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# *Mental Health and Productivity Development: An Analytical Perspective from Hospital Construction*

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***Abstract:*** Amidst the rising prevalence of mental health issues, this study critically examines the potential contribution of hospital construction to overall productivity. Utilizing a one-dimensional linear regression model, the paper draws insights from provincial panel data spanning the period 1996 to 2021, sourced from the National Bureau of Statistics of China. Additionally, robustness tests are conducted. This analysis aims to uncover patterns of heterogeneity across varying temporal, regional, and industrial contexts. The key findings of the study are as follows: 1. A positive correlation exists between the number of medical and health institutions in each Chinese region and the respective gross domestic product of that region. 2. The impact of the number of medical and health institutions on China's gross domestic product follows a descending order: the western region, the north-eastern region, the central region, and the eastern region. 3. The number of medical and health institutions in each Chinese region had the most significant positive effect on the gross domestic product after the 2008 financial crisis. The second-highest positive effect was observed before China's accession to the WTO in 2001, with no significant impact detected after the WTO accession or before the financial crisis in 2008. 4. The study reveals that hospital construction has the most substantial impact on the development of the service sector, the second strongest impact on the industrial sector, and the least impact on the agricultural sector.

***Keywords:*** Hospital construction, mental health, productivity, regression modelling, heterogeneity analysis

## 1. Introduction

In recent years, mental health issues have gained significant attention due to their impact on public safety. Incidents arising from psychological problems have become prevalent, with alarming statistics revealing that in 2019, nearly a billion people, including 14% of the world's adolescents, were living with a mental disorder. Disturbingly, suicide accounted for over 1 in 100 deaths, with 58% occurring before the age of 50 [1]. It is evident that the failure to address mental health issues poses a substantial risk to an increasing number of lives.

The pursuit of productivity as a national development goal holds paramount importance, influencing a country's vulnerability to economic crises. China, in particular, faces a deceleration in productivity growth, signifying a slowdown in economic advancement. While China's GDP per capita was a mere $156 in 1978, in contrast, the United States boasted a GDP per capita of $10,600 during the same period. Despite rapid economic growth following the reforms initiated in the late 20th

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century, China encountered a deceleration phase, exacerbated by the 2008 economic crisis and the loss of its labour advantage. Notably, China's GDP grew at a rate of 6.5% year-on-year in the third quarter, according to the China National Bureau of Statistics (CNBS) [2], reaching 9,130.27 billion yuan in the first three quarters of 2023, reflecting a 5.2% year-on-year increase at constant prices. Recognizing residents as a vital component of the workforce, it becomes imperative to address their mental health problems to fortify the nation's productivity. Consequently, mitigating mental health issues among residents emerges as a viable strategy to counteract China's economic deceleration.

The prevailing severity of mental health problems has drawn considerable public attention, posing a formidable challenge in the realms of social and medical care development. The inadequate and uneven distribution of mental health service resources in China hinders individuals with mental illnesses from accessing professional services, resulting in ineffective treatment. An Economist Intelligence Unit (EIU) report, as cited by Ng [3], reveals that around 90% of individuals in middle-income countries, such as China and India, do not receive mental health treatment. Hospitals serve as pivotal institutions for the treatment of mental health patients, yet a substantial proportion of medical facilities in China fail to meet the demands of its rapidly evolving society. Notably, the concentration of medical resources in large cities leaves townships and rural areas with limited access to essential healthcare services. The scarcity of physicians, coupled with varying skill levels, further impedes the capacity of healthcare institutions in townships and rural areas, leading to inadequate and untimely treatment for those with mental health disorders. Recognizing the pivotal role of hospital construction, this paper asserts that a comprehensive healthcare infrastructure is indispensable for safeguarding the mental health of a nation's residents.

This paper aims to empirically analyse the impact of hospital construction on productivity development in China. Leveraging macro data spanning from 1996 to 2021, a one-dimensional linear regression model will be employed to understand China's current situation comprehensively. Subsequent robustness tests and heterogeneity analysis will enhance the depth of our conclusions, shedding light on the intricate relationship between hospital construction and productivity development.

