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# Explaining provincial government health expenditures in China: evidence from panel data 2007–2013

Xiao Tan

Correspondence:
xiao.monica.tan@gmail.com
Asia Institute, The University of Melbourne, Melbourne VIC 3010, Australia

## Abstract

**Background:** Since the mid-2000s, the Chinese government has increased government health expenditures (GHE) significantly to address widespread complaints about health delivery. This study examines the real per capita provincial GHE over the period 2007–2013 to identify the determinants of provincial GHE during the most recent round of health reforms.

**Methods:** A range of theoretically grounded socioeconomic indicators were collected from the China Statistical Yearbooks and then factored to reduce the number of highly correlated indicators. Maps were drawn to visualise the spatial patterns of key variables and fixed-effects regressions were run to test relationships between the real per capita provincial GHE and various variables. GMM estimators were used to address endogeneity problems.

**Results:** Key determinants of provincial GHE in China include the real per capita budgetary deficits, *economy,* and *industrial structure* (two factors composed from an exploratory factor analysis). Increasing 1000 yuan real per capita budgetary deficits was expected to increase the real per capita GHE by 34 yuan.
A one-unit increase in the *economy* was associated with a 249 yuan higher real per capita GHE, while a one-unit increase in the *industrial structure* was expected to decrease the real per capita GHE by 33 yuan.

**Conclusions:** The findings of this study reveal
a worrisome picture: potential inefficiencies of the central government's funding efforts and the overwhelming importance of economic development for GHE.

**Keywords:** Government health expenditures, Panel data analysis, China

## Background

In contrast to its rapid economic growth, the equality of health care in China deteriorated significantly in the first two decades of economic reform. The gaps in health status and access to health services were widened both between urban and rural areas and across provinces (Liu et al. 1999; Zhang and Kanbur 2005). In 2000, China ranked 188th among 191 countries for fairness in health finance in the World Health Report (World Health Organization 2000), illustrating the severity of the inequality problem in China.

As a response to widespread complaints of growing inequality-related health problems, the Chinese government has initiated and implemented a series of policy changes since the mid-2000s. During the Sixth Plenum of the 16th Congress held in 2006, the unaffordability and inaccessibility of health services were formally conceptualized as "disharmonious features," and the establishment of a harmonious society by 2020 became the new chief task for China (Chinese Communist Party 2006; Woo 2009). Furthermore, in early April 2009, the central government announced a massive expansion of its health provisions with the aim of providing basic health services to the whole population by 2020 (Chinese Communist Party and State Council 2009). This is an important milestone signifying the Chinese state's determination to reverse the trend of deteriorating equity throughout the 1980s and 1990s. A range of efforts have been made to expand the coverage of health insurance schemes and improve the accessibility of health services.

Following the change in national policy direction, government health expenditures (GHE) jumped from 196 billion yuan in 2007 to 1195 billion yuan in 2015, a 510% increase within 8 years (National Statistical Bureau of China 2008; 2016). In comparison, the increase in gross domestic product (GDP) was only 152% during the same time period (National Statistical Bureau of China 2016). This signifies the government's determination to assert its role in the health sector.

Although the most recent round of health reforms has been documented and evaluated by a number of recent studies (for example, Chen 2009; Yip and Hsiao 2009; Zhao and Huang 2010; Yip et al. 2012), there has been a lack of research devoted to the pattern of provincial GHE. Studying provincial GHE is necessary because it shows how government resources have been allocated across the country and whether the pattern has been aligned with the prevailing target of improving health equality. The objective of this research is twofold. The first is to identify the pattern of provincial GHE during the most recent round of health reforms. The second is to explain this pattern by examining the impacts of three sets of key potential explanatory variables including economic development, globalization, and fiscal institutional structure.

## Literature review

The link between inequality in health outcomes and access to health services in China has been well documented (Zhang and Kanbur 2005; Li and Wei 2010; Fang et al. 2010; Uchimura and Jutting 2009). However, the understanding of determinants of why certain provinces have more or less GHE is more limited. For this reason, this review draws heavily from the literature on the determinants of welfare and public expenditure more broadly to compensate. In general, scholarly discussions of the determinants of GHE and welfare/public expenditure can be grouped into three strands. The first strand of literature highlights the importance of economic development. The German economist Adolph Wagner was among the earliest to predict that the development of an industrial economy would be accompanied by an increased share of public expenditure, later known as "Wagner's Law." Welfare state theorists, adopting the "logic of industrialism" approach, echoed this proposition and further argued that welfare state developments could also be attributed to economic growth (Wilensky and Lebeaux 1965; Wilensky 1975). They explained that the increase in government expenditure on welfare was driven by a growing demand originating from the industrialization process.

Empirical tests of Wagner's law, or the industrialization thesis, in the context of China have obtained mixed results. While some researchers identified a positive relationship between economic development and the expansion in public expenditure (Tobin 2005), others challenged this observation and cast doubt on the existence of Wagner's law in China (Lin and Song 2002; Huang 2006; Wu and Lin 2012). Leaving aside the contentiousness of the impact of economic development on the total public expenditure, studies examining the relationship between economic development and GHE exclusively in China have been scarce. Among the limited number of studies, Pan and Liu (2012) used panel data regression analyses for panel data from Chinese provinces over the period of 2002–2006 and concluded that provincial GHE is indeed affected by the local economy, a relationship further explored in this study.

The second strand of literature focuses on the impacts of globalization based on two competing debates. On the one hand, the race-to-bottom thesis claims that increases in trade and capital openness pressure governments to race to the bottom in social spending and labor standards to increase their competitiveness (Clayton and Pontusson 1998; Mishra 1999; Scharpf and Schmidt 2000; Swank 2010). On the other hand, the compensation thesis argues that economies that are more exposed to external risks expand the scale of their welfare states to compensate for these risks (Cameron 1978; Katzenstein 1985; Rodrik 1997, 1998). Apart from these two major theses, a large volume of work has been generated to question the impacts of globalization. The skeptics de-emphasize the effects of globalization and contend that globalization alone has limited influence on welfare state development (Swank 2002).

The race-to-bottom thesis has some support among researchers studying China. For example, Walker and Wong (2005) and Chau and Yu (2005) reasoned that the Chinese government intentionally keeps social welfare provisions limited to provide a preferred investment environment to please foreign investors out of fear that capitalists would withdraw their investments if welfare and labor costs were raised. However, this theory has yet to be tested with empirical data. Wu and Lin (2012) showed some evidence that openness to trade and foreign direct investment curtailed government expansion, but they did not differentiate between the different types of public expenditure. Overall, there is a lack of literature on the relationship between globalization and GHE in China.

Researchers in the third school of thought emphasize the role of institutional settings. Although focusing on different aspects of institutional structures, these institutionalists all point to the importance of institutional structures in shaping welfare state development (Immergut 1992; Pierson 1994, 2001; Obinger et al. 2005). In the case of China, among various institutional structures, it is the local-central relationship, particularly fiscal decentralization that has received the most scholarly attention. In their widely cited paper, West and Wong (1995) suggested that fiscal decentralization in China contributed to large and growing interregional inequalities in the provision of public services, including health. When higher level governments struggle to balance their own budgets, which has been the case since the 1994 tax reform, they tend to devolve expenditure responsibilities downward. However, the lower level governments are likely to have even more difficulties in balancing their budgets, therefore resulting in an inefficient provision of public services. As noted by Wong (2007), the intergovernmental system was undermined by the piecemeal reforms applied to the fiscal system during

the 1980s and especially the 1990s, which eroded the ability of local governments to perform many of their assigned functions.

