Interactive Governance Between and Within Governmental Levels and Functions: A Social Network Analysis of China’s Case Against COVID-19

Dongmin Yao¹, Jing Li¹, Yijing Chen¹, Qiunan Gao¹ and Wenhong Yan¹

Abstract
COVID-19 has created long-lasting yet unprecedented challenges worldwide. In addition to scientific efforts, political efforts and public administration are also crucial to contain the disease. Therefore, understanding how multi-level governance systems respond to this public health crisis is vital to combat COVID-19. This study focuses on China and applies social network analysis to illustrate interactive governance between and within levels and functions of government, confirming and extending the existing Type I and Type II definition of multi-level governance theory. We characterize four interaction patterns—vertical, inter-functional, intra-functional, and hybrid—with the dominant pattern differing across governmental functions and evolving as the pandemic progressed. Empirical results reveal that financial departments of different levels of government interact through the vertical pattern. At the same time, intra-functional interaction also exists in provincial financial departments. The supervision departments typically adopt the inter-functional pattern at all levels. At the cross-level and cross-function aspects, the hybrid interaction pattern prevails in the medical function and plays a fair part in the security, welfare, and economic function. This study is one of the first to summarize the interaction patterns in a multi-level setting, providing practical implications for which pattern should be applied to which governmental levels/functions under what pandemic condition.

Keywords
multi-level governance, COVID-19, public health crisis, China, social network analysis

Date received: 3 March 2021; final manuscript received: October 24, 2021; accepted: 25 October 2021

COVID-19 is a deadly pandemic that proliferates rapidly and unboundedly. By October 22, 2021, the WHO has announced that 223 countries and territories worldwide have reported 242,348,657 COVID-19 cases with 4,927,723 deaths. Although 6.6 billion doses of vaccine have been administered, COVID-19, especially its Delta variant, remains an unprecedented healthcare crisis. Combating the disease requires the joint effort of pharmaceutical and non-pharmaceutical interventions (NPIs). Among existing studies on NPIs against COVID-19, most have focused on evaluating the effects of NPIs. These studies survey how NPIs influence people’s behavioral patterns (Cooper et al., 2020; Jiao et al., 2020), assess how NPIs affect the proliferation and health outcome of COVID-19 (Kraemer et al., 2020; Pan et al., 2020), and comment on some aspects of NPIs (Bonaccorsi et al., 2020; Zaremba et al., 2020).

However, a review of COVID-19 NPIs by Perra (2021) suggests that the literature has understudied the contextual aspect of NPIs. The few studies that emphasize the importance of institutional arrangements or public administration practices on NPI strategies (Weible et al., 2020; Yan et al., 2020) have not delved into how the arrangements translate into anti-COVID-19 practice. Therefore, such a shortage of discussion regarding the governmental response patterns in anti-pandemic NPIs provides opportunities for further research.

This study introduces the multi-level governance (MLG) as the theoretical foundation, and hence it constructs

¹Central University of Finance and Economics, Beijing, China

Corresponding Author:
Jing Li, Room 126, Teaching Compound #10, Central University of Finance and Economics, Beijing 102206, China.
Email: 17801051019@163.com
an analytical framework that employs social network analysis (SNA) as the primary research method. The study focuses on China to analyze how an interactive governance system, comprising multiple levels and functions, responds to COVID-19 during the Wuhan Lockdown. By doing so, the study aims at identifying intergovernmental interaction patterns and sorting out which pattern should be applied by which governmental levels/functions under what circumstance.

The study may contribute to the existing public administration literature in the following ways. First, in theoretical terms, the study identifies and clarifies the ambiguities in the existing MLG literature, especially the so-called Type II MLG. The study proposes four MLG interaction patterns of public health crisis management by partially confirming and extending the existing definition of Type I and Type II MLG. Second, in methodological terms, the study proposes an analytical framework based on MLG and SNA that can be replicated in the study of other countries’ responses against COVID-19. Finally, in practical terms, this study interprets the dynamic change in the importance of various Chinese government functions and interaction patterns, providing general suggestions on which intergovernmental interactions should prevail under what pandemic condition.

**Multi-Level Governance and Social Network Analysis**

*Multi-Level Governance in Emergency/Crisis Management Studies*

Conventionally, countries use multi-level governance (MLG) to deal with emergencies such as terrorist attacks (Hu et al., 2014), natural disasters (Kapucu, 2008; Kapucu et al., 2009), climate issues (Bache et al., 2014; İrepoglu Carreras, 2019). Many countries have also adopted MLG to deal with health emergencies before COVID-19 and have achieved success in most cases (Touati et al., 2019; Wilson, 2004). Before discussing MLG’s performance on anti-COVID-19 actions, this section first reviews the original definition and classification of MLG.

MLG theory first appeared in the study of “how the EU was performing as a polity and machinery”(Kohler-Koch & Eising, 1999, p. xii; Marks, 1993). After that, it has been widely used in economics, political science, sociology, international relations, and public policy and administration (Bache & Andreou, 2013; Enderlein et al., 2010; Piattoni, 2009). MLG is defined as a governance system within which power is dispersed across government levels vertically and across sectors horizontally (Bache & Flinders, 2004; Enderlein et al., 2010; Hooghe & Marks, 2003). In order to further broaden the explanatory power of MLG theory, studies have categorized MLG as Type I and Type II according to the common political factors of many traditional governance theories (Bache & Flinders, 2015; Hooghe & Marks, 2003).

Type I MLG is based on the knowledge of federalism (Besley & Coate, 2003; Inman & Rubinfeld, 1996). A Type I framework is “system-wide, where functions are bundled, and the power-sharing is stable” (Hooghe & Marks, 2003, p. 4); the accountability can be tracked clearly, and governmental levels and entities are multiple but limited. Type II MLG is derived from neoclassical political economics and the public choice theory (Blatter J., 2001; Casella & Weingast, 1995; Frey & Eichenberger, 1999). Under Type II MLG, independent jurisdictions formed by multiple levels and entities interact, collaborate, and perform specific functions respectively, which applies to “negotiation systems with innumerable entities” (Marks, 1993, p. 392) that create flexible and adaptive governance.

