# Regional Disparity in Health and Health Care in China

(January 2006)

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## Abstract

One major critique of the Chinese economic reform focuses on disparities in development. This study examines the recent trends in the disparities in health and health care resources across the provinces. This study also examines the relationship between health status, health care resources, and socioeconomic status. A panel data from "All China Data" and China Health Statistic Yearbooks is used in this study. These data include health status, health care resources, and socioeconomic status variables at the provincial level from 1980 to 2003. Index of disparity was used as the indicator for measuring regional disparity in health and health care resources. A fixed effect model was used to estimate the relationships between health status and health care resources and their potential determinants. The results of this study show that the disparities in maternal mortality, number of beds, and number of doctors increased and then declined in most recent years. However, the values of their indexes of disparity in 2002 are still higher than their values in 1985. Therefore the disparities in health status and health care resources across the provinces increased after the economic reform. The results of this study also suggest that socioeconomic status has significant association with health status and health care resources. The association between socioeconomic indicators and health status and health care resources varies in different economic zones.

## I. Introduction

Within the past 25 years, China has transformed its economic system from a highly centralized planned economy to a market-oriented economic system. This process has led to massive and rapid changes in all aspects of society. The Gross Domestic Product (GDP) per capita increased from 460 Yuan in 1980 to 9,073 Yuan in 2003, an almost twenty-fold increase during the past 23 years (All China Data 2005). Although the majority of the population still live in rural areas, the percentage of the population living in urban areas increased from 19% in 1980 to 36% in 2000 (China Statistical Bureau 2001). Along with rapid economic growth and urbanization, the standard of living has improved. The Engel's Coefficient (the proportion of food expenditure out of total expenditure) was about 37% in urban areas in 2003, which is a decrease of 20 percentage points compared to the level in 1978. This figure was 45.6% in rural area in 2003, which is a decrease of 21 percentage points compared to the level in 1978 (All China Data 2005). People now have a greater capability to purchase health-related merchandises as well as health services.

Along with rapid economic development, the health system has also expanded rapidly. The number of hospitals has increased from 9,902 in 1980 to 17,844 in 2002. The number of hospital beds per 10,000 populations has increased from 20.2 beds in 1980 to 23.2 beds in 2002. The number of doctors per 10,000 people has increased from 11.7 in 1980 to 14.4 in 2002. The health status of the overall population has also steadily increased. Infant mortality has declined from 34.7 per thousand live births in 1981 to 28.4 per thousand live births in 2000. Life expectancy has increased from 67.9 years in 1981 to 71.4 years in 2000 (Ministry of Health PRC 2003).

However, one major critique of the Chinese economic reform focuses on disparities in development (Bhalla 1990; Xie and Dutt 1991; Smith and Fan 1995). Almost two decades after the implementation of the "get rich first" policy, the Gini coefficient, the indicator that measures income inequality, increased from 0.16 in 1978 to 0.30 in 1999 in urban China, and from 0.21 in 1978 to 0.42 in 2000 in rural China. In 2001 per capita GDP in Shanghai is 37,382 Yuan, while it is only 2,895 Yuan in Guizhou. The income gap between urban and rural populations was 2.9 times different at the beginning of the economic reform. This figure declined to 2.3 during the initial reform period from 1978 to 1985 which focused on the rural area. This gap, however, has increased since 1986 to reach 3.5 times difference by the late 1990s (China Statistical Bureau 2001).

The disparity in population health status also widened over the course of the economic transition. The ratio of Infant Mortality Rate (IMR) between rural and urban areas increased from 1.67 in 1981 to 1.75 in 1990 and to 2.93 in 1993 (Liu, Hsiao et al. 1999). Life expectancy was reported to range from 74.5 years in big city areas to 64.5 years in the poorest rural areas. The prevalence of disability also showed a similar pattern; it ranges from 6.3 per 1,000 population in large urban areas to 12.4 per 1,000 population in the poorest rural areas (Liu, Rao et al. 2001). In terms of health care resources, although 70% of the population lives in rural areas, only 37.3% of health manpower is located in rural areas (Yin 2000).

A number of studies have been done on health disparities in China, but there is little work on the regional disparity in health and health care resources at the provincial

level. This study examines the recent trends in the disparities in health and health care resources across the provinces. This study also examines the relationship between health status, health care resources, and socioeconomic status (SES).

This paper is organized into four sections. The introduction provides background information on the economic reform of the past 25 years and its potential influence on health and health care resources. Section II defines the concept of disparity and the methods of its estimation. The method used to estimate the relationship between health and health care resources and SES indicators is also introduced in this section. Section III describes the results of the analyses. Section IV discusses the results and policy implications.

## II. Methods

### 1. Defining disparity in health and disparity in health care resources

The term health disparity has been used extensively in recent literature and has sometimes been used interchangeably with the terms "health inequality" and "health inequity" (Carter-Pokras and Baquet 2002). The similarities and differences of these terms have been discussed in several publications. The conclusion reached is that health disparity is the same as health inequality, which is defined as the differences and variations in the health achievements across individuals and groups. The term health inequity, though, refers to disparities in health that are deemed unfair or stem from some form of injustice (Kavachi, Subramanian et al. 2002). Therefore, health

disparity and health inequality can be considered as generic measures of or descriptions of health difference across the population, while health inequity represents inequalities that can be considered unjust and avoidable. Measuring health disparity is the first step toward the identification of inequity in health (PAHO 2001). Similar to health disparity, in this study the disparity of "health care resources" can be defined as the differences and variations in the health care resources across individuals and groups.

## 2. Determinants of health and health care resources

It is important, as a first step, to describe the magnitude of variations in health status of the population. However, the study of population health also involves explaining why health status varies and what the determinants of health are. The question of "why are some people healthy and others not?" has been intensively investigated from epidemiological, sociological, and economic perspectives.

Epidemiological perspectives. Epidemiology is the study of the distribution and determinants of health status in populations (Gordis 1996). The model that epidemiology uses is the host-agent-environment trinity. For example, an infectious disease requires an agent: the microorganism, a susceptible host: a patient who may be a malnourished alcoholic; and an environment: perhaps an overcrowded shelter shared by others who have been infected (Young 1998).

While diseases have come and gone, some infectious diseases have been eradicated, others have emerged, and a host of noninfectious diseases continue to cause death and

disability. To understand these patterns, epidemiological approaches to understanding disease etiology now incorporate social experiences as a more direct cause of disease and disability. Social epidemiology, one branch of epidemiology, emphasizes the study of the social distribution and social determinants of health status. Its aim is to identify socio-environmental exposures that may be related to a broad range of physical and mental health outcomes (Berkman and Kawachi 2000).

Sociological perspective. Sociologists do not significantly differentiate their works on determinants of health from that of epidemiologists. As William C Cocherham mentioned, sociologists working in the field of medicine are epidemiologists (Cockerham 1998).

Sociological studies on the relationship between social structure and health or disease status are highly variable, depending on the aspects of the social structure they focus upon. The major elements of the social structure that investigators seek to relate to health and illness, both cross-sectional and longitudinal, are social identities, social relationships, and socio-cultural systems. Social identities include the socioeconomic characteristics of age, gender, religion, race, ethnicity, marital status, occupation, and a wide range of structural characteristics. Social relationships include social networks and the effect of social relationships upon health status, such as marriage, friendship, parenthood, and work group that may affect the likelihood of exposure to health promoting and health threatening circumstances, vulnerability to disease, and the courses of illnesses. Socio-cultural system includes the nature of consensual values and health-relevant behavior patterns (House, Landis et al. 1988; Kaplan 1989; Pappas, Queen et al. 1993; Berkman 1995; Robert 1998).

Economic perspectives. The most popular framework used for the analysis of determinants of health status from an economic perspective is the model of health production, which was largely developed by Michael Grossman (Grossman 1972). This model considers "health" as an economic good that contributes to a person's utility function. One person's health is a function of the endowment of health, depreciation of health, investment of health, etc.

Field model of determinants of health. In 1974, the Canadian government released a working document called "A New Perspective on the Health of Canadians". It introduced a framework to analyze of health determinates called the health field concept, which categorizes the determinants of health status into four fields: human biology, environment, lifestyles, and health care organizations (Government of Canada 1981). A recent attempt to refine and expand this model by economists Robert Evans and Gregory Stoddart presents a more complete view of the multiple determinants of health, encompassing interactions between medical care, the environment, socioeconomic status, genetics, and individual behaviors (Evans and Stoddart 1994).

