International Journal of Hospitality Management 120 (2024) 103757

Contents lists available at ScienceDirect

International Journal of Hospitality Management

journal homepage: www.elsevier.com/locate/ijhm

Minimum wage and the survival of hotel industry: Evidence from China

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ARTICLE INFO

Keywords:
Minimum wage
Hotel industry
Survival analysis
Digital economy
Informal hotel enterprises

ABSTRACT

The economic impacts of the minimum wage have been the focus of ongoing conflicting debates among policymakers and researchers. Taking a sample of 69694 firms established from 2011 and 2019 in the Chinese hotel sector, we analyzed the impact of minimum wage on firm survival and the moderating effect of the digital economy. Empirical evidences show that minimum wage has a positive impact on the survival risk of hotels, and the digital economy can negatively moderate the relationship between minimum wage and the survival risk of hotels. These findings are robust when tested with the hotel data of cross-provincial city pairs, other estimation models or longer observation periods. In addition, this study finds that the impact of the minimum wage and the moderating effect of the digital economy vary with hotel types. The rise of the minimum wage has brought greater operating pressure to formal hotel enterprises, and the digital economy has a greater inhibitory effect on the relationship between the rise of the minimum wage and the survival risk of hotel enterprises in informal hotel enterprises. The results indicate that informal hotels are less adversely affected by the increasing minimum wage and benefit more from the development of the digital economy.

1. Introduction

In 1993, China's first national minimum wage regulation was issued. In 2004, the Chinese Ministry of Labor and Social Security passed the Minimum Wage Regulations. In 2008, the Labor Contract Law was promulgated, and the implementation of the minimum wage policy in China was further strengthened. The increase in the minimum wage protects the rights of low-wage workers, but it also leads to an increase in labor costs for enterprises (Fan et al., 2018). According to the National Bureau of Statistics, the average annual wage of urban workers in China was 15920 yuan in 2004, and increased to 90501 yuan in 2019. Existing literatures have examined the impact of the minimum wage increases on enterprises. Opponents of the minimum wage believe that a high minimum wage can increase firm costs (Chorna, 2021), reduce firm profitability (Draca et al., 2011; Bell and Machin, 2018) and even lead to higher business risks and failures (Aaronson et al., 2018; Luca and Luca, 2019; Alexandre et al., 2022). Supporters argue that a high minimum wage can force managers to improve their management methods, improve firm productivity (Riley and Rosazza Bondibene, 2017; Wang et al., 2023), and bring positive economic effects (Mun and Woo, 2021). Although the findings are controversial, there is a consensus that the impact of the minimum wage should vary in different industries and regions (Draca et al., 2011; Harasztosi and Lindner, 2019).

The hotel industry is a typical low-income, labor-intensive industry (Adam-Smith et al., 2003; Warhurst et al., 2008). According to the China Bureau of Statistics, in 2021, the average annual wage of accommodation and catering industries was 53631 yuan which is the lowest average wage among town/township non-private enterprises. Among town/township private units, the average annual wage of accommodation and catering industries was 46817 yuan, which is only higher than that of agriculture, forestry, animal husbandry and fishery, water conservancy, environment and public facilities services. These data indicate that the hotel industry employs a relatively large proportion of low-wage employees (Casado-Díaz and Simón, 2016). Therefore, the minimum wage increase may have a greater impact on hotels than other industries that rely less on minimum wage workers (Mun and Woo, 2021). For instance, a new minimum wage rate directly increases the average labor cost of hotel firms (Agarwal et al., 2024), which in turn decreases hotel firms' income (Song et al., 2022; Agarwal et al., 2024) and enforces a higher survival risk. Moreover, most hotels belong to micro, small, and medium enterprises (MSMEs), which have scarce resources and a higher exit rate than enterprises of other sizes (Vivel-Búa et al., 2019). The impact of a minimum wage increase on the survival of the hotel industry may be substantial. In this vein, examining the effect of a minimum wage

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https://doi.org/10.1016/j.ijhm.2024.103757
Received 28 June 2023; Received in revised form 2 March 2024; Accepted 9 April 2024
Available online 13 April 2024

increase is of significant importance to the hotel industry. However, in the hospitality literature, previous examples have mainly investigated the impact of minimum wage on firm performance (Mun and Woo, 2021; Song et al., 2022; Agarwal et al., 2024), or the relationship between top executives/manager's remuneration and firm survival risk (Trinh and Seetaram, 2022). There is no empirical evidence to support the relationship between minimum wages and the survival of hotels.

Some researchers have examined the relationship between the minimum wage and firm exit using data from various industries. Mayneris et al. (2018) found that a higher minimum wage increased the exit probability of industrial enterprises in China. Aaronson et al. (2018) and Luca and Luca (2019) found that an increase in the minimum wage can lead to a high exit rate of American catering enterprises. These studies provide a solid research foundation for our paper. However, given the significant disparity between the hotel industry and the industrial sector (Madan, 2019), as well as the distinctive tip credit system in the American catering industry (Even and Macpherson, 2014), it is essential to re-evaluate their findings in various industries and regions. Moreover, previous studies have overlooked the moderate role of the digital economy. At present, the digital economy has become the most active economic field in China (Tang, 2023). The application of digital technology has a great impact on the traditional operations of hotels (Iranmanesh et al., 2022). In addition, there are a large number of informal hotel enterprises in China (Tian and Guo, 2021). The types of Chinese enterprise registration include companies limited by shares, companies with limited liability, partnership enterprises, solely-owned enterprises, and self-employed businesses. The first four types are enterprises with formal qualifications and tax incentives from the government (Wang et al., 2020). Self-employed businesses belong to the private non-enterprise sector, most of them are typically small-scale, lack standardized internal operational mechanisms, and do not need to hire financial experts. They are usually regarded as informal enterprises (Wang, 2020; Xu et al., 2020; Guo et al., 2022). Compared with formal hotel firms, informal hotel firms have more flexible forms of employment (Thomas et al., 2011) and are less strictly regulated by the supervision of labor departments (Badaoui and Walsh, 2022). Therefore, the impact of minimum wage increases on the survival risk of formal and informal hotel firms may be differ.

To address these concerns, this study aims to examine the effect of the minimum wage on the hotel survival in China. More importantly, the main purpose of this study is to explore the moderating role of the digital economy and the differences between informal and formal hotels. This can help us more fully examine the impact of minimum wage increases on hotel enterprises. The main contributions of this paper are as follows. First, to the best of our knowledge, this study is the first attempt to empirically examine the relationship between the minimum wage increases and firms' survival risk, as well as the moderating effect of the digital economy in the hotel industry. These findings can add value with originality to the hospitality literature. Second, this paper finds that the digital economy can negatively moderate the relationship between minimum wage and firms' survival risk. Digital transformation and access to digital platforms are crucial strategies in the hotel industry. Our findings can contribute to management decision-making. Specifically, it is imperative for hotel managers/owners to embrace the opportunities from the digital economy and actively use digital technology to address the corporate survival challenges caused by increasing labor costs. Third, the paper also reveals that the impact of the minimum wage increase and the moderating effect of the digital economy vary between formal hotel enterprises and informal hotel enterprises. More specific research findings can contribute to the study of firm survival. In addition, the results of this study are valuable for policymakers as they offer insights into the impacts of the minimum wage system and the digital economy, thereby guiding policy adjustments.

2. Literature review and research hypothesis

2.1. The minimum wage in China

The minimum wage is the lowest remuneration that an employer needs to pay to employees on the premise that the employee performs his/her job duties. As an important policy to protect the rights of workers, the minimum wage system has become an institutional arrangement widely adopted by countries all over the world. In 1993, China promulgated regulations on the minimum wage and began to implement the minimum wage system. However, due to the imperfection of the legal system, it was not until the promulgation of the Minimum Wage Regulations in 2004 that the minimum wage policy really began to be popularized and implemented nationwide. According to the regulation, the government of all provinces, autonomous regions and municipalities in China have rights to set minimum wage standards on the basis of their regional living costs, economic development levels and employment conditions (Wang and Gunderson, 2011). Furthermore, the Minimum Wage Regulation in 2004 requires governments to renew the minimum wage standard at least once every two years, and introduces hourly minimum wage for part-time workers in addition to the existing monthly minimum wages for full-time workers. With the advancement of China's economic reform, the government has gradually strengthened the regulation of labor market and the protection of workers. As a result, the minimum wage standards have shown an increasing trend (Fan et al., 2018). In the sample cities, the average monthly minimum wage in China increased from 845.86 yuan in 2011 to 1616.20 yuan in 2019, with an annual increase of 8.43%. The average hourly minimum wage increased from 8.18 yuan in 2011 to 16.15 yuan in 2019, with an annual increase of 8.87%. Both of them exceed the annual growth rate of 6.36% in per capita GDP.

2.2. The relationship between the minimum wage and firm survival

According to the firm theory of microeconomics, companies with higher production costs and lower profit margins are more likely to exit. The minimum wage is the lowest wage that the government forces employers to pay to workers, and it is a price control policy in the labor market. When the minimum wage is higher than the equilibrium wage, this regulatory policy will increase production costs (Geng et al., 2022), reduce profits (Álvarez and Fuentes, 2018; Mayneris et al., 2018), and increase corporate financial risks (Chava et al., 2023). In addition, according to the organizational justice theory (Cropanzano et al., 2007), the high minimum wage strengthens the protection of low-skilled workers but also affects the sense of organizational justice of high-skilled workers (Dube et al., 2019). As a result, high-skilled employees may demand higher wages due to the psychology of comparison. To prevent high-skilled workers from reducing their work efforts, managers often agree to their wage premium demands. Therefore, enterprises have to face an overall increase in wages (Ma et al., 2012; Wang and Zhu, 2018). Moreover, there is a view that the minimum wage increase can lead to the higher price of production factors, thereby increasing the production costs of enterprises (Sun et al., 2013). Therefore, the high minimum wage can exacerbate the firm financial crisis by increasing the production and operational costs, potentially leading enterprises to exit the market.

