Supplementary Information

The Government Plays a Critical Role in the Containment of COVID-19: Lessons from China

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Methods

Estimation sample

Our estimation sample contains 332 prefecture-level cities in China and spans a period of 3 months, from January to late March. This period contains ten weeks in total, immediately following the Wuhan lockdown.

Regression specifications

Our analysis exploits variations in city-specific government management capability measures and examines how they are linked to variations in the effectiveness of COVID-19 control. Specifically, we estimate the following regression model on a weekly basis:

$$y_{it} = \beta_0 + \beta_1 Gov_i + X_i\Gamma + \varepsilon_{it},$$

where outcome variables y_{it} are the number of new cases and the number of new recoveries in city i for week t. These numbers have been recorded daily by the National Health Commission of China since January 2020; we aggregate the data into weekly frequency. Recovery rate is defined as cumulative total recoveries over the cumulative number of closed cases (recoveries plus deaths).

Explanatory variables include a set of city-specific, time-invariant determinants of the spread and control of COVID-19. Those of our particular interest are a variety of government management capacity measures, Gov_i for city i, drawn from the 2019 Global Urban Competitiveness Yearbook. Other important determinants are population age structure, connection with Wuhan, and the local health system's capacity. The construction and data sources of these variables are discussed later in detail.

Additional control variables X_i include the share of Wuhan-origin residents, total population, employment rate, percentage of population with a college degree, and an indicator variable for municipality. For recoveries, regressions also control for the number of closed cases in that week. Conditional on these variables, estimated coefficients from the regressions reflect the effects of the determining factors of our interest during the coronavirus outbreak.

We use ordinary least squares regressions to examine the effects of government management in different phases of the outbreak, on a weekly basis. The statistical analysis is carried out using Stata 16.

Government management capacity measures: data source

We draw data on the government management index and four sub-indicators—government efficiency, capacity in law enforcement, transparency of laws and policies, and government organization size—from the 2019 Global Urban Competitiveness Yearbook. The Yearbook is published by the Chinese and Foreign Institute of City Competitiveness, the Hong Kong Gui Qiang Fang Institute of Global Competitiveness, and the World Organization for City Cooperation and Development.

Researchers from these institutes collect information from various professional yearbooks—such as the China City Statistical Yearbook—and cities' yearbooks or official websites—such as Statistical Bulletins. Based on such information, they construct various indicators of cities' competitiveness—including government management—and carry out expert evaluations to make the indicators as accurate, objective, and comparable as possible.

Government management capacity measures: construction

All data reported in the Global Urban Competitiveness Yearbook are processed following two steps. The first step is indexation of original indicators. The formula of indexation is as follows,

$$X_i = \frac{x_i - \min(x)}{\max(x) - \min(x)}$$

where X_i is indicator i's value after indexation; x_i is indicator i's initial value; $\max(x)$ and $\min(x)$ are the maximum and minimum of indicator i's initial values in the sample of cities, respectively. When an indicator has an initial value of the minimum in the sample, the value after indexation would be 0. In order not to mistake these indicators as having an initial value of 0, we convert the indexed indicator X_i to one that is evenly distributed between [10, 100], using the following formula,

$$Y_i = 90X_i + 10$$

The second step is standardization of the indexed indicators, based on the following formula,

$$z_i = \frac{Y_i - \bar{Y}}{\sigma(Y)}$$

where z_i is indicator i's value after standardization; Y_i is the indexed indicator that is evenly distributed between [10, 100]; $\bar{Y}$ and $\sigma(Y)$ are the mean and standard deviation of Y_i, respectively. After standardization, each indicator has a mean of 0 and a standard deviation of 1.

In constructing various indicators of the competitiveness of cities, sub-level indicators are first processed following the two steps. Then each aggregate indicator is obtained based on its sub-level indicators by conducting a principal component analysis. That is, after sub-indicators are indexed and standardized, and a weighted value is obtained as the aggregate indicator, which is then indexed and standardized.

In particular, for the aspect of government management, the indicator of government efficiency, that of capacity in law enforcement, that of transparency of laws and policies, and that of government organization size are first indexed and standardized; then the government management index is constructed on the basis of the values of these sub-indicators (plus some other subjective measures) based on the technique of principal component analysis.

Other determinants of the COVID-19 spread

In our study, other important determinants of the spread and control of COVID-19 are population age structure, connection with Wuhan, and the local health system's capacity. Data on population age structure (the elderly, children, and working-age population as a percentage of total population) are from the 2015 China population mini-census. Based on an index of the size of daily population flow that proxies for the total intensity of migration out of Wuhan to other cities, provided by Baidu Migration, we construct a variable by calculating the average of the migration index over 14 days before the lockdown of Wuhan. We also consider the share of Wuhan-origin residents in the city, using data from the census. Health system capacity is proxied by the total number of hospital beds in the city and the total number of hospital employees, based on data from the 2019 China City Statistical Yearbook.

Table S1 in supplementary information presents the definitions and summary statistics of the above-mentioned variables.