The determinants of the distribution of health care resources have also been examined in Western studies (Marden 1966; Steele and Ramlinger 1967; Jaroff and Navarro 1971; Krishnan 1992; Westert and Groenewegen 1999). Based on the economic supply and demand mechanisms, health care resources tend to be distributed to where (1) the effective demand for their services is greatest and/or (2) the need for their services is greatest (Busch and Dale 1978). The first factor is related to

socioeconomic status (SES) since a higher SES population would have more effective demand for health services than a lower SES population. The second factor is related to the health status of the population. The distribution of health care resources will be also driven by the economic return of investment. Regions with a higher SES will have greater potential to have better economic returns, such as higher incomes for doctors, or higher charges per hospital day, than the regions with lower SES (Busch and Dale 1978). Therefore, health care resources will tend to be distributed in the regions with higher SES rather than in the regions with lower SES.

## 3. Data and variables

A panel data from "All China Data"(All China Data 2005) and China Health Statistic Yearbooks (for maternal mortality rate) is used for this study. These data include health status, health care resources, and SES variables at the provincial level from 1980 to 2003. Due to missing values, only 28 provinces are included in the analysis. The following are the variables used in this study:

### 3.1 Health and health care resources (Table 1)

Based on data availability, we selected the crude mortality rate and the maternal mortality rate as the measurement of health status; and the number of hospital beds per 10,000 people, the number of doctors per 10,000 people, and government spending on culture/science/education/health as the measurement of health care resources.

Crude mortality rate. Regardless of the complexity of the World Health Organization's definition of health (WHO 1978), the most common measure of a population's health is mortality, not only because being dead precludes any concept of health, but also because mortality rates are one of the most available and accurate health statistics (Kindig 1997). In this study, we used crude mortality rates in each province from 1980 to 2003 as the crude measurement of health status in each provincial population. However, we realized that the crude mortality rate may not be an appropriate measure when comparing the differences in different groups of population or in different time periods since the age distribution in different populations and at different times may not be the same, and age is one of the single most important characteristics that affect mortality (Gordis 1996). Due to the data availability, however, we still use the crude mortality rate as a health measurement.

Maternal mortality rate. We also collected the maternal mortality rate across the provinces and the time period to represent the health status of the population. The maternal mortality rate is defined as the number of maternal deaths related to childbearing divided by the number of live births in that year. It has long been used as a marker of the health of a population (Graham, Fitzmaurice et al. 2004). Reducing maternal mortality is one of the health goals in the United Nations Millennium Declaration (United Nations 2000). According to the modernization and demographic transition theories, economic development leads to higher standards of living and advanced medical technology which in turn contribute to lower maternal mortality (Shen and Williamson 1999). Much of the literature on maternal mortality focuses on medical, social, and cultural causes that vary among countries and geographical

regions (Shen and Williamson 1999; Buor and Bream 2004; Graham, Fitzmaurice et al. 2004).

Hospital beds, number of doctors, and government expenditure on culture/science/education/health. In addition to health status, we also analyzed the disparity in health care resources. The reason for including health care resource variables is not only that they are easy to collect and access, but because of its importance in health policy. Health status is influenced by many social factors that are not directly under social control (Rawls 1999). Due to the lack of a direct way to influence health, many policies focus on the distribution of health care resources. The underlying hypothesis is that by increasing health care resources, the probability of people's access to health care will increase, and therefore their health status will improve. The indicators of health care resources in this study include the number of doctors per 10,000 people, the number of hospital beds per 10,000 people, and the local government's expenditure per capita on culture/science/education/health (we are unable to obtain government expenditure data on health alone).

**3.2 SES indicators (Table 2)**

Based on the theoretical frameworks of social determinants of health and health care resources, the existing literature, and data availability, we selected SES indicators including income, urbanization, employment, and education as potential determinants of health and health care resources.

Expenditure on food consumption as a percentage of total income. Income is an important measure of socioeconomic position because it relates directly to material conditions that may influence health. Adequate income has important implications for a range of material circumstances that have direct implications for health. Numerous studies have showed that there is a strong positive relationship between health status and income (Wagstaff 1986; House, Kessler et al. 1990; Lynch and Kaplan 2000). Instead of using the absolute value of income, we used the share of food consumption in total income as the potential determinant of health status. The more that people spend on food, the less that they can spend on other goods and services including investment in health. Since the living standard varies significantly province by province, we believe that the share of food consumption in total income is a more appropriate indicator to measure people's capacity to invest in health. We expect that there is negative relationship between health and the share of food consumption in total income.

It is also expected that an increase in income will lead to greater demand for health service utilization (Rosett and Huang 1973; Newhouse and Phelps 1976; Busch and Dale 1978). Therefore it is expected that there will be more health care resources located in regions with a lower share of food consumption in total income (Steele and Ramlinger 1967).

Employment status. Many studies have shown that unemployment status has a significant impact on mortality, morbidity, and health-related behaviors (Kasl and Jones 2000). We used the share of employed population in the total working age

population as an indicator for employment status, and expect that it has a positive relationship with health status.

The effect of unemployment on demand for health care is uncertain. On the one hand, unemployment could lead to more health problems, and the unemployed have a lower opportunity cost to use health services, all of which could lead unemployed people to use more health services. On the other hand, since unemployed peoples lose their income and fringe benefits (such as health insurance), their capacity for using health services decreases, which could lead to less use of health services. If resource distribution is positively associated with the demand for health care, the relationship between employment status and the provision of health care could be either positive or negative.

Share of urban population**.** Urbanization could have a significant impact on health and health care resources. On the one hand, urbanized populations increase their standard of living, with better housing and sanitation systems and ease of accessing health facilities, which could improve people's health status. On the other hand, urbanized population faces new risk factors, such as air pollution and stress, which could have a negative impact on health.

It is expected that health care resource are more abundant in urban areas in than in rural areas since the demand for health care and the economic return for health care resource investments are higher in urban areas than they are in rural areas. Thus, it is expected that there is positive relationship between the share of urban population and health care resources.

Education. Education is of special interest when studying the demand for health. As in the demand for health production model, education is seen as a factor that improves the efficiency of investment in health (Grossman 1972; Wagstaff 1986). Educated people are likely to recognize the benefits of improved health. They may adopt more healthy behaviors than less educated people. Education is expected to have a positive association with health status (Guralnik, LaCroix et al. 1993; Ross and Wu 1995; Grossman and Kaestner 1997).

It is more difficult to define the relationship between education and health service utilization than the relationship between education and health. Educated people value health more, which leads them to demand more health services. However, educated people have less depreciation on health and therefore their demand for investment in health should be less than that of less-educated people. If provision is positively associated with demand for health care, the relationship between educational status and health care resources could be either positive or negative.

Economic zone. The disparities in socio-economic development across Chinese provinces are large. These disparities are caused by many factors, such as geography facts, population distribution, and especially by the "open-door" economic development policy (Xie 1991). Three economic zones were set up by the Chinese government in 1985 (Xie 1991). In the early stages of economic reform, priority was given to the Eastern coastal region. More recently the attention has turned to inland areas. In this study, we re-categorized these three economic zones into two zones: the Western area, and the Eastern and Intermediate areas, and use it as an interaction term

to examine the differences in the relationship between health and health care resources and SES across different economic zones. We expect that the relationship between health, health care resources, and SES will be different in these two economic zones.

## 4. The methods of empirical analysis

### 4.1 Estimating the disparity of health and health care resources

Based on definition of "health disparity," several generic indicators, such as range, coefficient of variance, and Gini coefficient have been considered as measurements of disparity in this study. The defect of the range is obvious; it overlooks what is going on in the intermediate groups (Wagstaff, Paci et al. 1991). The problem is that the unit of the coefficient of variance is the square of the original unit, which makes it difficult to track changes over time (Pearcy and Keppel 2002). The Gini coefficient measure is analogous to measures of income distribution in a population (Murray, Gakidou et al. 1999). However, it measures the distribution of health status across individuals in a population, not its distribution across the groups of a population (Anand, Diderichsen et al. 2001; Pearcy and Keppel 2002), although it has been suggested for measuring health disparity at a regional/country level (PAHO 2001). Instead we adopted a simple summary measure, the Index of Disparity (ID), as the indicator for measuring regional disparity in health and health care provision.

ID is a modified coefficient of variation defined as "the average of the absolute differences between rates for specific groups within a population and the overall

population rate (we used mean rate across a province as the implied reference in our study), divided by the rate for the overall population and expressed as a percentage" (Pearcy and Keppel 2002). In this study, a group is defined as one province**.**

### 4.2 Estimating the relationship between health status, health care resources, and SES

Since the data used in this study is a panel of data, we used a fixed effect model (Wooldridge 2000) to estimate the relationships between health status and health care resources and their potential determinants.