The MLG systems of Type I and Type II work as a significant theoretical and practical concept within the context of multi-level decision-making. However, MLG has lost its efficacy in response to COVID-19. Many proficient MLG users, such as the EU and the US, have suffered deeply, responding insufficiently to different degrees (Anderson et al., 2020; Jalali et al., 2020; Tang & An, 2020). This phenomenon was foreseen by scholars based on influenza pandemics as early as 2011, but why is it so?

Brattberg and Rhinard (2011) already predicted that the MLG adopted by the EU and the US would create at least three pandemic preparedness troubles making it difficult to carry out effective MLG: domestic operation, inter-state coordination, and international cooperation. From a theoretical perspective, the incapacity of MLG is because neither Type I nor II MLG is compatible with solving COVID-19. According to Daniell and Kay (2018), Type I MLG mainly exists in a relatively stable vertical system with limited jurisdictional levels and entities. It is more suitable for dealing with conventional policy problems, so it is unlikely to be efficacious because COVID-19 is so unknown and unprecedented. The response of the United States represented by Type I MLG also reflects these problems. The US typically adopts the bottom-up approach. Under this approach, local governments develop response policies based on upper-level governmental guidelines; the federal and state governments provide coordination and support without directly replacing the local government’s response (Kapucu, 2008). The problem with this approach is that Type I MLG only works if government levels and entities are limited and the boundaries are clear. However, COVID-19 is a problem challenging all levels and every state of the US. Indeed Tang and An (2020) suggest that while the US system allows local officials to warn early of an emergency, there is little coordination between government levels and agencies. As a result, various American states’ responses varied greatly (Baccini & Brodeur, 2021; Neff et al., 2020). This uncoordinated response to the outbreak, particularly the premature
relaxation of control in some states, has kept the overall outbreak in the US very severe (Jalali et al., 2020).

On the other hand, although Type II MLG is a supplement to Type I, it is usually in a relatively flexible and non-tiered system, which can better deal with new problems such as pandemics in theory. However, a “flexible and negotiation system” is lacking in most federalist countries, the division of jurisdictions is not standardized, and the number is difficult to control (Hooghe & Marks, 2003). As a result, in the face of highly complex and challenging problems, the government’s transaction costs for coordinating multiple jurisdictions are likely to exceed the benefits brought by the flexibility of their scale (Hooghe & Marks, 2001). Such deficiency is reflected in the EU’s response. The EU relies on member-state-level policy coordination (Benz, 2000). It uses “problem-solving” as the policymaking model to solve problems beyond a single state’s capacity through coordinated policy outputs. The EU has a more flexible system than the US; however, it lacks coherence and consistency across MLG systems. As a result, the transaction costs incurred by the government in coordinating multiple jurisdictions have increased significantly (Daniell & Kay, 2018). In its fight against COVID-19, EU member states have been nationalizing their anti-pandemic actions, and there is little unified action at the Union level (Renda & Castro, 2020). As a result, countries adopt “uncoordinated and sometimes competitive” anti-pandemic strategies(Alemanno, 2020). The EU’s loose MLG model leads to a potential conflict between sovereign state health policy autonomy and collaborative action (Anderson et al., 2020).

In this sense, the conventional MLG types have failed the anti-pandemic campaign despite their past success. Therefore, this study aims to determine what kind of interactive governance should occur at which governmental levels and functions under what circumstance, especially because the problems of overlapping jurisdictions and unclear division of Type II MLG have significantly increased the cost of interaction and coordination. This study adopts the MLG framework without strictly sticking to the two MLG types and re-classifies the MLG types according to governmental levels and functions using the Chinese government’s response to COVID-19 as a case.

**Social Network Analysis: The Tool Facilitating the Research on Interaction Governance**

SNA investigates social structures by characterizing networks in terms of nodes (actors within the network) and the connecting edges (relations or interactions). From the SNA perspective, the interaction among actors can be expressed as patterns. Therefore, SNA is often used to study the interaction among organization members, such as coordination of response teams dealing with industrial emergencies (Mohammadmofir et al., 2015), terrorist attacks (Hu et al., 2014; Kapucu, 2006), and natural disasters (Cui & Li, 2020; Guarnacci, 2016). This study follows such literature and uses SNA as the primary tool to help us understand the organization and coordination mechanism of the Chinese government in combating COVID-19.

This study reveals the interactive relationship of government departments formed by issuing and receiving policy documents, hence the collaboration and exchange of information, resources, and trust. We form our social network based on the issuing of policy documents following similar ideas in studies on policy systems based on bibliometric analysis of policy documents (Nan et al., 2020; Zhang et al., 2018). According to these studies, the number of policy documents issued individually measures how dominant each department is; the number of documents issued jointly measures how stable and reliable the cooperative relationship between departments is.

**China’s Institutional Background and the Validity of Selecting China as a Case**

This study uses China as a backdrop for the anti-COVID-19 MLG analysis. Before discussing the selection validity, this section first presents some essentials of China’s institutional background, providing general knowledge of China’s governance system.

China’s administrative system is a centralized system combining a hierarchical system and a horizontal functional system (Wang, 2017). As for the hierarchical system, China’s administrative system is divided vertically into five levels: central, provincial, prefecture, county, and township, in the descending order of jurisdictional size and power. A superior level can govern the subordinate levels. This study simplifies this five-tier system to three levels by combing all sub-provincial levels into a so-called local level. As for the horizontal functional system, each level comprises several functional departments in charge of economic advancement, financial resource allocation, supervision, etc. Therefore, many departments are found at different levels and oversee similar responsibilities within the corresponding jurisdiction. An essential feature of China’s administrative system structure is “dual subordination”, where a department subordinates to both the upper-level department and the same-level government. Therefore, the upper-level department vertically ensures the policy homogeneity of all lower-level departments. Simultaneously, horizontally with a level, the government of the jurisdiction can command all constituting departments to ensure the overall management of affairs at this level (Yao et al., 2021).