On the contrary, the efficiency wage theory (Webb, 1912; Akerlof and Yellen, 1986) is a prominent viewpoint that supports enterprises to can benefit from a higher minimum wage. This theory holds that employees' wages are positively correlated with the firm productivity under conditions of underemployment. For employees, the high minimum wage raises the opportunity cost of not working and encourages them to work more actively, thereby boosting firm productivity (Georgiadis, 2013). In addition, the high minimum wage can improve the salary satisfaction of low-income employees and reduce the turnover rate (Dube et al., 2016). Enterprises with more skilled workers will have

higher productivity. For enterprises, the high minimum wage can motivate managers to implement organizational changes to reduce the impact of minimum wage increases. For example, managers will provide more training for employees (Dustmann and Schönberg, 2009), replace low-skilled workers with more high-skilled workers (Hamermesh and Grant, 1979), raise employees' performance standards (Riley and Rosazza Bondibene, 2017), and implement technological innovations (Liu and Lv, 2022). Under these circumstances, the high minimum wage will promote firm productivity. The competitiveness of enterprises will not be weakened, and may even be enhanced. Therefore, if most enterprises can offset the impact of the minimum wage increase by improving productivity, the survival risk of enterprises will not rise along with the minimum wage increases.

2.3. The impact of the minimum wage on the survival risk of hotels

The minimum wage increases can lead to cost effect and efficiency wage effect. However, this study holds that the high minimum wage has a significant negative impact on the survival rate of hotels for the following reasons. On the one hand, the hotel industry is a typical labor-intensive industry (Adam-Smith et al., 2003; Warhurst et al., 2008), and a new minimum wage will have a greater impact on hotel costs. For hotel operators, the implementation of the minimum wage law means incurring an additional operating cost of 20–40 % (Ahmad et al., 2016). In addition, Higgins (2005) pointed that hotel employees who had been receiving above minimum wage reacted negatively when the statutory minimum wage policy was implemented. This implies that the introduction of a minimum wage not only influences the low-income employees, but also the expectations of other staff (Xiao and Xiang, 2009). Of course, the high minimum wage may have an incentive effect on employees (Mun and Woo, 2021). But, at present, the minimum wage in China is generally low, and most employees believe that wage increases are actions that enterprises are forced to take, rather than genuine efforts to care for employees. In addition, Wen et al. (2020) argued that, according to the organizational equity theory, hotel employees pay more attention to relative salary than absolute salary. When the minimum wage of low-level employees rises, hotel managers often increase the welfare of high-level employees to alleviate their unfairness (Ma et al., 2012; Wang and Zhu, 2018). Therefore, the relative salaries of hotel employees before and after the adjustment of the minimum wage are almost the same.

On the other hand, although hotel managers may take some measures to reduce the cost effects caused by an increasing minimum wage, such as dismissing employees, increasing pricing, replacing low-wage employees with automated equipment, and improving the performance standards of employees, etc. However, these measures may not lead to better organizational outcomes. First, if the hotel reduces the number of employees, the workload of retained employees may increase (O'Neill and Davis, 2011). The longer working hours and heavier tasks will aggravate the work pressure of employees, and reduce their job satisfaction and service quality (Cleveland et al., 2007). Second, although hotels can pass on the costs to consumers by raising product prices, raising price can lead to a decrease in the number of hotel guests and profits (Chava et al., 2023). Third, the capacity of firms to adjust production processes or use smart devices to reduce low-skilled labor in the face of rising minimum wages will vary widely by industry or occupation. The task of cleaning hotel rooms may not be replaced by smart devices without degrading service quality. In this scenario, labor productivity is largely constrained, and firms have little choice when the minimum wage increases (Wimmer, 2000). Fourth, raising employees' performance standards is equivalent to increasing the workload of employees. Once employees perceive that the wage increase does not match the workload content, they are more likely to have a negative slacking mentality (Baker and Riley, 1994), thereby affecting the normal operation of hotels and increasing the survival risk. Therefore, based on the above analysis, this paper puts forward the following assumptions:

H1. The minimum wage increase has a significantly negative impact on the survival of hotel enterprises in China.

2.4. The moderating effect of the digital economy

With the rapid development of mobile internet, cloud computing, and artificial intelligence, the digital economy has become the most active field in China's economic development. The impact of the digital economy on the relationship between the minimum wage increase and the survival of hotel enterprises mainly manifests in three aspects. First, the development of the digital economy can offset the impact of the minimum wage by reducing transaction costs for hotels. Williamson (1975) transaction cost theory treats markets, firms, and other institutions as a collection of contractual agreements that govern financial transactions in the presence of transaction costs. These costs include various transaction-related expenses, such as information gathering, evaluating options, negotiating, and contracting. Nagle et al. (2020) pointed out that transaction costs for enterprises are changing in the digital economy era. This is the same for the hotel industry. For example, the information exchange platform based on digital technology has greatly reduced the information asymmetry between hotels and customers, and helps hotels understand the various needs of customers (Velázquez et al., 2015). Based on the history of customer needs, hotels are able to meet customer requirements either before or shortly after the customer makes the request (Buhalis and O'Connor, 2005). This can reduce the number of interactions service personnel have with a specific customer for a specific request (Chathoth and Law, 2011). That is, the transaction costs associated with coordination are reduced. Online booking can reduce the number of employees handling customer booking requests over the phone (Domke-Damonte and Levsen, 2002). This avoids opportunistic behavior by agents (Chathoth, 2007) and decreases the transaction costs associated with regulation. Digital payments help hotels reduce waiting lines (Cheng et al., 2021), eliminating the operational costs associated with checkout. In this sense, while hotels are vulnerable to minimum wage increases, the growth of the digital economy will help reduce their transaction costs. Hotels with lower transaction costs may be less pressured to survive in conditions of rising labor costs.

Second, the digital economy can reduce the impact of minimum wage increases by improving hotel productivity. Existing literatures found that the increasing minimum wage standard can reduce the operating performance of hotels (Agarwal et al., 2024; Song et al., 2022). According to the behavioral theory of the enterprise, the operating conditions of the enterprise can affect managers' strategic choices. When the enterprise performance is lower than the target level, managers are driven to implement exploratory behaviors to bring the enterprise performance back to the expected level (Cyert and March, 1963). Therefore, when the increase in the minimum wage leads to a reduction in profits for hotel enterprises, hotels can respond to this challenge through strategic adjustments. The development and penetration of digital technology provide an opportunity for the strategic adjustment of hotel enterprises (Alrawadieh et al., 2021). Managers can improve hotel productivity by incorporating more digital innovation behaviors (Melián-González and Bulchand-Gidumal, 2016). For example, by introducing smart hotel management system, hotels can decrease internal information exchange time and team collaboration costs (Forman and Van Zeebroeck, 2012), thereby improving management efficiency. Self-service technology, which can reduce customer waiting time (Kokkinou and Cranage, 2013), and advanced technologies such as artificial intelligence and robots, which can enhance customer service and experience (Lin and Mattila, 2021), will increase customer satisfaction and service efficiency. Displaying hotel information, room facilities, promotions, and special offers on digital platforms can attract more customers and increase the hotel's visibility (Liu et al., 2023) and increase hotel occupancy and revenue (Ho et al., 2022). In cities with a higher level of digital economy, hotels are more likely to build more

digital capabilities to improve productivity. And higher productivity will help them survive and grow in domestic market. Taken together, the application of digital technology by hotel enterprises can enhance productivity, and thereby reducing the failure risk of business caused by minimum wage increases.

Third, the development of digital finance provides new solutions for hotel financing, easing the financial pressure on hotel companies caused by increased costs. The increase in the minimum wage reduces the profits of hotel companies (Agarwal et al., 2023; Song et al., 2022). Stable hotel businesses can come under financial stress due to a lack of cash. In this case, obtaining external financing is critical for the survival of the hotel enterprises (Jang et al., 2008). However, according to agency theory, there is a general information asymmetry between borrowers (agents) and lenders (principals) (Jensen and Meckling, 1976). This information asymmetry creates the challenge of adverse selection, where lenders are reluctant to provide loans to firms that are perceived as risky borrowers (Dogru and Sirakaya-Turk, 2017). It has been proven that bank lending is more challenging for riskier MSMEs (Yoshino and Taghizadeh-Hesary, 2015). Most hotels belong to MSMEs (Yuan et al., 2023) and are therefore often excluded from the formal financial services threshold. Digital finance has more advantages than traditional finance. Because digital finance can obtain a large amount of behavioral data deposited by lenders on the Internet at a low cost (Ji et al., 2022) (e.g., Ant Financial has accumulated rich data on MSMEs in various areas such as trade, distribution, logistics, and customer reviews through e-commerce platforms like Taobao, Alipay, and Tmall). This can alleviate information asymmetries between digital financial institutions and hotel companies. Therefore, for hotel enterprises that are in financial distress because of the increase in the minimum wage, obtaining digital financial support can help them improve their cash flow and decrease their risk of survival. Therefore, this study hypothesized the following:

H2. The digital economy has a moderating effect on the relationship between the minimum wage increase and the survival of hotels in China. The higher the level of the digital economy, the less negative the impact of the minimum wage increase on the survival of hotels.