In this model, a fixed effect parameter is added in order to capture unobserved heterogeneity associated with the provinces. This model can be described by equation (1).

$$Y_{it} = \beta X_{it} + a_i + u_{it},\ t=1,2\ldots \qquad (1)$$

Here $Y_{it}$ represents health status and health care resources, $i$ represents the province, and $t$ represents the year. $X_{it}$ is vector variable representing SES variables that have a potential influence on health status and health care resources. The parameter $a_i$ is called the fixed effect factor, which captures all unobserved time-constant factors that might affect the distribution of health status and health care resources. The error term $u_{it}$ is the idiosyncratic error or time varying error. The vector of parameters to be estimated is $\beta$.

By averaging equation 1 over time, we obtain equation 2.

$$\overline{Y_i} = \beta \overline{X_i} + a_i + \overline{u_i} \quad (2)$$

The bar on the top part of the variable denotes the mean of the variable over time. $a_i$ is fixed over time and it appears in both (1) and (2). In order to eliminate the fixed effects $a_i$, we subtract (2) from (1) for each $i$ and then obtain equation (3).

$$\ddot{Y}_{it} = \beta \ddot{X}_{it} + \ddot{u}_{it}, \; t=1,2\ldots \quad (3)$$

Where the variable with "¨" is a time-demeaned data of the respective variables. Because the fixed effect is time invariant, it is removed prior to estimation in the fixed effect model. As a result, the parameters in equation (3) can be estimated using the ordinary least square (OLS) model.

## III. Empirical results

### 1. Mean level and disparity in health status

The results demonstrated that the mean level of the crude mortality rate fluctuated in 1/1,000 people range across provinces during 1980-2003. The pattern of its change is significantly different before and after 1990. Before 1990, the mean level of crude mortality rate varies year by year without a specific pattern, while it jumps from 6.1/1,000 in 1989 to 6.8/1,000 in 1990 and then displayed a stable trend of decline

from 1990 to 2003. The disparity, as measured by ID, also declined from 12.1% in 1980 to 8.6% in 2003 with a peak of 15.6% in 1983. (Table 1 and Figure 1)

The mean level of the maternal mortality rate and its ID displayed an increase before 1991 and declines afterward. The mean level of maternal mortality rate increased from 60.9/100,000 people in 1985 to 95.4/100,000 people in 1991, and then declined to 61.5/100,000 people in 2002. The ID of the maternal mortality rate increased from 49.8% in 1985 to 82.2% in 1991, and then declined to 68.9% in 2002. (Table 1 and Figure 2).

The ID of the maternal mortality rate is significantly larger than the ID of the crude mortality rate across provinces.

**2. Mean level and disparity in health care resources**

Similar to the maternal mortality rate, the mean level of hospital beds per 10,000 people and its ID displayed the same pattern, increasing before 1993 and declining afterward. The mean level of hospital beds increased from 24.3/10,000 people in 1980 to 29.1/10,000 people in 1993, and then declined to 27.5/10,000 people in 2003. The ID of the number of hospital beds increased from 26.2% in 1980 to 31.0% in 1993 and then declined to 28.0% in 2003. (Table 1 and Figure 3)

The mean level of the number of doctors per 10,000 people displayed steady increases since 1980, except for a drop in the past two years. The mean number of doctors increased from 15.7/10,000 people in 1980 to 20.8/10,000 people in 2001, with a

recent drop to 18.8/10,000 people in 2002 and 2003. The ID of the number of doctors increased from 36.6% in 1980 to 38.1% in 1982, then fluctuated during 1982 and 1995 within 1%, and then dropped to 35% since 1995. The ID of the number of doctors is larger than the ID of the number of hospital beds per 10,000 people across the provinces. (Table 1 and Figure 4)

The mean level of government spending on culture/science/education/health increased dramatically, from 18.6 Yuan per person per year in 1980 to 421.9 Yuan per person per year in 2003, an almost twenty-threefold increase in the past 24 years. The ID of government spending across provinces fluctuated in the range of 6% during 1980 and 1992, then began increase rapidly. The ID of government spending increased from 34.6% in 1992 to 51.9% in 2003 (Table 1 and Figure 5/6).

**3. The changes in socioeconomic status**

SES steadily improved across all selected SES indicators with the exception of the percentage of employed urban population. The mean share of food consumption in total income in rural populations across provinces declined from 61% in 1980 to 45.7% in 2003. In urban populations, this figure declined from 57.5% in 1980 to 37.7% in 2003. The mean percentage of the urban population across provinces increased from 24.1% in 1980 to 32.6% in 2003. The mean percentage of students in higher education institutes across the provinces increased from 5.6% in 1980 to 8.5% in 2003. The mean percentage of the urban population that is employed, however, declined from 63.2% in 1980 to 55.1% in 2003. Considering the variation in SES across provinces, measured by the indicator of standard deviation (SD), the variations

fluctuated and slightly declined, with the exception of the share of food consumption in total income in rural population (Table 2).

**4. The association between health and socioeconomic status**

Table 3 and 4 display the results of the fixed effects model estimations with and without the interaction effects of the economic zone variable.

Crude mortality rate. The results from the estimation without the interaction effect showed that the percentage of the population that is urban has a positive association with the crude mortality rate, which might be due to the effect of population aging in urban areas. The results from the estimation with the interaction effect showed the coefficient between the crude mortality rate and the percentage of the population that is urban in economic zone=0, which represents the Western Zone, is 0.153; while the coefficient between crude mortality rate and the percentage of the population that is urban in economic zone=1, which represent the Eastern and Intermediate Zones is only 0.006 (0.153-0.1466). This result indicates that the percentage of the population that is urban has a much larger effect on the crude mortality rate in the Western area than in the Eastern and Intermediate areas assuming that this relationship is causal.

The percentage of urban dwellers who are employed is negatively associated with the crude mortality rate in the model without an interaction effect. This negative association, however, is only statistically significant for the interaction variable of percentage of urban dwellers who are employed and economic zone=1, which indicates that this relationship may only exist in the Eastern and Intermediate areas.

The variable of percentage of student in higher education institutes displayed a negative association with the crude mortality rate, which demonstrates the potential effect of education on the crude mortality rate. This negative association is stronger in the Western area than in the Eastern and Intermediate areas. The results from the estimation with the interaction effect yielded a coefficient between the crude mortality rate and the percentage of students enrolled in higher education in economic zone=0 is –0.3086, while this coefficient in economic zone=1 is only –0.0556 (–0.3086+0.253).

We expected that the percentage of income spent on food consumption would have a positive relationship with the crude mortality rate since the more that people spend on food the less that they can spend on other goods and services, including investment in health. As expected this relationship is positive in the Western area. However, this relationship is negative in the Eastern and Intermediate areas. The results from the estimation with the interaction effect yielded a coefficient between crude mortality rate and the percentage of food consumption total income in urban population in economic zone=0 is 0.0387. However this coefficient in economic zone=1 is –0.0008 (0.0387–0.0395).

Maternal mortality rate. There are few significant results in the maternal mortality model. As we expected, the percentage of food consumption in total income in urban area is positively correlated with maternal mortality in the model without interaction effects. In the model with interaction effects, both percentage of food consumption in

total income in rural and urban areas are all positively correlated with maternal mortality in the Western area.

**5. The association between health care resources and socioeconomic status**

In the three health care resources models, most SES indicators displayed the expected association with health care resources indicators in the models that do not take interaction effects into account (Table 3). For example, percentage of income spent on food consumption in urban areas displayed a negative relationship with the number of doctors per 10,000 people and also with government spending on culture/education/science/health per capita. Both the percentage of the urban population and percentage of the urban population that is employed displayed positive relationships with all three health care indicators. The percentage of students enrolled in higher education displayed a positive association with the number of hospital beds and government spending. However, it displayed an unexpected negative association with the number of doctors per 10,000 people.

In the model that takes into account interaction effects (Table 4), the percentage of food consumption in total income in urban area is negatively associated with all three health care resource indicators, except between percentage of income spent on food consumption in urban areas and the number of hospital beds per 10,000 people in the Western area. The variable of percentage of the population that is urban is positively associated with number of hospital beds in all areas. However this positive relationship is much stronger in the Western area than in the Eastern and Intermediate areas. The coefficient between the number of hospital beds and the percentage of the

population that is urban in economic zone=0 is 0.8841, while this coefficient in economic zone=1 is only 0.324 (0.8841–0.5601). As expected, the percentage of the population that is urban has a positive association with number of doctors in the Eastern and Intermediate areas. However, it displayed a negative association with number of doctors in the Western area.

