

ORIGINAL ARTICLE

The redemption of The Accidental Republic: 70 years of Chinese Workers' Compensation Insurance

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Abstract

The Accidental Republic is a concern for all industrialised countries, and China is no exception. To solve this problem, Workers' Compensation Insurance (WCI) is a perfect option. The redemption of The Accidental Republic can be understood through the development of WCI. However, little attention has been paid to the development of Chinese WCI. Starting from labour insurance regulations promulgated in 1951, this research explores over 70 years of reform and development of Chinese WCI, explicitly dividing reforms into three phases – establishment and implementation, exploration and practice, and adaptation and formation – that aligned with stages of China's economic development. Further, the insurance fund performance in the last decade is evaluated by Data envelopment analysis and Malmquist (DEA-Malmquist), through the static and dynamic results, yielding generally average results. Subsequently, five major problems of WCI are identified and discussed and five suggestions offered drawing on international comparison and the national situation. Lastly, the accidental and inevitable aspects of China's WCI system during the redemption of The Accidental Republic are summarised.

Keywords: China; DEA-Malmquist; reform and development; The Accidental Republic; workers' compensation insurance

JEL Codes: I38; J28; J58; J83; J88

Introduction

The term 'The Accidental Republic' originates from John Fabian Witt's work 'The Accidental Republic: Crippled Workingmen, Destitute Widows, and the Remaking of American Law.' The initial draft was a doctoral thesis submitted by Witt to the History Department at Yale University (Witt 2004) describing the appalling working conditions and occupational hazards in the United States after the Civil War, narrating the crisis of industrial accidents and the resultant reform of American law. The book explores four primary approaches to addressing industrial accident issues. The first approach involved American lawyers and judges organising the originally disordered legal rules and standards into the tort law system within common law, resulting in what Gilmore famously termed the 'From Tort to Contract' (Gilmore 1977). The second approach witnessed the spontaneous formation of cooperative insurance associations by ordinary workers; such organisations were once widely prevalent but have since been largely forgotten. The third approach was the development of private employer compensation programs driven by corporate employers and proponents of the scientific management

movement, while the fourth approach involved social insurance advocates pushing for mandatory worker compensation programs through the legislative processes. Ultimately, the developments and approaches of the early 20th century, outlined above, led to a significant leap forward in industrial safety being achieved (Witt 2004).

The Accidental Republic illustrates that industrial accidents are a recurring challenge that every industrialised nation must confront. The International Labour Organization estimates that 2.34 million people die annually from industrial accidents and occupational diseases, equating to around 6,000 deaths every day. Every year across the world, about 340 million people suffer from industrial accidents and 160 million from industrial illnesses. These numbers are continuously on the rise, with the annual economic cost of work-related accidents currently around 3.94% of global gross domestic product. Worldwide occupational injuries and fatalities result in \$3 trillion in economic losses (ILO, 2021).

As industrialisation advances and evolves, the Accidental Republic emerges in the development of every industrialised nation. Breaking free from the 'Accidental Republic' demands both political resolve and the establishment of a legal framework for risk management. At the national level, there is a need to craft systems that safeguard workers' rights, with a clear preference towards protecting employees over employers, thus aligning with modern labour law principles that prioritise the well-being of workers (Adler, 2011). Workers' Compensation Insurance (WCI), which serves as an economic incentive for companies to protect the health of their employees and maintain a safe working environment (Zheng 2018), is considered one of the most influential government regulations to date (Viscusi 1966). Germany pioneered the WCI system in 1884, inspiring other industrialised nations to adopt similar models. The United Kingdom deviated from the German approach in 1946, overhauling its social insurance system, including workers' compensation. Unlike most nations, the UK's current program differs significantly from its predecessor. The Netherlands and New Zealand have integrated their workers' compensation systems into broader social insurance programs covering both work- and non-work-related injuries. Switzerland was the first to include non-work-related injuries in its program (Williams 1991). Building upon Germany's establishment of the WCI, these industrialised nations innovate and refine the approach before adopting it domestically.

As the largest developing country, China is also undergoing industrialisation, a process inevitably accompanied by industrial accidents, especially in the early years. In the initial stages of rapid economic development, high production was prioritised over safety and working conditions (Tang 2019), which, not surprisingly, led to a significant incidence of industrial injuries and fatalities. In recent years, despite improvements in workplace safety, accidents have continued to plague key industries like mining, manufacturing, construction, and so on. Between 2014 and 2019, a total of 11.82 million beneficiaries received work-related injury benefits, with 653.4 thousand cases officially recognised as work-related injuries (Gang 2021). Like other industrialised nations, therefore, China must take greater measures to redeem and address the formidable challenge of The Accidental Republic.

Regardless of how developing countries tackle industrial safety challenges, WCI will shape their legal framework. Insurance serves as more than contracts, fulfilling vital roles in managing, deterring, and compensating risks to economic and social order (Stempel 2010). The Social Insurance Law and the Workers' Compensation Insurance Rules (WCIR) explicitly state that Chinese WCI, as a part of the social insurance system, mitigates the employers' risks and provides employee relief after suffering work-related injuries or occupational diseases (Hu and Manning 2010). This system relieves workers' concerns and ensures thorough and timely medical treatment and rehabilitation after a work-related accident or illness (Liu and Leisering 2017), fulfilling the original purpose and intent of China's WCI system established at the nation's founding. WCI thus serves a dual purpose: for one thing, it aims to prevent accidents and protect the safety of workers (Liu 2018); for another, it safeguards the rights and interests of injured workers with timely medical