## 2. Literature Review

Among the articles pertinent to this paper, one aspect delves into the examination of the impact of hospital construction on productivity. Raghupathi and Raghupathi [4] investigate the correlation between public health expenditure and economic performance in the United States. They posit that healthcare expenditure can lead to improved health opportunities, thereby enhancing human capital and bolstering productivity, ultimately contributing to economic performance. Dion and Evans [5] have contributed by developing three comprehensive conceptual strategic frameworks designed to guide the management of hospitals and healthcare facilities. These frameworks encompass considerations for energy efficiency, green hospital initiatives, and corporate governance. Vysochyna et al. [6] offer insights into the empirical patterns of healthcare expenditures' influence on sustainable economic growth during both pandemic and pre-pandemic periods. Presently, China's public health sector grapples with challenges stemming from the inadequate management of public hospitals, significantly impacting demographic structures and socioeconomic development [7].

Another pertinent aspect to this paper involves research that investigates the impact of mental health on productivity. Mental health challenges are prevalent in the workplace and can have severe consequences for both individuals and companies. This may manifest in diminished productivity, increased absenteeism, elevated turnover rates, legal complications, and, ultimately, a decline in revenue and profits [8]. De Oliveira et al. [9] conducted a comprehensive review of the relationship between mental health and lost productivity, offering a critical analysis of existing literature. Ali et al. [10] explore the mediating role of mental health issues in the workplace (MHIW) to elucidate the

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intricate connection between person-organization-fit (P.O-fit) dimensions and variations in workers' productivity (WP) during the COVID-19 pandemic, specifically in the Egyptian soap and detergents industry.

Moreover, additional literature relevant to this paper delves into factors influencing productivity from various perspectives. Tian and Liu [11] employ the LP semi-parametric method and ACF method to assess the total factor productivity of China's listed digital economy enterprises spanning from 2013 to 2018. They construct a multiple regression model to explore the influencing factors of total factor productivity. Chang et al. [12] propose a two-way influence of Artificial Intelligence (AI) and the natural resources market on green total factor productivity (GTFP). Brien et al. [13] challenge the rhetoric and implication that productivity growth is boundless, questioning the belief that the tourism industry has substantial productivity gains available to it. Addressing the growth slowdown from an inequality perspective, Shen and Zhao [14] utilize a comprehensive dataset with strong comparability. They employ a dynamic panel threshold model to investigate the effect of income inequality on economic growth, exploring its channels of influence and differences in channels due to country disparities, considering variations in income levels and countries. The internal mechanism and linear relationship between digitalization and green economy growth are scrutinized based on panel data spanning from 2013 to 2019[15].

Drawing from the aforementioned literature, this paper is poised to make four significant contributions. Firstly, the selection of the research topic exhibits strong timeliness, enriching academic discourse on mental health issues, hospital construction, and productivity development in China. Secondly, in terms of research methodology, the propositions undergo empirical analysis using numerical statistical tools, complemented by a robustness test to scrutinize the benchmark regression results. The exploration of the impact of hospital construction on productivity development is further deepened through a meticulous heterogeneity analysis across different regions, time periods, and industries in China. Thirdly, this study utilizes comprehensive and novel data characterized by a lengthy time dimension, covering 31 provinces, cities, or autonomous regions in China. Lastly, within the context of the rapid development and accelerated pace of Chinese society in the 21st century, the research on hospital construction and mental health in China, particularly the examination of whether hospital construction can contribute to economic growth, holds immense theoretical and practical significance. This research is poised to provide valuable Chinese experiences for other developing countries globally, thereby contributing to the expansion of the boundaries of economic theory.

## 3. Characteristic Facts about the Mental Health of Chinese Residents

This section aims to present and analyse the mental health characteristics of China's residents, drawing insights from the country's macro data. Figure 1 illustrates the trend of the crude mortality rate of Chinese residents with mental disorders from 2009 to 2021 in both urban and rural areas. According to Figure 1, the crude mortality rate for mental disorders in China has exhibited a gradual upward trend since 2009, affecting both urban and rural residents. Specifically, the rural crude death rate for mental disorders has shown less fluctuation, increasing from 3.08% in 2009 to 3.54% in 2021. Notably, 2021 recorded a historical high, while 2014 marked a historical low at 2.7%. Over the period from 2009 to 2021, the average crude mortality rate for mental disorders in rural China stands at 2.96%, with a standard deviation of 0.22.

Conversely, the urban crude mortality rate for mental disorders reached a historical low of 2% in 2012 and a historical high of 3.6% in 2009. The trend was downward before 2012, followed by an upward trajectory. From 2019 to 2021, the average crude mortality rate for mental disorders in urban China is 2.87%, with a standard deviation of 0.39.

