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The effects of public long-term care insurance on the long-term care industry in China: a quasi-experimental study

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Abstract

Background Meeting the increasing need for long-term care (LTC) is a pressing issue for aging societies worldwide. The public long-term care insurance (LTCI) scheme offers a potential solution to this challenge. However, limited research has been conducted on the scheme's impact on the LTC industry. Utilizing the unique research opportunity presented by the pilot LTCI scheme in China, this study evaluated the policy effects on the LTC industry and investigated the heterogeneity of these effects.

Methods The unit of analysis was prefecture-level cities. We collected over 456 thousand records of registration information for LTC organizations from three national platforms, which were then aggregated at the city level. The development of the LTC industry in each city was measured using two dependent variables: the annual increase in the number and registered capital of LTC organizations. We collected city-level socioeconomic and demographic confounding factors from the *China City Statistical Yearbooks* and census data. These data constituted an unbalanced panel dataset of 3,949 city-year observations for 289 prefecture-level cities. We employed a staggered difference-in-differences model to evaluate the policy effects.

Results The LTCI scheme led to an additional increase of 157.85 (95% CI: 124.23–191.46) in the number of LTC organizations and of 3.44 billion yuan (US$531.48 million; 95% CI: 2.46–4.43) in the registered capital of LTC organizations per city. The policy effects were particularly pronounced for LTC organizations providing non-residential care services or operating as enterprises. For instance, the scheme resulted in an additional increase of 156.27 (95% CI: 122.68–189.85) in the number of non-residential care organizations, nearly 95 times greater than the increase for residential care organizations (1.65; 95% CI 0.05–3.24). Similarly, the scheme led to an additional increase of 157.54 enterprises per city (95% CI: 125.41–189.67), a substantially greater effect than that observed for individual businesses (6.39; 95% CI: 1.55–11.24). However, it did not affect the number of LTC organizations operating as civil non-enterprises or public institutions.

Conclusion These findings highlight the significant impact of public LTCI scheme on the growth of the LTC industry, particularly for non-residential care services and enterprise-operated organizations.

Keywords Long-term care insurance, Quasi-experiment, Long-term care industry, China

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Background

From 1950 to 2019, the global life expectancy at birth steadily increased from 46.5 years to 73.0 years [1]. Prolonged life expectancy has significantly heightened the need for long-term care (LTC) services. Meeting these needs has become a considerable challenge for aging societies due to the high cost of care, a shortage of caregivers, and the declining availability of informal care [2]. In response, countries such as Germany, South Korea, and Japan have implemented public long-term care insurance (LTCI) schemes to address these challenges [3, 4]. Existing research has assessed the effects of such policies on the health and mortality of older adults [5, 6], use of formal or informal care [7–10], and utilization and cost of medical services [11, 12]. However, few studies have examined the causal relationship between LTCI and the development of the LTC industry. China's policy experimentation with LTCI provides a unique opportunity to address this gap [13, 14].

Since 2016, the Chinese government has been piloting a public LTCI scheme. The primary objective of the policy is to enhance access to LTC services for individuals with long-term disabilities while alleviating the caregiving burden on their spouses, children, and other informal caregivers. It provides services and financial support for basic daily care (e.g., bathing, dressing, and continence) and closely related medical care (e.g., pressure ulcer care and gastrostomy tube replacement) for beneficiaries [7, 13]. The scheme covers both institutional care services and home- and community-based services. Beneficiaries are required to pay approximately 30% of the service costs. The Chinese central government sets overarching principles for scheme design while allowing local governments to formulate policies tailored to local circumstances. Detailed descriptions of the scheme design, including the target population, funding sources, eligibility criteria, and benefit packages, have been documented previously [13]. By the end of 2022, a total of 169.90 million individuals in 49 pilot cities had participated in the scheme, accounting for over 12% of the total population [15].