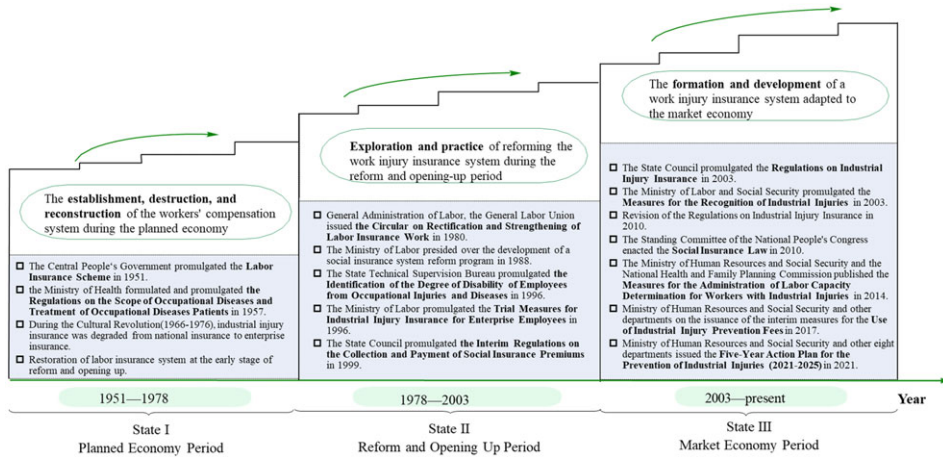


Figure 1. The developmental stages of China's Workers' Compensation Insurance (WCI) across different economic periods.

treatment, rehabilitation, and economic compensation (Kruk et al 2018), transferring the potential occupational injury risk to specialised companies that can afford it (Chen et al 2021).

However, like WCI legislation in other countries, the development of the Chinese WCI system was not established smoothly. Combining the historical stages of Chinese economic development with relevant WCI policy documents,¹ the Chinese WCI system can be divided into three phases: establishment and implementation during the planned economy period; reform exploration and practice during the period of economic reform and opening up; and adaptation and formation in the market economy period, these are shown in Figure 1. The WCI system was established and grew through the publishing of legal provisions across the different economic periods. This article examines the development process of WCI over more than 70 years since the founding of the People's Republic of China (the PRC). In addition, we evaluate the performance of the WCI over the past decade, outlining its historical and current development in response to The Accidental Republic.

Internationally, many scholars have studied WCI and the problems derived from it. An early piece of research was by Knowles and Legis (1920), who examined the legal foundations of workers' compensation and accident insurance in over 30 different countries. Over a century later, Andersson et al (2022) examined statutory workplace accident insurance in order to improve the welfare of Swedish workers. Bae et al (2018) explored the influences of income changes caused by industrial accidents, while Kim et al (2012) examined the Korean industrial accident compensation insurance system, and Tompa et al (2007) looked for evidence on the effectiveness of workers' compensation insurance and the enforcement of occupational health and safety regulation. In 2012, Lippel explored how to preserve workers' dignity in workers' compensation systems from an international perspective.

However, research on Chinese WCI has mainly focused on anti-therapeutic effects (Shan 2018) or compensation for occupational fatalities (Liao and Chiang 2015). There has been research about the reform and development of WCI. Related research has focused on three aspects: the first starts with the social security system (Xi et al 2021), where the development and evaluation of WCI as a sub-project of the social insurance system was studied (Zhou et al 2019), although in these studies the research object is social insurance and the evaluation index is highly universal, making it challenging to reflect the more specific aspects of characteristics of WCI in China. The second aspect has been studies of

the insurance itself separately, from the perspective of the establishment of laws and regulations (Zhang and Mi 2020), economic management (Zheng 2020), the protection of rights and interests under the new format (Lou 2022), or investigating international comparisons (Tilindyte 2012). The development process is only briefly described as part of the review, and the research is primarily from Chinese literature and thus challenging to demonstrate the international influence of WCI. The third aspect refers to the development process of other social insurances, including pension insurance, medical insurance, and other social insurances (He and Deng 2011; Song *et al.* 2021; Xie *et al.* 2020), and specifically with regard to the development process of social insurance or the choice of an appropriate index system to promote the development of insurance through performance evaluation (Liu *et al.* 2017; Liu 2013). Overall, these research concepts and methodologies have reference value for research on WCI.

This paper aims to fill in some of the gaps in the theoretical and practical aspects of Chinese WCI research and is structured as follows: Section 2 combines the characteristics of Chinese economic development with the insurance process to show the changes of WCI over 70 years of history. Section 3 uses the Data envelopment analysis and Malmquist (DEA-Malmquist) model to calculate WCI fund performance during the last 10 years, offering readers a thorough development and performance analysis through qualitative and quantitative analysis. Based on this, Section 4 suggests policy implications for improving WCI from both an international and Chinese perspective. Section 5 concludes the paper.

Development process

Establishment and implementation in the planned economy period (1951–1978)

The Labor Insurance System (LIS), enacted in 1951, was the first social insurance regulation since the founding of the PRC and granted the urban workforce access to health insurance, injured-worker insurance, old-age insurance, and so on. The LIS provided essential support for those temporarily or permanently unable to work (Rickne 2013; Tang and Ngan 2001) and mandated that all insurance costs were covered by employers, with no contribution required from individual workers. This provision remains unchanged to this day. Initially, 30% of the fees collected went to the All-China Federation of Trade Unions as a national adjustment fund, while 70% were retained by enterprise-level trade union committees for labour insurance funds. These funds were used for various benefits like retirement, resignation, funeral subsidies, and medical relief. At all levels, from national to local, there were well-established labour insurance management institutions with dedicated staff.

However, the labour insurance system changed during The Great Leap Forward and the Cultural Revolution. The LIS was stigmatised as a revisionist regulation and criticised, resulting in many workplaces struggling to implement labour welfare policies and regulations. The smooth operation of labour welfare became difficult, and labour insurance management suffered severe degradation, leading to paralysis and chaos as the original insurance system could not operate generally due to disruption of the contribution mechanism (Qiao 2019). Meanwhile, the All-China Federation of Trade Unions was forced to stop their labour protection activities, and at the enterprise level, the labour insurance business was left unmanaged. In the planned economy system, under the strong influence of collectivism, the personal interests of workers were highly aligned with those of enterprise and society (Tiessen 1997). Enterprises were attached to various political and social functions, such as protecting workers against work-related injuries. Since that time and for the next 40 years or so, labour insurance degenerated from a state to an enterprise insurance. However, fortunately, enterprises remained under the State, which retained responsibility for profit and loss and thus, enterprises did not bear the ultimate responsibility for insurance coverage (Perotti *et al.* 1999).