2.5. Formal hotel enterprises and informal hotel enterprises

Another objective of this study is to examine the relationship between hotel types. There are two reasons for the differences between formal and informal hotel enterprises. The compliance of enterprises with the minimum wage is an important factor that causes the impact of minimum wage increases on formal hotel companies and informal hotel companies to be different. If the enterprise's compliance with the minimum wage is low, the impact of the minimum wage on enterprise operation will be weakened (Rama, 2001). Long and Yang (2016) found that the compliance of enterprises with the minimum wage depends on the supervision cost of government and the illegal cost of enterprises not complying with the minimum wage. In fact, as in most developing countries (Badaoui and Walsh, 2022), many informal hotel enterprises in China would not be able to survive if they followed the minimum wage policy. This means that the authorities have an incentive to turn a blind eye. Therefore, non-compliance with minimum wage standards is more serious in informal enterprises than in formal enterprises. Although employee complaints can prompt companies to comply with minimum wage policies (Ioannou and Dukes, 2021), low-wage workers often do not complain (Danziger, 2010). Most of the employees in informal hotels have low academic qualifications (Tian and Guo, 2021) and do not know how to protect their rights through complaints. They may also be afraid to complain about low wages for fear of retaliation and losing their jobs. The different composition of employees is another important factor that leads to the different effects of the minimum wage increase on formal hotel enterprises and informal hotel enterprises. Most informal business in China are family-owned, with an average of just two (2.03) persons per entity, usually the owner(s) and a family member, sometimes a relative or friend or apprentice (Huang, 2013). Only when the business scale is expanded will informal hotels choose to hire external employees. Therefore, informal hotel companies employ fewer external workers than formal hotel companies (Thomas et al., 2011). And the informal hotels are less affected by the minimum wage increases. Consequently, the study hypothesized the following:

H3. The increase of the minimum wage has a greater negative impact on the survival of enterprises in formal hotels than that in informal hotels.

In addition, the moderating effect of the digital economy on the relationship between the minimum wage increase and the survival of hotels may vary with the type of enterprises for the following reasons. First, from the perspective of firm productivity, informal hotel enterprises have fewer departments than formal hotel enterprises. Therefore, the data resources accumulated through digital transformation are easier to transfer and integrate between departments (Li et al., 2023). In addition, Liu et al. (2021) found that digital project investment has a significant positive impact on enterprise productivity, but the impact of different digital projects is heterogeneous. The impact of Enterprise Resource Planning investment on enterprise productivity decreases with the increase of enterprise scale, and the impact of Manufacturing Execution System investment on enterprise productivity increases with the increase of enterprise scale. In the hotel industry, the application of digital technology is more in management system than in manufacturing (Sari, 2018), so the application of digital technology may have a stronger impact on improving the capital allocation efficiency of smaller informal enterprises. Second, from the perspective of enterprise competition, the emergence of digital platforms has reconstructed the competition pattern of the hotel industry. Hollenbeck (2018) found that the value of offline reputation such as chain and brand has decreased significantly in the digital economy era, and the motivation of enterprises to choose direct operation or franchise has weakened. Liu et al. (2023) found that platform access has a positive impact on improving hotel occupancy rate by optimizing online reputation, and non-chain hotels can benefit more from platform access compared to chain hotels. Similarly, if formal and informal hotels are both listed on digital platforms, they have equal competitive opportunities. Since informal hotels are at a relative disadvantage under the traditional reputation mode (Williams and Horodnic, 2017), the digital platform has a greater impact on them. Finally, from the perspective of enterprise financing, in the traditional financial system, informal enterprises are difficult to obtain financing because of their small scale, poor anti-risk ability, unstable capital flow, and few mortgaged assets (Turkson et al., 2022). The emergence of digital finance has specifically alleviated this situation (Li et al., 2022; Lin et al., 2022), reducing the cost and threshold for informal enterprises to obtain financial services. Therefore, digital finance plays a larger role in informal hotels than in formal hotels, which have an advantage in the traditional financial system. Based on the above analysis, this paper puts forward the following hypotheses:

H4. The digital economy has a greater moderating effect on the relationship between the minimum wage increase and the survival of enterprises in informal hotels than in formal hotels.

3. Methodology

In tourism and hospitality literature, research methods used to study the factors influencing firm survival include linear regression (e.g., Trinh and Seetaram, 2022), Cox proportional risk modeling (e.g., Gémar et al., 2016; Falk and Hagsten, 2018; Yuan et al., 2023), and discrete-time risk modeling (e.g., Türkcan and Erkuş-Öztürk, 2020; Fan et al., 2023). Among them, the linear regression model corresponds to the study of listed companies with higher levels of information disclosure. Trinh and Seetaram (2022) used Altman Z-score to measure the survival probability of listed companies in the tourism and leisure

industry, and used the Ordinary Least Square (OLS) approach to investigate the impact of executive compensation on corporate survival probability. The Cox proportional hazards model and the discrete-time risk model are commonly used to analyze MSMEs with low information disclosure. The outcome variable is the "time before the event ", where "time" refers to the duration that the sample enterprise stays in the observation period, and "event" refers to the exit of the hotel. Since the sample firms in this paper are MSMEs, and there is limited data disclosed by the firms, the linear regression model is not applicable. Both the Cox proportional hazards model and the discrete-time risk model are commonly used to study the factors affecting the survival of MSME hotel companies (Gémar et al., 2016; Falk and Hagsten, 2018; Yuan et al., 2023; Türkcan and Erkuş-Öztürk, 2020; Fan et al., 2023). However, in this study, the use of the Cox proportional hazards model has the following limitations. First, the model has a continuous time specification. The data for hotels are collected at discrete-time intervals (e.g., yearly), so there are many enterprises with the same survival time. In this case, using the Cox proportional hazard model to estimate will lead to biased coefficients and standard errors (Türkcan and Erkuş -Öztürk, 2020). Second, the Cox proportional hazard model needs to satisfy the assumption of proportional hazards, but there are three control variables in this paper violate the assumption. Although the extended Cox proportional hazard model can overcome this problem, it needs to estimate many additional parameters. Hess and Persson (2012) pointed out that the discrete-time hazard model is a better choice than the Cox proportional hazard model. It can effectively avoid these problems, and it is also easy to control unobservable heterogeneity. Therefore, this study follows the approach of Fan et al. (2023) and Türkcan and Erkuş -Öztürk (2020), using a discrete-time hazard model.

3.1. Discrete time hazard model

The first step of discrete-time hazard model is to divide continuous time into a series of infinite contiguous time intervals $(0, m_1], (m_1, m_2], \cdots, (m_{t-1}, m_t]$. Then, at the specified tth time interval $(m_{t-1}, m_t]$, The discrete-time hazard function is defined as:

$$h(t, X) = 1 - \exp[-\exp(\beta' X + \gamma_t)] \tag{1}$$

where γ_t is the benchmark hazard rate in the tth interval; X is the vector of covariates that may affect the hazard rate; β is the vector of covariate estimation coefficient. The positive sign of the coefficient indicates that the possibility of firm survival risk is higher, so the possibility of firm survival is lower.

The discrete-time hazard function is calculated by the following log-likelihood functions:

$$\ln L = \sum_{i=1}^{n} \sum_{t=1}^{t_i} [y_{it} \ln(h_{it}) + (1 - y_{it}) \ln(1 - h_{it})] \tag{2}$$

where y_{it} represents the state of individual i in the tth time period. If the individual i has experienced the event in the tth interval, the value of y_{it} is 1, otherwise the value is 0. According to Allison (1982), the dummy variable y_{it} can be regarded as the result in the logical model. Therefore, the discrete-time hazard model can be designated as a logical model. This can provide a convenient method to obtain the maximum likelihood estimation. The cloglog transformation can be used to estimate Eq. (2). In the cloglog model, the discrete-time hazard function takes the following form:

$$\text{cloglog}(1 - h(t, X)) \equiv \log(-\log(1 - h(t, X))) = \beta' X + \gamma_t \tag{3}$$

It should be noted that the cloglog model described in Eq. (3) does not consider the potential unobserved differences between individuals, because it assumes that the baseline risk of all individuals is the same in duration. Ignoring unobserved individual differences may bring bias to the estimation. Therefore, it is necessary to add the individual random effect to the cloglog model in Eq. (3)

$$\text{cloglog}(1 - h(t, X, v)) \equiv \log(-\log(1 - h(t, X))) = \beta' X + \gamma_t + u \tag{4}$$

where $u = \log(v)$, v is an individual random effect with a normal distribution ($v \sim N(0, \sigma^2)$).

In this study, we used Eq. (5) to test the impact of the minimum wage increase on the survival risk of hotels

$$\text{cloglog}(1 - h_{it}) = \alpha + \beta \bullet w_{jt} + \beta_1 \bullet E_{it} + \beta_2 \bullet C_{jt} + \theta_n + \gamma_t + \varepsilon_{it} \tag{5}$$

where w_{jt} represents the minimum wage of city j in tth year. E_{it} represents control variables at the enterprise level, including firm age, scale, location and firm type. C_{jt} represents control variables at the city level, including per capita GDP, population size, average wage, the number of hotels and the development level of tourism economy. θ_n and γ_t represent provincial fixed effect and year fixed effect, respectively. ε_{it} represents a random error term.