In terms of GHE, Pan and Liu (2012) revealed that a 10% increase in transfers from the central government (which are used to compensate for budget deficits) increase GHE by 2.27%. In a case study of a poor rural county, Tang and Bloom (2000) found little evidence that lower level governments mobilized additional financial resources, thereby confirming the argument that fiscal decentralization is detrimental to public health services in China. Two relevant studies used the *total* health expenditure as the dependent variable. Chou (2007) performed the panel LM unit roots tests using a sample of data from 28 provinces in China, covering the period 1978–2004. They demonstrated that government budget deficits have a significant impact, with every 10 million yuan increase in budget deficits associated with an approximate 26.3% decrease in health expenditure in the long term. Based on the same dataset, Chou and Wang (2009) later carried out cross-section regressions and a cluster analysis to prove that provincial government budget deficits are useful in explaining the disparity in health expenditures. Their findings indicate that budget deficits decrease the total health expenditure, which may also extend to GHE.

Apart from the three major strands of literature discussed above, some empirical studies also included socio-economic indicators in their analysis and showed certain patterns. For example, Brixi et al. (2013) found GHE to be regressive (negatively correlated with the population's basic health needs and financial barriers in accessing health care) across and within provinces. Pan and Liu (2012) highlighted that the proportion of the population under age 15, medical insurance coverage, and urbanization are also key determinants of real per capita provincial GHE in China.

A review of the existing literature revealed two major gaps. First, empirical examinations of the determinants of GHE in China have been rare. Although the studies of public expenditure or health expenditure shed some light on determinants of GHE, their results could not be easily applied to GHE. The limited number of studies devoted to investigate determinants of GHE have focused on the time period between 1978 and 2006. However, the Chinese government's approach to health has changed significantly since the mid-2000s, indicating a need to reassess these relationships. Furthermore, the increases in government spending and the changes in health policies may also mean new determinants of GHE. Second, among the three strands of literature, economic growth and fiscal decentralization received relatively more scholarly attention in China, but as the theoretical literature implies, globalization could also have an impact on GHE. A statistical test of this relationship is warranted.

To fill these gaps in the literature, this paper tests the relationship between GHE and all three potential explanatory factors identified: economic growth, globalization, and budgetary deficits. It covers the most recent period to examine whether there have been significant changes in determinants of GHE since the mid-2000s.

## An overview of government health expenditure in China

### *Importance of government health expenditure*

The importance of GHE can be reflected in its substantial contribution to the total health expenditure (THE) in China. The government's growing input has increased GHE contributions during the study period: while GHE made up 22% of THE in 2007,

the percentage jumped to 30% in 2013 (National Statistical Bureau of China 2014). Since the government expenditure is usually expected to have the strongest equalizing effect among the key components of THE,[1] it is essential to look at the allocative pattern of GHE to investigate whether it has indeed played an equalizing role.

As Table 1 shows, GHE in China consists of four major components. The most significant one is medical insurance. In particular, two social health insurance schemes, the New Rural Cooperative Medical Scheme (NRCMS) and the Urban Residents' Basic Medical Insurance (URBMI)—the former for rural residents and the latter for urban residents who are not formally employed—are heavily subsidized by the government and have absorbed the majority of GHE on medical insurance. The remaining GHE is almost evenly divided among subsidies to public hospitals, primary care facilities, and public health. In other words, examining the allocation of GHE is particularly helpful for us to understand the aggregate allocative patterns of subsidies to medical insurance, public hospitals, primary care facilities, and public health.

### *Origin of local variations*

By making national policies, the central government determines the broad outline of budgeting and expenditure assignments. Since the mid-2000s, there has been a tendency for the central government to expand the list of expenditure assignments under the banner of "harmonious society" (Wong 2016). In the health sector, for example, a series of notifications have been issued to set government subsidy standards for the NRCMS and URBMI. Since 2009, the central government also clarified the government subsidy standard for providing basic public health services.

Although the central government has the authority to assign expenditure responsibilities, large variations exist across localities. This is possible for several reasons. First, national policies in China usually maintain some flexibility and allow local governments to make adjustments according to local circumstances. Second, the budget law establishes the legal foundation for local governments' autonomy in budgeting.[2] Governments at all five levels, including the central, provincial, prefectural, county, and township levels, need to have an independent budget that must be approved by the People's Congress at that level.[3] Third, the complex institutional arrangement makes China's fiscal system rather decentralized. The structure is a nested hierarchy: the central government deals directly only with the provincial administrations, which in turn only deal with their respective prefectures, and so on. This arrangement creates a large

**Table 1** Key components of government health expenditure, 2010–2013

| | 2010 (%) | 2011 (%) | 2012 (%) | 2013 (%) |
|---|---|---|---|---|
| Administration | 3 | 2 | 2 | 2 |
| Public hospitals | 18 | 15 | 14 | 14 |
| Primary care facilities | 9 | 9 | 12 | 11 |
| Public health | 16 | 17 | 15 | 15 |
| Basic Public Health Services | 4 | 5 | 5 | 5 |
| Medical insurance | 46 | 51 | 50 | 52 |
| NRCMS | 22 | 27 | 28 | 29 |
| URBMI | 4 | 6 | 6 | 7 |

Data source: Author's calculation based on statistics compiled from the national final accounts released on the official website of the Ministry of Finance (http://yss.mof.gov.cn/zhengwuxinxi/caizhengshuju/), various years

number of de facto decision makers in budgetary processes, making GHE at different levels results of complicated negotiations.

In addition, China's fiscal system is further characterized by two salient features: heavy expenditure responsibilities for sub-national governments and a high level of reliance on transfers (World Bank 2002). In aggregate, 99% of GHE is spent at local levels, and approximately 30% of the spending is financed by transfers from the central government (Table 2). The total scale of transfers should be larger because, similar to the central government, sub-national governments also make transfers to lower level governments. The consequence is that GHE at each level of government is financed by a combination of local revenues and transfers from higher level governments.[4] Given that the availability of a local government's revenues is usually dependent upon local economic development, the industrial structure, and other factors, while the amount of transfers can be attributed to higher level governments' own resources, preferences and negotiations between different levels of governments, GHE is a result of many factors. To identify the key determinants among the long list of potential factors is the central task of this study.

## Methods

### Data

Data for 31 provinces in China (excluding Hong Kong, Macao, and Taiwan) for the period 2007–2013 were collected from China Statistical Yearbooks (2008–2014), the most comprehensive source of official data in China. Only post-2007 data were applied because 2007 is the year when classification methods for budgetary items (including GHE) changed significantly, which makes the data since then incomparable to those before 2007.