Based on China’s multi-level and multi-functional institutional arrangements and its response to COVID-19, we suggest that China is a country worth studying because of its internal validity and the potential for extrapolation. In terms of internal validity, we suggest that China has done
well in controlling the viral contagion and balancing economic recovery. Specifically, China has taken rigorous lockdown or restriction measures to bring down the massive domestic spread. Studies confirmed that the Wuhan lockdown “decreased the reproduction number to 0.28 and the total infections in Wuhan by 96.0%” (Hao et al., 2020) and “delayed the arrival of COVID-19 in other cities by 2.91 days” (Tian et al., 2020). Occasional outbreaks in January and July-August 2021 were also contained by similar restriction measures, such that daily confirmed cases were low. China has also maintained low levels of confirmed and mortality cases relative to its population, ranking the sixth- and seventh-lowest per capita confirmed and mortality cases, respectively. In addition, China is one of the first countries to enter a period of full-scale economic recovery. After unlocking Wuhan on April 8, China restarted its mass-scale economic activities and is the only major economy that sustained positive economic growth in 2020 based on the IMF.

In addition to internal validity, we suggest that our China-based case study provides extrapolation opportunities in theoretical and practical terms. In practical terms, China’s multi-functional and multi-level characteristics can be extrapolated to many other countries. Specifically, this study focuses on governmental functions (i.e., a group of departments) rather than specific government departments. Whereas departments vary across countries, functions are primarily homogeneous. Similarly, most governments worldwide have more than one government tier; thus, between-level and within-level interactions occur in and outside China. In this sense, practical suggestions proposed by this study based on Chinese government levels and functions can be extrapolated to that of other countries. In methodological terms, this study uses the MLG and SNA framework to construct and study the intergovernmental interaction network. The method of this study can be replicated in other countries regardless of the country’s anti-pandemic performance or its institutional background because SNA is a systematic methodology that depicts intergovernmental communication. For instance, one could add non-government entities to the network to study gov-NGO interaction; one could also change our SNA input (policy documents) to fiscal funds flowing across government entities to study the financial interaction during the pandemic.

Despite the above internal validities and external implications, China’s case has limitations. Internally, the Wuhan government’s initial response was sluggish; the national-wide lockdown heavily constrained movement; the mass business shutdown halted many industries, pressurized employment, and burdened national budgets. Externally, although most countries are multi-level and multi-functional regimes, China’s centralized system is still different from many other countries. As such, this study can only provide general governance suggestions on interaction patterns rather than concrete anti-pandemic guidelines. Therefore, this study is by no means propagandizing, suggesting a complete replication of China’s strategies. Instead, it conducts evidence-based research to reveal how China’s different intergovernmental interactions took place and evolved as the nation fights the pandemic, hoping to elaborate MLG against the crisis backdrop and to provide precedents for other countries.

The Construction of the Network

Our networks are constructed based on policy documents related to COVID-19. We collect policy documents issued by the three government levels from January 23 to April 8, 2020. After a full-text filter for policy documents containing COVID-19 or epidemic on China’s government websites. Among the 911 documents collected from 182 departments, 72 central departments issued 594 documents, 65 provincial departments issued 236 documents, and 45 local departments issued 81 documents. Some documents were issued vertically from superior departments to subordinate departments; others were issued and received horizontally to form a cooperative relationship. For ease of analysis, we split the lockdown period into five stages based on the progression of COVID-19 (see Table 1).

We categorize two types of networks after analyzing the policy documents. Suppose a policy document has one specific issuer and one recipient. In that case, we establish a directed and weighted edge linking the nodes representing the issuer and recipient, referred to as a vertical network. We also construct a network to analyze the cooperative relationship of government departments at the same level where many policy documents were issued jointly. Furthermore, as demonstrated below, the latter type of association usually exists within the central or provincial departments, forming the peer association network.

For the vertical network, we group the 182 China-specific departments into seven more homogeneous government functions: financial, medical, security, economic, welfare, technical, and supervision. Together with the three levels, we get a total of 21 nodes. Table 2 shows the primary

### Table 1. Five Stages of the Wuhan Lockdown.

| Stage         | Key features                                           |
|---------------|--------------------------------------------------------|
| Stage I (Jan 23-Feb 4) | Initial response to COVID-19; inter-provincial assistance arrived in Wuhan |
| Stage II (Feb 5-Feb 17) | The peak of virus spread; national-wide control intensified |
| Stage III (Feb 18-Mar 1) | The turning point when discharges exceed newly confirmed cases |
| Stage IV (Mar 2-Mar 20) | Virus spread contained and economic recovery on the agenda |
| Stage V (Mar 21-Apr 8) | Progressing towards post-pandemic normalization gradually |
responsibilities, representative departments of each governmental function. The grouping is based on the primary responsibilities and our analysis of the policy content. By so doing, we avoid redundancy caused by the excessive number of departments, and we allow for easier cross-country comparison because departments are country-specific while functions are less heterogeneous. The visualization of the vertical network as of April 8 is in Figure 1. To analyze the interaction pattern among government functions, we use centrality, clique and community analysis. We define an indicator named weight ratio to identify the primary interaction mode of each function. By observing the change of weight ratio and community in each stage, we discover the evolution characteristic of the dominating interaction pattern of each function in the vertical network. We employ cliques as tools to detect subgroups in the peer association network.

Descriptive Analysis and the Confirmation of Dominating Interaction Patterns

Based on the intuitive illustrations of the vertical network, we find several nodes and edges depicting complicated interactions among different tiers of the Chinese government. Figure 1 shows that prefixes C, P, and L indicate the central, provincial, and local government levels, respectively. Each arrow points from the document issuer to the recipient. The larger the label, the greater the weighted degree and the number of policy documents issued by functional departments. Supervision and financial departments of the central and provincial government have been involved in the most frequent interaction, as is shown by large labels and arrows. Besides, other functional departments have developed a dense network of policy interactions.