The combination of high care costs and deeply rooted Confucian values leads to a strong preference for family care among older adults, limiting the utilization of formal care services in China [16–19]. The LTCI scheme may promote the LTC industry through at least two mechanisms. First, it substantially alleviates the financial burden on disabled individuals seeking formal care. Prior to the implementation of the scheme, many older adults were unable to afford the high costs of formal care. For example, in 2014, the average monthly cost of residing in an elderly care facility was 2,134 yuan (US$303.25 in constant 2022 prices), exceeding the average monthly pension income of urban enterprise retirees, which was 2,061 yuan (US$292.88) [20]. The scheme offers reimbursement for formal care expenses, with official statistics showing that the average monthly expenditure per beneficiary was 720 yuan (US$102.32) in 2022 [15]. Second, the scheme may increase the utilization of formal care services by influencing elderly care culture. Drawing on Japanese experience, the scheme has the potential to reduce perceived filial responsibility norms among family caregivers, particularly daughters-in-law, thereby increasing public acceptance of formal care services [21].

However, few studies have empirically examined the policy effects of the LTCI scheme on the growth of the LTC industry in China and other countries. To date, only seven countries—the Netherlands, Israel, Germany, Japan, Luxembourg, South Korea, and China—have implemented the LTCI scheme as a social insurance scheme, limiting comprehensive research on its policy effects [22]. A few previous studies have suggested significant growth in the LTC industry following the implementation of this scheme. For instance, in South Korea, the introduction of the scheme saw the number of LTC organizations increase from 6,618 in 2008 to 15,970 in 2018, reflecting an average annual growth rate of 2.38% [4]. However, these descriptive analyses alone cannot provide sufficient evidence for the policy's effects on the LTC industry.

Therefore, this study employed a quasi-experimental research design to address two key questions. First, does the LTCI scheme result in an additional increase in the number and registered capital of LTC organizations? Second, do policy effects differ based on the types of services provided by these organizations (residential care vs. non-residential care) and the types of organizations themselves (individual businesses, enterprises, civil non-enterprises, and public institutions)?

Methods

Data source

The Chinese government maintains registration data for over 250 million organizations across 3 national platforms: the *National Enterprise Credit Information Disclosure System*, the *National Platform for Credit Information of Social Organizations*, and the *Platform for Registration and Management of Government Departments and Public Institutions*. To gather data on LTC organizations, we used an extracted dictionary to search their business profiles on national platforms covering the period from 2010 to 2023 (Supplemental Table 1). This process identified 456,239 organizations providing LTC services, from which we extracted their registration information.

Most LTCI pilot schemes are implemented at the prefecture level. In line with the previous literature [23], this study adopted prefecture-level cities as the unit of analysis. Organization-level information was aggregated

at the city level to reflect the annual development of the LTC industry in each city. Cities hosting LTC organizations were identified using their registered address information.

Additionally, to ensure adequate control for confounding factors, we collected socioeconomic and demographic data for each city from the *China City Statistical Yearbooks* and the China census data for 2010 to 2023. However, due to the remote geographical locations of certain prefecture-level cities and the difficulty of data collection, the yearbooks do not cover all prefecture-level cities in China. For example, the *China City Statistical Yearbooks 2019* included 297 prefecture-level cities. Moreover, observations for nine cities were excluded from the analysis using list-wise deletion due to missing data on certain variables. The final database comprised 3,949 city-year observations, forming unbalanced panel data for 289 prefecture-level cities. These cities represent over 86% of all prefecture-level cities in the Chinese mainland.

Measurements

Drawing on previous literature [23], this study used two variables to measure the development of the LTC industry: (1) the annual increase in the number of LTC organizations, referring to the number of newly established organizations each year, and (2) the annual increase in registered capital, referring to the capital of these newly established organizations. The year of establishment for each LTC organization was determined by its registration date, which enabled us to calculate the number of new organizations and their registered capital for each city and year.

