

# Citizen-Driven International Networks and Globalization of Social Movements on Twitter

Social Science Computer Review

2017, Vol. 35(1) 68-83

© The Author(s) 2015

Reprints and permission:

[sagepub.com/journalsPermissions.nav](http://sagepub.com/journalsPermissions.nav)

DOI: 10.1177/0894439315617263

[journals.sagepub.com/home/ssc](http://journals.sagepub.com/home/ssc)**Qinfeng Zhu<sup>1</sup>****Abstract**

Social media offer an avenue for the formation of citizen-driven global networks that are vital to mobilizing international support and curating global public discourse in social movements. This study looks into the global flow of information and communication about Hong Kong's Occupy Central Movement with a focus on the country/territory-level international network that emerged on Twitter. Drawing on the world systems theory and the literature on social movement, it examines whether the globalization of a local social movement via social media is circumscribed by the existing order of the world system (i.e., from the developed core countries/territories to the developing peripheral). It focuses its analysis on the network structure and the predictors of countries/territories' centrality in the network. Findings of the social network analysis show that the structure of the international network still follows the existing order of the world system to a large extent. It is further supported by the result of the multivariate analysis that national income, a widely used benchmark for determining a country/territory's position in the world economy, is significantly and substantially related to centrality. However, national income does not have the largest predicting power. Instead, a country/territory's level of political grievances is found to be the strongest predictor. In addition, countries/territories with high Internet penetration rates tend to have high-centrality scores, and yet the effect size is smaller than the other predictors.

**Keywords**

social media, social movement, world systems theory, social network analysis

Social media offer an avenue for the formation of global networks of communities. Although direct contacts on social media are mostly geographically local (Takhteyev, Gruzd, Wellman, 2012; Quercia, Capra, & Crowcroft, 2012), thanks to a small "degree of separation" (Backstrom, Boldi, Rosa, Ugander, & Vigna, 2012), individuals are easily connected into a network that transcends territorial boundaries. Because it is largely created through individual ties and activated through personal

---

<sup>1</sup> City University of Hong Kong, Kowloon, Hong Kong, S.A.R., Hong Kong

**Corresponding Author:**

Qinfeng Zhu, Department of Media and Communication, City University of Hong Kong, M5009 Level 5, Run Run Shaw Creative Media Centre, Cornwall Street, 18 Tat Hong Avenue, Kowloon/Hong Kong, S.A.R., Hong Kong.

Email: [qinfenzhu3-c@my.cityu.edu.hk](mailto:qinfenzhu3-c@my.cityu.edu.hk)

interaction, the international network formed on social media is thought to be largely citizen driven, horizontal, decentralized, and thus able to bypass the intermediation of authoritative institutions (Crooks et al., 2014).

The citizen-driven nature of the international network formed on social media is vital to the diffusion of social movements on a global scale. The horizontal and decentralized network structure, combined with the “self-mass communication” (Castells, 2009), can translate a local social movement into a global event (Castells, 2012). During the Arab Spring, local social movement leaders and participants actively used social media to broadcast the event to the neighboring countries and the international community, to draw their attention and sympathy, and to inspire them to join and celebrate their causes (Howard & Hussain, 2011; Hussain & Howard, 2013). Cross-country information dissemination and communication on social media are also important to the “formation of the global public sphere” (Tufekci & Freelon, 2013, p. 843). Moreover, according to Edward Said’s (1982) notion of “communities of interpretations,” foreign countries constitute an international community whose responses form interpretations of the movement producing meanings that shape people’s perceptions of the event. Such constructed reality can in turn influence local people’s (including the participants’) views toward the movement and thus affect its development.

Therefore, studying the international network formed via social media is important as it can shed some light on the globalization of social movements. Existing studies have mainly focused on the network structure and interaction patterns at the individual user level (e.g., González-Bailón, Borge-Holthoefer, & Moreno, 2014; Lim, 2012; Tufekci, 2013). Little is known about it at the country/territory level. Individual-level communication on social media offers us an opportunity to map the configuration of countries/territories. Moreover, as Mills (1959) articulates, the characters and conducts of individuals are not only situated within the immediate milieu but also enacted within the larger political, economic, and social institutions. The diffusion of a social movement on social media may thus be influenced or predetermined by the institutional power.

This study thus focuses its analysis on the international network formed via social media at the country/territory level. Drawing on world systems theory, it assesses whether the international network formed on social media follows the orders of the existing world system (i.e., along the continuum between center and periphery). Based on the literature on social movement, this study further evaluates economic and political grievances and Internet connectivity as (alternative) predictors of countries/territories’ centralities in the network. It focuses on Twitter as a demonstrative social media platform and the Hong Kong Occupy Central Movement as the research case. A social network analysis approach is employed to examine the network structure and a multivariate analysis is applied to estimate the predictors of the constituent countries/territories’ centralities in the network.