While both urban and rural rates are increasing at a slower pace, there are nuanced differences. The urban crude mortality rate for mental disorders experienced a decline post-2012, with fluctuations

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from 2013 to 2017, followed by an increase after 2017. Conversely, the rural crude mortality rate of mental disorders accelerated in 2019, indicating a faster increase in the mental health mortality rate of rural residents. Moreover, the small standard deviation for both areas suggests minimal fluctuation in the crude mental health mortality rate of Chinese residents, indicating a stable prevalence of mental health problems. Contrary to the conventional perception that mental health issues are more severe in urban areas due to fast-paced lifestyles and high stress, the data reveals that the average crude mortality rate for mental disorders in rural China (2.96%) exceeds that in urban China (2.86%). This disparity is attributed to the more favourable public health and medical care infrastructure in urban areas. The shortage of hospitals and specialized mental health institutions in rural regions compounds the challenge for rural residents to receive professional attention for their mental health problems.

In conclusion, since the beginning of the 21st century, both rural and urban areas in China have witnessed a more pronounced prevalence of mental health problems among residents.

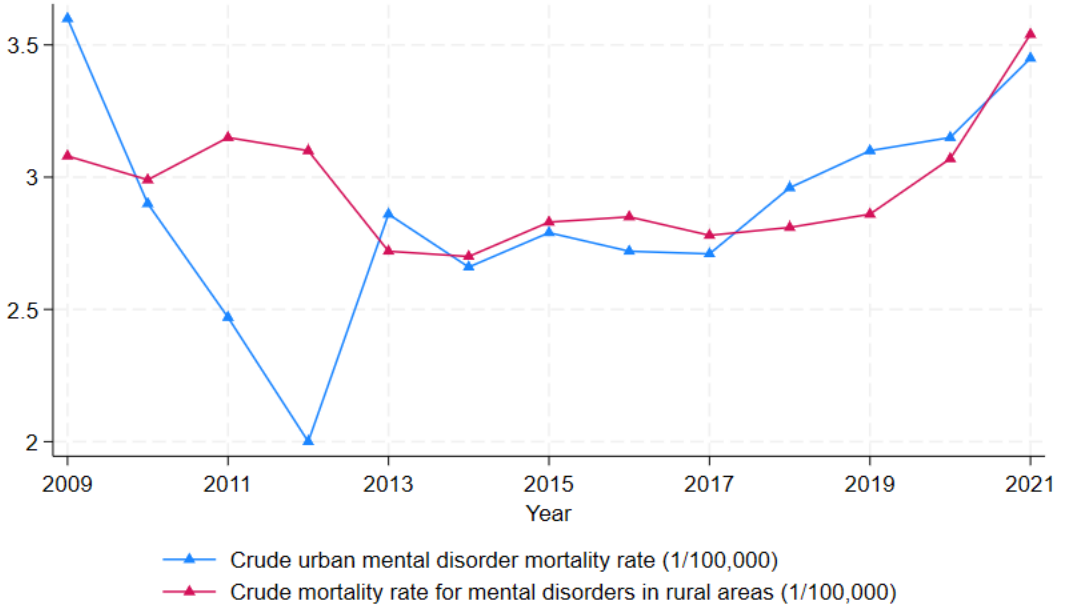


Figure 1: Trend of Crude Mortality Rate of Chinese Residents with Mental Disorders
Source: National Bureau of Statistics of China

## 4. Research Design

### 4.1. Variable Selection

In this study, the primary explanatory variable is productivity development, quantified through gross domestic product (GDP). The central explanatory variable is hospital construction, gauged by the number of regional healthcare institutions in China. Drawing from existing research, a noteworthy observation is that a significant proportion of large healthcare organizations incorporate psychology departments. Consequently, a higher density of healthcare institutions within a region implies a greater presence of psychological departmental units, thereby indicating a more extensive addressing of mental health issues. Thus, the number of regional healthcare institutions in China is employed as a metric to quantify the extent of hospital construction. Moreover, robustness tests will be conducted using the number of specialized hospitals in each region of China and China's per capita gross domestic product. Additionally, an analysis of industrial heterogeneity will be undertaken using China's value added of the primary industry, value added of the secondary industry, and value added

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of the tertiary industry. This comprehensive approach to variable selection ensures a thorough examination of the relationship between hospital construction and productivity development, incorporating multiple dimensions to enhance the robustness and depth of the analysis.