The treatment variable in this study is whether a city has implemented the LTCI scheme. To account for the "signaling effect" of policy, we designated the time when the central or local government announced the launch or forthcoming launch of the scheme as the initiation time of policy intervention. The signaling effect is rooted in the literature on policy anticipation and rational expectations [24, 25]. Policy announcements serve as a public signal of government intent influencing expectations and behaviors even before actual policy implementation. In the context of the LTCI scheme, these announcements may raise expectations regarding formal care needs and attract more investment in the LTC industry. For pilot cities, the treatment variable was coded as 1 following the initiation time and 0 otherwise. For non-pilot cities, the treatment variable was consistently coded as 0. A total of 44 pilot cities were identified, and the initiation time of policy intervention for each city is detailed in Supplemental Table 2.

In line with previous literature [23], we controlled for city-level socioeconomic and demographic variables in our analyses, covering the period from 2010 to 2023. First, the socioeconomic variables included the logarithm of gross domestic product (GDP) per capita and the GDP growth rate, which reflect economic development and fiscal capacity—critical foundations for implementing the LTCI scheme. Additionally, the proportion of the tertiary sector's GDP was included as an indicator of the service sector's scale, which significantly influenced the provision of healthcare and LTC services. The fiscal deficit rate, serving as a proxy for fiscal health, reflects a city's capacity to finance the LTCI scheme. Other variables such as the number of foreign investment projects, average employee salary, and number of hospitals capture the degree of economic openness, labor market conditions, and healthcare infrastructure, respectively. Together, these factors shape a city's ability to support the development of its LTC industry. Second, the demographic variables included the logarithm of population size, proportion of the population aged 65 years and over, and population growth rate, which collectively reflect the demand for the LTC industry. The proportion of the population aged 65 years and above for the year 2010 and 2020 was obtained from China census data, while values for other years within the 2010 to 2023 period were estimated through linear regression interpolation.

Statistical analysis

Given that the pilot cities initiated the LTCI scheme at different points in time (Supplemental Table 2), we employed a staggered difference-in-differences (DID) model to assess the policy's effect on the development of the LTC industry [26, 27]. All analyses were performed at the city level. The dependent variable was the annual growth in the number of LTC organizations and their registered capital within each city. The treatment variable indicated whether the city had implemented the LTCI scheme with its coefficient reflecting the policy effect. In line with existing literature [28], the model controlled for city-level socioeconomic and demographic confounding factors, as shown in Table 1, and incorporated both city and year fixed effects. The variance inflation factor (VIF) was estimated to assess potential multicollinearity in the staggered DID model [29, 30]. The mean VIF was 1.88, indicating that multicollinearity was not a concern in the analyses (Supplemental Table 3). Moreover, we conducted an event study to test the parallel trend assumption for the staggered DID analysis. The results also shed light on how long it took the LTCI scheme to significantly influence the LTC industry.

Furthermore, we investigated whether the policy effects varied based on the services provided and the types of organizations. First, the LTC organizations were categorized into different groups. According to their registered business scope, they were classified as providing either

Table 1 Sample characteristics ($N = 3949$, Mean ± SD)

Variable	Full Sample ($N = 3949$)	Pilot ($N = 588$)	Non-pilot ($N = 3361$)	T-Test
LTC organizations				
Annual increase in number	97.07 ± 193.20	218.34 ± 312.16	72.98 ± 142.43	145.36***
Annual increase in registered capital (billion yuan)	1.90 ± 4.90	4.49 ± 7.57	1.35 ± 3.54	3.14***
Socioeconomic variables				
Log per capita GDP	10.76 ± 0.59	11.04 ± 0.531	10.71 ± 0.58	0.33***
GDP growth rate (%)	8.50 ± 4.32	8.31 ± 3.41	8.54 ± 4.47	-0.22
Tertiary sector GDP (%)	42.84 ± 10.16	46.40 ± 10.13	42.07 ± 9.77	4.33***
Fiscal deficit rate (%)	-1.97 ± 1.94	-1.04 ± 1.24	-2.13 ± 2.00	1.09***
Foreign investment projects	96.76 ± 297.32	307.85 ± 655.75	57.60 ± 135.77	250.25***
Avg. salary (thousand yuan)	63.05 ± 24.79	67.65 ± 27.50	61.96 ± 23.59	5.69***
Number of hospitals	169.01 ± 170.85	255.38 ± 239.98	151.99 ± 147.50	103.40***
Demographic variables				
Log population size	5.89 ± 0.70	6.31 ± 0.62	5.81 ± 0.69	0.50***
Population aged 65+ (%)	12.26 ± 3.48	12.91 ± 3.22	12.16 ± 3.52	0.75***
Population growth rate (%)	5.44 ± 5.39	4.66 ± 4.77	5.57 ± 5.49	-0.92***