The article is organized as follows. In the second section, a brief overview of the Occupy Central Movement in Hong Kong is provided. In the third section, based on reviewing the literature on world systems theory and social movement mobilization, a set of hypotheses is proposed. It is followed with methods and results and concluded with a discussion and outlook in the final section.

## Occupy Central Movement

Occupy Central Movement in Hong Kong is a civil disobedience movement calling for genuine universal suffrage for the Chief Executive election in 2017 and Legislative Council elections in 2020. On August 31, 2014, the Standing Committee of the National People’s Congress (NPCSC) of People’s Republic of China (PRC) announced its decision on the proposed reform of Hong Kong’s electoral system. It mandates that candidates for the 2017 Chief Executive election must receive support from more than half of the members of a nominating committee and that the new elected Chief Executive will have to be appointed by the central government (South China Morning Post, 2014). Incensed by the NPCSC’s ruling, Hong Kong Federation of Students staged a class boycott and

began protesting outside the government headquarter on September 22, 2014. The Occupy Central with Love and Peace organization announced the beginning of civil disobedience on September 28, 2014. Protests blocked the main roads in Hong Kong's financial district, Central, and the government center, Admiralty. Police employed tear gas against peaceful protestors, which triggered more citizens to join the street protests. The protests escalated and spread to other parts of Hong Kong Island and some parts of Kowloon. Protesters demanded the resignation of the current Chief Executive C.Y. Leung who was chosen by a pro-Beijing selection committee in 2012 and a back down from Beijing on its plan. The protest lasted for more than 70 days.

The Occupy Central Movement was seen as a prodemocracy movement by the international community and joined by many. Rallies showing solidarity with the movement were held in more than 64 cities, including Taipei, Singapore, Washington, Paris, London, and so on (Griffiths, 2014). International news media covered the movement extensively, a majority of which showed support for the protesters' aspirations for democracy and dubbed it "Umbrella Revolution."

Social media also played a big role in promoting the Occupy Central Movement into a global topic. Movement leaders and participants actively used Twitter to transmit messages, to coordinate participants, to broadcast the events, and to mobilize support. Occupy Central with Love and Peace had more than 25,000 followers on Twitter commanding the largest volume of attention. The anti-Occupy camp also used Twitter to attract supporters to win them over for the cause; it is estimated that 1.3 million tweets were posted during the early days of the event, making Occupy Central as one of the most talked about events in the world (Lee, 2014).

Hong Kong, the former British colony, is a special administrative region of the PRC practicing a high degree of autonomy since the handover in 1997 under the constitutional arrangement known as One Country, Two System. Since then, the territory has seen rising tension with mainland China over political, social, and economic issues. The PRC central government has been accused of eroding Hong Kong's democratic character by trying to push through a national security law in 2003 and introduce a "national education" curriculum in 2010 and by pressuring the city's independent critical media outlets (Harold, 2014). The rift between Hong Kong and mainland China has widened even more since the local population believes that mainland property investors are responsible for a soaring high housing price in Hong Kong and that the influx of mainland immigrants drains Hong Kong's education and health care resources, burdens the social welfare, and drives up home prices (Harold, 2014). In addition, Hong Kong itself is a deeply divided society. Although considered a rich city with a high rate of economic growth, Hong Kong has been seeing a widening wealth gap (Gini coefficient scored .537 in 2011), an enlarging section of the population living under poverty line (19.6%), and a falling average household income (Hu & Yun, 2013; Yip, 2014). The profile of Hong Kong indicates that the Occupy Central Movement may be a result of long-standing grievances over economic and political strains.

## Literature Review

### *World Systems and Social Media Network Structure*

The world systems theory states that countries are located in a three-tier system (core, semi-periphery, and periphery), following an imperialistic order that developed countries occupy the core and developing countries lie at the edge (Wallerstein, 1974). Developed in the industrial age, world system theory describes that core countries monopolize the production of capital-intensive, high-wage, and high-technology goods and export them to the semi-periphery and the periphery, whereas the periphery specializes in the production of labor-intensive, low-wage, and low-technology goods that are supplied to the core and the semi-periphery (Barnett & Park, 2005). As a country's structural position determines its development capacity, the arrangement of the world system tends to be stable

(Barnett & Park, 2005). A country's structural position also determines its pattern of interaction with others. Galtung's (1971) Structural Theory of Imperialism, a theory related to world system theory, states that interaction concentrates in the core and is largely missing among the peripheral, and that interaction between the center and periphery is vertical.