### 4.2. Data Sources

In the empirical segment of this paper, analyses are conducted on a sample comprising 31 provinces, cities, or autonomous regions in China, spanning the observation period from 1996 to 2021. The sample data utilized are sourced from the National Bureau of Statistics of China (NBS). All data presented in this paper have been logarithmically transformed. Descriptive statistics have been meticulously examined for all variables, and the results are summarized in Table 1.

Table 1: Descriptive statistics

| Variable | Unit | Obs | Mean | Std.Dev. | Min | Max |
|---|---|---|---|---|---|---|
| Number of regional health-care institutions | units | 806 | 20516 | 19602 | 476 | 88162 |
| Gross domestic product (GDP) | billions | 806 | 14035 | 17889 | 65 | 124720 |
| Number of specialised hospitals by region | units | 432 | 198.4 | 149.4 | 1 | 730 |
| Gross domestic product per capita | Yuan/per person | 806 | 31937 | 29259 | 2048 | 187526 |
| Value added of primary industry | billions | 806 | 1237 | 1210 | 26.50 | 6029 |
| Value added of the secondary sector | billions | 806 | 6022 | 7785 | 11.30 | 52679 |
| Value added of tertiary sector | billions | 806 | 6777 | 9449 | 27.20 | 69179 |

### 4.3. Model Setting

The research model employed in this paper is a one-way linear regression, formulated as follows:

$$Y = \alpha X + \beta + \varepsilon \tag{1}$$

Here, $Y$ represents the explanatory variable, the Gross Domestic Product of each region in China, $X$ is the core explanatory variable denoting the Number of Healthcare Institutions in each region of China, and $\varepsilon$ represents the random error term.

## 5. Empirical Analysis

### 5.1. Correlation Analysis

Figure 2 depicts the correlation between China's gross domestic product (GDP) and the number of regional healthcare facilities. An initial examination of the trend in the figure indicates a positive correlation, suggesting that as the number of regional healthcare facilities increases, China's gross domestic product (GDP) also experiences an upward trajectory. However, it is imperative to substantiate and quantify this relationship through regression analysis, a step undertaken in the subsequent sections of this paper.

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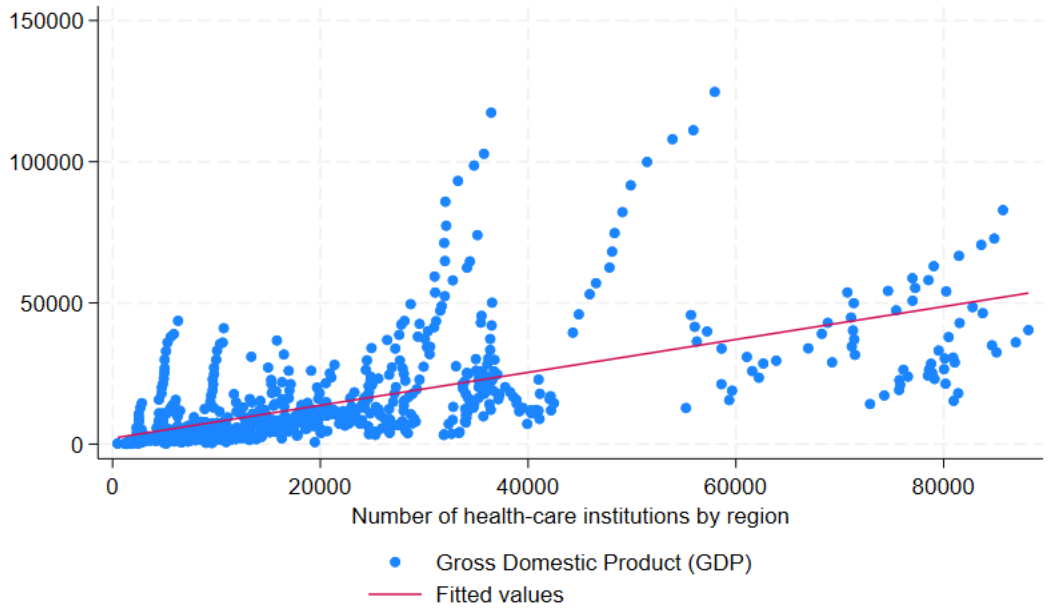


Figure 2: Correlation between China's Regional Gross Domestic Product and the Number of Regional Healthcare Facilities

## 5.2. Benchmark Regression

Table 2 presents the main regression results (Model 1) evaluating the impact of the number of healthcare institutions in each region of China on the GDP of that region. Specifically, the estimated coefficient for the core explanatory variable in the model is 0.6691, demonstrating statistical significance at the 1% level. This preliminary analysis suggests a positive and significant impact of the number of healthcare institutions on the GDP of each region of China.