The dependent variable for this study is GHE, measured by per capita budgetary expenditures on health in each province. As identified in previous research, three key explanatory factors (independent variables) for GHE need to be tested: economic development, globalization, and budgetary deficits. After a selection based on the relevance, importance, and availability of data, indicators for the three independent variables were limited to one indicator for budgetary deficits (per capita budgetary deficits) and 15 indicators for economy and globalization. Three indicators of population characteristics were also identified as potential control variables for later analysis. Since the dataset covers the years between 2007 and 2013, price-related items need to be converted to real values to subtract the influence of inflation and in this way to better facilitate comparison between years. For this purpose, the consumer price indices (CPI) reported by the Yearbooks were used to convert all price-related indicators to values at the 2010 price level. Descriptive statistics for each indicator are summarized and presented in Table 3.

**Table 2** Central-local division of government health expenditure, 2010–2013

| | 2010 (%) | 2011 (%) | 2012 (%) | 2013 (%) |
|---|---|---|---|---|
| The central government | 1 | 1 | 1 | 1 |
| Local governments | 99 | 99 | 99 | 99 |
| Transfers from the central government | 29 | 26 | 27 | 30 |

Data source: Author's calculation based on statistics compiled from the national final accounts released on the official website of the Ministry of Finance (http://yss.mof.gov.cn/zhengwuxinxi/caizhengshuju/), various years

**Table 3** List of indicators and descriptive statistics

| Category | Indicators (unit) | Obs. | Mean | SD | Min | Max |
|---|---|---|---|---|---|---|
| GHE | Real per capita GHE (yuan) | 217 | 429 | 226 | 101 | 1159 |
| Budgetary deficits | Real per capita budgetary deficits (yuan) | 217 | 3532 | 3632 | 334 | 26179 |
| Economic development and openness | Real per capita gross regional product (GRP) (yuan) | 217 | 33120 | 17865 | 7967 | 87915 |
| | Real per capita disposable income in urban areas (yuan) | 217 | 18356 | 5560 | 11257 | 39633 |
| | Real per capita net income in rural areas (yuan) | 217 | 6516 | 2962 | 2595 | 17710 |
| | Real per capita salary in urban enterprises (yuan) | 217 | 36004 | 11331 | 19696 | 82546 |
| | Real per capita consumption (yuan) | 217 | 11057 | 6054 | 3523 | 35450 |
| | Percentage of GRP from the first industry | 217 | 0.11 | 0.06 | 0.01 | 0.30 |
| | Percentage of GRP from the secondary industry | 217 | 0.48 | 0.08 | 0.22 | 0.62 |
| | Percentage of GRP from the tertiary industry | 217 | 0.41 | 0.09 | 0.29 | 0.77 |
| | Unemployment rate | 215[a] | 0.04 | 0.01 | 0.01 | 0.05 |
| | Percentage of population employed in urban enterprises | 217 | 0.11 | 0.06 | 0.06 | 0.35 |
| | Percentage of population who are self-employed or work in private enterprises | 217 | 0.12 | 0.06 | 0.04 | 0.32 |
| | Funds from Hong Kong, Macao, and Taiwan/ total investment in fixed assets | 216[b] | 0.03 | 0.03 | 0.00 | 0.15 |
| | FDI/total investment in fixed assets | 217 | 0.03 | 0.03 | 0.00 | 0.12 |
| | Trade (by location of importers or exporters)/ GRP | 217 | 0.29 | 0.39 | 0.01 | 1.80 |
| | Trade (by place of destination or origin)/GRP | 217 | 0.28 | 0.35 | 0.00 | 1.71 |
| Population characteristics | Percentage of urban population | 217 | 0.51 | 0.15 | 0.23 | 0.90 |
| | Adolescent dependency rate | 217 | 0.22 | 0.07 | 0.09 | 0.42 |
| | Dependency rate of the aged | 217 | 0.12 | 0.03 | 0.05 | 0.19 |

Data sources: Author's calculation based on statistics compiled from National Statistical Bureau of China (2008–2014) and Ministry of Health (2008)
[a]The two missing values are the values for Tibet in 2007 and 2008
[b]The missing value is the value for Tibet in 2009

### Visualization

To visualize the indicators, the provincial average values for the years between 2007 and 2013 were calculated[5] and presented as maps. The average values were used instead of values in any single year to show the overall pattern across the study period. Maps were produced by using ArcMap (ArcGIS 10.3). China's shapefile (province map) was downloaded from the website StatSilk. "Quantile" was used as the method to classify data for clearer visualization, and this classification scheme was followed in all maps in this paper for consistency.

### Exploratory factor analysis

One problem in running regression with the identified indicators is that many of them are highly correlated. This is intuitive because these 15 indicators all measure either the economy or openness, which are correlated with each other. If all these variables were entered into the same regression, the estimates of their separate effects would be hampered by multicollinearity, thereby making the coefficient estimates of the multiple regression unreliable across samples.

To address this issue, an exploratory factor analysis was performed to identify a smaller number of less correlated factors to capture the common variance among the original indicators. An exploratory instead of confirmatory factor analysis is more appropriate in this study because there is no theory-based hypothesis of the meaning and number of factors (Bartholomew et al. 2008). The factors were estimated for the general linear factor model ($p$ observed indicators and $q$ factors):

$$X_i = \alpha_{i0} + \sum_{j=1}^{q} \alpha_{ij} f_j + \varepsilon_i \ (i = 1, \ldots, p)$$

where $X_i$ are the indicators, $f_j$ are the common factors, $\varepsilon_i$ are residuals, and $\alpha_{ij}$ are the factor loadings. The factor loadings indicate the degree of correlation between the indicators and the factors. The higher the load is, the more relevant it is in defining the factor's dimensionality.

The principal component approach to factor analysis was adopted to extract factors. The number of retained factors was determined by a combination of the Kaiser criterion and observation of the proportion of variance explained by each factor and the scree plot. The judgment of whether one indicator should be included for a factor analysis was based on observation of its factor loadings and uniqueness. When the factor loadings were low and uniqueness high, indicating that they were not well accounted for by factors, the indicators were removed from the factor analysis. To fine tune the model, promax rotation with Kaiser normalization was applied. Promax, an oblique rotation, was chosen because it allows us to relax the assumption of the linear factor model that the factors be independent. Given the indicators listed in Table 3, it is more reasonable to expect that factors are correlated. The analysis was conducted by using Stata 13.0. For later analyses, the factor scores, the provincial scores for the factors, were calculated and obtained as a linear combination of the indicators following the formula:

$$F_j = \sum_{i=1}^{p} C_{ij} X_i \ (j = 1, \ldots, q)$$

where $F_i$ are the factor scores, $X_j$ are the indicators, and $C_{ij}$ are the factor score coefficients.

#### Panel data regression analysis

The relationships between GHE and various independent variables were tested by fixed-effects regression analyses to account for the impact of changes in our predictors on our outcome measure, GHE. The independent variables included the common factors obtained from factor analysis. Two control variables included one variable that was removed from the factor model due to its high level of uniqueness and the other one describing population characteristics. Scatterplots were first drawn to identify outliers and visualize the relationships between the dependent variables and four key independent variables.