The percentage of urban dwellers who are employed displayed the expected positive relationship with all three health care resources indicators. The percentage of students enrolled in higher education, however, displayed a mixed picture. As expected, the percentage of students enrolled in higher education has a strong, positive association with government spending on culture/education/science/health. It also displayed a positive association with the number of beds in the Eastern and intermediate areas (coefficient=0.8589–5849). However, it displayed a negative association with the number of beds in the Western area. It also displayed negative association with the number of doctors in all areas.

## IV. Discussion and Policy Implications

There is growing concern about the disparities in health and health care resources in China. Many studies have shown that along with the increases in disparities in socioeconomic development across the regions, disparities in health status and health care resources across the regions, such as urban vs. rural and rich vs. poor regions, have also increased. In this study we investigated trends over the past 23 years in the disparity of health status, as measured by the crude mortality rate and maternal mortality rate, and health care resources, as measured by the number of hospital beds

and number of doctors per 10,000 people and government investment per capita in culture/science/education/health, across all provinces in China. We also explored the relationships between several SES factors and health and health care resources. Two major findings are discussed here.

**1. The disparity of health status and health care resources increased and then declined in most recent years**

The results from this study showed that the disparity in health status and health care resources increased after economic reform. This conclusion comes from the analysis of the maternal mortality rate, the number of hospital beds per 10,000 people, and government spending on culture/science/education/health.

The trend in the maternal mortality rate has two distinct periods, with increases from 1985-91 and then a decline after 1991. It is worth noting that although the mean maternal mortality declined after 1991, its value in 2002 is still slightly higher than the values during 1985-88, which were the lowest during the period considered in this study. Similar to the maternal mortality rate, the disparity in maternal mortality across provinces also displayed two distinct periods, with increases during 1987-91 and then a decline after 1991. Again, although disparity declines after 1991 its value in 2002 is still higher than the value in 1985. The ID of maternal mortality rate is 68.9% in 2002, while this figure is only 49.8% in 1985. Therefore both maternal mortality and its disparity across the provinces increased after the economic reform.

The results of this study show that the mean number of hospital beds and mean number of doctors increased after the economic reform. Their mean values increased to peak values in 1994-95 and then began to decline. The mean numbers of bed and doctors were 27.5 and 18.8 per 10,000 people respectively in 2003, which is higher than their values in 1980. The disparity in the number of doctors declined slightly after economic reform. Contrary to the number of doctor, the disparity in the number of hospital beds increased during 1980-93, and declined after 1993. The ID of the number of hospital beds is 28%, which is still higher than 1980 (26.2%).

Government spending on culture/science/education/health displayed dramatic changes in terms of both mean value and its disparity across the provinces. The mean government spending on culture/science/education/health increased from 18.6 Yuan per capita in 1980 to 421.9 Yuan per capita in 2003, an almost a twenty-threefold increase in the past 24 years. Unlike the number of hospital beds, the disparity in government spending on culture/science/education/health did not increase until 1992. However, it showed a rapid increase since 1992. Its ID increased from 34.6% in 1992 to 51.9% in 2003.

Unlike maternal mortality, we find that the crude mortality rate stabilized and even slightly increased in the past 23 years, which is consistent with the previous findings (Fang 1993). One of the explanations for this is the aging of the population. With the birthrate and mortality rate declining and life expectancy increasing, the aging of the population accelerated after the economic reform. The percentage of people over 65 years old increased from 4.9% in 1982 to 7.0% in 2000 (China Statistical Bureau 2001). Estimates suggest this figure will climb to 14%, which is similar to Japan's

current status, in 25 years (Chen 2002). With the increase of aging population, the crude mortality rate, which is not adjusted by the age structure, will increase. The findings from this study also showed that the disparity, as measured by ID, has decreased dramatically since the economic reform. This reduction in disparity in the crude mortality rate can be also partially explained by demographic changes. A great deal of evidence showed the natural growth rate of the population is usually higher in underdeveloped regions than it is in developed regions. The age structure in underdeveloped regions, therefore, is younger than that in developed region. Thus, the crude mortality rate might be even lower in underdeveloped regions than in developed regions due to age structure differences. Therefore, the disparity in crude mortality rate across the region might be declining due the age structure effects.

**2. SES has significant association with the disparities of health status and health care resources distribution**

Our results are consistent with the neo-material theory of health. We find that, on average, a higher percentage of total income spent on food in both urban and rural areas is positively associated with a high crude mortality rate and maternal mortality rate in the Western area. We also find that education is negatively associated with the crude mortality rate. This effect is stronger in the Western area than in the Eastern and Intermediate areas. The percentage of urban employed, however, is negatively associated with crude mortality only in the Eastern and Intermediate areas. These results suggest that income and education have relative larger effects on health status in the Western regions, while employment has a relatively larger effect on health status in the Eastern and Intermediate regions, if these relationships are causal.

Most SES indicators have a strong relationship with health care resources. For example, in the models without interaction effects, the percentage of total income spent on food in urban area displayed a negative association with the number of doctors per 10,000 people and government spending on culture/education/science/health per capita. Both the percentage of the population that is urban and the percentage of the urban population that is employed displayed a positive association with all three health care resources indicators. The percentage of student enrolled in higher education displayed a positive relationship with the number of hospital beds and government spending.

If the relationships between health status and health care resources and SES described above are causal relationships, and if the current increases of disparity in SES cannot be reversed, the disparity of health status and health care resources across provinces might increase further.

This study has several limitations. First, the crude mortality rate that we used is not age-adjusted. It is also not available in terms of the variable of population age structure, which might allow us to adjust the crude mortality in the multiple regression analysis. Therefore, the change in crude mortality rate may not represent the change in health status of the population accurately. Secondly, due to availability, we are not able to get the government spending data on health alone. Therefore we used the government spending on culture/science/education/health as a proxy, which might not be a valid proxy variable for government spending on health if governments' spending on culture, science, education, and health have not increased or decreased in

the same direction. Thirdly, the model R-squares are relatively small, especially for the model of maternal mortality, which implies that we might be missing variables that are very important to the distribution of health status and health care resources due to data availability.

Given these limitations, this study provided critical evidence that the improvement in a population's health status slowed down and the disparity in population's health status increased after China adopted market-oriented economic reform. These findings are consistent with other studies described in the introduction.

Although the stagnation of health improvement and the widening in health disparities in China are widely recognized, there are no short-term remedies. At the invitation of the Chinese government, the World Bank has begun a comprehensive sector study on China's rural health care system (The World Bank 2005). The initial results of this study displayed that system-wide weaknesses, such as high medical cost, low insurance coverage, inappropriate incentive for providers, and a lack of government intervention lead to the health inequity in the population (The World Bank 2005). Therefore health care system reform is one of the critical approaches for further improving the Chinese population health status.

First, in addition to the sector approach, broader social policies have to be considered to improve overall population health and reduce disparities in health status. First of all, the social value of "equity" should be reinforced. With the economic transition, social values have also changed. Disparity in income, as well as disparities in other aspects of society such as accessing health care and population health, has become a normal

and acceptable phenomenon. Therefore, social value development should be the first step in making effective value-based policies (Whitehead, Dahlgren et al. 2001).

Second, the goals of improving population health status should be integrated into broad economic and social development policy. Population health is the result of multiple determinants. As discussed in the previous section, the disparity in socioeconomic development is one of most important factors leading to the disparity in population health and health care resources. Therefore, measures to reduce disparities in population health relies on a sustainable economic and social development must be balanced with great efficiency and reasonable equity (Wang 2004).

Third, a transfer payment mechanism from the rich to the poor is critical to reduce the disparities in health care access and health status across different populations in China. Market competition creates winners and losers. The winners obtain more resources to enjoy goods and services provided by the market, and better health status. The losers, however, obtain few resources to access basic goods and services provided by the market, and do not enjoy better health status. A transfer payment mechanism from the rich to the poor and from more developed regions to less developed regions could effectively reduce the disparity in socioeconomic status and health status across different population in China.