We used Eq. (6) to test the moderating effect of digital economy

$$\text{cloglog}(1 - h_{it}) = \alpha + \beta \bullet w_{jt} + \beta_0 \bullet w_{jt} \bullet DE_{jt} + \beta_1 \bullet DE_{jt} + \beta_2 \bullet E_{it} + \beta_3 \bullet C_{jt} + \theta_n + \gamma_t + \varepsilon_{it} \tag{6}$$

where DE_{jt} represents the digital economy level of city j in tth year. $w_{jt} \bullet DE_{jt}$ represents the interaction term between the minimum wage and the digital economy; the rest are the same as Eq. (5).

3.2. Variable measures

3.2.1. Exit of hotels (Exit)

According to the Regulations of the People's Republic of China for Controlling the Registration of Enterprises as Legal Persons, the registration status of an enterprise includes surviving, in business, revoked and cancelled. Based on this, if the hotel's registration status is displayed as "surviving" and "in business", the establishment date of the hotel will be documented. If the hotel's registration status is "revoked" and "cancelled", the establishment date, revocation date, and cancellation date of the enterprise are recorded, and the hotel will be considered as having exited. For example, if a hotel was established in 2011 and then cancelled or revoked in 2015, it is considered that the company exited in 2015. The observation period of the company is 2011–2015.

3.2.2. Minimum wage (Ln_wamo and Ln_waho)

China's urban minimum wage is the core explanatory variable in this paper. According to Fan et al. (2018), this paper measures minimum wage by the natural logarithm of the monthly minimum wage and the hourly minimum wage in the city where the hotel enterprise is located. It should be noted that although the minimum wage standards in China are accurate to the district level, this paper does not consider the differences within the cities, and uses the highest level of the minimum wage standard in the city where the enterprise is located.

3.2.3. Digital economy (DE)

Scholars have adopted various indicator systems for the measurement of digital economy index. In this paper, we constructed a comprehensive index evaluation system for the digital economy at the city level in China based on the availability of urban data and previous studies by Zhang et al. (2022), Bai and Zhang (2021), and Ma and Zhu (2022). The evaluation system includes three dimensions: the fundamentals of digital industry development, the level of digital industry, and the capability for digital innovation. Table 1 presents the specific indicators and data sources. In order to assess the level of the digital economy of each city in China, this study adopts the following calculation method. The first step is to standardize the original data. Since the indicators in this paper are positive, the standardization calculation formula is shown in Eq. (7). The second step is to use the arithmetic average method, as shown in Eq. (8), to combine the standardized

Table 1
The secondary indicators and data sources of the digital economy index.

Dimensions	Secondary indicators	Data sources
Fundamentals of digital industry development	Number of internet users per hundred people	CEIC database
	Number of mobile phone users per hundred people	
	Number of internet broadband access ports per hundred people	China Statistical Yearbook[a]
	Number of internet domain names per hundred people	
Digital industry level	Total telecom revenues	CEIC database
	Number of digital enterprises	"Qichacha" database
	Digitalization degree of listed companies	CSMAR database
	Digital inclusive financial level	Digital financial research center of Peking University and Ant Financial Group
Digital innovation capability	Proportion of scientific expenditure to government financial expenditure	CEIC database
	R&D investment of listed companies in digital economy	CSMAR database
	Number of new information industry patents	Dawei Innojoy patent database
	Number of digital creative industry patents	

[a] The data on the number of internet broadband access ports per hundred people and the number of internet domain names per hundred people are only accessible at the provincial level. This paper calculates city-level data by multiplying these two indicators by the ratio of each city's total telecom revenue to that of the province in which it is located.

secondary indicators into the digital economic development index of cities.

$$x'_{njt} = \frac{x_{njt} - \min\{x_n\}}{\max\{x_n\} - \min\{x_n\}} \times 10 \tag{7}$$

$$DE_{jt} = \frac{1}{m}\sum_{n=1}^{m} x'_{njt} \tag{8}$$

Where x_{njt} is the value of the nth indicator for the city j in tth year; $\max\{x_n\}$ and $\min\{x_n\}$ represent the maximum and minimum values of x_n; x'_{njt} is the standardized value; m represents the total number of indicators, which is set as 12 in this study; DE_{jt} is the level of the digital economy for the city j in tth year.

3.2.4. Control variables

According to the existing relevant literature (He et al., 2020; Lado-Sestayo et al., 2016) and data availability, this paper selects control variables at the enterprise level as follows. I. The life of enterprises (Ln _age) was measured by adding 1 to the number of years from the date of establishment to the statistical year (taking natural logarithm). II. The size of enterprise (Ln _cap). Since most hotels belong to small and micro enterprises, there is no database to count their business scale. This paper uses registered capital to represent the enterprise scale of hotels (taking natural logarithm). III. Location (Ln _loc) is defined as the natural logarithm of the shortest geographical distance from the hotel to the nearby railway station or high-speed railway station or A-level scenic spot. IV. Type of enterprise (Type) is a dummy variable. If a hotel is informal hotel enterprises, the value is 1, otherwise it is 0. In addition, this paper selects the following control variables at the city level. V. The population size (Ln _pop) is defined as the logarithm of the city population, indicating the potential consumption scale. VI. Per capita GDP (Ln _pgdp) was measured by logarithm of city per capita GDP, indicating the market consumption capacity. VII. The number of hotels (Ln _num) was measured by the logarithm of the number of city existing hotels, and is used to control the industrial competition. VIII. The average wage (Ln _avwa) was obtained from the logarithm of the city average wage, and is used to control the local labor price. IX. The level of tourism development (Ln _tour). Hotels are likely to benefit from the level of tourism development. For example, tourist attractions and expositions can attract many tourists who need to stay in hotel. Therefore, this paper controls the level of city tourism development, which was measured by the logarithm of city tourism income. In addition, to avoid the impact of different provincial policies and macroeconomic cycles on the empirical results, this paper set province dummy variables and annual dummy variables.

3.3. Data

The data at the enterprise level comes from the "Qichacha" database, which provides information such as firm name, firm type, registered address, industry category, registered status, registered capital, establishment time, change record and business scope. We collected data on accommodation industry enterprises from 2011 to 2019 from " Qichacha"[1] as the primary sample and then screened the enterprises to obtain the sample of hotels required for this paper. The specific steps are as follows: (1) exclude accommodation enterprises that belong to the industry subcategories of "campsite services" and "other accommodation services"; (2) exclude duplicated enterprise samples; (3) exclude accommodation enterprises with missing information such as registered address, business status, registered capital, and time of establishment; and (4) cross-check the data of the accommodation enterprises with the industrial and commercial registration data in the RESSET enterprise information database, and remove the mismatched samples. It is worth noting that if we directly use the entire sample from 2011 to 2019 for survival analysis, we will face the issue of left-censored observations and right-censored observations. Especially, if we ignore the issue of left-censored observations, the estimated result will underestimate the survival time. According to Hess and Persson (2012) and Esteve-Pérez et al. (2013), we excluded left-censored observations, that is, only the enterprises established from 2011 to 2019 were selected as the final analysis samples. Although there are still right-censored observations, survival analysis methods are appropriate to address the issue. Finally, we obtained a sample of 69,694 hospitality firms (Table 2). Among these, 15 % are tourist hotels, 79 % are general hotels, and 6 % are guesthouses, totaling 284,584 enterprise-year observations. Data on minimum wage standards are from the human resources and social security of municipalities and provinces. The data sources for the level of urban digital economy development are shown in Table 1. The number of hotel enterprises in cities is from China's industrial and commercial regis-

Table 2
Lifetable of hotels.

Year	Entries	Failures	Balance
2011	4,178	16	4,162
2012	4,558	24	8,696
2013	5,659	49	14,306
2014	6,444	75	20,675
2015	8,956	340	29,291
2016	9,443	896	37,838
2017	9,621	1,596	45,863
2018	9,915	1,719	54,059
2019	10,920	2,164	62,815

[1] The "Qichacha" database categorizes enterprises based on the industry they belong to. The accommodation industry includes tourist hotels, general hotels, guesthouses, campsite services, and other accommodation services.

tration data, and the remaining city-level control variables are from China's urban statistical yearbook and the CEIC database. After excluding prefecture-level cities with missing data, we finally obtained the panel data of 283 cities from 2011 to 2019. Then, the city panel data is matched with the data of hotels according to the city name and year. A comprehensive database containing information on hotels, minimum wage rates in cities, and data on control variables was obtained.

4. Empirical analysis

4.1. Descriptive statistics

The descriptive statistical results of variables are listed in Table 3. The results show that the average values of the monthly minimum wage (Ln_wamo) and hourly minimum wage (Ln_waho) were 7.3238 and 2.6947, respectively. The standard deviations of the monthly minimum wage and hourly minimum wage were 0.1980 and 0.2008, respectively. This indicates that the deviation range of minimum wage was low. The average value of the digital economy (DE) development of Chinese city was 1.6411, the standard deviation was 1.5771. According to the average value of enterprise types (Type), among the 284584 enterprise-year samples, 36.90 % in samples were informal hotel enterprises and 55.1 % in samples were formal hotel enterprises. We also calculated the skewness and kurtosis of the explanatory variables (continuous variables). According to Kline (2011), if the absolute value of the skewness of the data is less than 3 and the absolute value of the kurtosis is less than 10, then the data is essentially normally distribution. In Table 3, except for the variable "*DE*" whose kurtosis is slightly higher than 10, the results of the kurtosis and skewness of the other variables are in line with the judgment criteria of Kline (2011). In addition, this study divided the samples into low minimum wage group and high minimum wage group according to the median value of the minimum wage, and used Kaplan-Meier survival curve to reflect the survival probability of hotels under different minimum wage levels (Fig. 1). The figures show that whether grouped by monthly minimum wage or hourly minimum wage, hotels with a lower minimum wage have a higher probability of survival than hotels with a higher minimum wage. This provides preliminary evidence for the research hypothesis.