In Model 2, where the data has been logarithmically transformed, the estimated coefficient for the core explanatory variable is 1.1927, maintaining statistical significance at the 1% level. These results further affirm the positive influence of the number of healthcare institutions on the GDP of each region of China.

Table 2: Benchmark Regression Results and Robustness Tests

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | y | y | y | y |
| x | 0.6691*** | 1.1927*** | 0.8729*** | 1.0593*** |
| | (27.6218) | (40.0890) | (41.3104) | (36.6578) |
| _cons | 307.3259 | -2.5226*** | 5.3003*** | -0.1137 |
| | (0.1701) | (-8.2199) | (40.4203) | (-0.3953) |
| N | 806 | 806 | 432 | 806 |
| R2 | 0.4933 | 0.6700 | 0.7989 | 0.6822 |

t statistics in parentheses

* p < 0.1, ** p < 0.05, *** p < 0.01, same below.

## 5.3. Robustness Test

To assess the stability and reliability of the benchmark regression estimates, this paper conducts robustness analyses by substituting the explanatory variables and the explained variables, specifically

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focusing on measures of hospital construction and productivity development. The core explanatory variable in the benchmark regression, the number of healthcare institutions in each region of China, is replaced with the number of specialized hospitals in each region of China. Additionally, China's per capita gross domestic product replaces the explanatory variable, the gross domestic product of each region of China, for the robustness test. Due to data availability, the number of specialized hospitals in each region of China is considered for the years 2008-2021. The empirical results of Model (3) in Table 2 reveal that the impact of the number of specialized hospitals in each region of China on the Gross Domestic Product (GDP) per capita of each region remains significantly positive. Similarly, the empirical results of Model (4) in Table 2 demonstrate that the effect of the number of healthcare institutions in each region of China on the Gross Domestic Product (GDP) per capita of each region remains significantly positive. These outcomes affirm the robustness of the conclusions drawn from the benchmark model in this paper. The consistency of the findings across different variables reinforces the credibility and validity of the relationship between hospital construction and economic development in each region of China.

## 5.4. Heterogeneity Analysis

### 5.4.1. Regional Heterogeneity Analysis

To unveil regional characteristics regarding the number of healthcare institutions in each region relative to the Gross Domestic Product (GDP) of each region in China, all provinces are categorized into four regions: Eastern, Central, Western, and Northeastern China. This classification aligns with the 2011 categorization by the National Bureau of Statistics of China (NBS). Table 3, Models (1), (2), (3), and (4) present the regression results for the number of healthcare institutions in each region of China influencing the GDP of Eastern, Central, Western, and Northeastern China, respectively. The estimated coefficients of the explanatory variables for these four regions are 1.1012, 1.1151, 1.2846, and 1.2236, respectively. Significantly positive at the 1% level of significance, these coefficients indicate a robust positive impact of the number of healthcare institutions on the GDP of each region. Notably, the estimated coefficients vary across regions, highlighting regional disparities.

Table 3: Regional Heterogeneity Analysis

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | y | y | y | y |
| x | 1.1012*** | 1.1151*** | 1.2846*** | 1.2236*** |
| | (17.1502) | (22.0709) | (27.4930) | (23.9710) |
| _cons | -0.9934 | -1.9093*** | -3.8244*** | -2.9258*** |
| | (-1.5575) | (-3.6601) | (-8.5070) | (-5.8606) |
| N | 260 | 156 | 312 | 78 |
| R2 | 0.5825 | 0.7648 | 0.8549 | 0.9231 |

### 5.4.2. Temporal Heterogeneity Analysis

To explore temporal variations, this paper strategically selects China's accession to the World Trade Organization (WTO) in 2001 and the financial crisis in 2008 as temporal nodes. The sample period is then divided into three distinct time periods: 1996-2001, 2001-2008, and 2008-2021.

Table 4, Models (1), (2), and (3), present the regression results for the impact of the number of healthcare institutions in each region of China on the GDP of each region during the specified time periods. The estimated coefficients of the explanatory variables are 0.3355, 0.1147, and 1.6942, respectively. Notably, the regression results demonstrate that the number of medical and health

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institutions in each region of China significantly contributes to the GDP of each region at the 1% level of significance during 1996-2001 and 2008-2021. However, from 2001 to 2008, the results are not significant at the 1% level.