The descriptive analysis above indicates that different functions present differentiated ways of interaction. Next, we aim to identify the dominating interaction patterns of each governmental function and explain why different governmental functions have applicable patterns at specific levels of government and stages of anti-pandemic. We conclude four interaction patterns based on features of the network and the statistics of weight ratios. The pattern with the highest weight ratio is regarded as the dominating pattern, as indicated in Table 3.

- **Vertical interaction is predominant among financial departments at all levels and stages:** In the vertical social network, vertical interaction prevails among the financial departments, indicated by the larger labels and thick purple edges extracted from the full network as the upper right part of Figure 1 for a more straightforward illustration. From Table 3, it is evident that vertical interaction predominates the financial function at all three levels of government throughout the five stages, indicating that financial resources are mobilized vertically from top to bottom within the governments throughout the lockdown. The technical function also extensively utilizes vertical interactions at the provincial and local levels. Other functions may have also adopted the vertical pattern at specific stages, which rarely play a dominant role.

- **Inter-functional interaction is typical in supervision departments at all levels and stages:** Besides apparent vertical interactions, the network also allows for other flexible arrangements. Inter-functional interaction is typical among the supervision function, illustrated by red nodes and lines in Figure 1, which is extracted to the lower right. That means almost every supervision department tends to issue policies to the other six functions throughout the five stages of pandemic response. For example, all central departments receive instructions from the central-level supervision function. Similarly, the General Offices of the Hubei Government and Wuhan Government supervise at the provincial and local levels. Exceptions exist at the first two stages of central supervision departments, which are more like a mixed pattern.

- **Intra-functional interaction is detected mainly in the Hubei peer association network:** Intra-functional interaction means that two same-level departments performing the same function establish connections. Figure 2 suggests that intra-functional interaction exists in the Hubei peer association network, and the pattern is seen within the financial function among various Hubei provincial financial departments. The purple color in Figure 2 shows that

### Table 2. Overview of Governmental Functions.

| Function | Responsibilities | Example |
|----------|------------------|---------|
| Financial| Financial policy and fund management and deployment | Ministry of Finance |
| Medical  | Guide and implement COVID-19 prevention & control health works | National Health Commission |
| Security | Maintain social stability and monitor social distancing | Ministry of Public Security |
| Economic | Promote the resumption of production and restore the economy | Ministry of Industry and Information Technology |
| Welfare  | Carry out work related to human resources management, welfare, and social security | Ministry of Human Resources and Social Security |
| Supervision | Control, supervise, and manage the whole process of COVID-19 prevention and control | The Joint Prevention and Control Mechanism of the State Council |
| Technical | Traffic control and supply transportation management | Ministry of Transport |
the financial departments in Hubei connect, formulate cliques, and interact intra-functionally. The cliques evolve independently and dynamically until the last phase, during which a coalescent network is finally formed. The core members of finance cliques include Hubei Financial Supervision and Administration Bureau (HFSAB), Hubei Provincial Department of Finance (HPDF), Wuhan Branch of the People’s Bank of China (WBPBC), and China Banking and Insurance Regulatory Commission of Hubei (HCBIRC). Based on Table 3, the intra-functional interaction pattern is most used only in the central economic function during Stage I; therefore, this pattern is less dominating than others in the vertical network.

- The hybrid pattern prevails among medical, security, welfare, and economic functions: Thus far, we have zoomed in from government levels to same-level functions and finally to departments within a function. However, intergovernmental interaction could also be simultaneously cross-level and cross-function, which we call hybrid interaction. Hybrid interaction is a mixture of the above patterns, occur among different functions across government levels. Figure 3 describes the dynamic formulation process of communities in the vertical social network. Nodes with the same color belong to the same community, which depicts the evolution of hybrid interaction between different governmental levels and functions at each stage. It prevails in the medical function since Stage II, and it is also the basic pattern in the security, welfare, and economic function. The pattern describes that the medical and non-medical functions of different levels transfer resources and information through those departments, exchanging information, materials, and personnel.

Table 4 suggests that each function dynamically changes its prevailing government levels and stages to perform typical duties. Most government functions continue to expand their influence and perform in a multi-level setting. They act as critical agents to reshape the MLG system and provide continuous support for the anti-pandemic efforts. Central medical and welfare departments and provincial
Before further analysis, the following text explains the relationship among lockdown, government interaction, and public health to answer whether the Wuhan lockdown would have produced significant public health benefits with fewer interactions. The histogram in Figure 4 shows the number of confirmed cases in Hubei, and the green curve shows the document-issuing frequency of supervision function at the provincial level. We note that the public health outcome had not improved immediately after the Wuhan lockdown. On the contrary, the number of confirmed cases in Hubei Province showed an upward trend in Stage I, peaked at 14,840 cases on February 12. Based on this statistical result, we infer that lockdown alone is not enough to improve public health. On February 13, the Communist Party Chief of Hubei province was replaced. The new Party Chief strengthened supervision measures and commanded the province to be more stringent in the epidemiological investigation and “stay-home” management. It is evident that the frequency of policy documents issued by the provincial supervision function significantly surged, peaked until the end of Stage II. Till the end of Stage II, the number of confirmed cases began to decrease gradually.

To further interpret the above evidence from a network perspective, three networks in Figure 5 show the evolution of the network interaction of the Hubei supervision function, depicting the direct interaction between the Hubei supervision function and its neighboring functions before, on, and after February 12. Edge width measures the interaction closeness, from which we can determine the evolution of the interaction pattern of the Hubei supervision function. Figure 5 indicates that the dominating interaction pattern of Hubei supervision changed dynamically from inter-function to vertical between February 4 and February 12, suggesting the changes in supervision intensity. After the replacement of the Hubei Party Chief, the Hubei supervision function returns to an inter-function-dominance pattern. As a result, strengthening supervision ensures close cooperation between various functions in Hubei, resulting in better prevention and control against COVID-19 and improvement in public health. As such, we infer that the Wuhan lockdown would have produced fewer public health benefits had there been less government interaction. In other words, public health measures rely highly on government interactions to ensure their success and pace of implementation.