To account for panel effects, two models are available: fixed effects and random effects. The major advantage of the fixed-effects regression model is that it eliminates the omitted variable bias arising both from unobserved variables that are constant over

time and from unobserved variables that are constant across provinces (Stock and Watson 2012). This is a desirable property for data in this study because unobserved province-specific and time-specific effects are expected. For example, one unobserved province-specific effect could be the government administrative capacity in a given province. A stronger capacity may be associated with higher GHE while also contributing to the local economy and openness. If not controlled, this type of effect would lead to an omitted variable bias, which makes the regression results unreliable. On the other hand, time-specific effects are also relevant because national policies in a given year could affect both the dependent and independent variables in the regression. The fixed effects regression model, by focusing on the changes in the same province over years and variations across entities in the same year, can control for unobserved variables that are constant either over time or across provinces. The regression model ($n$ independent variables) including both the province and time fixed effects could be written as follows:

$$Y_{it} = \alpha_i + \lambda_t + \sum_{j=1}^{n} \beta_j X_{jit} + u_{it}$$

where $Y_{it}$ is the real per capita GHE for province $i$ at year $t$, $X_{jit}$ are independent/control variables for province $i$ at year $t$, $u_{it}$ are error terms, $\alpha_i$ are the province fixed effects, $\lambda_t$ are the time fixed effects, and $\beta_j$ are unknown coefficients.

The other option, the random-effects model, assumes the variation across provinces to be random and uncorrelated with the predictor or independent variables included in the model. The model looks very similar to the fixed-effects model, with the only difference being the addition of the term $\varepsilon_{it}$ at the end of the formula to account for within-entity errors. Since the choice between the fixed-effects and random-effects models depends on whether the province-specific effects are correlated with the independent variables, a Hausman test was conducted to determine which model is more appropriate. The results indicated that the fixed effects model should be adopted.

One problem with the regression results is potential endogeneity due to reversed causality. GHE can potentially enlarge budgetary deficits and promote the economy through the enhancement of human capital. In other words, real per capita budgetary deficits and economy are potentially endogenous. To test for this, endogeneity tests were conducted. This study then followed Wu and Lin (2012)'s and Checherita and Rother (2010)'s approach by adopting the generalized method of moments estimators and using lag regressors as instruments to mitigate the possibility of reversed causation.[6] A series of standard tests, including those for under-identification, weak identification, and over-identification, were carried out to test the appropriateness of models.

## Results

### Spatial patterns

To capture variation in GHE, Fig. 1 presents a graphical overview of real per capita GHE between 2007 and 2013. Interestingly, the fifth quintile group (with the highest real per capita GHE) includes Beijing, Tianjin, Shanghai, Tibet, Qinghai, and Ningxia, the former three of which are municipalities, while the latter three are poor provinces

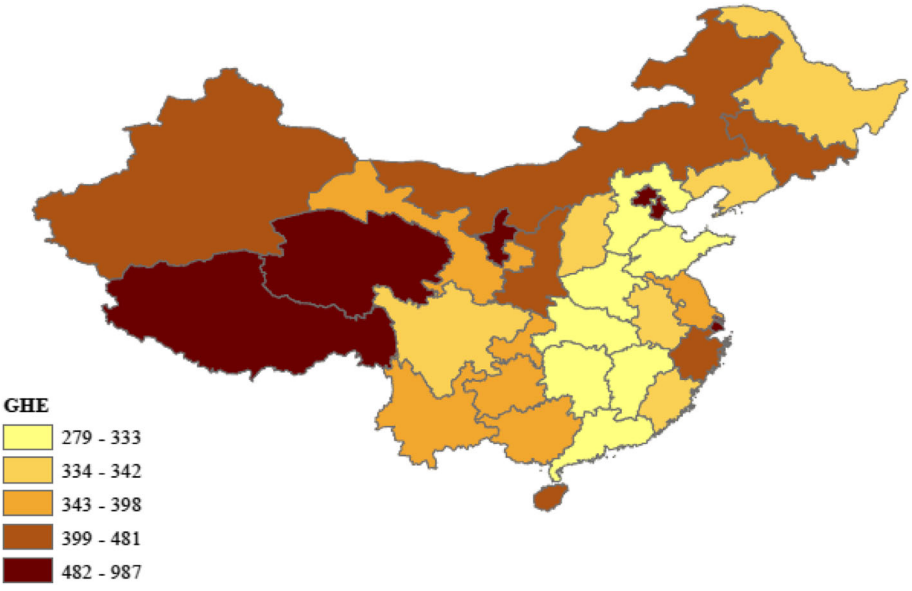


**Fig. 1** Real per capita GHE, 2007–2013 (yuan). The figure shows the spatial pattern of real per capita government health expenditure. For each province, per capita government health expenditure was calculated by dividing the government appropriation for health by the local population, which was adjusted to the 2010 price level by the corresponding consumer price index. The values from 2007 to 2013 were then averaged

in the western region. Given that the western region is the most economically underdeveloped and the people there are more likely to find health services inaccessible or unaffordable, the overall higher level of GHE in the west appears to reflect that the central government's efforts to improve equality across provinces have succeeded to some extent. Nevertheless, it should be noted that provinces in the central region, which is also a relatively poor region, had a low level of GHE in general.

From the review of the literature and China's GHE, the central-local fiscal dynamics were identified as an important determinant of GHE. Figure 2 shows the spatial pattern of real per capita budgetary deficits. While western provinces had larger budgetary deficits, provinces in the coastal region had healthier balance sheets. The two figures together provide some descriptive evidence that GHE appears to be positively correlated with budgetary deficits, a relationship further explored in the "Regression results" section.

### Common factors for indicators

In the first round of factor analysis, all 15 indicators for economy and openness were included. The uniqueness of only one variable, the unemployment rate, was particularly high, with its uniqueness as high as 62.51%, meaning that the majority of its variance could not be explained by the three common factors. The variable was therefore removed, and the 14 other variables were included for a second round of factor analysis. The data for the second round of factor analysis had a Kaiser-Meyer-Olkin (KMO) index of 0.843, meaning that the dataset was suitable for factor analysis. The Bartlett test of sphericity also confirmed the suitability of the factor analysis with the $p$ value at 0.00. Three factors were identified, together explaining 94.22% (68.56% by the first factor, 13.42% by the second factor, and 12.24% by the third factor) of the common

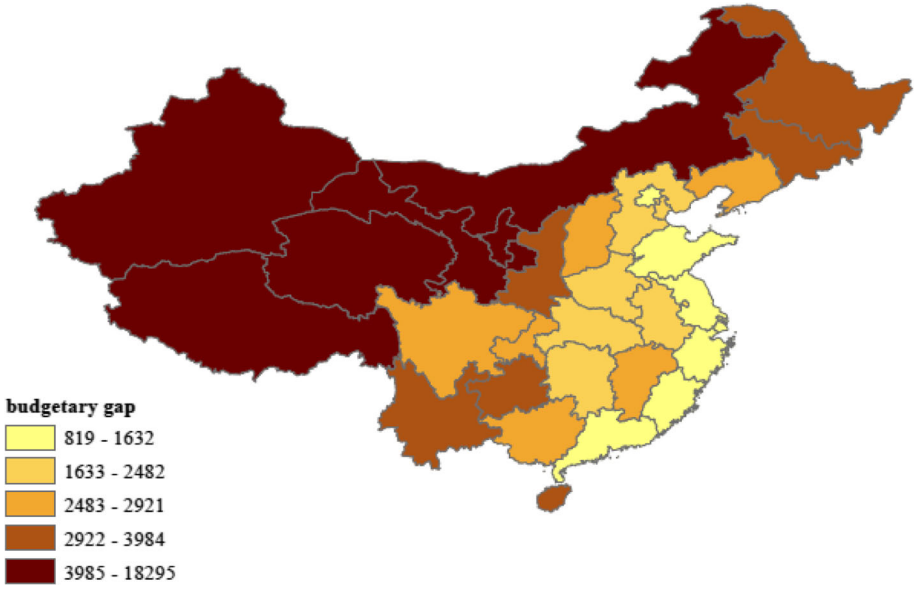


**Fig. 2** Real per capita budgetary deficits, 2007–2013 (yuan). The figure shows the spatial pattern of the real per capita budgetary deficits. For each province, the per capita budgetary deficit was calculated by subtracting the government budgetary revenue from the government budgetary expenditure and then dividing the difference by the local population. The values in different years (from 2007 to 2013) were all adjusted to the 2010 price level by the corresponding consumer price index and were then averaged