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**Table 1. Means and their index of disparities of health and health care indicators across provinces in China, 1980-2003**

| Year | Crude mortality rate (per 1,000) | | | Maternal mortality rate (per 100,000) | | | Number of beds (per 10,000) | | | Number of doctors (per 10,000) | | | Govt. spending* (per capita, Yuan) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | SD | ID | Mean | SD | ID | Mean | SD | ID | Mean | SD | ID | Mean | SD | ID |
| 1980 | 6.2 | 0.9 | 12.1 | . | . | . | 24.3 | 8.3 | 26.2 | 15.7 | 7.7 | 36.6 | 18.6 | 8.8 | 37.2 |
| 1981 | 6.3 | 1.0 | 12.3 | . | . | . | 24.4 | 8.2 | 26.2 | 16.6 | 8.5 | 37.9 | 20.1 | 9.6 | 37.7 |
| 1982 | 6.2 | 1.0 | 12.0 | . | . | . | 24.4 | 7.8 | 25.8 | 17.0 | 8.8 | 38.1 | 23.1 | 11.1 | 38.5 |
| 1983 | 6.4 | 1.3 | 15.6 | . | . | . | 25.1 | 8.7 | 27.6 | 17.3 | 9.1 | 38.1 | 26.2 | 13.1 | 39.8 |
| 1984 | 6.0 | 1.1 | 13.5 | . | . | . | 25.5 | 8.9 | 28.0 | 17.5 | 9.2 | 37.9 | 31.1 | 16.9 | 41.7 |
| 1985 | 6.0 | 1.2 | 13.8 | 60.9 | 41.8 | 49.8 | 25.8 | 8.8 | 28.1 | 17.7 | 9.2 | 37.6 | 36.4 | 18.3 | 40.2 |
| 1986 | 6.1 | 1.0 | 10.9 | 58.6 | 37.4 | 43.4 | 26.3 | 9.2 | 28.8 | 18.0 | 9.4 | 38.0 | 42.8 | 21.4 | 38.4 |
| 1987 | 6.3 | 1.1 | 13.5 | 58.2 | 39.9 | 40.3 | 27.1 | 9.6 | 29.3 | 18.2 | 9.7 | 38.2 | 45.1 | 23.5 | 38.2 |
| 1988 | 5.8 | 0.8 | 10.4 | 60.3 | 45.9 | 45.5 | 27.8 | 10.0 | 29.8 | 19.6 | 10.2 | 38.1 | 53.7 | 26.4 | 36.2 |
| 1989 | 6.1 | 0.8 | 10.7 | 65.8 | 61.2 | 56.7 | 28.3 | 10.4 | 29.8 | 20.3 | 10.4 | 37.7 | 59.6 | 29.5 | 36.1 |
| 1990 | 6.8 | 0.8 | 9.7 | 88.8 | 136.2 | 78.6 | 28.3 | 10.8 | 30.9 | 20.3 | 10.4 | 36.9 | 65.1 | 33.1 | 36.2 |
| 1991 | 6.7 | 1.0 | 11.8 | 95.4 | 158.0 | 82.2 | 28.6 | 11.0 | 31.0 | 20.4 | 10.5 | 37.6 | 70.0 | 35.3 | 35.6 |
| 1992 | 6.7 | 0.9 | 10.0 | 90.6 | 123.2 | 71.3 | 28.9 | 11.2 | 30.8 | 20.4 | 10.4 | 37.1 | 80.4 | 39.3 | 34.6 |
| 1993 | 6.6 | 0.9 | 10.7 | 85.3 | 115.4 | 73.6 | 29.1 | 11.3 | 31.0 | 20.5 | 10.5 | 37.3 | 96.2 | 50.9 | 36.2 |
| 1994 | 6.7 | 0.8 | 8.4 | 70.9 | 66.6 | 60.3 | 29.2 | 11.4 | 30.8 | 20.7 | 10.4 | 37.0 | 125.4 | 69.9 | 39.2 |
| 1995 | 6.5 | 0.9 | 9.8 | 72.5 | 63.1 | 62.7 | 29.0 | 11.3 | 30.4 | 21.1 | 11.2 | 37.9 | 143.5 | 91.2 | 43.3 |
| 1996 | 6.6 | 0.8 | 8.8 | 80.0 | 80.0 | 67.7 | 28.8 | 11.4 | 30.7 | 20.5 | 9.7 | 35.7 | 168.7 | 119.8 | 47.4 |
| 1997 | 6.5 | 0.8 | 9.0 | 74.1 | 68.7 | 62.8 | 28.7 | 11.3 | 30.2 | 20.6 | 9.7 | 35.8 | 186.0 | 142.7 | 48.1 |
| 1998 | 6.5 | 0.8 | 9.2 | 75.8 | 83.7 | 69.9 | 28.7 | 11.2 | 29.2 | 20.4 | 9.5 | 35.9 | 212.9 | 163.3 | 50.0 |
| 1999 | 6.4 | 0.7 | 9.2 | 75.9 | 103.6 | 71.1 | 27.8 | 11.2 | 29.9 | 21.2 | 11.3 | 39.7 | 233.9 | 183.1 | 49.7 |
| 2000 | 6.1 | 0.7 | 8.0 | 68.9 | 85.5 | 69.4 | 27.5 | 11.1 | 28.5 | 20.5 | 9.4 | 35.0 | 258.6 | 208.4 | 49.6 |
| 2001 | 6.1 | 0.6 | 8.3 | 59.8 | 63.0 | 64.2 | 27.6 | 11.4 | 29.2 | 20.8 | 9.6 | 35.7 | 320.5 | 254.1 | 49.2 |
| 2002 | 6.1 | 0.7 | 8.5 | 61.5 | 74.6 | 68.9 | 27.8 | 12.2 | 28.6 | 18.8 | 9.0 | 33.9 | 367.9 | 284.5 | 49.0 |
| 2003 | 6.1 | 0.7 | 8.6 | . | . | . | 27.5 | 11.2 | 28.0 | 18.8 | 9.4 | 35.6 | 421.9 | 338.5 | 51.9 |

* Government spending includes spending on Culture/Science/Education/Health.

**Table 2. The descriptive analysis of socioeconomic status**

| year | % food consumption in rural population | | % food consumption in urban population | | % urban population | | % employed urban population | | % students in higher education institutes | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| 1980 | 61.0 | 4.8 | 57.5 | 3.2 | 24.1 | 18.1 | 63.2 | 13.7 | 5.6 | 2.1 |
| 1981 | 59.4 | 5.3 | 57.6 | 3.8 | 24.3 | 18.1 | 64.2 | 13.8 | 4.9 | 1.9 |
| 1982 | 60.2 | 5.2 | 58.5 | 3.3 | 24.5 | 18.1 | 64.7 | 13.5 | 4.6 | 1.8 |
| 1983 | 60.8 | 9.2 | 59.1 | 3.1 | 24.8 | 18.1 | 64.7 | 12.9 | 4.5 | 1.7 |
| 1984 | 60.7 | 9.2 | 57.2 | 2.8 | 25.4 | 18.1 | 64.2 | 12.5 | 4.8 | 1.7 |
| 1985 | 57.9 | 6.3 | 52.6 | 4.1 | 26.2 | 17.9 | 63.6 | 12.0 | 4.9 | 1.8 |
| 1986 | 56.8 | 6.4 | 53.3 | 4.0 | 26.4 | 17.8 | 63.7 | 11.5 | 5.2 | 1.8 |
| 1987 | 56.1 | 6.2 | 53.9 | 2.8 | 27.3 | 18.3 | 62.8 | 11.7 | 5.1 | 1.8 |
| 1988 | 54.0 | 6.5 | 52.0 | 4.4 | 27.2 | 17.7 | 63.3 | 10.9 | 4.9 | 1.7 |
| 1989 | 54.3 | 5.8 | 55.4 | 3.6 | 27.5 | 17.8 | 62.1 | 10.5 | 4.7 | 1.6 |
| 1990 | 57.7 | 6.4 | 55.2 | 4.1 | 27.4 | 17.8 | 62.2 | 10.5 | 4.6 | 1.5 |
| 1991 | 56.4 | 6.5 | 54.5 | 4.0 | 27.6 | 17.8 | 63.6 | 11.0 | 4.6 | 1.5 |
| 1992 | 56.5 | 6.9 | 53.0 | 3.5 | 28.0 | 17.7 | 63.1 | 10.7 | 4.7 | 1.5 |
| 1993 | 55.1 | 9.1 | 50.6 | 4.0 | 28.5 | 17.6 | 63.0 | 11.0 | 4.7 | 1.5 |
| 1994 | 57.9 | 7.4 | 50.3 | 3.6 | 29.1 | 17.4 | 61.9 | 11.2 | 4.9 | 1.5 |
| 1995 | 58.1 | 7.8 | 51.0 | 3.8 | 29.5 | 17.4 | 61.4 | 10.3 | 5.2 | 1.6 |
| 1996 | 54.9 | 12.2 | 49.7 | 4.1 | 29.9 | 17.3 | 60.9 | 9.9 | 5.5 | 1.7 |
| 1997 | 54.7 | 7.3 | 47.4 | 3.8 | 30.2 | 17.1 | 59.7 | 9.7 | 5.7 | 1.8 |
| 1998 | 54.6 | 6.5 | 45.4 | 3.8 | 30.5 | 17.1 | 57.2 | 10.1 | 5.9 | 1.9 |
| 1999 | 53.2 | 7.1 | 42.6 | 3.8 | 30.4 | 17.1 | 55.8 | 10.4 | 6.5 | 1.7 |
| 2000 | 50.2 | 8.2 | 39.8 | 3.8 | 31.1 | 16.8 | 56.0 | 16.1 | 6.9 | 1.6 |
| 2001 | 48.4 | 6.8 | 38.4 | 3.5 | 31.9 | 17.4 | 52.1 | 10.6 | 7.5 | 1.6 |
| 2002 | 46.4 | 6.8 | 37.7 | 3.5 | 31.5 | 15.7 | 53.7 | 11.1 | 8.0 | 1.7 |
| 2003 | 45.7 | 7.0 | 37.7 | 3.5 | 32.6 | 16.3 | 55.1 | 9.8 | 8.5 | 1.6 |