Theoretical Development of Interaction Patterns in MLG

As governments worldwide still struggle to combat the pandemic, what can we learn from our social network analysis based on Chinese multi-level and multi-functional governance? We suggest no one-size-fits-all approach for different government tiers and functional departments to coordinate with each other. Therefore, we characterize four intergovernmental interaction patterns based on the network...
characteristics (Figure 6). Then we conclude network distribution for each governmental function to illustrate what interaction patterns should prevail at which governmental levels and functions and under what circumstances (Figure 7). Theoretically, our interaction patterns extend the original definition of governance in a multi-level setting.

The nature of MLG is the dispersion or decentralization of authority and the fragmentation of the governance system. The distribution of authority, like Type I and Type II governance (Hooghe & Marks, 2003; Marks, 1993), or division of decision-making patterns, like informal and procedural interaction (Popering-Verkerk & Buuren, 2016), is the...
The nature of the COVID-19 crisis requires intergovernmental coordination and cooperation for effective policy responses (Paquet & Schertzer, 2020). Due to the enormous uncertainty and continuous destruction, the unprecedented COVID-19 demands a more flexible and constructive multi-level management system that would change the traditional emergency response system. During the lockdown, China initiated responses to COVID-19 across and within different governmental levels and functions, thus providing some implications for a better understanding of MLG. Our SNA confirms the importance of vertical interactions which coordinate among the various governmental levels, focusing on intergovernmental coordination to implement complex policy problems (Kapucu et al., 2009). Vertical interaction depicts the traditional hierarchical structure of authority in Type I, which is necessary to integrate resources efficiently and make consistent decisions from top to down, which is very common in federalism thought.

Nevertheless, Type I is criticized widely for its lack of transparency and flexibility in dealing with newer issues, extreme events, pandemics, and climate change (Daniell & Kay, 2018, p. 440). More researchers, instead, focus on more flexible and adaptable Type II governance, which has solid potential for innovation. Although it has been nearly 30 years since the concept of Type II MLG first appeared, the perception of Type II remains at the level of features and examples. The specific classification of Type II MLG remains uncharted territory. Therefore, we tend to make a more explicit definition of Type II regarding the differences within/between levels and functions of MLG, including intra-functional, inter-functional, and hybrid interaction.

Intra-functional interaction shows internal cooperation when facing complex but similar decision-making problems. Inter-functional interaction is a pattern emphasizing coordination and collaboration across different governmental functions. In contrast to intra-functional interactions that are internal, inter-functional interactions are external because they connect departments that rarely work together. Hybrid interaction is the most complicated of the four, but it helps us understand the coherent logic of how an MLG system responds to an unprecedented crisis like COVID-19. Hybrid interactions are not common in traditional emergencies at specific locations without widespread transmission because each department/function has its designated superior agencies according to Type I MLG. In the COVID-19 response, the traditional emergency management department was dysfunctional. As a result, governments at all levels are forced to form a hybrid interaction, connecting otherwise rarely linked departments/functions. In COVID-19 management, hybrid interactions are frequent, and such a policymaking process requires the mobilization of additional resources and strength. Therefore, departments that play a crucial role in a hybrid network must have strong organizational and integrated capabilities. Our network analysis captures the overall allocation and scheduling capacities of the core functions. We found similar hybrid cooperation in the September 11 terrorist attack, which called for collaboration among technical departments and other organizations at various government levels (Kapucu et al., 2010). For instance, the Emergency Management Assistance Compact (EMAC) of the United States responded to the catastrophic disasters Hurricanes Katrina and Rita and called for collaborative decision-making practices among governments and agencies (Kapucu & Garayev, 2011).

### Table 4. Network Distribution and Interaction Patterns of Functional Departments.

| Functional departments | Dominating Level | Dominating Stage | Dynamic changes through five stages | Interaction Pattern |
|------------------------|------------------|------------------|------------------------------------|--------------------|
| Economic               | Central & Provincial | Stage V         | Incremental                        | Hybrid             |
| Supervision            | Central & Provincial | Stage V         | Incremental                        | Inter-functional   |
| Welfare                | Central & Provincial | Stage IV        | Inverted U-shape                   | Hybrid             |
| Security               | Central & Local   | Stage V          | Incremental                        | Hybrid             |
| Technical              | Provincial & Local | Stage V          | Incremental                        | Vertical           |
| Medical                | Central Provincial | Stage I Stage V | U-shape                            | Hybrid             |
| Finance                | Central Provincial | Stage V Stage II | Incremental Fluctuant              | Vertical Intra-functional |

Consequence of the ongoing process of interactive governance from the perspective of public administration. However, there are apparent theoretical defects and ambiguities in the existing division of MLG. The interactive governance between and within different governmental levels and functions and the specific classification of Type II governance are not yet studied systematically. The traditional structure of MLG calls for “the coordination of actors that span sectors and levels of government” (Koliba et al., 2017, p. 22). Our empirical investigation confirms and extends the existing Type I and Type II definitions of interactive governance.

The graphic and statistical illustrations allow us to verify that multiple intergovernmental interaction patterns were used during the Wuhan Lockdown. Figure 7 depicts the distribution of four intergovernmental interaction patterns based on the network characteristics: vertical, intra-functional, inter-functional, and hybrid. These patterns describe the complex policymaking and implementation process in pandemic management among the three government tiers in China.
Practical Implications for COVID-19 Response

Almost any country would be ill-prepared in the face of such a severe, destructive, and unpredictable public health crisis as COVID-19. The traditional MLG theory has limited explanatory power about pandemic management. COVID-19 has a significant impact on the medical and health care system, which has brought short-term problems such as the shortage of financial resources and materials, social isolation, and information barriers. At the same time, it poses new challenges to the long-term reform of inter-governmental cooperation, interaction, and administration. Our research attempts to propose a more general response plan for other parts of

Figure 4. Lockdown, function interaction and public health. Note: Grey dashed lines mark the end date of each stage.