variance of the 14 indicators. After a promax rotation with Kaiser normalization, the results are shown in Table 4.

The first factor loaded heavily (|factor loadings| > 0.90) on per capita salary in urban enterprises, per capita GRP, per capita disposable income in urban areas, per capita net income in rural areas, and first industry (negative). The factor was named "*economy*"

**Table 4** Factor loadings of the 14 economic and globalization indicators

| Indicators | *F1* | *F2* | *F3* | Uniqueness |
|---|---|---|---|---|
| Real per capita gross regional product (GRP) (yuan) | 0.9441 | | | 0.0875 |
| Real per capita disposable income in urban areas (yuan) | 0.9288 | | | 0.1132 |
| Real per capita net income in rural areas (yuan) | 0.9191 | | | 0.0965 |
| Real per capita salary in urban enterprises (yuan) | 0.9539 | | | 0.1278 |
| Real per capita consumption (yuan) | 0.8816 | | | 0.0592 |
| Percentage of GRP from the first industry | −0.9048 | | 0.3696 | 0.2118 |
| Percentage of GRP from the secondary industry | | | −1.0326 | 0.0026 |
| Percentage of GRP from the tertiary industry | 0.4321 | | 0.7191 | 0.0661 |
| Percentage of population employed in urban enterprises | 0.7789 | | | 0.2089 |
| Percentage of population who are self-employed or work in private enterprises | 0.6000 | 0.3157 | | 0.2876 |
| Funds from Hong Kong, Macao, and Taiwan/total investment in fixed assets | | 0.8297 | | 0.4048 |
| FDI/total investment in fixed assets | | 0.8446 | | 0.2306 |
| Trade (by location of importers or exporters)/GRP | | 0.7565 | | 0.1191 |
| Trade (by place of destination or origin)/GRP | | 0.9191 | | 0.1026 |

Notes: The total number of observations is 216 because the value for the FDI variable of Tibet in 2009 is missing. Only factor loadings higher than 0.3 are displayed. For the sensitivity test, the data for the years between 2009 and 2013 were also factored, and the results were similar and therefore are not reported separately here

because all the variables listed here mainly describe the level of economic development. The second factor was named "*openness*" because it loaded heavily (|factor loadings| > 0.80) on the four items measuring the percentage of funds from non-domestic sources in the total fixed-asset investment and the percentage of trade in GRP. The last factor was named "*industrial structure*" because it mainly loaded on the three indicators describing the industrial structure.

In this way, the 14 indicators for economic development and globalization were captured by three factor variables. The first factor and third factor both describe the economy, the first independent variable to be tested in this study. The former concerns the level of economic development, while the latter describes the industrial structure. The second factor describes openness, the second independent variable to be investigated.

The average provincial factor scores for the years between 2007 and 2013 are presented in Figs. 3, 4, and 5. For *economy*, the northern and coastal provinces tended to have higher factor scores compared to their counterparts in the western and middle regions. The degree of *openness* was also higher in coastal areas than those in the western and middle regions. The greatest difference is that provinces in the northern area no longer belong to the high-performer group and the southern areas tended to be more open. For *industrial structure*, the provinces in the south-western regions had higher scores.

As discussed in the "Exploratory factor analysis" section, the reason the factor analysis was carried out in the first place was that the original indicators were highly inter-correlated (the correlation coefficients between many indicators were higher than 0.80 or even 0.90), therefore posing problems for the regression analysis. Table 5 shows the correlation coefficients between the new indicators

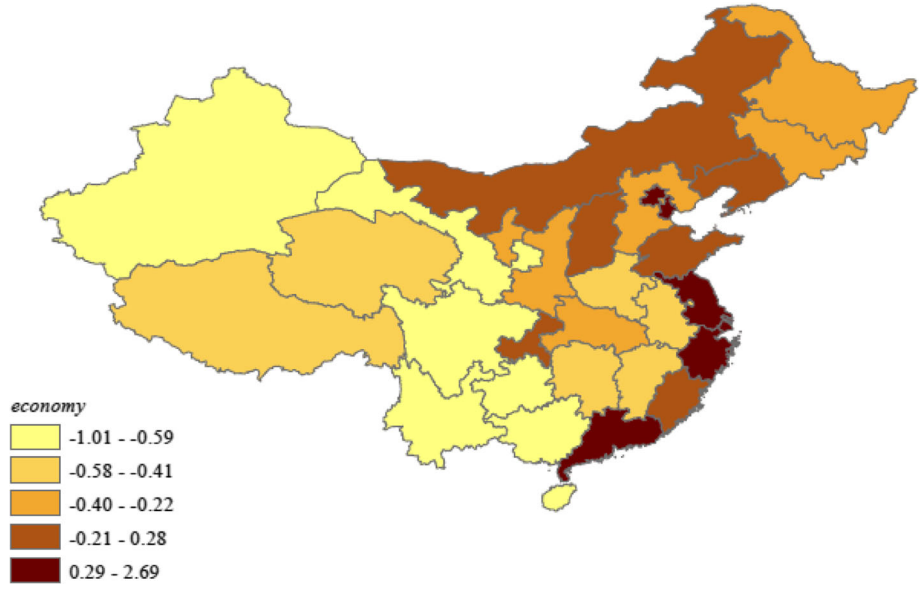


**Fig. 3** *Economy,* 2007–2013. The figure shows the spatial pattern of scores for the first factor from the factor analysis. The factor was named "*economy*" because it loaded heavily on the per capita salary in urban enterprises, per capita GRP, per capita disposable income in urban areas, per capita net income in rural areas, and first industry (negative)