4.2. Regression results of minimum wage on the survival risk of hotels

This part mainly analyzes the impact of the minimum wage increase on the survival risk of hotels (Table 4). The estimated results in columns (1) and (3) do not include province dummy variables and annual dummy variables. It shows that the minimum wage has a significant and positive impact on the survival risk of hotels (Ln_wamo: *coef.* =0.6594, $p<0.01$; Ln_waho: *coef.* =0.9132, $p<0.01$). Columns (2) and (4) are the estimated results after controlling the year fixed effect and province fixed effect. The results show that the minimum wage still has a significant and positive impact on the survival risk of hotels. Specifically, for every 1 % increase in monthly minimum wage and hourly minimum wage, the survival risk will increase by 2.9540 % and 2.8613 %, respectively. These results indicate that the rising minimum wage can increase the hotels survival risk, supporting H1.

According to the coefficient estimation results of control variables, start-ups and small hotels have higher survival risks, similar to Vivel-Búa et al. (2019) and Türkcan and Erkuş-Öztürk (2020). The survival risk of informal hotel enterprises is lower, indicating that self-employed hotels are more likely to survive. Surprisingly, this paper finds that the location of the enterprise has a negative impact on the survival risk of hotels at the significance level of 1%. That is, the closer the hotel enterprise is to the station, high-speed rail or tourist attractions, the higher its exit probability. This estimation result is not consistent with Gémar et al. (2016) and Lado-Sestayo et al. (2016), but consistent with Leoni (2020). There may be two reasons for this result. First, although the closer to the station, high-speed rail or tourist attractions, hotels can have more tourists, but they are also facing more intense market competition. This makes the probability of enterprises exit increase. Second, most consumers pay more attention to cost-effectiveness. Hotels closer to stations, high-speed trains or tourist attractions do not mean higher quality (Leoni, 2020), but higher prices because of their geographical location. This may lead some consumers to choose a higher quality hotel over a better location. The control variables at the city level show that population size and per capita GDP are negatively correlated with the survival risk of hotels at the significance level of 1%, indicating that the greater the consumption potential, the lower the survival risk of hotels. The average wage is positively correlated with the survival risk at the significance level of 1%. The high city average wage can increase the labor cost and factor cost of hotel industry, thereby posing a threat to the survival of hotels.

4.3. Regression results of moderating effect of the digital economy

The moderating effects of digital economy on the relationship between minimum wage and survival risk of hotels are listed in Table 5. Column (2) adds the interaction term between the monthly minimum wage and digital economy, column (4) adds the interaction term between the hourly minimum wage and the digital economy. The estimation results show that the coefficient of the interaction term between the monthly minimum wage and digital economy (Ln_wamo × DE) is −0.4872, the coefficient of the interaction term between the hourly minimum wage and digital economy is (Ln_waho × DE) −0.3348. Both of them are significant at the 1% level. This indicates that the effect of the minimum wage on survival risk of hotels is moderated by digital economy. The higher the level of digital economy, the lower the probability of hotels exit caused by the increasing minimum wage. H2 was supported.

4.4. Regression results of formal hotel enterprises and informal hotel enterprises

This study divided the hotel samples into informal hotels and formal hotels, and then tested the impact of the minimum wage and the moderating effect of the digital economy, respectively (Table 6). The estimation results show that the positive effect of minimum wage on firm survival risk and the negative moderating effect of digital economy are still valid in different types of enterprise samples. This indicates that the results of the basic regression are robust. The comparison of the estimation results of two type hotels shows that the degree of influence varies with the types of enterprises. For formal hotels, the survival risk can increase by 3.4469% and 3.6045% for every 1% increase in the monthly minimum wage and the hourly minimum wage, respectively. For informal hotels, the survival risk can increase by 1.4799% for every 1% increase in the monthly minimum wage, and the coefficient of hourly minimum wage is not significant. The difference of coefficients indicates that the minimum wage has a greater impact on the survival risk of formal hotels, supporting H3. In addition, the estimation results from the sample of formal hotels show that the interaction coefficient between monthly minimum wage and digital economy is −0.3183 ($p<0.01$). The estimation results from the sample of informal hotels show that the interaction coefficient between monthly minimum wage and digital economy is −1.2415 ($p<0.01$) and the interaction coefficient between hourly minimum wage and digital economy is −1.4327 ($p<0.01$). It is obviously that the digital economy has a greater moderating effect on informal hotels. H4 was supported.

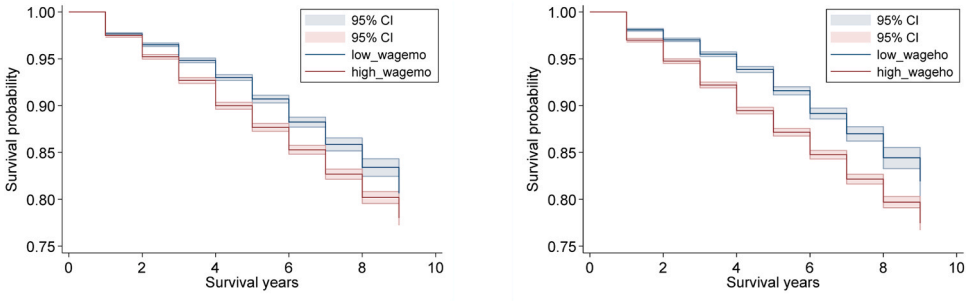
4.5. Robustness test

4.5.1. Endogenous problem

Policymakers should consider the operation of local enterprises when setting the minimum wage. Therefore, there may be an endogenous problem caused by two-way causality between the minimum wage

Table 3
Summary of descriptive statistics.

Variable	N	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis
Exit	284,584	0.0233	0.1508	0.0000	1.0000	—	—
Ln_wamo	284,584	7.3238	0.1980	6.3969	7.8099	-0.0536	2.9934
Ln_waho	284,584	2.6947	0.2008	1.7918	3.1780	-0.7864	4.1077
DE	284,584	1.6411	1.5771	0.0342	9.0973	2.6135	10.2840
Ln_age	284,584	0.9673	0.6771	0.0000	2.1972	-0.1360	1.8339
Ln_cap	284,584	13.0469	1.8104	9.2103	21.3266	0.2907	2.7250
Ln_loc	284,584	7.8800	1.1268	0.0591	11.8789	-0.1525	3.6935
Type	284,584	0.3690	0.4825	0.0000	1.0000	—	—
Ln_pop	284,584	15.5193	0.6394	12.6105	17.3466	-0.0463	4.3712
Ln_pgdp	284,584	11.0814	0.8210	8.7297	13.1851	0.3829	2.5404
Ln_num	284,584	6.4262	0.9054	2.1972	8.6333	-0.0551	3.1288
Ln_avwa	284,584	11.1281	0.2974	9.7531	12.0622	0.0458	3.2572
Ln_tour	284,584	20.2599	1.1252	14.0813	22.5518	-0.3554	3.1718



(a) Group by *Ln_wamo* (b)Group by *Ln_waho*

Fig. 1. Survival probability of hotels in China.

Table 4
Regression results of minimum wage on the survival risk of hotels.

	(1)	(2)	(3)	(4)
Ln_wamo	0.6594***	2.9540***		
	(5.3888)	(15.0186)		
Ln_waho			0.9132***	2.8613***
			(8.1359)	(15.7150)
Ln_age	0.0005	-0.0553***	-0.0064	-0.0571***
	(0.0247)	(-2.9738)	(-0.3410)	(-3.0741)
Ln_cap	-0.0165**	-0.0603***	-0.0189**	-0.0603***
	(-2.1836)	(-7.5938)	(-2.4925)	(-7.6053)
Ln_loc	-0.0354***	-0.0431***	-0.0343***	-0.0430***
	(-3.2159)	(-3.8712)	(-3.1166)	(-3.8705)
Type	-0.5401***	-0.8719***	-0.5178***	-0.8715***
	(-16.6929)	(-22.6198)	(-16.0177)	(-22.5973)
Ln_pop	-0.3707***	-0.1040***	-0.3585***	-0.1173***
	(-14.1635)	(-3.2374)	(-13.5537)	(-3.6584)
Ln_pgdp	-0.3973***	-0.3108***	-0.3677***	-0.2845***
	(-16.5333)	(-9.2096)	(-15.6805)	(-8.4770)
Ln_num	0.2159***	-0.0080	0.1909***	0.0226
	(7.9634)	(-0.2210)	(6.9646)	(0.6262)
Ln_avwa	0.8165***	1.1817***	0.6920***	1.0944***
	(9.2133)	(9.5980)	(7.8131)	(8.7944)
Ln_tour	0.0725***	-0.0125	0.0712***	-0.0273
	(3.1950)	(-0.4484)	(3.1452)	(-0.9830)
_cons	-9.7747***	-34.3510***	-6.3345***	-19.0928***
	(-11.2755)	(-26.2027)	(-7.8259)	(-15.7837)
Year	No	Yes	No	Yes
Province	No	Yes	No	Yes
N	284,584	284,584	284,584	284,584
Loglikelihood	-30793.06	-29565.36	-30774.34	-29554.19

NOTE: *z* statistics in parentheses, *$p < 0.1$, ** $p < 0.05$, ***$p < 0.01$

increase and the survival risk of hotels. After Card and Krueger (1994) analyzed the impact of the minimum wage on employment in New Jersey and Pennsylvania, more and more researchers deal with endogenous problems by comparing individual behavior differences in

Table 5
Regression results of moderating effect of digital economy.