Figure 5. Evolution of Hubei supervision function subnetwork.
the world, rather than a summary of a practical experience only applicable to a particular country’s system. We emphasize the critical role of control and command of different functional departments in an integrated anti-crisis governance system.

First, governments from the central to provincial and local levels are responsible for mobilizing many financial resources vertically for effective pandemic response. The policy contents indicate that financial funds of governments at all levels played a guiding and leveraging role and subsidized loans to key enterprises in epidemic prevention and control. By May 31, 2020, $23.13 billion financial funds had been allocated by all levels of Chinese governments to fight COVID-19. Such financial aid played a crucial role in ensuring the supply of medical resources to meet frontline demand. In addition to large-scale vertical financial resources allocation, provincial financial departments have integrated internal financial resources, described as intra-functional interaction above. It implies that governments should attach importance to both large-scale raising and local allocation of financial resources.

Second, when faced with an unpredictable public health crisis such as COVID-19, only an integrated department has the organizational capabilities to mobilize sufficient resources horizontally to contain it. Therefore, with the de jure responsibility to organize, guide, and coordinate other departments on behalf of the government, the supervision function at each level acquires control over most resources and information. For that reason, control and command occur swiftly and smoothly. Taking the Joint Prevention and Control Mechanism of the State Council (JPCM) as an example, it is the most crucial joint agency established and directed by the State Council to combat COVID-19. It is a temporary task force consisting of 32 central level departments and is responsible for scrutinizing frontline prevention and control, medical treatment, scientific research, publicity, foreign affairs, and logistical support. With the support of rapid information transmission, the JPCM works as an “inter-functional hub” that connects and coordinates otherwise independent departments. The JPCM held regular meetings to ensure pandemic-related information transparency, dispatched medical teams, and allocated medical supplies. It also made swift policy adjustments in response to the pandemic developments and issued guidelines for local authorities to promote enterprises’ resumption to work.

Thirdly, the anti-pandemic NPIs require the total mobilization of inter-hierarchical (within & between levels) and inter-functional (within & between functions) resources by multi-level governments. The “frequent and multi-leveled social interactions” will promote trust and efficiency for functional consolidation in the MLG framework (Leland & Thurmaier, 2014). The COVID-19 pandemic requires medical efforts and NPIs jointly. The former is managed by medical functions, while the latter relies on the collaboration of various other functions. Such collaboration requires the economic advancement sector to collect and distribute relief materials, the public security function to suspend traffic and monitor social distancing, and the social welfare department to guarantee the benefits of the insured, medical

---

**Figure 6.** Intergovernmental interaction patterns in response to COVID-19.
workers, and other people. Therefore, governments have attempted to mobilize resources and information within hybrid networks for medical, economic, security, and welfare departments.

**Conclusion**

This study uses China as a case for the anti-COVID-19 MLG analysis. China’s internal validity and potential for extrapolation provide us with a unique opportunity to characterize and identify four intergovernmental interaction patterns. Our empirical analysis deepens the understanding of multi-level governance in this pandemic context and contributes to public administration both in theory and practice. One of the most important patterns is the vertical interaction that prevails among the financial departments. Intra-functional and inter-functional interactions are two types of horizontal interaction. They highlight the departments that account for the flow of resources and information at the same government levels during the crisis response. Finally, the epicenter of this catastrophe is in medical departments and security, welfare, and economic functions. China’s containment of COVID-19 suggests that no single interaction pattern should dominate the entire period of policy intervention. Instead, the MLG system should utilize all possible interaction patterns, and the dominating pattern is subject to change as the situation evolves (see Table 3 and Figure 7).

Coordination and cooperation among different government levels and different divisions of functions must be followed for a uniform but flexible MLG system.

In the global post-epidemic era, we should reflect more on the reform of MLG in addition to strict lockdowns and social distancing. The study extends the interactive governance between and within different governmental levels and functions and proposes a more specific classification of Type II governance. The study finds that in the public health crisis response, strict hierarchical arrangements (similar to Type I) for large-scale integration and allocation of specific resources are necessary (e.g., financial assistance). In addition, the nature of MLG is to strengthen interactive governance. The study defines Type II more explicitly regarding the differences within/between levels and functions of MLG, including intra-functional, inter-functional, and hybrid interaction. The study illustrates what interaction patterns should prevail at which government levels and functions and under what circumstances a given pattern should be selected as the pandemic progresses. The study also enriches the literature on public health crisis management, showing what alternative solutions are possible when the conventional MLG approach (i.e., bottom-up and top-down) fails. It provides helpful NPI precedents for other multi-level systems to follow. First, financial resources should be mobilized from top to bottom for large-scale epidemic prevention and control. After the central level initiates intergovernmental interaction, the provincial levels are more suitable for integrating internal financial resources. Second, an integrated governmental function is needed to organize, guide, and coordinate other functional departments nationwide to mobilize sufficient resources to combat COVID-19. Third, COVID-19 requires medical efforts and NPIs jointly. Such hybrid collaboration requires medical, economic, security, and welfare departments to collect and distribute relief materials, regulate traffic, and protect the welfare, respectively. Building upon the above points, the study suggests that an important area for future research is to consider overcoming some obstacles (e.g., ensuring the operation of integrated governmental function) in implementing the above practical take-aways.
Declaration of Conflicting Interests
The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding
The author(s) received no financial support for the research, authorship and/or publication of this article.

ORCID iD
Jing Li https://orcid.org/0000-0002-9864-6269

Supplemental material
Supplemental material for this article is available online.