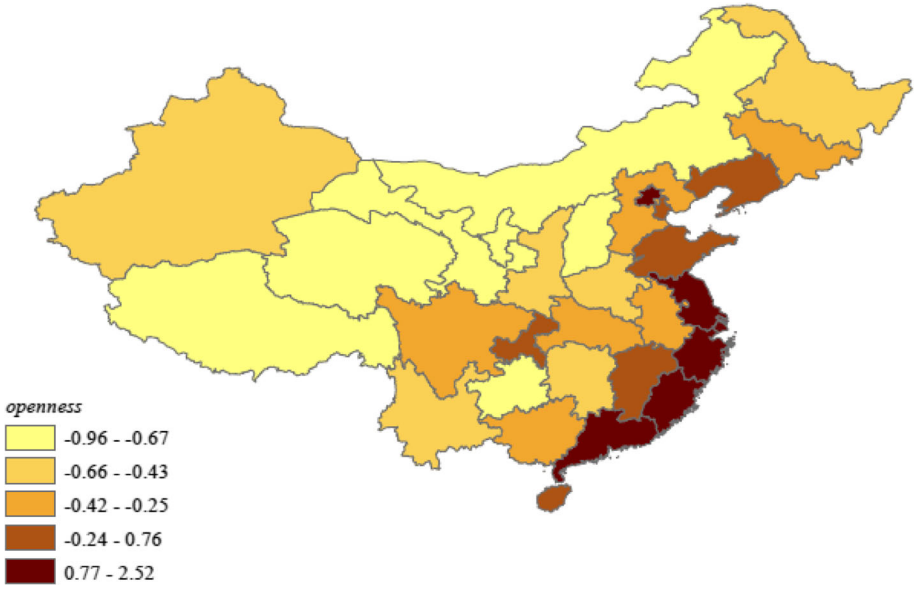


**Fig. 4** *Openness*, 2007–2013. The figure shows the spatial pattern of scores for the second factor from the factor analysis. The second factor was named "*openness*" because it loaded heavily on the four items measuring the percentage of funds from non-domestic sources in total fixed-asset investment and the percentage of trade in GRP

generated from the factor analysis. According to the table, the largest coefficient is the one between *economy* and *openness*, with a value of 0.5617. Given that this figure is much lower than the correlation coefficients between many original indicators and indicates a moderate (instead of strong) relationship, it was considered acceptable for the following regression analyses.

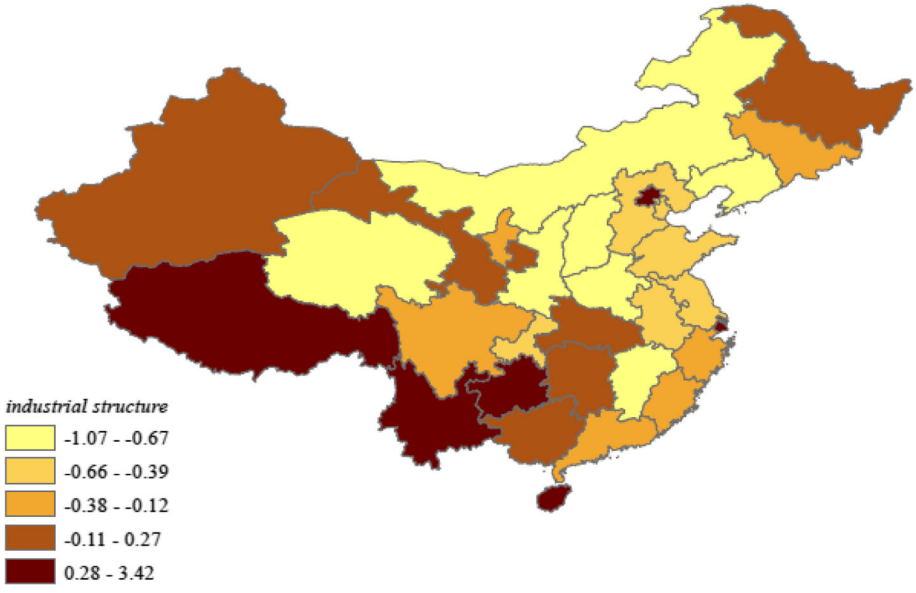


**Fig. 5** *Industrial structure*, 2007–2013. The figure shows the spatial pattern of scores for the third factor from the factor analysis. The last factor was named "*industrial structure*" because it mainly loaded on the three indicators describing the industrial structure

**Table 5** Correlation coefficients between factors

| | *Economy* | *Openness* | *Industrial structure* |
|---|---|---|---|
| *Economy* | 1.0000 | | |
| *Openness* | 0.5617 | 1.0000 | |
| *Industrial structure* | 0.3039 | 0.2080 | 1.0000 |

### Regression results

After the factor analysis was performed, three key indicators were generated to serve as proxies for the first two independent variables explored in this study: *economy* and *industrial structure*, which together measured the first key independent variable in this study, economic development; and *openness* captured globalization, the second key independent variable. The per capita budgetary gap quantified the fiscal institutional structure between central and local governments, the third independent variable as identified in the literature review.

The indicator of the unemployment rate, although capturing some aspects of the economy, was excluded from the factor analysis due to its high uniqueness. It was added back to the regression to serve as a control variable due to its potential correlation with GHE (because unemployed people usually have a greater demand for health care services and are in particular need of government support). Among the three population characteristics identified at the beginning, the percentage of the urban population, the adolescent dependency rate, and the dependency rate of the aged, only the last was entered into the regression because the first two were found to be strongly correlated with *economy*. This is intuitive because more urbanized areas tend to have higher levels of economic development, and it is much more expensive to raise children in these areas, therefore lowering the number of children. In total, four indicators plus two control variables were included in the regression analyses.

The data of the dependent variable and six independent/control variables for the years between 2007 and 2013 had a $p$ value of 0.000 for the Breusch and Pagan Lagrangian multiplier test for random effects, indicating that the null hypothesis that variance across entities is zero was rejected at the 1% significance level. In other words, OLS regression is inappropriate and panel effects should be considered.

The solution to address the problem with the panel effects was to examine the changes in various variables across years instead of their values in different years. Scatterplots for the average annual difference in real per capita GHE and various independent variables were drawn. In all figures, Qinghai is clearly an outlier due to its large increase in real per capita GHE. Tibet is also an obvious outlier, with its large increase in real per capita budgetary deficits. It appears that Qinghai and Tibet may not fit into the same model with the other provinces. Therefore, regressions were run both with and without these two provinces for sensitivity test.

Two time periods, the years between 2007 and 2013 and the years between 2009 and 2013, were also analyzed separately to see whether there were significant changes since the initiation of the most recent round of heath reforms. The results for the regression analysis are presented in Table 6. Year effects were tested for all models, and the null hypothesis that the coefficients for all years are jointly equal to zero was always rejected, with a $p$ value of 0.000. Therefore, control of time effects is essential. Two additional model specification issues with the models are heteroskedasticity and