With the end of the Cultural Revolution, associated reconstruction work was prioritised. Consequently, the labour insurance system gradually resumed, with management responsibilities returning to central, local, and grassroots units. The labour insurance system aligned with the high employment, low-wage, and heavily subsidised labour wage system of the planned economy (Li 2019). It met the basic needs of injured workers and their families while also aiming to mitigate the risks of industrial accidents and promote economic development.

During this period, policies aimed to revive and advance the national economy while also ensuring workers' rights. The insurance policies resembled employee benefits, with WCI striving for absolute fairness within the centralised planned economy. However, the insurance lacked risk-diversification functionality. The operation mode was primarily managed by the state, with enterprises taking charge (Sun and Zhu 2009). Due to setbacks like the Great Leap Forward and Cultural Revolution, leading to the shift to enterprise-based insurance, the absence of risk diversification led to inconsistencies in burdens borne by enterprises, resulting in significant disparities in employee benefits and systemic distortions, ultimately weakening protection efforts.

Exploration and practice in the reform and opening up period (1978–2003)

With Deng Xiaoping's 1978 reform and opening up, China transitioned from a planned economy to a socialist market economy, prioritising economic development. With an emphasis on economic development and relentless pursuit of growth and efficiency, safety incidents surged (Naughton 2006). Consequently, reconstructing the WCI system became imperative. Regulatory bodies issued a slew of directives, expanding the coverage of labour insurance, streamlining processes, and bolstering effectiveness. They provided clarity on treatment and expenses for work-related injuries, instituted protocols for subsidies and compensation for families of deceased workers, and expanded the catalogue of occupational diseases.

Simultaneously, the ongoing responsibility of enterprises for the insurance system had created a substantial burden that conflicted with the pursuit of economic profitability. Employment underwent significant changes as enterprises entered competitive markets and former enterprise personnel integrated into broader society. Individuals, freed from the constraints imposed by enterprise, boosted workers' energy (Chen, Wang, et al 2020). The traditional development model, which sacrifices personal interests to safeguard national interests, proved difficult to sustain. As a result, individual, national, and collective interests tend to diverge, leading to conflict among stakeholders (Zeng et al 2015). These dynamics influenced the design and operation of the WCI system. Consequently, the tension between the WCI system and rapid economic growth became more pronounced. The Labor Law first introduced WCI as a separate system in 1994, and the Trial Measures for WCI for Enterprise Employees were issued in 1996. These measures shifted enterprise insurance to social insurance, ensuring balanced funding for sustainable and fair management of funds. Differential rate mechanisms were instituted, with fund management primarily at the county level. The work-related injury system was fundamentally altered to emphasise and implement the combination of prevention, compensation, and rehabilitation of industrial injuries.

During this period, the reform of the Chinese WCI system prioritised efficiency. Not surprisingly, the concept of comprehensive protection of workers' rights remained relatively weak. This shift did not favour the development of the WCI system, instead resulting in a passive response to reforming political and economic systems. It was not until the release of the Trial Measures in 1996 that the focus of the State shifted from solely pursuing economic development and efficiency towards promoting the coordinated development of the economy and society. The idea of fully safeguarding workers' rights

gained traction, which also led to significant changes in the WCI system. National responsibility started to return, transitioning management oversight from enterprises to government control. The notion of preventing work-related injuries began to surface, although occupational rehabilitation still remained in its infancy, and compensation and treatment remained focal points of the system (Sun and Zhu 2009).

Adaptation and formation in the market economy period (2003–now)

With deepening reform of the Chinese market economy and the rapid rise of industrialisation and urbanisation, the government issued a series of laws, regulations, and rules to protect the rights of workers and accelerate legislation related to occupational injury protection. China's transition from exclusively pursuing economic growth, speed, and efficiency to prioritising harmonious economic and social development signalled a shift from undirected development to reasoned progression that was in accordance with legislation designed to foster economic and social development (Yeh *et al* 2015). In the 6 years of operation following the 1996 Trial Measures, several 'rural to urban' transfers of employment occurred. The original WCI system was limited to enterprises with a narrow scope of application, which no longer met the requirements of the socialist market economy (Liu 2014), thus demands for legal construction increased. The promulgation of the Trial Measures for WCI for Enterprise Employees also created active conditions for legislation. In this context, the WCIR, promulgated by Premier Wen in 2003, not only bolstered its authority and legal effect but also expanded its applicability and elaborated on multiple aspects with precision. In so doing, a Trinity WCI system was established, encompassing prevention, compensation, and rehabilitation of work-related injuries, wholly tailored to the Chinese socialist market economy. Furthermore, the WCIR modification of 2010 further optimised policies, bringing the WCI system more in line with the requirements for social growth. The government issued notices requiring nationwide implementation of municipal-level coordination for WCI, gradually transitioning to provincial-level coordination. During this shift, management oversight moved from the original county level to the municipal level. In the same year, the Social Insurance Legislation explicitly designated WCI as a national law, raising its legislative status. Before 2017, only four municipalities² and seven provinces³ had transitioned from municipal-level to provincial-level coordination. The Guiding Opinions on Provincial-level Coordination of WCI Funds issued in 2017 aimed for full implementation of provincial-level coordination by the end of 2020, with this objective now largely met nationwide.

More recently, the new production paradigm of Industry 4.0 (Polak Sopinska *et al* 2020) has promoted adjustments in economic and industrial structures, leading to changes in the occupational structure. More workers are shifting towards emerging industries, with the Internet bringing about changes in employment methods and forms. Additionally, the outbreak of the COVID-19 pandemic in 2019 posed particular challenges to social insurance, including WCI. New issues emerged, such as the lack of protection for older workers, which further complicated the challenges faced by WCI.