	(1)	(2)	(3)	(4)
Ln_wamo	2.9375***	3.4071***		
	(14.7461)	(14.9468)		
Ln_wamo × DE		-0.4872***		
		(-4.4955)		
Ln_waho			2.8365***	3.1695***
			(15.4891)	(14.9707)
Ln_waho × DE				-0.3348***
				(-3.2616)
DE	0.0113	3.7853***	0.0269	1.0556***
	(0.5205)	(4.5081)	(1.2500)	(3.3383)
Ln_age	-0.0550***	-0.0549***	-0.0566***	-0.0567***
	(-2.9548)	(-2.9507)	(-3.0408)	(-3.0490)
Ln_cap	-0.0604***	-0.0604***	-0.0607***	-0.0609***
	(-7.6071)	(-7.5995)	(-7.6448)	(-7.6633)
Ln_loc	-0.0431***	-0.0428***	-0.0430***	-0.0431***
	(-3.8696)	(-3.8479)	(-3.8681)	(-3.8796)
Type	-0.8736***	-0.8671***	-0.8754***	-0.8752***
	(-22.5928)	(-22.3919)	(-22.6376)	(-22.6331)
Ln_pop	-0.1092***	-0.1820***	-0.1294***	-0.1663***
	(-3.2468)	(-4.8908)	(-3.8673)	(-4.7083)
Ln_pgdp	-0.3178***	-0.3799***	-0.3020***	-0.3429***
	(-8.7346)	(-9.7410)	(-8.2935)	(-8.8866)
Ln_num	-0.0126	-0.0460	0.0110	-0.0134
	(-0.3373)	(-1.2109)	(0.2953)	(-0.3540)
Ln_avwa	1.1753***	1.1444***	1.0755***	1.0679***
	(9.4954)	(9.2472)	(8.5747)	(8.5149)
Ln_tour	-0.0101	-0.0305	-0.0215	-0.0281
	(-0.3579)	(-1.0760)	(-0.7634)	(-0.9974)
_cons	-34.0563***	-34.6866***	-18.5689***	-18.1439***
	(-23.8595)	(-23.9559)	(-14.5071)	(-14.0965)
Year	Yes	Yes	Yes	Yes
Province	Yes	Yes	Yes	Yes
N	284,584	284,584	284,584	284,584
Loglikelihood	-29565.22	-29555.23	-29553.41	-29548.16

Table 6
Regression results of formal hotel enterprises and informal hotel enterprises.

	formal hotel enterprises				informal hotel enterprises			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ln_wamo	3.4469***	3.5876***			1.4799***	2.5026***		
	(15.4402)	(13.9843)			(3.3894)	(4.6232)		
Ln_waho			3.6045***	3.5892***			0.3785	1.8147***
			(17.1369)	(14.9597)			(1.0057)	(3.5743)
Ln_wamo × DE		-0.3183***				-1.2415***		
		(-2.7063)				(-3.8673)		
Ln_waho × DE				-0.1174				-1.4327***
				(-1.0392)				(-4.6350)
DE		2.5551***		0.4656		9.3965***		4.1497***
		(2.8002)		(1.3349)		(3.8022)		(4.4367)
Ln_age	-0.1924***	-0.1908***	-0.1963***	-0.1952***	0.5241***	0.5231***	0.5427***	0.5360***
	(-9.1733)	(-9.0945)	(-9.3710)	(-9.3155)	(11.4814)	(11.4550)	(11.8455)	(11.6938)
Ln_cap	-0.0822***	-0.0836***	-0.0825***	-0.0845***	0.0245	0.0257	0.0261	0.0276
	(-9.4548)	(-9.6002)	(-9.4895)	(-9.7002)	(1.2136)	(1.2736)	(1.2941)	(1.3642)
Ln_loc	-0.0023	-0.0016	-0.0026	-0.0022	-0.1597***	-0.1619***	-0.1592***	-0.1611***
	(-0.1793)	(-0.1248)	(-0.1972)	(-0.1690)	(-7.5563)	(-7.6558)	(-7.5307)	(-7.6152)
Ln_pop	-0.1671***	-0.2556***	-0.1785***	-0.2362***	0.0547	0.0041	0.0292	-0.0066
	(-4.6251)	(-6.1216)	(-4.9483)	(-5.9939)	(0.6856)	(0.0445)	(0.3667)	(-0.0726)
Ln_pgdp	-0.3692***	-0.4672***	-0.3351***	-0.4201***	-0.0083	-0.0788	-0.0028	-0.0670
	(-9.6501)	(-10.5439)	(-8.7949)	(-9.5609)	(-0.1070)	(-0.8967)	(-0.0366)	(-0.7833)
Ln_num	0.1451***	0.0823*	0.1747***	0.1142**	-0.2066***	-0.2778***	-0.1724**	-0.2284***
	(3.3573)	(1.8173)	(4.0694)	(2.5078)	(-2.5799)	(-3.3616)	(-2.1671)	(-2.8233)
Ln_avwa	0.5763***	0.5284***	0.3783***	0.3251**	2.3768***	2.5292***	2.7662***	2.8763***
	(4.1533)	(3.7895)	(2.6913)	(2.2983)	(8.3285)	(8.3903)	(9.6435)	(9.5747)
Ln_tour	-0.0535*	-0.0440	-0.0740**	-0.0489	-0.0528	-0.0654	-0.0551	-0.0933
	(-1.8100)	(-1.4427)	(-2.5158)	(-1.6152)	(-0.6828)	(-0.8373)	(-0.7125)	(-1.1816)
_cons	-29.3687***	-27.4712***	-11.2161***	-9.2464***	-39.2199***	-46.4469***	-33.6951***	-36.6720***
	(-19.4581)	(-16.6553)	(-8.0960)	(-6.3707)	(-13.6815)	(-13.3949)	(-12.8746)	(-11.4845)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	179,575	179,575	179,575	179,575	105,009	105,009	105,009	105,009
Loglikelihood	-21518.38	-21508.22	-21488.88	-21478.73	-7722.11	-7711.99	-7727.44	-7713.37

cities (countries) across state (province) boundaries (Dube et al., 2010; Fan et al., 2018). The study also follows the approach constructing a dataset of all city pairs in China that straddle a province border. Specifically, if two cities share a border and belong to two different provinces, we treated them as a pair and assign each city pair a pair id. Then, the firm-level dataset was matched with the city-pair dataset. This new city-pair-firm dataset reduces endogeneity concerns in two ways. First, the potential economic conditions of adjacent cities are relatively similar (Dube et al., 2010), and the minimum wage standards are completely different because they belong to different provinces. This can form a natural experiment to estimate the effect of the minimum wage. Second, the minimum wage in border cities may be less affected by local economic conditions, because border cities are often far away from provincial governments that set minimum wage standards (Fan et al., 2018). In addition, because the minimum wages of Beijing, Tianjin, Shanghai and Chongqing are set by the city government, this study deleted the city pairs including these cities, and finally obtained 436596 observations of 206 city pairs.[2] Table 7 shows the estimated results with firm dataset after matching with city-pair. Columns (1) and (3) show that the coefficients of the monthly minimum wage (Ln_wamo) and the hourly minimum wage (Ln_waho) are 2.6510 and 1.9660, respectively, with a significant level of 1%. Columns (2) and (4) show that the coefficients of the interaction term between minimum wage and digital economy (Ln_wamo×DE and Ln_waho×DE) are −0.4736 and −0.7665, and the significance levels are 5% and 1%, respectively. These results are consistent with previous conclusions, supporting H1 and H2.

4.5.2. *Changing the estimation model*

To avoid the estimation bias caused by model selection, this paper further uses Probit model and Logit model for testing (Table 8). The regression results using Probit model (columns (1)-(4)) and Logit model (columns (5)-(8)) show that the monthly minimum wage (Ln_wamo) and hourly minimum wage (Ln_waho) both have a significant positive impact on the survival risk of hotels, and the digital economy can negatively moderate the relationship between the minimum wage and the survival risk of hotels. H1 and H2 are still supported after changing the estimation model.

4.5.3. *Longer observation time*

To further test the robustness of the basic regression results, we extended the observation period from 2011 to 2019–2011–2021. This can examine whether the estimation results of the basic regression change when considering the period of the COVID-19. It should be noted that due to the large number of missing values in China's urban tourism revenue data in 2020 and 2021, we had to exclude the cities with missing values from the sample, resulting in data of 245 cities. During 2011–2021, 245 cities included 83,767 hotel enterprises in the sample, with a total of 399,673 "enterprise-year" observations. Table 9 shows the results of the re-tests conducted using data from China's hotel firms between 2011 and 2021. The regression results in columns (1) and (2) show that the coefficients of the monthly minimum wage (Ln_wamo) and the hourly minimum wage (Ln_waho) are significantly positive at the 1% level. This is consistent with the results of the benchmark regressions, indicating that the conclusion that minimum wage increases can exacerbate the survival risk of hotel firms is robust. In addition, to investigate whether there is a difference in the impact of minimum wage increases on hotel firm survival risk during normal periods and the COVID-19 period, we introduced a period dummy variable (Period).

