp://10.1093/ser/mwad049
31. Mustafa G, Solli-Sæther H, Bodolica V et al (2022) Digitalization trends and organizational structure: Bureaucracy, ambidexterity or post-bureaucracy? Eurasian Bus Rev 12:671–694. ttp://10.1007/s40821-021-00196-8
32. Neumann U (2025) Digital transformation, employment change and the adaptation of regions in germany. Struct Change Econ Dyn 73:37–50. ttp://10.1016/j.strueco.2024.12.014
33. Norden L, Ribeiro T (2025) Local credit in brazil: The role of digital connectivity and education. Emerg Markets Rev 65. ttp://10.1016/j.ememar.2025.101265
34. Norton ST, Shapiro JN (2023) Digital tech: Some way to go for ipcc-style governance. Nature 620:727–727. ttp://10.1038/d41586-023-02630-5
35. Qin XD, Wu HT, Li RR (2022) Digital finance and household carbon emissions in china. China Econ Rev 76:101872. ttp://10.1016/j.chieco.2022.101872
36. Shao YM, Xu KL, Shan YG (2024) Leveraging corporate digitalization for green technology innovation: The mediating role of resource endowments. Technovation 133. ttp://10.1016/j.technovation.2024.102999
37. Shen WT, Avotra A, Yu X et al (2025) The effect of digitalization on total factor productivity: A dynamic capabilities perspective. Humanit Social Sci Commun 12. ttp://10.1057/s41599-025-05938-x
38. Wang CH, Zhao XH (2024) See how your body works in real time - wearable ultrasound is on its way. Nature 630:817–819. ttp://10.1038/d41586-024-02066-5
39. Wang J, Gao Q, Zhang R (2025) Gig economy and its impact on individual employment: An empirical analysis. Humanit Social Sci Commun 12. ttp://10.1057/s41599-025-05970-x
40. Wang K, Wei YX (2025) Digital regulation and firm productivity: Evidence from a quasi-natural experiment in china. Econ Model 152. ttp://10.1016/j.econmod.2025.107306
41. Wu F, Hu H, Lin H et al (2021) Enterprise digital transformation and capital market performance: Empirical evidence from stock liquidity. J Manage World 130–144
42. Wu XM, Wu XH, Shang D et al (2025) Digital transformation and firm business diversification: An inverse u-shaped relationship. Econ Anal Policy 87:874–892. ttp://10.1016/j.eap.2025.06.042
43. Xu HW, Usuyama N, Bagga J et al (2024) A whole-slide foundation model for digital pathology from real-world data. Nature. ttp://10.1038/s41586-024-07441-w

44. Xuan Y, Wu K (2023) Overtime work and labor income share: Empirical evidence based on satellite night light. J World Econ 217–240
45. Yan YC, Lei YF, Wang YD et al (2025) Digital transformation and customer enterprise innovation - from the perspective of supply chain spillover effects. Finance Res Lett 76. ttp://10.1016/j.frl.2025.106941
46. Yan YL, Wang MC, Lai JJ (2024) Does corporate digitalization promote labor investment efficiency? Evidence from chinese listed companies. Humanit Social Sci Commun 11. ttp://10.1057/s41599-024-03777-w
47. Yu L, Zhao SY, Liu C et al (2025) The acceleration and attenuation: Internet infrastructure and employment. Struct Change Econ Dyn 75:726–743. ttp://10.1016/j.strueco.2025.10.003
48. Yu ZP, Cao XN, Tang L et al (2024) Does digitalization improve supply chain efficiency? Finance Res Lett 67. ttp://10.1016/j.frl.2024.105822
49. Zhang J, Yu CH, Zhao JS et al (2025) How does corporate digital transformation affect green innovation? Evidence from china's enterprise data. Energy Econ 142. ttp://10.1016/j.eneco.2025.108217
50. Zhang J, Yu Q, Zhou K (2025) Changes in labor share of china: A micro-level anatomy. China Economic Q Int 5:85–101. ttp://https://doi.org/10.1016/j.ceqi.2025.05.002
51. Zhang XH, Yue SJ, Tao JY et al (2025) Does digital transformation affect corporate mergers and acquisitions? From the perspective of information asymmetry. Econ Anal Policy 86:764–778. ttp://10.1016/j.eap.2025.03.049
52. Zhang YC, Chen Y, Ye F (2025) Digital financial innovation, productivity and modernization of industry chain and supply chain. Econ Anal Policy 87:1198–1211. ttp://10.1016/j.eap.2025.07.005
53. Zheng HY, Li D, Cai JY (2025) Driving green innovation: The impact of digital finance on china's transition to clean energy. Energy 318. ttp://10.1016/j.energy.2025.134760

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