In response to these changes, the Chinese government has been moving the social security system to a more prominent position by promoting the development of WCI and other sub-projects. For example, the Healthy China Initiative (2019–2030) aims to achieve complete coverage of the statutory population and progressively increase the number of participants (Tan *et al* 2019). Similarly, the Five-Year Action Plan for Injury Prevention (2021–2025) was designed to ensure the positive development of WCI during the 14th Five-Year Plan period.

During this period, the notion of 'people foremost' in safeguarding human life and health gained widespread recognition and acceptance. The WCI system entered a phase of

comprehensive development, becoming more legally structured and progressively moving towards an integrated approach of prevention, compensation, and rehabilitation. Government responsibility was further strengthened. The conceptual values of this period represent a balanced blend of fairness and efficiency, with systemic reforms shifting from passive to proactive measures.

The transformation in China's WCI journey shows a shift from company-focused welfare insurance to broader social coverage. The Trinity system reflects a transition from merely easing labour conflicts and maintaining social stability to actively preventing injuries and safeguarding workers' well-being. The function of the WCI system, which was initially used to spread enterprise risks and evade responsibilities, has gradually diminished. Ultimately, it has transformed from a double-win situation for both workers and businesses to a goal of maximising worker protection (Tang 2019). Just as pointed out by Witt in *The Accidental Republic*, the accident of the American accident law system is that the history of American accident law 'does not presuppose a deterministic relationship' but is 'dynamic,' telling a story of experimentation (Witt 2004). Similarly, the development of China's WCI has been one of constant adjustment within its own economic growth, reflecting both exploration and historical inevitability under the principle of prioritising people.

Performance evaluation

The development process illustrates that with the acceleration of China's industrialisation, WCI has made progress in legal regulations during different economic periods, exerting influence on society, enterprise development, and workers' rights. History has shown that stable and sufficient funding is essential for a WCI's smooth operation, which requires considerable investigation. The WCI fund, a crucial component of the system, is a specialised fund established by the state for specific purposes through legal channels to implement WCI. Therefore, quantitatively assessing the fund can provide objective insights into WCI's performance from a financial perspective. Moreover, China's WCI is still in development, and ensuring fair and effective resource allocation for the WCI fund is a key issue that needs serious attention.

Data envelopment analysis (DEA) was initially proposed by American operations researchers Cooper and Charnes (Ahn et al 1988) and gradually matured, becoming widely used in relative efficiency evaluation systems. The main idea of the DEA model is to treat each evaluation unit as a decision-making unit (DMU) and use mathematical programming to find the optimal solution for each DMU, thereby determining its effectiveness based on the extent to which it lies on the efficient production frontier (Chen, Song, et al 2020). Since the DEA method plans computations based on the input and output indicators of DMUs, there is no need to subjectively weight each indicator in advance, ensuring the objectivity and rationality of the evaluation results (Kaffash and Marra 2017). In addition, the DEA method is easy to operate, has small errors, and does not require pre-assumed specific production functions and parameters. As a result, it has become a frequent and significant analytical tool in management, economics, and system science, widely used in insurance efficiency analysis, and demonstrating good practical application in basic pension insurance, medical insurance, and other social insurance. Therefore, this article selects the non-parametric DEA method to evaluate the efficiency of the WCI fund.

However, DEA requires high data quality and accuracy and cannot handle discrete data. Therefore, this article selects continuous data from official agencies for the DEA model. Although the DEA method does not require weighting of indicators, the process of selecting indicators involves some subjectivity. Therefore, this article combines the inherent logic of insurance fund operation and other social insurance performance

evaluation indicators to determine the indicators comprehensively. Additionally, the DEA method can only provide a description and comparison of performance without explaining the specific reasons for improvement or deterioration. Therefore, in formulating improvement suggestions, this article introduces the dynamic Malmquist index for explanation.

Research method

Model selection

CCR model and BCC model. Suppose there are n DMUs, each with m inputs and s outputs. To establish input and output matrices $X = [x_{ij}] m \times n$ and $Y = [y_{rj}] s \times n$. Here, x_{ij} represents the quantity of the i -th input in the j -th DMU, and y_{rj} represents the quantity of the r -th output in the j -th DMU, satisfying $x_{ij} > 0$, $y_{rj} > 0$. The weighting coefficient v_i represents the weight of the i -th input, and u_r represents the weight of the r -th output, where $i = 1, 2, \dots, m; j = 1, 2, \dots, n; r = 1, 2, \dots, s$. Then, the efficiency evaluation index of each DMU is represented as a vector:

$$h_j = (uT \cdot Y_j) / (vT \cdot X_j), j = 1, 2, \dots, n \quad (1)$$

When aiming for the j_0 th DMU efficiency index, it is always feasible to choose suitable weighting coefficients, u and v , in order to fulfil the condition $h_j \leq 1$, that is:

$$\max h_{j_0} = (uT \cdot y_0) / vT \cdot x_0 \quad (2)$$

$$s.t. (uTY_j) / vT \cdot X_j \leq 1; u \geq 0; v \geq 0 \quad (3)$$

In this context, the input-output vector (x_0, y_0) corresponds to (x_{j_0}, y_{j_0}) . By utilising the Charnes-Cooper transformation, Equations (1)–(3) are converted into a dual problem in linear programming. By incorporating the concept of the non-Archimedean infinitesimal, these equations can be further transformed into the following format:

$$\begin{aligned} & \min [\theta - \varepsilon(\hat{e}^T S^- + e^T S^+)] \\ & s.t. \begin{cases} \sum_{j=1}^n X_j \lambda_j + S^- = \theta X_0 \\ \sum_{j=1}^n Y_j \lambda_j - S^+ = Y_0 \\ \lambda_j \geq 0, S^-, S^+ \geq 0 \end{cases} \end{aligned} \quad (4)$$

In the formula, ε denotes a non-Archimedean infinitesimal, and S^- and S^+ represent slack variables corresponding to inputs and outputs, respectively. θ serves as an indicator of the efficiency of the basic pension insurance fund.