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

Fig. 1 Increases in the number of LTC organizations and their registered capital per city, 2010–2023

residential or non-residential care. Additionally, based on coding rules of *Chinese Unified Social Credit Code*, they were divided into four types: individual businesses, enterprises, civil non-enterprises (organizations established without public funding and providing non-profit services) [31], and public institutions. Second, we examined the heterogeneity in policy effects by performing the aforementioned staggered DID analyses across different groups of LTC organizations and comparing the results.

Data cleaning was performed using Python (version 3.8.1), and statistical analyses were performed using Stata (version 17.0). Detailed model settings are provided in the **Technical Appendix**.

Results

Sample characteristics

The LTC industry experienced rapid growth from 2010 to 2023, although the pace of development varied across cities. During this period, the number of LTC organizations increased by an average of 97.07 per city annually, with registered capital growing by 1.90 billion yuan (US$293.55 million) per city annually. Meanwhile, pilot cities exhibited significantly greater growth in the LTC industry than non-pilot cities. The means and standard deviations of the socioeconomic and demographic variables are summarized in Table 1, and detailed descriptive analysis results by year are provided in Supplemental Table 4. Furthermore, the annual growth in the number and registered capital of LTC organizations by service and organization types are provided in Supplemental Table 5.

As illustrated in Fig. 1, the annual increase in the number of LTC organizations per city surged from 11.86 in 2010 to 189.07 in 2020. However, partly due to the COVID-19 pandemic, this annual increase declined slightly to 140.58 in 2023. Meanwhile, the annual

Table 2 Policy effects of LTCI on LTC industry: staggered DID analysis ($N = 3949$)

	Number of LTC organizations	Registered capital of LTC organizations
Estimates	157.85	3.44
95% CI	124.23–191.46	2.46–4.43
p value	< 0.001	< 0.001
Year fixed effect	Yes	Yes
City fixed effect	Yes	Yes
Control variables	Yes	Yes
r2	0.66	0.61

increase in registered capital rose from 0.27 billion yuan (US$41.72 million) in 2010 to 3.72 billion yuan (US$574.74 million) in 2020 before decreasing to 1.65 billion yuan (US$254.93 million) in 2023.

The policy effects of LTCI on the LTC industry

The LTCI scheme had a positive effect on the growth of the LTC industry. According to the staggered DID analysis, the scheme's implementation led to an additional increase of 157.85 (95% CI: 124.23–191.46) in the number of LTC organizations and 3.44 billion yuan (US$531.48 million; 95% CI: 2.46–4.43) in their capital per city (Table 2).

The results of event study analysis revealed no significant differences in the annual growth of the LTC industry prior to the LTCI intervention, indicating that the staggered DID analysis satisfied the parallel trend assumption (Fig. 2). Furthermore, the analysis showed that LTCI had a significant impact on the establishment of new LTC organizations and their registered capital within one year of its introduction, with this effect persisting for up to four years post-policy adoption.