[2] Since a city may belong to multiple city pairs, an individual city may have multiple replicates in this city-pair dataset, and the enterprises located in the city will also appear many times in the sample when matching enterprises. Huang et al. (2014) propose assigning less weight to the duplicate observations, so we conduct regressions by weighing observations according to (the inverse of) the number of duplicates.

Table 7
Regression results with firm dataset after matching with city-pair.

	(1)	(2)	(3)	(4)
Ln _wamo	2.6510***	2.8086***		
	(9.1454)	(8.3640)		
Ln _wamo × DE		-0.4736**		
		(-2.0006)		
Ln _waho			1.9660***	2.4131***
			(7.4647)	(6.9022)
Ln _waho × DE				-0.7665***
				(-3.2697)
DE		3.7285**		2.4188***
		(2.0420)		(3.3774)
Ln _age	0.1739***	0.1734***	0.1777***	0.1762***
	(9.4012)	(9.3714)	(9.5979)	(9.5144)
Ln _cap	-0.0772***	-0.0774***	-0.0767***	-0.0771***
	(-10.2527)	(-10.2761)	(-10.1921)	(-10.2371)
Ln _loc	-0.0355***	-0.0356***	-0.0348***	-0.0350***
	(-3.4451)	(-3.4529)	(-3.3814)	(-3.3996)
Type	-0.6791***	-0.6796***	-0.6797***	-0.6807***
	(-20.0682)	(-20.0803)	(-20.0983)	(-20.1267)
Ln _pop	-0.1464**	-0.2369***	-0.1570**	-0.2714***
	(-1.9892)	(-2.8956)	(-2.1391)	(-3.3394)
Ln _pgdp	-0.2047***	-0.2631***	-0.1633**	-0.2401***
	(-2.7698)	(-3.4450)	(-2.1805)	(-3.1220)
Ln _num	-0.1601***	-0.1843***	-0.1138*	-0.1551***
	(-2.6890)	(-3.0133)	(-1.9437)	(-2.5847)
Ln _avwa	1.7944***	1.7350***	1.8807***	1.7898***
	(9.8191)	(9.3646)	(10.1245)	(9.4791)
Ln _tour	-0.0233	-0.0240	-0.0216	-0.0279
	(-0.5418)	(-0.5614)	(-0.4991)	(-0.6499)
_cons	-34.6236***	-33.1736***	-21.9588***	-19.5202***
	(-16.8315)	(-13.2709)	(-10.3442)	(-8.3377)
Year	Yes	Yes	Yes	Yes
Province	Yes	Yes	Yes	Yes
City pair	Yes	Yes	Yes	Yes
N	436,596	436,596	436,596	436,596
Logpseudolikelihood	-130660.70	-130651.84	-130699.17	-130676.91

When the observation year belongs to the normal period (2011–2019), Period1 is 1, otherwise it is 0. When the observation year belongs to the new crown epidemic period (2020–2021), Period2 is 1, otherwise it is 0. The coefficients of the period dummy variable on the interaction term of the minimum wage are listed in columns (3) and (4) in Table 9. The results indicate that the impact of minimum wage increases on the survival risk of hotel firms is significantly positive in both periods. However, the absolute values of the coefficients of Ln _wamo and Ln _waho during the normal period (2011–2019) are smaller than those during the COVID-19 period (2020–2021). The coefficient estimation indicates that the negative impacts of minimum wage increase on the survival of hotel firms persist over time, but these impacts are more pronounced during the COVID-19 period.

5. Discussion and conclusion

Taking Chinese hotels established in 2011–2019 as samples, this paper uses the discrete-time hazard model to test the relationship between the minimum wage increase and the survival risk of hotels, and then explore the moderating effect of the digital economy. First, the results of this study show that the minimum wage has a significant positive impact on the survival risk of hotels. This conclusion is valid by using firm dataset after matching with city-pair, changing estimation model and extending the sample observation period. Second, the research results show that the digital economy can negatively moderate the relationship between the minimum wage increase and the survival risk of hotels, that is, the minimum wage has less impact on hotels exit in cities with high level of digital economy. The rapid development of digital economy, especially the emergence of digital finance, digital platform and the application of digital technology, not only alleviates the financing constraints of hotels, but also improves the efficiency of resource allocation. This weakens the cost effect caused by the minimum wage increase. Finally, the study finds that the higher minimum wage brings greater operating pressure to formal hotels than that to informal hotels, and the inhibitory effect of the digital economy on the relationship between minimum wage increase and survival risk of hotels is greater in informal hotels than in formal hotels. This means that informal hotels are less adversely affected by the increasing minimum wage and benefit more from the development of the digital economy. This result indicates that the competition pattern between informal hotel enterprises and formal hotel enterprises will change in the digital economy era, and the competitive advantage of formal hotel enterprises will be lower.

5.1. Theoretical contribution

The empirical results, based on data from Chinese hotels, enrich the literature in several ways. First, this paper contributes to the understanding of the impact of minimum wage increases on the survival of hospitality firms. Although existing literature has examined the factors influencing the survival of hospitality enterprises, they mainly focused on firm size, hotel occupancy, competitive environment, seasonality, etc. (Lado-Sestayo et al., 2016; Vivel-Búa et al., 2019; Zhang and Xie, 2021), ignoring the key firm labor cost-related policy factor - minimum wage. In the hotel literature, there are several studies on the impact of the minimum wage. However, these studies mainly focused on the impact of the minimum wage on employee pay satisfaction (Su et al., 2014; Ahmat et al., 2019), firms' labor costs (Song et al., 2022), and enterprise performance (Mun and Woo, 2021; Song et al., 2022; Agarwal et al., 2024). The paper found that minimum wage increases exacerbate the survival risk of hotel firms. This indicates that the study contributes to the business longevity theory in the hotel industry by introducing a new factor, namely minimum wage, that impacts hotel survival. It is worth noting that Mun and Woo (2021), Song et al. (2022), and Agarwal

Table 8
Regression results using Probit model and Logit model.

	Probit model				Logit model			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ln_wamo	1.1545***		1.3437***		2.9820***		3.4411***	
	(13.9482)		(14.1836)		(14.9025)		(14.8562)	
Ln_waho		1.1033***		1.2234***		2.8860***		3.1968***
		(14.4842)		(14.0501)		(15.5876)		(14.8679)
Ln_wamo × DE			-0.2031***				-0.4936***	
			(-4.4670)				(-4.4764)	
Ln_waho × DE				-0.1282***				-0.3367***
				(-3.1257)				(-3.2393)
DE			1.5717***	0.3982***			3.8334***	1.0597***
			(4.4554)	(3.1427)			(4.4861)	(3.3094)
Ln_age	-0.0046	-0.0056	-0.0042	-0.0053	-0.0505***	-0.0524***	-0.0500***	-0.0519***
	(-0.5522)	(-0.6770)	(-0.5121)	(-0.6396)	(-2.6591)	(-2.7642)	(-2.6334)	(-2.7370)
Ln_cap	-0.0249***	-0.0250***	-0.0249***	-0.0251***	-0.0610***	-0.0611***	-0.0611***	-0.0616***
	(-7.1602)	(-7.1858)	(-7.1684)	(-7.2240)	(-7.5359)	(-7.5492)	(-7.5403)	(-7.6041)
Ln_loc	-0.0193***	-0.0193***	-0.0192***	-0.0194***	-0.0440***	-0.0440***	-0.0438***	-0.0441***
	(-3.9719)	(-3.9829)	(-3.9455)	(-3.9925)	(-3.8792)	(-3.8792)	(-3.8543)	(-3.8880)
Type	-0.3831***	-0.3814***	-0.3803***	-0.3824***	-0.8895***	-0.8887***	-0.8842***	-0.8922***
	(-22.9301)	(-22.8201)	(-22.6666)	(-22.8081)	(-22.6604)	(-22.6284)	(-22.4260)	(-22.6579)
Ln_pop	-0.0547***	-0.0593***	-0.0830***	-0.0750***	-0.1086***	-0.1219***	-0.1866***	-0.1703***
	(-3.7909)	(-4.1129)	(-5.0297)	(-4.7770)	(-3.3030)	(-3.7121)	(-4.9029)	(-4.7159)
Ln_pgdp	-0.1366***	-0.1253***	-0.1605***	-0.1438***	-0.3168***	-0.2902***	-0.3856***	-0.3479***
	(-9.2810)	(-8.5626)	(-9.4376)	(-8.5732)	(-9.2082)	(-8.4795)	(-9.6936)	(-8.8435)
Ln_num	0.0003	0.0129	-0.0135	0.0009	-0.0077	0.0235	-0.0454	-0.0122
	(0.0209)	(0.8215)	(-0.8161)	(0.0521)	(-0.2088)	(0.6369)	(-1.1721)	(-0.3152)
Ln_avwa	0.5775***	0.5479***	0.5690***	0.5446***	1.2219***	1.1341***	1.1861***	1.1092***
	(10.7752)	(10.1302)	(10.5765)	(9.9967)	(9.7276)	(8.9343)	(9.3967)	(8.6724)
Ln_tour	-0.0030	-0.0090	-0.0115	-0.0108	-0.0126	-0.0276	-0.0311	-0.0288
	(-0.2493)	(-0.7493)	(-0.9367)	(-0.8821)	(-0.4455)	(-0.9772)	(-1.0779)	(-1.0032)
_cons	-14.9201***	-8.9885***	-15.2420***	-8.7635***	-34.8719***	-19.4722***	-35.2586***	-18.5551***
	(-26.6862)	(-17.0856)	(-24.5521)	(-15.6637)	(-26.0972)	(-15.7814)	(-23.8861)	(-14.1386)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	284,584	284,584	284,584	284,584	284,584	284,584	284,584	284,584
Loglikelihood	-29526.97	-29518.91	-29516.99	-29514.03	-29560.97	-29550.03	-29550.97	-29544.19

Table 9
Regression results with longer observation time.