**Table 3. Association between health and socioeconomic status (without the interaction effect of economic zone variable)**

| Variable | Crude mortality (per 1,000) | Maternal mortality (per 100,000) | Number of bed (per 10,000) | Number of Doctor (per 10,000) | Govt. spending (per capita, Yuan) |
|---|---|---|---|---|---|
| % food consumption in rural | -0.0029 | 0.4141 | -0.02 | 0.0093 | -0.4669 |
| | (0.0047) | (0.4213) | (0.0272) | (0.0286) | (0.7351) |
| % food consumption in urban | 0.0059 | 1.0986 | -0.0225 | -0.2189 | -6.7751 |
| | (0.0056) | (0.5311)** | (0.0326) | (0.0343)*** | (0.8812)*** |
| % urban population | 0.0133 | 0.2052 | 0.3475 | 0.1826 | 5.4259 |
| | (0.0068)** | (0.6988) | (0.0391)*** | (0.0412)*** | (1.0575)*** |
| % urban employed | -0.0073 | -0.2617 | 0.1319 | 0.0647 | 2.4629 |
| | (0.0040)* | (0.3486) | (0.0232)*** | (0.0244)*** | (0.6278)*** |
| % student in high education | -0.077 | 1.0483 | 0.255 | -0.8648 | 57.3865 |
| | (0.0243)*** | (2.4185) | (0.1407)* | (0.1483)*** | (3.8101)*** |
| Constant | 6.6116 | -4.4601 | 10.0762 | 25.7216 | -119.5148 |
| | (0.5413)*** | (50.5848) | (3.1277)*** | (3.2948)*** | (84.8107) |
| Observations | 609 | 459 | 608 | 608 | 602 |
| Number of provinces | 28 | 28 | 28 | 28 | 28 |
| R-squared | 0.04 | 0.02 | 0.18 | 0.13 | 0.68 |

Standard errors in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%.

Note: Government spending includes spending on Culture/Science/Education/Health.

**Table 4. Association relationship between health and socioeconomic status (with the interaction effects of economic zone variable)**

| Variable | Crude mortality (per 1,000) | Maternal mortality (per 100,000) | Number of beds (per 10,000) | Number of doctors (per 10,000) | Govt. spending (per capita, Yuan) |
|---|---|---|---|---|---|
| % food consumption in rural | -0.0038 | 1.9422 | -0.082 | -0.0398 | 2.1933 |
| | (0.0123) | (1.1063)* | (0.0725) | (0.0747) | (2.0041) |
| % food consumption in rural*Econ=1 | 0.0004 | -1.805 | 0.0753 | 0.0336 | -3.6627 |
| | (0.0133) | (1.1976) | (0.0781) | (0.0804) | (2.1537)* |
| % food consumption in urban | 0.0387 | 2.1458 | 0.1811 | -0.2879 | -11.4091 |
| | (0.0109)*** | (0.9503)** | (0.0640)*** | (0.0659)*** | (1.7501)*** |
| % food consumption in urban*Econ=1 | -0.0395 | -1.7562 | -0.2636 | 0.0536 | 6.6508 |
| | (0.0127)*** | (1.1657) | (0.0746)*** | (0.0768) | (2.0360)*** |
| % urban population | 0.153 | 1.5908 | 0.8841 | -0.4489 | 6.61 |
| | (0.0340)*** | (3.8812) | (0.2007)*** | (0.2066)** | (5.5199) |
| % urban population*Econ=1 | -0.1466 | -1.4385 | -0.5601 | 0.6462 | -1.3984 |
| | (0.0347)*** | (3.9457) | (0.2045)*** | (0.2105)*** | (5.6215) |
| % urban employed | 0.0157 | -0.8025 | 0.1772 | -0.1026 | 3.5848 |
| | (0.0103) | (1.0424) | (0.0606)*** | (0.0624) | (1.7164)** |
| % urban employed*Econ=1 | -0.0236 | 0.6992 | -0.0332 | 0.1818 | -1.5977 |
| | (0.0111)** | (1.1117) | (0.0656) | (0.0676)*** | (1.8462) |
| % student in high education | -0.3086 | -0.0713 | -0.5849 | -2.5502 | 28.2149 |
| | (0.0599)*** | (5.9901) | (0.3533)* | (0.3637)*** | (9.8045)*** |
| % student in high education*Econ=1 | 0.253 | -0.5268 | 0.8589 | 1.8833 | 36.6977 |
| | (0.0654)*** | (6.6151) | (0.3854)** | (0.3968)*** | (10.6601)*** |
| Constant | 5.6706 | -6.0843 | 7.2595 | 35.2447 | -132.6392 |
| | (0.6353)*** | (61.8251) | (3.7553)* | (3.8664)*** | (101.2306) |
| Observations | 609 | 459 | 608 | 608 | 602 |
| Number of provinces | 28 | 28 | 28 | 28 | 28 |
| R-squared | 0.13 | 0.04 | 0.22 | 0.21 | 0.69 |

Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.

The individual variable of economic zone dropped in the result since it is constant variable over time.

Government spending includes spending on Culture/Science/Education/Health.