Sensitivity analyses of policy effects

We conducted four analyses to assess the robustness of the policy effects. First, we excluded Beijing and Tonghua, where the LTCI scheme was implemented in only one district of these cities, and the staggered DID analyses were rerun. The results shown in Supplemental Table 6 were very similar to those presented in Table 2. Second, we performed a mixed placebo test following the approach of La Ferrara et al. [32] to examine whether the omitted regional unobserved characteristics might affect the model results. By randomizing the initiation year and location of the LTCI scheme, we selected a few cities and years from the sample as "fake treatment units" without replacement and used the bootstrap method to repeat the placebo effect simulations 500 times. Supplemental Fig. 1 shows that the placebo effect followed a normal distribution around 0, indicating that unobserved characteristics

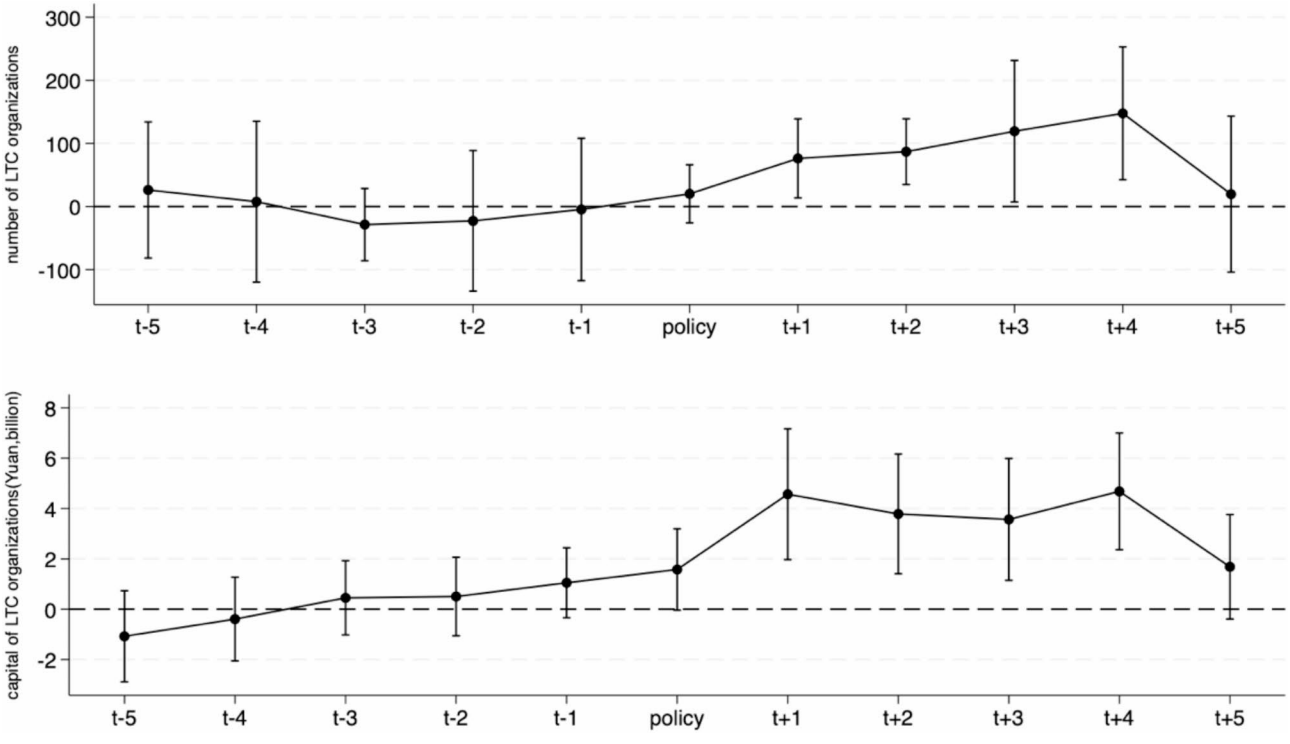

Fig. 2 Policy effects of LTCI on LTC industry: event study analysis ($N = 3949$). "Policy" denotes the initiation of the LTCI scheme; t + 1 represents one year after the scheme's initiation, t-1 represents one year before its initiation, and so on. The figure displays the coefficient estimates along with their 95% confidence intervals

Table 3 Policy effects of LTCI on LTC industry by services provided: staggered DID analysis ($N = 3949$)