**Table 6** Fixed-effects (FE) models

| | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| Number of provinces | 31 | 29 (Tibet and Qinghai excluded) | 31 | 29 (Tibet and Qinghai excluded) |
| Years | 2007–2013 | 2007–2013 | 2009–2013 | 2009–2013 |
| Real per capita budgetary deficits | 0.019** (0.009) | 0.042*** (0.006) | 0.009 (0.012) | 0.031*** (0.009) |
| *Economy* | 84.042** (40.975) | 124.566*** (31.532) | 85.828 (64.939) | 145.280** (55.846) |
| *Openness* | 0.539 (8.048) | −3.593 (7.674) | −12.485 (9.183) | −13.167 (9.569) |
| *Industrial structure* | −17.628 (11.124) | −18.217** (8.769) | −34.009 (21.513) | −28.022 (18.270) |
| Unemployment rate | −816.269 (2848.755) | −2101.171 (1383.514) | 0.471 (2550.578) | −1789.106 (1473.1) |
| Dependency rate of the aged | 961.461*** (208.640) | 769.547*** (161.244) | 1136.961*** (246.679) | 865.509*** (213.074) |
| Factors = 0 | 0.100 | 0.001 | 0.214 | 0.030 |
| Year dummies = 0 | 0.000 | 0.000 | 0.005 | 0.010 |
| Panel effects = 0 | *p* value = 0.000 | *p* value = 0.000 | *p* value = 0.000 | *p* value = 0.000 |
| Hausman test | *p* value = 0.000 | *p* value = 0.000 | *p* value = 0.000 | *p* value = 0.000 |
| Heteroskedasticity test (Modified Wald) | *p* value = 0.000 | *p* value = 0.000 | *p* value = 0.000 | *p* value = 0.000 |
| Autocorrelation test | *p* value = 0.000 | *p* value = 0.004 | *p* value = 0.000 | *p* value = 0.001 |
| *N* | 214 | 203 | 154 | 145 |
| *R*-squared (within) | 0.9580 | 0.9732 | 0.9133 | 0.9416 |

Notes: Standard errors are given in parentheses after the coefficients. The individual coefficient is statistically significant at the *10%, **5%, or ***1% significance level. The statistics are robust to heteroscedasticity and autocorrelation. The null hypothesis for the Hausman test is that the preferred model is random effects. A significantly low *p* value indicates that fixed effects should be used

autocorrelation. The results for the modified Wald test for group wise heteroskedasticity and the autocorrelation test suggested the necessity of correcting both. For this reason, heteroskedasticity and autocorrelation were controlled for in all regression models presented in this paper.

According to Table 6, in both time periods, the results for the fixed effects are sensitive to whether Tibet and Qinghai are included, confirming the earlier observation that both are outliers in the scatterplots. Given the particularities of these two provinces, it makes more sense to rely on the regression models where they are excluded. Furthermore, the results for the fixed-effects and random-effects models were different, demonstrating the impacts of whether the variance across provinces was assumed to be random. Hausman tests were conducted for all fixed-effects models presented here and their corresponding random-effects models. The *p* value remained at 0.000, which means that the null hypothesis that the unique errors are uncorrelated with the regressions was rejected. In other words, the variance across provinces is unlikely to be random, and fixed-effects models are more appropriate. For these reasons, only fixed-effects models with Tibet and Qinghai excluded are discussed below.

For the period between 2007 and 2013, coefficients for the real per capita budgetary deficits, *economy*, and dependency rate of the aged are all significant at the 1% significance level. The coefficient for real per capita budgetary deficits is 0.042, meaning that increasing 1000 yuan for real per capita budgetary deficits would lead to 42 yuan more real per capita GHE. The coefficient for *economy* is 125. This indicates that increasing one unit of *economy* would contribute to 125 yuan more real per capita GHE. The

coefficient for the dependency rate of the aged is 770, which suggests that an increase of one percentage point of the dependency rate of the aged is associated with 8 yuan more real per capita GHE. Compared to the model for the years between 2007 and 2013, the corresponding model for the period between 2009 and 2013 yielded similar results. Still, the coefficients for the real per capita budgetary deficits, *economy*, and dependency rate of the aged are the three variables that are significant, the difference being that the coefficient for economy is no longer significant at the 1% significance level but instead at the 5% significance level. The coefficient for real per capita budgetary deficits dropped from 0.042 to 0.031, indicating that the influence of budgetary deficits has decreased since 2009. On the other hand, the magnitude of the coefficients for the *economy* and dependency rate of the aged both improved. A one-unit increase of *economy* would this time lead to 145 yuan more real per capita GHE, and increasing one percentage point of the dependency rate of the aged would mean 9 yuan more real per capita GHE.

### Correcting for endogeneity

To test and control for endogeneity, lag one to lag two real per capita budgetary deficits were used as instruments in model 5 and lag one to lag two *economy* were used as instruments in model 6. The results are summarized in Table 7. Both models passed

**Table 7** General method of moments (GMM) models

| | Model 5 | Model 6 |
|---|---|---|
| Instrumented variable | Real per capita budgetary deficits | *Economy* |
| Instruments | L(1/2). real per capita budgetary deficits | L(1/2).*economy* |
| Endogeneity test | *p* value = 0.6055 | *p* value = 0.0161 |
| Real per capita budgetary deficits | 0.037*** (0.014) | 0.034*** (0.008) |
| *Economy* | 167.859*** (54.612) | 248.886*** (44.731) |
| *Openness* | −12.046 (9.079) | −9.525 (9.356) |
| *Industrial Structure* | −26.148 (17.685) | −32.773** (14.302) |
| Unemployment rate | −1844.576 (1324.935) | −2493.487** (1064.039) |
| Dependency rate of the aged | 804.165*** (198.447) | 1018.315*** (191.3554) |
| Province dummies | Included (29, Qinghai and Tibet excluded from data) | Included (29, Qinghai and Tibet excluded from data) |
| Time dummies | Included | Included |
| Under identification | *p* value = 0.0094 | *p* value = 0.0045 |
| Weak identification (Cragg-Donald Wald F statistic) | 53.349 | 71.133 |
| Over identification (Hansen J statistic) | *p* value = 0.4606 | *p* value = 0.1140 |
| *N* | 145 | 145 |
| *R*-squared | 0.9412 | 0.9374 |

Notes: Standard errors are given in parentheses after the coefficients. The individual coefficient is statistically significant at the *10%, **5%, or ***1% significance level. The GMM estimates reported are all two-step results. The statistics are robust to heteroscedasticity and autocorrelation. The null hypothesis for the endogeneity test is that the specified endogenous regressor can be treated as exogenous. A significantly low *p* value suggests endogeneity. The null hypotheses for the under-identification test are that the model is under identified. For the weak identification test, the null hypothesis is that the model is weakly identified. Stock-Yogo weak ID test critical values are 19.93 for 10% maximal IV size, 11.59 for 15% maximal IV size; and 8.75 for 20% maximal IV size. The Cragg-Donald Wald F statistics for both model 5 and model 6 are significantly higher than the critical values, therefore rejecting the null hypothesis. The null hypothesis for the over-identification test is that the model is identified

the under-identification, weak identification, and over-identification tests (statistics shown in the table), suggesting the appropriateness of the instruments.

The null hypothesis for the endogeneity test is that the instrumented variable is exogenous. As the *p* values indicate, the null hypothesis cannot be rejected in model 5 but can be rejected in model 6 at a 5% level of significance. In other words, the variable of real per capita budgetary deficits is likely to be exogeneous while the *economy* is likely to be endogenous. Additionally, the other two factors, *openness* and *industrial structure*, were also instrumented to test for endogeneity. Both tests failed to reject the null hypothesis.

Given that *economy* was identified as an endogenous variable, the results of model 6 are more reliable compared to the previous models because it corrected for endogeneity. Most results generated from fixed-effects models over the same period of time (model 2) still hold: real per capita budgetary deficits, *economy*, *industrial structure*, and dependency rate of the aged are key predictors of GHE; *openness* does not matter much.