These findings reveal that the positive impact of the number of medical and health institutions on the GDP is most pronounced after the financial crisis in 2008, followed by the period before China's WTO accession in 2001. No significant impact is observed between China's WTO accession in 2001 and the financial crisis in 2008.

Table 4: Temporal Heterogeneity Analysis

| | (1) | (2) | (3) |
|---|---|---|---|
| | y | y | y |
| 1996-2001 | 0.3355*** | | |
| | (7.6956) | | |
| 2001-2008 | | 0.1147 | |
| | | (1.5075) | |
| 2008-2021 | | | 1.6942*** |
| | | | (11.6265) |
| _cons | 4.5584*** | 7.3117*** | -7.4144*** |
| | (11.2755) | (10.5418) | (-5.0324) |
| N | 186 | 217 | 403 |
| R2 | 0.6906 | 0.5923 | 0.4694 |

### 5.4.3. Industrial Heterogeneity Analysis

To explore the impact of the number of medical and health institutions in each region of China on the industrial structure, this paper conducts an industrial heterogeneity analysis by categorizing the GDP of each region into the value added of primary industry, the value added of secondary industry, and the value added of tertiary industry, based on the classification of industrial structure.

Table 5, Models (1), (2), and (3), present the results of regression analyses for the number of medical and health institutions affecting the value added of China's primary, secondary, and tertiary industries, respectively. The estimated coefficients of the explanatory variables are 0.8207, 1.1975, and 1.3057, respectively, all significantly positive at the 1% level of significance. These results indicate that the number of medical and health institutions in each region of China positively influences the value added of the primary, secondary, and tertiary industries. Moreover, the construction of hospitals demonstrates varying impacts on different sectors. It has the most significant effect on the development of the service industry, followed by the impact on the development of the industrial sector, and the smallest impact on the development of agriculture.

Table 5: Industrial Heterogeneity Analysis

| | (1) | (2) | (3) |
|---|---|---|---|
| | y | y | y |
| x | 0.8207*** | 1.1975*** | 1.3057*** |
| | (40.6934) | (40.4205) | (39.0306) |
| _cons | -1.2631*** | -3.4639*** | -4.4144*** |
| | (-5.9860) | (-11.1819) | (-12.8638) |
| N | 806 | 806 | 806 |
| R2 | 0.8035 | 0.6726 | 0.6616 |

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## 6. Conclusions

This study yields several key findings, providing valuable insights into the intersection of mental health, hospital construction, and productivity development in China. The main conclusions are as follows: Firstly, since the onset of the 21st century, both rural and urban areas in China have experienced a significant rise in mental health issues among residents. Secondly, empirical analyses establish a positive correlation between the number of healthcare institutions in each region of China and the country's gross domestic product (GDP), a relationship validated through robustness testing. Thirdly, regional disparities are evident, with the western region demonstrating the highest correlation between healthcare institutions and GDP, followed by the north-eastern region. Conversely, the central region shows the third-strongest correlation, and the eastern region exhibits the weakest correlation. In terms of temporal dynamics, the positive impact of healthcare institutions on regional GDP is most pronounced after the 2008 financial crisis, followed by the period preceding China's accession to the World Trade Organization (WTO) in 2001. Notably, there is no significant effect observed after China's WTO accession in 2001 and before the financial crisis in 2008. Further, the analysis of industry types reveals that hospital construction has the most substantial impact on the development of the service sector, followed by industrial development, and least on agricultural development.

Based on these findings, several recommendations emerge: 1. In rural areas, fostering telemedicine and mobile medical units can help overcome geographical barriers to mental health services. In urban areas, emphasis should be placed on developing hospital infrastructure and expanding mental health facilities and professionals. 2. Strategic investments in healthcare infrastructure, especially in mental health, should be accelerated to promote high-quality development. 3. Region-specific strategies include establishing medical education institutions in the western region, enhancing healthcare viability in the north-east, integrating healthcare with other sectors in the central region, and focusing on innovation and technology in the eastern region. 4. Countries should develop adaptive healthcare policies to respond to major shocks, such as trade and financial shocks. 5. Encouraging the development of complementary services like insurance, medical tourism, and health and wellness can further bolster the healthcare sector.

While this study sheds light on the relationship between hospital construction, mental health, and productivity, it acknowledges the potential influence of unexplored factors such as education and environment. Future research could delve into these aspects to provide a more comprehensive understanding. Additionally, acquiring first-hand mental health data through dedicated research could enhance the depth and accuracy of future investigations.

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