Although the theory was developed to describe global interaction during the industrial age, its stated structural and interaction patterns have been found across various international information networks, such as telecommunication, Internet hyperlinks, and news production and coverage (Barnett & Choi, 1995; Barnett & Park, 2005; Chang, Himelboim, & Dong, 2009; Golan, 2008). Although the web is considered "a self-organized system with a well-defined structure of linkage that implies an underlying social structure" (p. 1113), nations are arrayed along a core-periphery continuum in the international hyperlink network and bandwidth network (Barnett & Park, 2005). Barnett and Park (2005) find that the United States and the wealthier nations of Western Europe are at the center and the less-developed nations of Latin America, Asia, and Africa along the edge. Similarly, contrary to the belief that "the Internet can allow news organizations to overcome geographical hierarchies in international news flow" (Himelboim, Chang, & McCreery, 2010, p. 297), the news hyperlink network is found to perpetuate the existing order of world system (Chang et al., 2009; Himelboim, 2010; Himelboim et al., 2010).

Moreover, holding a central position means domination in information production and command of foreign attention, which can reinforce the core countries' power over the semi-periphery and the periphery where information is consumed (Price, 2002). Chang (1998) finds that, in Reuters' news coverage of a world event, the core countries have much higher chances to be in the news than those located in the semi-periphery or periphery, and that the appearance of the semi-peripheral countries in news depends on the core countries to give them a ride. In comparison, the peripheral countries have little chance to be covered in the news. Similarly, online international news coverage is also distributed disproportional, heavily favoring the few core countries including the United States, the United Kingdom, and France (Himelboim et al., 2010).

While a considerable number of studies agree on the applicability of world system theory in the international network formed via Internet hyperlinks, news coverage, and flow, little is known about an international network formed via social media communication. News produced by media organizations is a result of organizational objectives, operational procedures, and journalistic practices, be it online or offline. It is thus subjected to state control and market orientation (Chang et al., 2009), which can contribute to the imperialistic structure and interaction pattern. Differently, the international network formed on social media is created through individual connections, activated by participation, and often carries user-generated content. It can thus theoretically allow information flow and communication to bypass the intermediation of traditional leaders in the world system. Crooks et al. (2014) find that the international network that emerged through retweet and mention activities on Twitter about the unrest in Syria shows a clear misalignment with the one defined by authoritative international relations (e.g., intergovernmental organizations and international arms trade). They argue that the citizen-driven international network formed via social media communication can defy the established state-driven international relations. However, they also note that, although Syria is the topic, the few core countries such as the United States and the United Kingdom still occupy the center of the network.

A country/territory's location in the world system can influence citizens' participation and action and in turn affect its position in the international network formed via social media. Individuals are always geographically located within the boundaries of countries/territories, with their conducts enacted within the larger economic, political, and civic institutions. For example, as a country's structural position determines its development, education resources are likely to distribute unevenly across the three zones. Since education is crucial to the acquisition of skills and resources of participation (Verba, Schlozman, & Brady, 1995), the core countries/territories may have a higher

participation level on social media than the rest. For instance, core countries such as the United States and the United Kingdom rank the top of United Nations Development Programme's 2013 Education Index (.890 and .860 respectively). In the meantime, 21% of the U.S. population and 17.16% of the U.K. population engaged in expressive participation on social network sites, sharing their views on community issues and politics (Pew Research Center, 2012). Brazil and Mexico, two semi-peripheral countries, have lower education scores (.661 and .638, respectively) and smaller percentages of the populations engaged in such expressive participation (13.8% and 10.07%, respectively). India, a peripheral country, ranks at the bottom of the education index (.473) and only 2.58% of its population engaged in expressive participation on social network sites (Pew Research Center, 2012). Besides, since both traditional and online international news is mostly produced in the few core countries and flows from the core to the margin (Chang, 1998; Chang et al., 2009; Chang, Lau, & Hao, 2000; Himelboim et al., 2010), citizens in the semi-periphery and the periphery may have been accustomed to seeking information about international events from the core nations, and their views influenced by the core countries' ideas and values. Information seeking behavior, as a result of long-term cultivation, may not easily change simply because alternative information becomes available on social media. It may be even more difficult to change when news media organizations, especially those of the core nations, have been scattering their news net on social media platforms.

In addition, existing studies have demonstrated that it is inadequate to attribute the international communication enabled by social media only to the structural positions of the countries/territories. For example, Twitter hashtag adoption and cross-country interpersonal email exchange are largely determined by physical distance and cultural proximity (e.g., shared language and former colonial relationships; Kamath, Caverlee, Cheng, & Sui, 2012; State, Park, Weber, Mejova, & Macy, 2013).