There were several changes after the mitigation of endogeneity: first, the magnitude of coefficients for *economy*, *industrial structure*, and dependency rate of the aged increased. A one-unit increase in *economy* would be expected to increase the real per capita GHE by 249 yuan, in contrast to 125 yuan in model 2; a one-unit increase in *industrial structure* would lead to a decrease of 33 yuan in real per capita GHE, compared to 9 yuan in model 2. The coefficient for the dependency rate of the aged also increased from 770 to 1018. Second, the coefficient for the real per capita budgetary deficits decreased, from 0.042 to 0.034. Third, the coefficient for the unemployment rate became statistically significant. An increase of one percentage point of the unemployment rate would be associated with 25 yuan less real per capita GHE.

## Discussion

### Budgetary deficit increases GHE

This study discovered that increasing 1000 yuan real per capita budgetary deficits would lead to 34 yuan more real per capita GHE for the period between 2007 and 2013. This means that the less capable a province is in financing its expenditures from its own revenue, the more it spends on health, which is possible because these deficits should have been filled by central transfers to compensate for any gap. In other words, provinces with larger budgetary deficits receive more money from the central government, which is then spent on province-level GHE. In this, the central government subsidizes high deficit province health expenditures.

Nevertheless, there are several clues from the results to cast doubt on the effectiveness of this mechanism. To begin with, the magnitude of the coefficient for budgetary deficits decreased significantly from the period of 2007–2013 to 2009–2013. This probably shows that the marginal effect of the central government's spending has diminished over time. In addition, when the endogeneity of *economy* was mitigated, the coefficient for budgetary deficits also decreased, meaning that the effect of budgetary deficits tends to be overestimated due to the noises posed by economic factors. These results appear to confirm some criticisms with central transfers in China, which argue that transfers were not properly targeted.

### Economic development increases GHE even more

Given that *economy* and budgetary deficits are both key determinants of provincial GHE, it is interesting to make a comparison of the magnitude of the two coefficients. For economy, the average annual increase ranged from 0.11 to 0.29 across different provinces (Qinghai and Tibet excluded). The coefficient of 249 indicates that *economy* could explain 27- to 72-yuan average annual difference in real per capita GHE. In comparison, the average annual increase in real per capita budgetary deficits ranged from 118 to 192 yuan (Qinghai and Tibet excluded). The coefficient of 0.034 means that real per capita budgetary deficits could potentially explain 4- to 7-yuan increase in average annual difference in real per capita GHE. The influence of economic development is much more significant than that of budgetary deficits. This means that despite the central government's efforts, GHE is still largely determined by economic development: richer provinces can enjoy a higher level of GHE. Moreover, a comparison of the coefficients for the overall period and the post-2009 period shows a worrisome picture. The magnitude of the coefficient for economy became even larger over time, suggesting that the impact of economic development was intensified.

*Industrial structure*, the other factor used to describe economic development, was also found to be statistically significant. Given that the *industrial structure* loaded most heavily on the percentage of GRP from the secondary industry (negative) and the sign of the coefficient for this factor is negative, the result means that provinces with heavier reliance on the secondary industry would have higher GHE. This is in accordance with the industrialization thesis discussed in the literature review. However, the magnitude of the coefficient for this factor is much smaller than that for economy, suggesting that the economy itself, rather than the structure of the economy, matters more for provincial GHE in China.

### Openness is irrelevant

Across all regression models in this paper, none of the coefficients for *openness* is significant. In other words, openness fails to be a helpful predictor of GHE. This finding provides some empirical evidence that contradicts globalization arguments and justifies the exclusion of openness variables in previous studies of provincial GHE (Pan and Liu 2012). This result is also consistent with a study of health status and resources (Li and Wei 2010). In their paper, although the two authors found a positive relationship between FDI and health resources, they argued that it was because FDI largely determines and reflects local economic growth. In this study, openness was separated from the economy and composed as an individual factor, and the coefficient was indeed insignificant.

## Conclusions

Since the mid-2000s, the Chinese government has asserted its role in the health sector, as manifested by the significant increase in GHE. One major goal of the reforms has been to curtail inequality across provinces, between urban and rural areas, and between different groups of people. This study mainly considers the first type of inequality, which is across provinces. As expected, the western region has benefited from the health reforms, with a high level of per capita GHE in many provinces between 2007

and 2013. On the other hand, provinces in the central region, which is also relatively economically underdeveloped, generally had a low level of GHE. This means that people in the central region may have experienced more financial difficulties when seeking medical services because they had neither a high level of government subsidy as in the western region nor a strong economy as in the coastal area.

Based on a panel dataset for Chinese provinces between 2007 and 2013, this study examined the key explanatory variables of provincial GHE. Different from previous research, a range of socio-economic indicators were factored before any regression analysis was performed to address the high correlation between variables, thereby ameliorating the measurement. The panel data regression analysis shows that real per capita budgetary deficits and economic development are the most important determinants of real per capita provincial GHE. More specifically, it was found that increasing 1000 yuan real per capita budgetary deficits would lead to 34 yuan more real per capita GHE; a one-unit increase in the *economy* was associated with 249 yuan higher real per capita GHE; and a one-unit increase in the *industrial structure* was expected to decrease the real per capita GHE by 33 yuan. A comparison of these coefficients showed that the influence of economic development is much larger than that of budgetary deficits. Furthermore, the comparison between the periods of 2007–2013 and 2009–2013 revealed an even influence of economic development and a diminishing effect of budgetary deficits, indicating that the central government's funding efforts have probably diminished over time.

This study contributes to the existing literature by adding empirical evidence to three major theoretical debates in the field of welfare state development and public expenditure. It confirms the importance of economic development and the institutional structure but rejects the relevance of globalization in China's GHE. The results also help us better understand the complicated budgeting process in China with a simple and straightforward message: economic development is the key to the availability of provincial GHE. Although central transfers also play a role, the impact is much smaller than that of economic development.

## Endnotes

[1]In China as well as other countries, the three key components of THE include GHE, social health insurance, and out-of-pocket payments. China's classification is slightly different from the international practice. While the latter classifies subsidies to social health insurance under the category of social health insurance, China classifies the subsidies under GHE. Nevertheless, the difference in classification does not change the conclusion that GHE is expected to have the strongest equalizing effects among the three key components of THE.

[2]The budget law was implemented between 1995 and 2014. A revised version was approved in 2014, and the new budget law was implemented in 2015. The provision for the local government autonomy remains the same. The new budget law introduced new procedures for budget preparation and approval, and budget reporting to the National People's Congress was strengthened.

[3]In other words, provincial GHE, the subject of this study, is actually an aggregate of health budgets of the provincial government itself *plus* all prefectural, county, and township governments in a given province.

[4]The system of transfers is fragmented. Governments at lower levels can receive transfers from multiple higher level governments. For example, a county government can receive transfers from central, provincial, and prefectural governments.

[5] $\frac{1}{7} \times \sum_{t=2007}^{2013} X_t$

[6]For this purpose, function xtivreg2 in Stata was used; xtivreg2 implements IV/GMM estimation of the fixed-effects and the first-differences panel data models with possibly endogenous regressors. It is essentially a wrapper for ivreg2, which was developed by Baum, Schaffer, and Stillman (2007).

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