The CCR model stands as the fundamental cornerstone among DEA models. Based on the CCR, by setting $\sum_{i=1}^n \lambda_i = 1$, we can then obtain the BCC model. The CCR model facilitates the computation of the technical efficiency value (CRSTE) of DMU when operating under fixed-scale returns. Conversely, the BCC model enables the derivation of variable returns to scale technical efficiency (VRSTE). By comparing the two, the scale efficiency of DMU can be determined, calculated as $SCALE = CRSTE/VRSTE$ (Banker et al 1984). This ratio offers a metric to assess the distance between the production frontier operating with both constant and variable scale returns (Huang et al 2023).

In the WCI fund evaluation, CRSTE measures the efficiency of WCI institutions in managing and allocating resources to provide work-related injury benefits. If it equals 1, it means that resource allocation is optimal, while improvements are needed if it is less than 1. VRSTE represents the efficiency of insurance institutions under a variable scale. SCALE

indicates whether the scale of social insurance institutions is appropriate. If it equals 1, the social insurance institution is operating at the optimal scale. If it is less than 1, the institution may not operate at a favourable scale. At the same time, if it is greater than 1, the institution may operate at a scale more significant than what is considered appropriate (De Weerd and Dercon 2006).

Malmquist index. Due to the introduction of time factors that can alter the production frontier, the CCR and BCC models often use cross-sectional data to horizontally compare the efficiency of DMUs. The Malmquist index, however, is suitable for panel data, which can measure efficiency changes over different periods, effectively addressing the shortcomings mentioned above. The Malmquist index aims to calculate total factor productivity (TFP) and decompose it to analyse the reasons for the changes. According to the definition of the Malmquist index by Färe et al (1998), the index can be decomposed into the technical efficiency change index (TEC) and the technical efficiency progress index (TP). The technical efficiency change index can further be decomposed into the pure technical efficiency change index (PTEC) and the scale efficiency change index (SEC). Therefore, total factor productivity is expressed as:

$$M(X^{(t+1)}, Y^{(t+1)}; X^t, Y^t) = TEC \times TP = SEC \times PTEC \times TP \quad (5)$$

The Malmquist index is introduced to analyse the changes in different periods and dynamically reflect the trend of WCI over 10 years. An index value less than 1 signifies a decline in production efficiency; a value exceeding 1 indicates an enhancement; and a value of 1 indicates stability in production efficiency. Utilising the gathered data can enhance understanding of the WCI fund performance.

Indicator selection

The index logic of input and output in the performance evaluation of social insurance, such as pension insurance and medical insurance, is used for reference. This logic forms the basis of insurance operations, with the services provided serving as input indicators and the expected results of insurance serving as output indicators.

Furthermore, combining factor analysis results with the WCI evaluation index: the first principal component is the coverage and treatment level standard, and the second is the fund operation index (Huang et al 2023). At the same time, with regard to the logic of index selection and the vital index, this article selects beneficiaries and participants representing the treatment level and annual coverage, thus choosing characterised fund operations such as revenue, expense, and balance at year-end as indicators. In selecting expense, which provides services to WCI participants, beneficiaries can represent the basis of operation as input indicators, and WCI development can be represented by the expected revenue balance at year-end as output indicators (Kaffash et al 2020). The performance evaluation indicators are shown in Table 1.

Data collection

The Chinese mainland comprises 33 administrative regions, although the policies implemented by Hong Kong and Macao special administrative regions differ from those of other provinces. Given that WCI is coordinated at the provincial level, we selected a total of 31 provinces on the Chinese mainland and divided them into six administrative regions, as shown in Table 2.

The data come from the China Statistical Yearbook published by the National Bureau of Statistics, which mainly reflects economic and social development. The social security section includes the WCI situation by region, covering 31 provinces and the whole country. Thus, we select the China Statistical Yearbook as the data source to collect a total of 32

Table 1. The indicators of Workers' Compensation Insurance (WCI) fund performance evaluation

Classification	Indicators	Unit	Definition
Input	Expense	Billion	Annual expense amount of WCI Fund
	Participants in WCI	Million	The annual number of WCI participants
	Beneficiaries	Million	Number of workers receiving WCI benefits
Output	Revenue	Billion	Annual revenue amount of WCI Fund
	Balance at year-end	Billion	Amount of accumulated fund balance at the end of the period after the excess of revenue over expense

Table 2. Geographical divisions of China

Region	Provinces covered
North China	Beijing, Tianjin, Hebei, Shanxi, and Inner Mongolia
Northeast China	Liaoning, Jilin, and Heilongjiang
East China	Shanghai, Jiangsu, Zhejiang, Anhui, Fijjian, Jiangxi, and Shandong
South Central China	Henan, Hubei, Hunan, Guangdong, Guangxi, and Hainan
Southwest China	Chongqing, Sichuan, Guizhou, Yunnan, and Tibet
Northwest China	Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang

units, including participants at year-end, beneficiaries at year-end, and revenue and expenses of the WCI from 2020 to 2020.

Evaluation results

Static results

The analysis software DEAP 2.1 was used in this study to focus on the output effects under WCI inputs and choose the input-oriented DEA-BCC model. We considered scale effects to better assess efficiency without being affected by the scale of operations (Huang *et al* 2023).

The DEA results and regional data for the 10 years under study are shown in Appendix A.1–A.3, while the trend changes are shown in Figure 2.

Overall, the VRSTE of WCI funds nationwide is 1, indicating that the WCI fund portfolio across the country has reached an optimal state. However, the CRSTE and SCALE over the past decade have averaged 0.63, showing a trend of initial decline, followed by improvement, and then decline again. The performance was poorest in 2012, at 0.437, and relatively better in 2017, at 0.72, indicating that there is room for improvement in the efficiency of WCI funds.