	Number of LTC organizations		Registered capital of LTC organizations	
	Non-residential	Residential	Non-residential	Residential
Estimates	156.27	1.65	3.44	-0.00
95% CI	122.68–189.85	0.05–3.24	2.47–4.43	-0.04–0.03
p value	< 0.001	0.043	< 0.001	0.809
Year fixed effect	Yes	Yes	Yes	Yes
City fixed effect	Yes	Yes	Yes	Yes
Control variables	Yes	Yes	Yes	Yes
r2	0.66	0.60	0.61	0.14

Table 4 Policy effects of LTCI on LTC industry by organization type: staggered DID analysis ($N = 3949$)

	Enterprises	Civil non-enterprises	Individual business	Public institution
Estimates	157.54	-5.98	6.39	-0.13
95% CI	125.41–189.67	-12.29–0.34	1.55–11.24	-0.40–0.14
p value	< 0.001	0.063	0.010	0.358
Year fixed effect	Yes	Yes	Yes	Yes
City fixed effect	Yes	Yes	Yes	Yes
Control variables	Yes	Yes	Yes	Yes
r2	0.72	0.36	0.09	0.20

had a minimal impact on the results. Third, considering the potential treatment effect heterogeneity across different time points, we employed the Callaway and Sant'Anna difference-in-differences (CSDID) method to analyze policy effects [33]. This approach allows for a more accurate identification and estimation of treatment effects in complex settings with multiple time periods and varying treatment timings [34]. The results obtained using the CSDID method were consistent with our previous findings (Supplemental Tables 7 and Supplemental Fig. 2). Fourth, we examined the policy effects of the LTCI scheme launched in 2016 by excluding data from other pilot cities to ensure a clean comparison between the treatment (2016 pilot cities) and control groups (non-pilot cities). To minimize potential biases associated with the COVID-19 pandemic, we restricted the analysis to data collected from 2010 to 2019. Using the traditional DID method, we found results consistent with those from the staggered DID analyses, further supporting the robustness of our conclusions (Supplemental Tables 8 and Supplemental Fig. 3).

Heterogeneity in policy effects

We further investigated whether the scheme's effects varied based on the services provided and types of LTC organizations. First, as shown in Table 3, the scheme had a significantly greater effect on the growth of organizations providing non-residential care compared to those providing residential care. Specifically, its implementation brought an additional increase of 156.27 (95% CI: 122.68–189.85) in the number of non-residential care organizations per city, nearly 95 times greater than the increase for residential care organizations (1.65; 95% CI: 0.05–3.24). Moreover, the scheme led to an additional rise of 3.44 billion yuan (US$531.48 million; 95% CI: 2.47–4.43) in the registered capital of non-residential care organizations, an effect not observed for residential care organizations.

Second, among the four types of LTC organizations, enterprises experienced the most significant developmental benefits from the introduction of the LTCI scheme (Table 4). The scheme resulted in an additional increase of 157.54 enterprises per city (95% CI: 125.41–189.67), a substantially greater effect than that observed for individual businesses (6.39; 95% CI: 1.55–11.24). However, it did not impact the number of civil non-enterprises or public institutions. Due to the failure to pass the parallel trend test, we did not assess the policy effects on registered capital by organization type.

Discussion

This study employed a quasi-experimental design to investigate the policy effects of the public LTCI scheme on the LTC industry in China by using unbalanced panel data consisting of 3,949 city-year observations from 289 prefecture-level cities. The findings indicated that the scheme significantly increased both the number and registered capital of LTC organizations. Moreover, the study revealed that the policy effects varied based on the services provided and the types of LTC organizations. Previous research has primarily focused on the scheme's impacts on informal and formal care use, the health and well-being of beneficiaries and their families, as well as healthcare utilization and expenditure [4, 11, 13]. Based on our review of the literature, this study is among the

first to empirically examine the policy effects on the growth of the LTC industry.