Figure 1. Crude mortality and its ID in China, 1980-2003

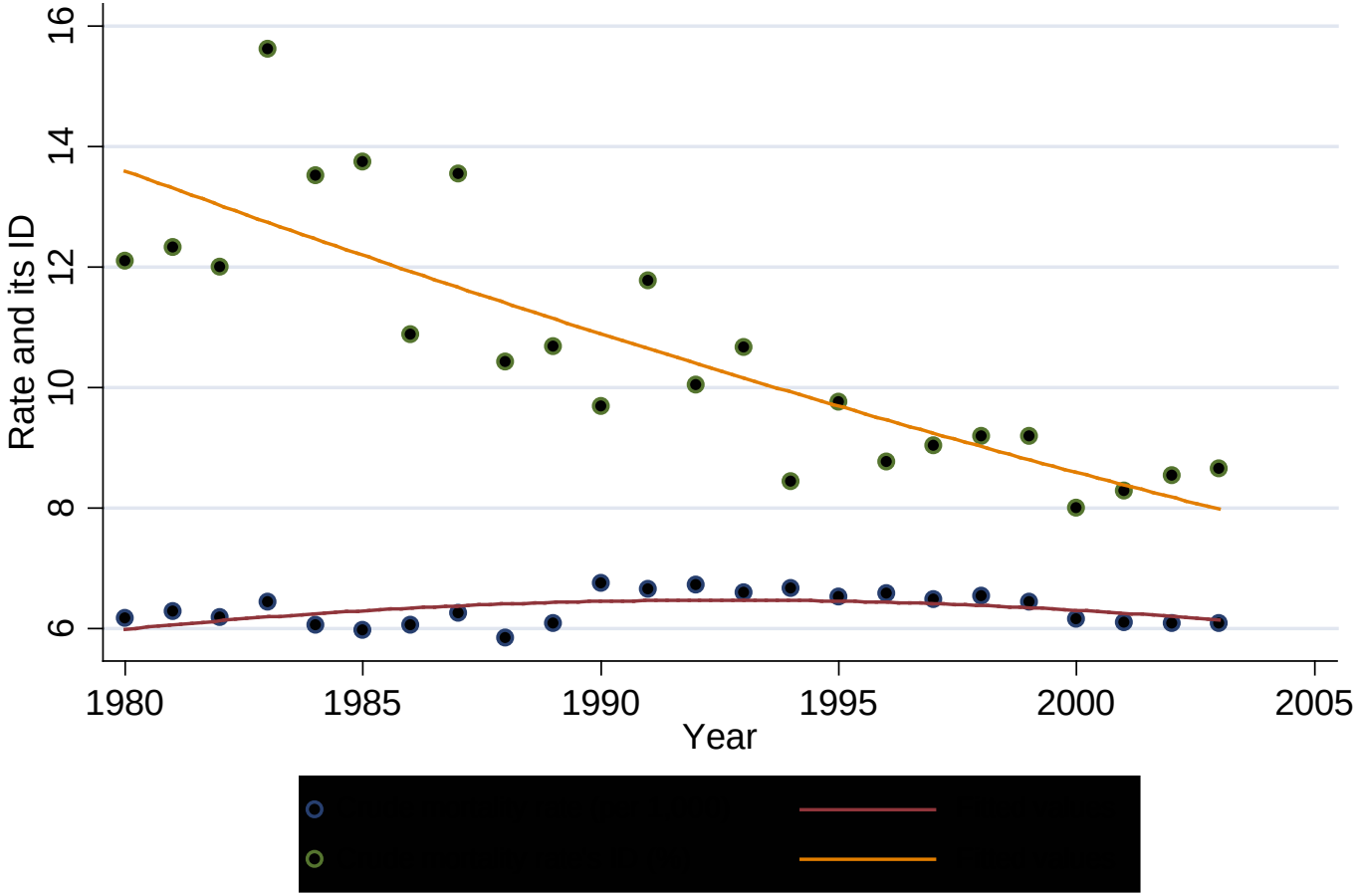

Figure 2. Maternal mortality and its ID in China, 1985-2002

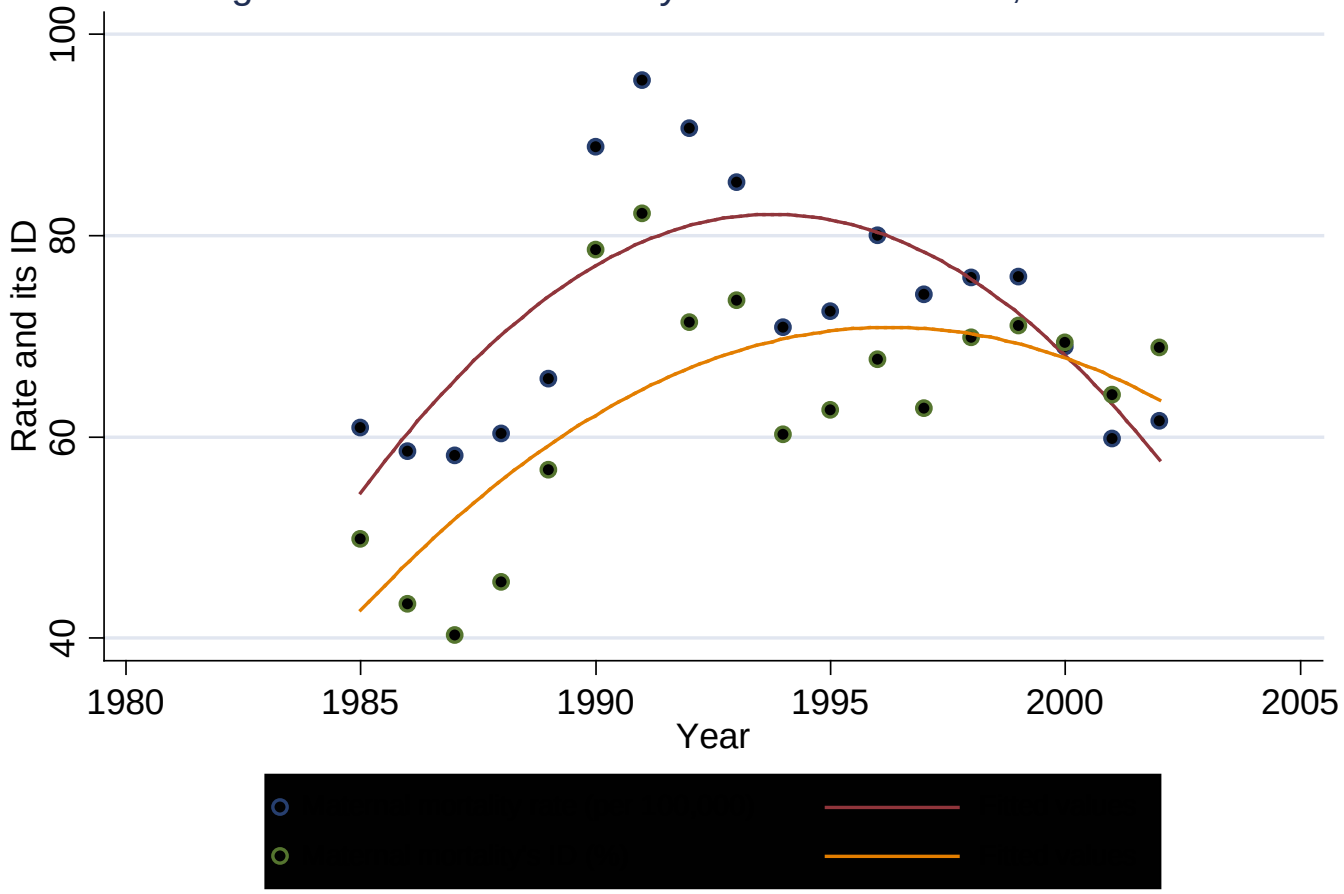

Figure 3. Mean number of hospital beds and its ID in China, 1980-2003

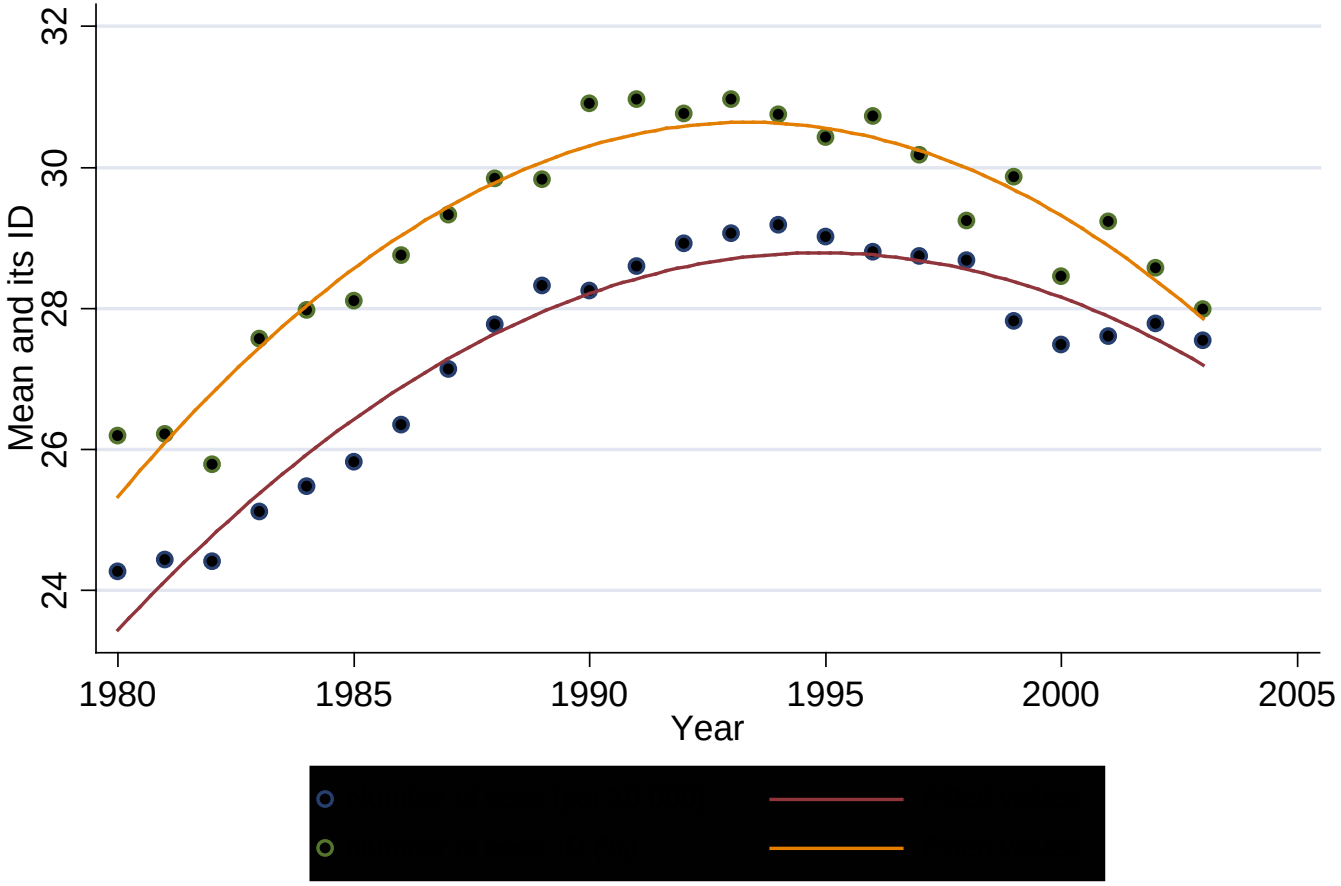