	(1)	(2)		(3)	(4)
Ln_wamo	2.3529***		Ln_wamo × Period1	1.4418**	
	(8.0542)			(2.1413)	
Ln_waho		2.4480***	Ln_wamo × Period2	2.5415***	
		(10.5020)		(9.3394)	
			Ln_waho × Period1		1.8263***
					(4.2658)
			Ln_waho × Period2		3.0156***
					(12.2960)
Ln_age	0.1727***	0.1719***	Ln_age	0.1709***	0.1707***
	(11.3189)	(11.2651)		(11.1913)	(11.1794)
Ln_cap	-0.0681***	-0.0682***	Ln_cap	-0.0686***	-0.0690***
	(-10.3904)	(-10.4112)		(-10.4720)	(-10.5226)
Ln_loc	-0.0380***	-0.0375***	Ln_loc	-0.0374***	-0.0371***
	(-4.1796)	(-4.1314)		(-4.1083)	(-4.0859)
Type	-0.6286***	-0.6311***	Type	-0.6329***	-0.6368***
	(-19.6850)	(-19.7696)		(-19.8112)	(-19.9416)
Ln_pop	-0.0082	-0.0180	Ln_pop	-0.0364	-0.0445
	(-0.2924)	(-0.6433)		(-1.2915)	(-1.5841)
Ln_pgdp	-0.1447***	-0.1244***	Ln_pgdp	-0.0994***	-0.0694**
	(-4.8605)	(-4.1858)		(-2.8959)	(-2.0976)
Ln_num	-0.0541*	-0.0454	Ln_num	-0.0152	-0.0147
	(-1.8088)	(-1.5257)		(-0.4979)	(-0.4903)
Ln_avwa	0.2910***	0.2463***	Ln_avwa	0.1883**	0.1575**
	(3.4516)	(2.9664)		(2.3218)	(1.9932)
Ln_tour	0.0258	0.0219	Ln_tour	0.0207	0.0207
	(1.1733)	(0.9973)		(0.9392)	(0.9392)
_cons	-18.1261***	-11.8506***	_cons	-11.5196***	-9.4652***
	(-15.1985)	(-13.0512)		(-7.5804)	(-10.0752)
Year	Yes	Yes	Year	Yes	Yes
Province	Yes	Yes	Province	Yes	Yes
N	399,673	399,673	N	399,673	399,673
Loglikelihood	-45122.22	-45086.50	Loglikelihood	-44891.90	-44867.19

et al. (2024) are inconsistent in their findings regarding the impact of minimum wage increases on hotel enterprise performance. This paper uses a discrete-time risk model to find that minimum wage increases rise the survival risks of Chinese hotel companies. This indirectly supports the neoclassical view of Song et al. (2022) and Agarwal et al. (2024) that minimum wage increases have a negative impact on hotel revenue.

Second, this paper shows that the digital economy plays an important role in moderating the relationship between minimum wage increases and the survival risk of hospitality firms. This provides a distinctive perspective for future research on minimum wage and firm survival. Existing studies have investigated the impact of various digital technologies on the hospitality industry, including big data analytics (Antonio et al., 2019), social media (Gupta, 2019), self-service technologies and robots (Liu and Hung, 2020), virtual reality (Leung et al., 2020), and front desk technologies (Shin et al., 2019) on hotel performance. Unlike existing studies that focused on the impact of a particular digital technology on hotels, this study considers the digital economy as a moderating factor. Furthermore, this paper extends the research of Aaronson and Phelan (2019) and Balsam et al. (2022). Aaronson and Phelan (2019) found that minimum wage increases result in a decrease in relative employment in cognitively routine occupations (e.g., hotel and restaurant servers) and that some cognitively routine tasks will be replaced by digital technologies. Balsam et al. (2022) found that non-profit organizations increased their investment in information technology after a minimum wage increase. This study uses the digital economy with a broader meaning to analyze its impact on the minimum wage effect, identifying an important boundary condition for the economic effect of the minimum wage. This provides a deeper understanding of the positive impacts of digital transformation in hotels. To the best of our knowledge, there is no existing study on this topic, we fill a gap and contribute to the existing body of knowledge.

Finally, by comparing the effect of the minimum wage and the moderating effect of the digital economy between informal hotels and formal hotels, this study drew more specific conclusions that contribute to the existing literature on firm survival. The McKinsey Global Institute (Farrell, 2004) regards informal firms as "parasites" engaging in unfair competition. Williams and Horodnic (2017) argue that the informal sector can pose a threat to hotels and restaurants. However, informal businesses account for up to half of all economic activities and provide a livelihood for billions of people in developing countries. It is prevalent in the tourism and hospitality industry (Thomas et al., 2011). Allowing them to operate in situations where the legal and regulatory systems are not well developed can help maintain economic stability. Biggs et al. (2012) found that informal tourism businesses in Thailand seem to be more resilient than formal tourism businesses in a crisis situation. Although this study has demonstrated the differences between informal and formal firms, it is conducted in the context of a sudden crisis scenario. This study revealed that the resilience of informal and formal hotel businesses varied in everyday risk scenarios. Specifically, this study demonstrates that the informal hotel industry in China is less adversely affected and has a higher survival rate than formal hotel firms when external minimum wages rise. The conclusions contribute to a better understanding of the distinctions between informal and formal firms in developing countries. In addition, this study demonstrates that the digital economy can better alleviate the adverse effects impacts of rising minimum wage on informal hotel enterprises. This means that we have identified the key factors that lead to differences in the moderating effects of the digital economy.

5.2. Management implications

These results provide significant guidance for hotel industry practitioners. The results show that the raising of the minimum wage increases the survival risk of hotels, and this effect is greater for formal hotel enterprises. Generally, hotel managers can take measures to reduce costs and improve productivity in the face of minimum wage increases. However, considering that layoffs and reducing employee welfare may be counterproductive (Song et al., 2022), we recommend that hotel managers take measures to improve hotel productivity, especially in formal hotel enterprises. For example, enhancing hotel employee training to improve employees' job skills (Tavitiyaman et al., 2022); adding additional employee benefits to promote employee commitment, thereby increasing employee motivation (Bandara et al., 2022), and resulting in high-quality customer service. In addition, this study finds that the digital economy can decrease the adverse effects of minimum wage increases. Therefore, we suggest that hotel managers to fully integrate digital technology into their operations. For example, implementing smart hotel services and remote room management by introducing digital information systems (He et al., 2015); using social platforms for online marketing to obtain more traffic and transactions (De Pelsmacker et al., 2018); adopting mobile-based booking apps to streamline operations and booking processes (Jung et al., 2014); and using self-service technology and virtual reality to create more unique and memorable experiences for guests (Leung et al., 2020). Moxy Hotels, owned by Marriott, is a notable example of implementing a gamification strategy focused on augmented reality to enhance guest experience (William, 2022). Additionally, due to the importance of digital technologies in the hospitality industry, it is important to train hotel employees on digital technologies. For hotel owners, employees with digital skills can provide customers with convenient, efficient, and time-saving services during the service process. For the employees, acquiring specific digital skills can help them in professional competition. The findings are also instructive for policymakers. The minimum wage policy is to protect low-income people, but too frequent and substantial minimum wage adjustment will affect labor-intensive industries survival. More firms exit can increase the possibility of unemployment of low-income people, which may lead to people who really need minimum wage protection losing the opportunity to get the minimum wage. Therefore, the minimum wage policy should be tailored to local conditions, and try to implement precise and differentiated policies in different industries and regions. Or the minimum wage policy can be implemented in coordination with preferential tax policies and other supporting policies, balancing the relationship between the protection of employees' rights and the affordability of enterprises. Furthermore, we discovered that the minimum wage increases had a greater negative impact on the survival of hotels during the COVID-19. Crisis is unavoidable. To reduce the high number of hotel failures during future crises, we suggest that policymakers differentiate between the minimum wage in regular times and the minimum wage during a crisis.

5.3. Limitations

There are some limitations in this paper that need to be considered in future research. First, due to the limited characteristic data of micro, small and medium hotels in China, the study only investigates the impact of the minimum wage on the survival risk of hotels, but does not draw more detailed conclusions by investigating the impact of the minimum wage on the number of employees, operating costs, production efficiency and financial performance. In the future, once the relevant data is available, it is necessary to study the internal mechanism of how the minimum wage affects firm survival. Second, the lack of compatibility between the digital economy of city and the digitalization of hotels also needs further research. For example, it would be meaningful to shift digital economy studies towards a much smaller scale with an empirical design in which the sample subject is focused on firm-level digitization. It is expected that such studies may provide a better understanding of the effect of the digital economy on firm survival. Third, this study found that the impacts of the minimum wage increase on informal and formal hotel enterprises are different. However, we fail to specifically capture the managerial actions that employers in different types of hotels take to address potential losses resulting from minimum wage increases. In the future, interviews can be used to understand the

measures taken by employers.

Funding

This research has been financed by the National Social Science of China (No. 19ZD25).

CRediT authorship contribution statement

Xuegang Feng: Conceptualization, Funding acquisition, Methodology, Project administration, Resources, Supervision, Writing – review & editing. **Xiaodong Guo:** Conceptualization, Methodology, Project administration, Supervision, Writing – review & editing. **Chen Hao:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Software, Validation, Visualization, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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