Our findings suggest that the LTCI scheme has a more pronounced positive effect on organizations offering non-residential care services. Like older adults in other countries, the older adults in China also prefer to age in place [16–19]. The scheme's benefit package includes non-residential care services, such as home-based care and day care. Some pilot cities further encourage the use of these services by reducing co-payment rates [13]. Additionally, compared to residential care providers, non-residential care providers typically face lower requirements in terms of capital, infrastructure, and other resources, giving them greater flexibility to adapt to market changes. Thus, as the LTCI scheme drives a significant increase in consumer demand for formal care services, non-residential care organizations are experiencing accelerated growth in both quantity and registered capital.

Furthermore, among the four types of LTC organizations, the LTCI scheme had the most significant effect on the growth of enterprises. In recent years, the Chinese government has adopted a market-oriented approach to addressing challenges in delivering formal care services, thereby creating favorable conditions for the expansion of corporate LTC entities [35]. These enterprises also possess a notable advantage in market responsiveness compared with public or civil non-enterprise LTC organizations. Public institutions, which primarily receive government funding, focus on providing care services to the most vulnerable groups supported by social assistance programs [13, 14, 22]. Their development plans are largely dictated by government policies, leading to a lack of responsiveness to market changes and resulting in minimal impact from the LTCI scheme. The approval process for civil non-enterprise organizations is typically more stringent, resulting in longer establishment periods.

These research findings have important policy implications. The primary objective of the LTCI scheme is to improve the accessibility of LTC services for individuals with disabilities and alleviate the burden on informal caregivers [13]. As demonstrated in this study, the LTCI scheme has a positive impact on the quantitative growth of LTC organizations, particularly enterprises offering non-residential services. This suggests that the scheme may, at least in part, achieve its policy objectives by fostering the development of LTC services.

In the future, China can further enhance the quality of LTC services by drawing on international experience. For example, under Japan's LTCI scheme, care managers play a crucial role in facilitating communication and coordination among care recipients, family members, and various care providers, ensuring a more integrated approach to service delivery. In Germany, contracts between LTCI funds and institutional and home care service providers define service expectations and outline measures for monitoring and improving care quality, in accordance with national regulatory standards [3]. Meanwhile, England leverages smart technologies to integrate healthcare and LTC data, utilizing remote monitoring systems to enable precise service matching, thereby significantly enhancing service efficiency and responsiveness [36, 37].

This study has four limitations. First, the registered business scope of LTC organizations may not accurately reflect their actual activities. Some organizations might have engaged in only a portion of the listed business activities during the study period. Due to the lack of necessary information, we were unable to assess the impact of this phenomenon on our conclusions. Second, approximately 10.79% of the LTC organizations lacked information on registered capital, which may have affected the evaluation of the policy effects on the registered capital. Third, the growth of the LTC industry involves both quantitative and qualitative dimensions. This paper focuses solely on the impact of the LTCI scheme on the industry's quantitative expansion. Future research could further explore its effects on qualitative aspects such as care quality. Finally, due to data limitations, this study only analyzes the impact of the LTCI scheme on the establishment of LTC organizations. Future research should further investigate the effects of this scheme on the closure and transformation of LTC organizations, which could provide valuable insights into the complete organizational lifecycle within this context.

In conclusion, the public LTCI scheme has substantially boosted both the number of LTC organizations and their registered capital, with particularly strong effects observed among organizations providing non-residential care services or operating as enterprises. This study is one of the first to evaluate the policy impacts of the LTCI scheme on the LTC industry, while also examining the heterogeneity of these effects. The provision of LTC services plays a pivotal role in determining whether the LTCI scheme can fulfill its policy objectives. By elucidating whether the LTC industry is evolving in alignment with these objectives, this study provides valuable insights for policymakers in China and other countries by considering the implementation of a public LTCI scheme to address the rising demand for care.

Supplementary Information

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Supplementary Material 1

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Author contributions
Conception and design: ZH, HC, and JW. Acquisition and analysis of data: ZH. Drafting of the manuscript: ZH, HC, and AJ. Revision of the manuscript: ZH, AJ, HC, and JW. All authors have read and agreed to the final version of the manuscript.

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Data availability
Data are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
This study used web scraping methods to collect long-term care organization data from three public national data platforms. Ethics approval was not required for this study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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