Notes
1. NPIs refer to non-medical measures that curb the spread of COVID-19 and measures that help alleviate the socio-economic destruction created by the pandemic.
2. Including party-political, policy distribution, legal constraints, fiscal power to tax and spend, path dependence, and formal and informal power relations among jurisdictions.
3. Based on Coronavirus Resource Center of Johns Hopkins University (last updated on July 30, 2021), available at https://coronavirus.jhu.edu/data/mortality.
4. From the IMF World Economic Outlook Database (last updated in April 2021), available at https://www.imf.org/en/Publications/WEO/weo-database/2021/April
5. For instance, Notice of the National Health Commission on Tracking and Follow-up of Discharged Patients with COVID-19 well issued to Provincial Health Commissions.
6. For instance, Notice of the Provincial Market Supervision Bureau on Supporting Enterprises to Resume Work and Production in An Orderly Manner issued by Hubei Market Supervision and Administration Bureau to Hubei Drug Administration.
7. On February 13, the China changed the diagnosis protocol, which is another reason why cases surged on February 12. Still, sustained decrement of new cases only appeared after February 13 after the replacement of Party Chief and the increase in government interaction.
8. On February 1, 2020, the Ministry of Finance issued the Notice on Supporting financial services to strengthen the prevention and control of novel Coronavirus pneumonia to the financial departments of lower governments.

References
Alemanno, A. (2020). The European response to COVID19. From regulatory emulation to regulatory coordination. European Journal of Risk Regulation, 11(2), 307–316. https://doi.org/10.1017/err.2020.44
Anderson, M., Mckee, M., & Mossialos, E. (2020). Covid-19 exposes weaknesses in European response to outbreaks. BMJ, 368(m1075), 1–2. https://doi.org/10.1136/bmj.m1075
Baccini, L., & Brodeur, A. (2021). Explaining governors’ response to the COVID-19 pandemic in the United States. American Politics Research, 49(2), 215–220. https://doi.org/10.1177/1532673X20973453
Bache, I., & Andreou, G. (2013). Cohesion policy and multi-level governance in South East Europe. London: Routledge.
Bache, I., Bartle, I., Flinders, M., & Marsden, G. (2014). Blame games and climate change: Accountability, multi-level governance and carbon management. The British Journal of Politics and International Relations, 17(1), 64–88. https://doi.org/10.1111/1467-856X.12040
Bache, I., & Flinders, M. (2004). Themes and issues in multi-level governance. In Multi-level governance (pp. 1–12). Oxford: Oxford University Press.
Bache, I., & Flinders, M. (2015). Multi-level governance: Essential readings. Northampton: Edward Elgar Publishing.
Benz, A. (2000). Two types of multi-level governance: Intergovernmental relations in German and EU regional policy. Regional & Federal Studies, 10(3), 21–44. https://doi.org/10.1080/13597560008421130
Besley, T. J., & Coate, S. (2003). Centralized versus decentralized provision of local public goods: A political economy analysis. Journal of Public Economics, 87(12), 2611–2637. https://doi.org/10.1016/S0047-2727(02)00141-X
Blatter, J., K. (2001). Debordering the world of states: Towards a multilevel system in Europe and a multi-polity system in North America? Insights from border regions. European Journal of International Relations, 7(2), 175–209. https://doi.org/10.1177/13540661007002002
Bonaccorsi, G., Pierri, F., Cinelli, M., Flori, A., Galeazzi, A., Porcelli, F., Schmidt, A. L., Valensise, C. M., Scala, A., Quattrococihi, W., & Pammolli, F. (2020). Economic and social consequences of human mobility restrictions under COVID-19. Proceedings of the National Academy of Sciences, 117(27), 15530–15535. https://doi.org/10.1073/pnas.2007658117
Brattberg, E., & Rhinard, M. (2011). Multilevel governance and informal power relations among jurisdictions. In Multi-level Governance: Essential readings. Northampton: Edward Elgar Publishing.
Casella, A., & Weingast, B. (1995). Elements of a theory of jurisdictional change. In Politics and institutions in an integrated Europe (pp. 11–41). Springer.
Cooper, M., Reilly, E. E., Siegel, J. A., Coniglio, K., Sadeh-Sharvit, S., Pisetsky, E. M., & Anderson, L. M. (2020). Eating disorders during the COVID-19 pandemic and quarantine: An overview of risks and recommendations for treatment and early intervention. Eating Disorders, 1–23. https://doi.org/10.1080/10640266.2020.1790271
Cui, P., & Li, D. Z. (2020). A SNA-based methodology for measuring the community resilience from the perspective of social capitals: Take Nanjing, China as an example. Sustainable Cities and Society, 53(2020), 101880. https://doi.org/10.1016/j.scs.2019.101880
Daniell, K. A., & Kay, A. (2018). Part 1: Conceptual Challenges. In K. A. Daniell & A. Kay (Eds.), Multi-level Governance: Conceptual Challenges and Case Studies from Australia (pp. 3–157). ANU Press.
Enderlein, H., Wälti, S., & Zürn, M. (2010). The European response to COVID-19 and measures that help alleviate the socio-economic destruction created by the pandemic.
Kapucu, N. (2006). Interagency communication networks during post-conflict, post-disaster Indonesia. *International Journal of Disaster Risk Reduction*, 16(1), 180–191. https://doi.org/10.1016/j.ijdrr.2016.03.001

Hao, X., Cheng, S., Wu, D., Wu, T., Lin, X., & Wang, C. (2020). Reconstruction of the full transmission dynamics of COVID-19 in Wuhan. *Nature*, 584(1), 420–424. https://doi.org/10.1038/s41586-020-2554-8

Hooghe, L., & Marks, G. (2001). *Multi-level governance and European integration*. Lanham: Rowman & Littlefield Publishers.