Figure 4. Mean number of doctors and its ID in China, 1980-2003

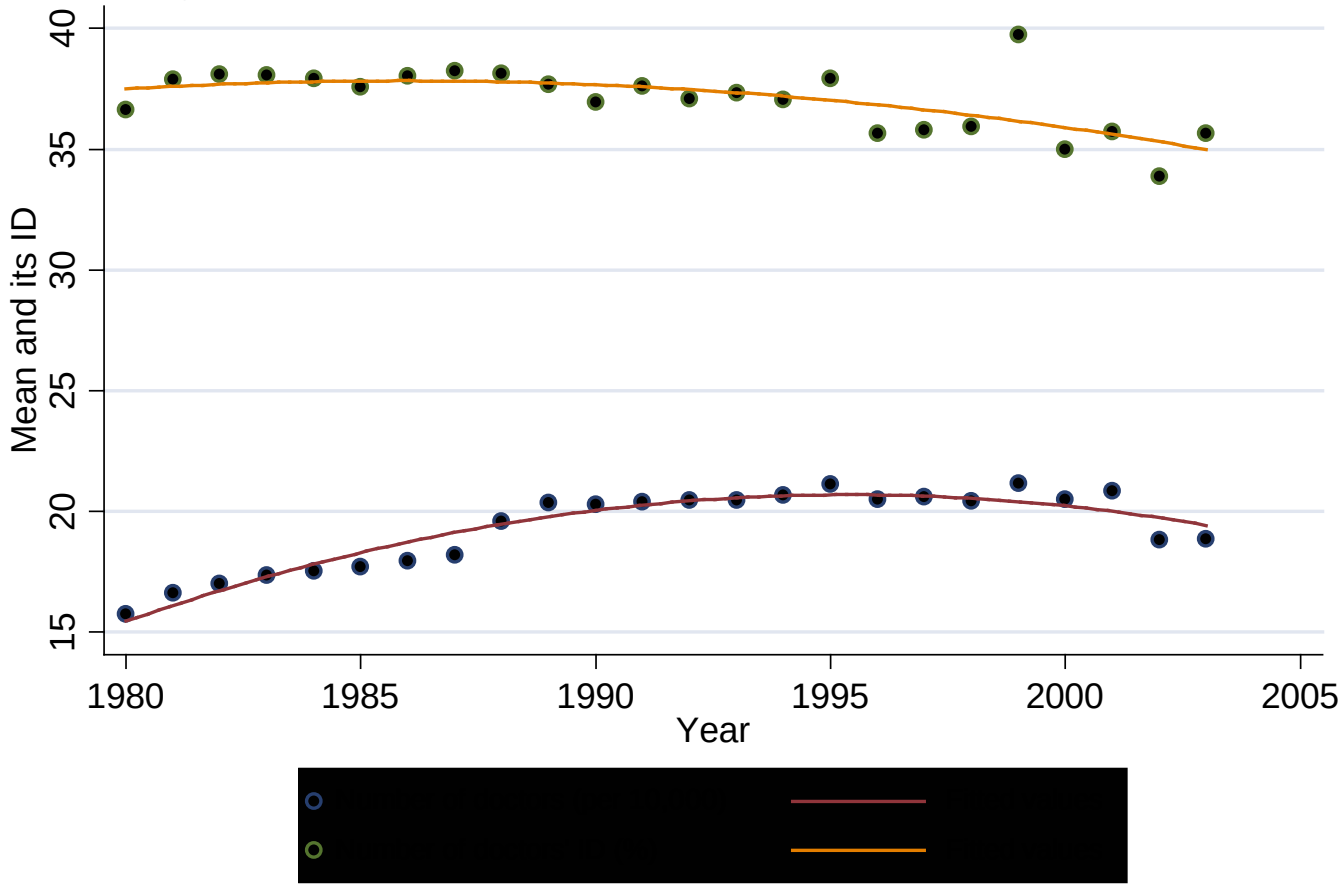

Figure 5. Mean government spending on culture/education/science/health in China, 1980-2003

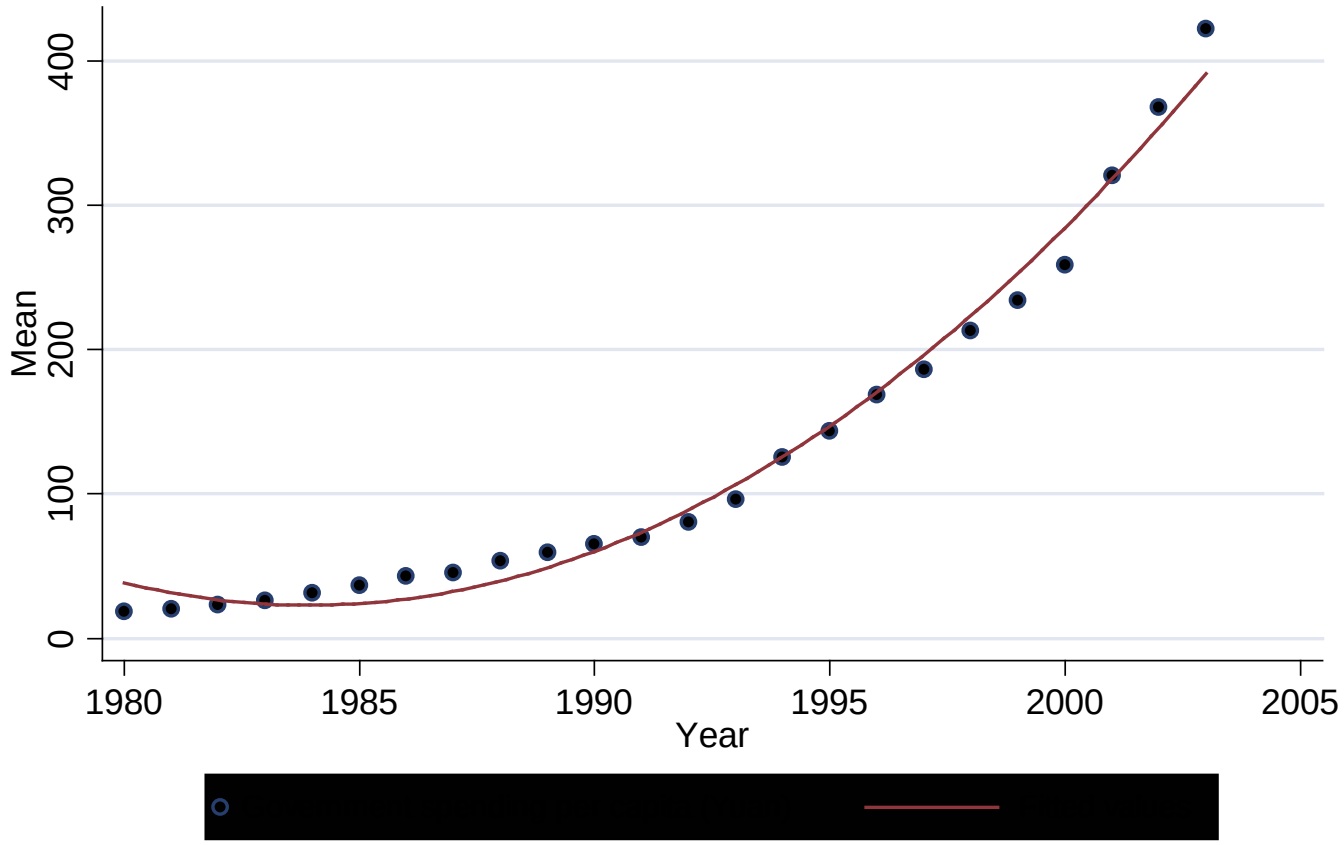

Figure 6. ID of mean government spending on culture/education/science/health in China, 1980-2003