Among them, most regions and the overall WCI fund performance show synergy across the three indicators, except for Northeast China, which exhibits a different trend overall and from other regions. This indicates that Northeast China's performance in WCI differs from the national and other regional levels, resulting in poorer fund performance in that area. Additionally, there are significant differences among the regions, with a 0.13 gap between the best and worst performances in CRSTE, a 0.11 gap in VRSTE, and a 0.14 gap in SCALE. Specifically, for CRSTE, East China's performance is generally poorer, while South Central China's performance is generally better. For VRSTE, although the overall WCI performance over the past 10 years is 1, the performance in each region is less than 1, indicating that

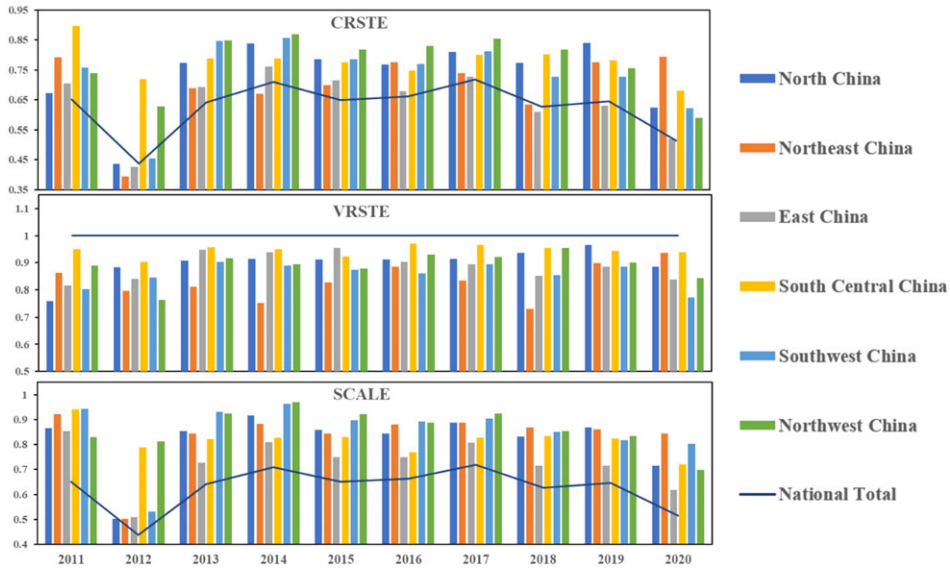


Figure 2. The variation trend of data envelopment analysis (DEA) results across China's mainland.

although the national WCI portfolio has reached optimal performance, each region still needs to coordinate and adjust the operation of WCI funds. Overall, South Central China performs relatively better. Regarding SCALE, East China performs the worst, while Northeast China performs the best, indicating that East China needs improvement in the scale of WCI funds.

Dynamic analysis

The panel data of WCI indicators from 2012 to 2020 were selected and combined with the DEA model, and the Malmquist index was calculated as shown in Appendix B. Analysis of the trend changes of TFP based on six administrative regions is illustrated in Figure 3.

Overall, from 2013 to 2018, the nation saw an increase in TFP, but it began to decline rapidly in 2019, with an average decrease of 3.3% over the decade, reflecting a regression in WCI efficiency. The change in TFP can be decomposed into *effch* and *techch*. The means of *effch* and *techch* are 1.003 and 0.960, respectively. The fundamental reason for the decline in overall operating efficiency is the decrease in technical change and scale efficiency change index, demonstrating the need to expand participation and improve the efficiency of fund utilisation.

The TFP-changing trend of WCI in various regions is inconsistent. The TFP in northwest China shows a lightning trend, which first plummets sharply, remains stable for a while, and then decreases abruptly. Northwest China performed well in 2012 and then showed a downward trend. The overall situation of the other five regions is similar to the national trend. From the cross-sectional point of view, various regions of the Chinese mainland show a downward trend.

Discussions

Problems

In earlier sections, qualitative analysis revealed that the construction of the WCI system and the corresponding legal framework have contributed to safeguarding workers' lives

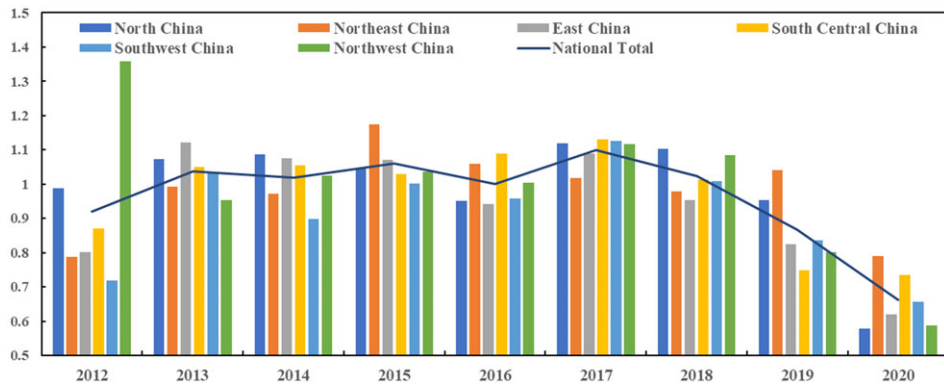


Figure 3. The variation trend of total factor productivity (TFP) across China's mainland.

and health. This reflects China's response to the challenges of the Accidental Republic posed during its industrialisation. Key indicators such as participants in WCI, beneficiaries, and fund expenses have all been increasing annually due to widespread policy implementation. However, along with this growth, indicators such as the revenue and balance of the fund have also risen. When both input and output indicators are on the rise, it becomes difficult to judge objectively, and insurance performance based solely on data increases. Therefore, the introduction of the DEA-Malmquist approach allows for quantitative performance analysis to evaluate the efficiency of WCI at each time point. Based on these data-driven results, it appears that WCI has not achieved optimal operating conditions, further indication that insurance still faces some problems.