Hooghe, L., & Marks, G. (2003). Unraveling the central state, But how? Types of multi-level governance. *American Political Science Review*, 97(2), 233–243. https://doi.org/10.1017/S0003055403000649

Hu, Q., Knox, C. C., & Kapucu, N. (2014). What have we learned since September 11, 2001? A network study of the Boston marathon bombings response. *Public Administration Review*, 74(6), 698–712. https://doi.org/10.1111/puar.12284

Inman, R. P., & Rubinfeld, D. L. (1996). The political economy of federalism. In D Mueller (Ed.), *Perspectives on Public Choice: A Handbook* (pp. 73–105). Cambridge: Cambridge University Press.

Irepoglu Carreras, Y. (2019). Problem-solving across literatures: Comparative federalism and multi-level governance in climate change action. *European Policy Analysis*, 5(1), 117–134. https://doi.org/10.1002/epa2.1066

Jalali, A., Peterson, B., & Galbadej, D. (2020). Early COVID-19 interventions failed to replicate 1918 St. Louis vs. Philadelphia outcomes in the United States. *Frontiers in Public Health*, 8(9), 1–8. https://doi.org/10.3389/fpubh.2020.579559

Jiao, W. Y., Wang, L. N., Liu, J., Fang, S. F., Jiao, F. Y., Pettocco-Mantovani, M., & Somekh, E. (2020). Behavioral and emotional disorders in children during the COVID-19 epidemic. *The Journal Of Pediatrics*, 221(6), 264–266.e1. https://doi.org/10.1016/j.jpeds.2020.03.013

Kapucu, N. (2006). Interagency communication networks during emergencies - boundary spanners in multiagency coordination. *The American Review of Public Administration*, 36(2), 207–225. https://doi.org/10.1177/0275074005280605

Kapucu, N. (2008). Collaborative emergency management: Better community organizing, better public preparedness and response. *Disasters*, 32(2), 239–262. https://doi.org/10.1111/j.1467-7717.2008.01037.x

Kapucu, N., Arslan, T., & Demiroz, F. (2010). Collaborative emergency management and national emergency management network. *Disaster Prevention and Management*, 19(4), 452–468. https://doi.org/10.1080/09653561011070376

Kapucu, N., Augustin, M. E., & Garayev, V. (2009). Interstate partnerships in emergency management: Emergency management assistance compact in response to catastrophic disasters. *Public Administration Review*, 69(2), 297–313. https://doi.org/10.1111/j.1540-6210.2008.01975.x

Kapucu, N., & Garayev, V. (2011). Collaborative decision-making in emergency and disaster management. *International Journal of Public Administration*, 34(6), 366–375. https://doi.org/10.1080/01900692.2011.561477

Kohler-Koch, B., & Eising, R. (1999). *The transformation of governance in the European Union*. London: Routledge.

Koliba, C., Meek, J. W., & Zia, A. (2017). Governance networks in public administration and public policy (1). Boca Raton: Routledge.

Kraemer, M. U. G., Yang, C.-H., Gutierrez, B., Wu, C.-H., Klein, B., Pigott, D. M., Plessis, L. D., Faria, N. R., Li, R., Hanage, W. P., Brownstein, J. S., Layan, M., Vespiagnani, A., Tian, H., Dye, C., Pybus, O. G., & Scarpino, S. V. (2020). The effect of human mobility and control measures on the COVID-19 epidemic in China. *Science*, 368(6490), 493–497. https://doi.org/10.1126/science.abb4218

Leland, S., & Thurmaier, K. (2014). Political and functional local government consolidation: The challenges for core public administration values and regional reform. *The American Review of Public Administration*, 44(4_suppl), 295–465. https://doi.org/10.1177/0275074014533003

Marks, G. (1993). Structural Policy and Multilevel Governance in the EC. In A. Cahafryn & G. Rosenthal (Eds.), *The State of the European Community State of the European Union the Maastricht Debate & Beyond* 391–411. Boulder: Lynne Riener.

Mohammadfam, L., Bastani, S., Esaghi, M., Golmohamadi, R., & Sae, A. (2015). Evaluation of coordination of emergency response team through the social network analysis. Case study: Oil and Gas refinery. *Safety and Health at Work*, 6(1), 30–34. https://doi.org/10.1016/j.shaw.2014.09.004

Nan, Y., Feng, T., Hu, Y., & Qi, X. (2020). Understanding aging policies in China: A bibliometric analysis of policy documents, 1978–2019. *International Journal of Environmental Research and Public Health*, 17(16), 5956. https://doi.org/10.3390/ijerph17165956

Neff, S. M., Roecker, C. B., Okamoto, C. S., Holguin, S. L., Napuli, J. G., Mattox, R., Hinkeldey, N. A., & Paris, D. J. (2020). Changes to Chiropractic Practice in Response to COVID-19: a survey of all 50 United States. *Chiropractic & Manual Therapies*, 28(1), 44. https://doi.org/10.1186/s12998-020-00333-6

Pan, A., Liu, L., Wang, C., Guo, H., Hao, X., Wang, Q., Huang, J., He, N., Yu, H., Lin, X., Wei, S., & Wu, T. (2020). Association of public health interventions with the epidemiology of the COVID-19 outbreak in Wuhan, China. *JAMA*, 323(19), 1915–1923. https://doi.org/10.1001/jama.2020.6130

Paquet, M., & Schertzer, R. (2020). COVID-19 as a complex inter-governmental problem. *Canadian Journal of Political Science*, 53(2), 343–347. https://doi.org/10.1017/S0008423920000281

Perra, N. (2021). Non-pharmaceutical interventions during the COVID-19 pandemic: A review. *Physics Reports*, 913(23), 1–52. https://doi.org/10.1016/j.physrep.2021.02.001

Piattoni, S. (2009). Multi-level governance: A historical and conceptual analysis. *European integration, 31*(2), 163–180. https://doi.org/10.1080/07036330802642755

Popering-Verkkerk, J. V., & Buuren, A. V. (2016). Decision-making patterns in multilevel governance. The contribution of informal and procedural interactions to significant multilevel decisions.