Narrow coverage

DEA-Malmquist analysis finds that scale efficiency accounts for the poor operations of WCI, suggesting that the participation issue should be addressed because determining labour relations is a prerequisite for participation in WCI. However, with the advent of Industry 4.0, the economic landscape has shifted again, this time to a new normal (Lin et al 2023), resulting in a surge of employees without formal labour relations experience facing significant occupational risks. Large numbers of employees have not yet been incorporated into the WCI system. This situation defeats the establishment's original purpose to protect workers' rights and interests.

Inadequate laws and regulations

While China has spent the last 20 years focusing on developing WCI laws and regulations; the practice has revealed weak operability and the likelihood of disputes (Liu et al 2021). Some legislative and regulatory changes have even caused administrative litigation disputes, while others have found the relevant mechanism challenging to operate smoothly. In addition, as internet technology and the digital economy have grown, changes in production techniques, occupational patterns, and occupational dangers have shattered the traditional definition of work-related injuries. The existing basic framework and rules are no longer adequate to address these evolving complexities.

Slow development of work-related injury prevention and rehabilitation

In the initial framework of the so-called Trinity WCI system, preventative and rehabilitative efforts have lagged behind compensation work. Additionally, the fund of

prevention and rehabilitation expenses has seen no significant growth, highlighting a weakness in the Trinity WCI system. Considering the varying changes in WCI data under the influence of the COVID-19 pandemic, a comparison with 2019 data reveals notable differences. In China, the proportion allocated to prevention stands at 0.30%, while in Germany, it is 11.55%. Similarly, for rehabilitation, China allocates 0.81% compared to Germany's 30% (Renmu 2023). The remaining funds cover various expenses, such as medical treatment and disability benefits. There appears to be a significant discrepancy between China and highly industrialised countries in terms of prevention and rehabilitation efforts. As a result, the objective of protecting worker safety and health and minimising the effects of occupational injuries has not been achieved.

Unbalanced regional development

The evaluation results reflect significant disparities in CRSTE, VRSTE, SCALE, and TFP between the best and worst-performing regions, reflecting significant differences in WCI operation. This could be attributed to differing levels of economic development, with more resources and technological support available in developed regions. Furthermore, differences in industry structure, regulatory enforcement, and regional culture contribute to divergent WCI fund performance across regions. Such discrepancies hinder the diversification of insurance market operational risks and may even exacerbate regional economic imbalances (Deng et al 2022). Moreover, most regions show consistent trends in WCI fund performance, except for Northeast China. According to the theory of convergence, if China's insurance industry trends towards convergence, it suggests a reduction in the imbalance. Conversely, continued divergence implies ongoing imbalances (Rickne 2013). Given the varied performance in certain regions, this may further widen the imbalance in WCI development.

Different trends in WCI fund performance and local economic level

There is a significant causal relationship between insurance development and economic growth. However, due to initial levels and regional gaps, the causal relationships vary across different regions (Lee 2022). While East China has a comparatively high economic level, it has the lowest CRSTE. On the other hand, the performance level of WCI does not entirely align with the local economic development level. Within East China, different cities have varying levels of economic development, leading to differences in industrial structure and market competition between highly developed provinces and cities like Shanghai, Jiangsu, and Zhejiang, and others like Anhui and Fujian. These differences lead to significant gaps in WCI fund performance among different provinces, worsening the imbalanced performance within East China.

Policy implications

To better leverage policy effectiveness, it is essential to adopt an international perspective while also considering China's national situation. As noted earlier, the United States initially modelled its worker compensation insurance system after Germany's. It is only a simple mechanical imitation system; however, it was more of a mechanical copy without fault compensation, statutory insurer oversight, or enforcement powers (Aiuppa and Trieschmann 1998). Consequently, the US system also faced significant issues like corporate negligence and 'free riding'. Moreover, insurance premiums often did not reflect a company's safety record (Blanc and Escobar Pereira 2020). Therefore, it seems China needs to combine the characteristics of socialist countries and walk out of its development path.

Reinvent development concept

The Japanese WCI system covers a wide range of industries, including employers themselves and workers working abroad (Amagasa *et al* 2005), which reflects the high inclusiveness and fairness of the system. Certainly the rights and interests of injured workers get better protection, which can assist a more stable society (Shin *et al* 2011). For China, the ideology should transition from a double-win situation for both workers and businesses to a singular goal of maximising worker protection, and the traditional rule of using labour relations as a component of insurance participation must be broken. Instead, universal coverage under social insurance for all workers, including those in flexible employment, emerging industries, and migrant workers, should be the primary objective. Additionally, the current guidelines for work-related injury recognition must be changed to recognise more occupational risks faced by workers. To provide socialised protection through WCI to more members of society, it also needs to build on the German experience. As such, it would strengthen the role of prevention and rehabilitation, lower the incidence of work injuries, and eliminate occupational risks and the adverse effects they cause.

Perfect the relevant legislation

The German Work Injury Insurance Act, the Singapore Work Injury Compensation Act, the American Workers' Compensation Insurance, the French Work Injury Insurance Social Law, and the Japanese Labor Disasters Compensation Act and supporting regulations, in conjunction with other supporting regulations, are excellent examples of highly effective legislation, containing detailed legal provisions and institutionally solid binding force (Fishback and Kantor 1998). Except for a change in 2010 and the introduction of the Social Insurance Law, the WCIR has been in place for well over a decade, yet the laws and regulations have not kept pace, as is evident from the many problems that have been found during the WCIR's operation. Legislative regulation is implemented in terms of both the system's internal architecture and the coordination of external policies. To offer complete legal regulation, the laws and regulations relating to WCI will need to be systematically changed to remove inconsistent or contradictory rules between laws, regulations, and departmental rules.

Improve a trinity WCI system

Legislation in Germany specifies that the task of WCI includes prevention, rehabilitation, and compensation first (Luig *et al* 2018). After about one hundred years of practice and recognition, prevention and rehabilitation now take priority and precedence over compensation (LaDou 2011). By contrast, WCI in China has been centred on compensating, reflecting the various systems and national circumstances of socialist nations.

When China is ready to focus on prevention and rehabilitation, it can learn from the successful experiences of other nations, such as determining premium measures for prevention and rehabilitation. Additionally, China can strengthen the actuarial computation of WCI rates and learn from the delicate grasp of Germany, Japan, and other countries for floating rates and differential rates.

For instance, labour insurance in Japan is split into 8 industries, 51 crafts, and 8 grades, with the highest industry rate being 12.9% and the lowest rate being 0.5%. Germany has more than 700 industries and 3 levels of differential rates. In comparison, China only divides industry risk into 8 categories and implements 3 grades for the first category and 5 grades for the second through eighth categories between industries. This rough rate setting has minimal effect on injury prevention. Besides, the average insurance rate in China is 0.9%, which is considerably lower than in Germany, Korea, and the United States,

which are 1.3%, 1.43%, and 3.24%, respectively. If both prevention and rehabilitation efforts in China are conducted as usual, it is evident that this rate level cannot maintain the system's healthy development.

Develop commercial supplementary insurance

Commercial insurance institutions offer employers' liability insurance, voluntary work injury compensation insurance, social insurance, and other insurance to meet the different needs of various industries. This is in combination with the history of WCI in Japan, Germany, New Zealand, and other industrially developed countries (Gao et al 2020). However, the development of Chinese commercial insurance projects, such as employer liability insurance, has lagged. Commercial supplementary insurance should be vigorously developed to reduce the burden on the government and meet the needs of different groups for insurance benefits.

Break down regional barriers, boost key province development

In addition to adopting an international perspective, targeted recommendations based on the actual development of WCI in China are needed. Some provinces with better performance, such as Guangdong, prioritise launching pilot reforms in WCI. They take the lead in establishing the system and continuously formulate policies in line with national laws and regulations, combined with the local situation, to promote the implementation of work-related injury prevention, rehabilitation, and compensation projects. Governments across provinces are lowering technical barriers in inter-provincial insurance, encouraging the flow of insurance information and technology in order to facilitate effective interaction and narrow the gap between provinces.

Furthermore, according to the application of the theory of convergence in China's insurance sector, relatively poorer regions (provinces) will probably experience faster growth compared to wealthier ones. For WCI, increasing investment in provinces with slower insurance development, such as Northeast China, could potentially spur faster progress. Policymakers should pay more attention to provinces in East China and Northeast China and enhance mutual communication among provinces in WCI development. This will promote convergence in WCI and reduce inter-provincial imbalances.

Conclusions

In Witt's 'Accidental Republic,' there's a clever play on words. It refers to both 'accidents' and 'chance' or 'opportunity'. Accidents are unexpected events, and the laws surrounding accidents involve elements of chance. When accidents prompt policymakers to adjust policies, they become 'opportunities'. The political decision to protect labour is fundamental, and reforms in each country must also occur 'accidentally' in accordance with its national conditions. Only by tailoring reforms to China's national situation and establishing a rule-of-law-based WCI system can make accidents into opportunities, helping China address the challenges of the Accidental Republic.

By organically combining the commercial insurance mechanism with social governance, WCI resolves labour-management games and labour-management conflicts, the most 'socialist' legal system, for socialising the sharing of risks. Furthermore, socialism embodies not only the socialisation and fairness of social wealth but also the risk and responsibility, and to a certain extent, the legal system of social insurance is the content of the socialist system. The insurance legislation has improved to enable workers to be properly compensated.

The labour insurance regulation in 1951 was the beginning of the Chinese WCI system. It has continued to develop along with the reform and opening up of the market economy. Combined with the development history of international WCI, Chinese insurance has evolved, and the planned economy period primarily focused on simple medical relief and economic reparation, coupled with rudimentary rehabilitation concepts. As China has transitioned into the reform and opening-up period, the system has begun to integrate medical treatment, economic compensation, and vocational rehabilitation, together with the emerging appreciation of injury prevention. Later, during the socialist market era, it combined medical treatment and economic compensation while simultaneously strengthening the concepts of injury prevention and vocational rehabilitation; this sort of path conforms with the law of development of WCI in the international arena and the inevitable course of salvaging The Accidental Republic.

In addition, WCI legislation has continuously improved after the reform and opening up period, becoming one of China's most legislated forms of insurance. What is more, the changes and improvements to WCI not only signify the return of the government's responsibility in the change from closed operation to socialised management but also signal the government's trade-off between fairness and efficiency. However, the unique characteristics of the WCI and China's primary national conditions determine that it is impossible to realise a mature development of processes such as Germany in a short period.

This paper has traced the historical lineage of WCI and then explored and analysed the development and performance of WCI over the last 10 years. It has clarified both old and new problems under the current economic situation, including narrow coverage, inadequate laws and regulations, slow development of an effective WCI system, and unbalanced regional development. On this basis, we highlight directions for the reconstruction and development of the WCI system into the future, including reinventing the development concept, perfecting relevant legislation, improving the processes of the WCI system, and developing commercial supplementary insurance. All of these new directions could provide unique Chinese insights into the world's labour protection policies.

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Notes

1 The historical stages of Chinese economic development are: the period of socialist revolution and construction; the new period of reform, opening-up, and socialist modernisation; and the new era of socialism with Chinese characteristics. Some relevant policy documents for further reference include the Labor Insurance Scheme (LIS) in 1951, the WCIR in 2003, the Social Insurance Law in 2010, and so on.

2 Beijing, Tianjin, Shanghai, and Chongqing.

3 Hebei, Shanxi, Guangdong, Guizhou, Qinghai, Tibet, and Xinjiang Production and Construction Corps.

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