Based on the aforementioned theory and literature, on the one hand, it would seem naive to view an international network formed via social media communication as free of institutional influence. On the other hand, there has been evidence showing that the network is not solely or even largely determined by the existing order of the world system. A research question and hypothesis are thus developed as following:

**Research Question 1:** Does the structure of the international network formed on Twitter around the Hong Kong Occupy Central Movement follow the existing order of the world system?

**Hypothesis 1:** A country/territory's national income (a widely used benchmark for positions in the world system) is positively associated with its centrality in the international network formed on Twitter.

## Social Movement

**Grievances.** According to the social-psychological perspective of strain theory, grievances are relative deprivations that occur when people assess their situations against reference groups' or anticipated situations (Gurr, 1970). Unfulfilled aspirations and lasting discontent are believed to fuel collective actions. The structural functional version of strain theory states that structural strain (i.e., structural conflicts of interests) is always there built into social and political institutions, and that grievances are triggered by precipitating factors such as a dramatic event (Smelser, 1963). Different from the relative deprivation theory, the structural perspective links individual-level inequality to structural imbalances in society, such as uneven wealth allocation (Cederman, Weidmann, & Gleditsch, 2011). Cederman, Weidmann, and Gleditsch (2011) further conceptualize inequality as economic and political structural asymmetries and grievances as the perception of the inequality charged with emotion.

Grievances are considered necessary for any form of social movement to occur. Cederman et al. (2011) find that both economic grievances based on measures of per capita income and political grievances estimated as ethnic groups' access to central executive power are predictive of rising conflicts. Moreover, grassroots often use inequality and grievances to justify their action, which indicates grievances' central role in mobilization processes (Gamson, 1992).

Existing studies have shown that social media can amplify shared grievances and thus aid the occurrence and diffusion of social movements (Hussain & Howard, 2013). Grievances of one country exposed during a social movement can ignite the simmering frustration and discontent in another. People from other countries with similar grievances may better relate to the participants and share their causes. People from nondemocratic countries where civil liberties are limited can also use a social movement occurring elsewhere as a legitimate excuse to address their own issues indirectly. This is witnessed in the spread of uprising during the Arab Spring, and the globalization of the Occupy Movement originated from the United States.

This study focuses on the economic and political dimensions of grievances given the context of the Occupy Central Movement in Hong Kong. On the one hand, it is a civil disobedience movement calling for genuine universal suffrage and Beijing's back down on the NPCSC's ruling. It is thus foremost a movement fueled with political discontent and aimed at political achievement. On the other hand, the movement is deeply rooted in the society's enlarging wealth gap and limited upward social mobility that is often associated with conflict (Kanbur, 2007). It is thus plausible to anticipate countries/territories with high levels of grievances to show active participation on social media. The vibrant discourse as a result may be able to generate and propagate foreign attention, which can bring the countries/territories toward the center of the international network. Two hypotheses are developed as following:

**Hypothesis 2:** A country/territory's economic grievance level is positively associated with its centrality in the international network formed via Twitter.

**Hypothesis 3:** A country/territory's political grievance level is positively associated with its centrality in the international network formed via Twitter.

*Internet connectivity.* Numerous studies have demonstrated that Internet is an integral part of modern social movements. It provides infrastructural resources, reinforces organizational logic, and cultivates political ideal (Garrett, 2006; Juris, 2004). Hussain and Howard (2013) find that Internet use contributes to movement success in countries with high wealth inequality during the Arab Spring. Moreover, in general, Internet usage, especially usage for news consumption and political expression, can drive up democratic expectation (Lei, 2011; Nisbet, Stoycheff, & Pearce, 2012), facilitate political participation (Boulianne, 2009), and create a sense of shared grievances and strong political efficacy (Hussain & Howard, 2013).

Based on this body of literature, a country/territory with high Internet connectivity is likely to locate in the center of the international network formed via social media. A high Internet connectivity of a country/territory suggests citizens' high exposure to and awareness of the event, a participatory culture (although the relationship between Internet use and participation still depends on the type of use), and an increased chance to be mobilized by the social movement leaders and participants. Their active participation in the information dissemination and discussion on social media can promote the country/territory to the center of the international network. A hypothesis is thus proposed as following:

**Hypothesis 4:** A country/territory's Internet connectivity level is positively associated with its centrality in the international network formed on Twitter.

## Method

To answer Research Question 1, this study uses social network analysis to examine the structure of the international communication network formed on Twitter. It describes the network based on the connectivity and clustering of nodes (i.e., countries/territories), frequency of communication (i.e., edge width), and reciprocity of the edges. NodeXL (Version 1.0.1.250) is employed for data analysis. Following the descriptive examination of the network structure, a multivariate analysis is performed to test the four hypotheses.

### Data Collection

**Network data.** Using Tweet Archivist, the researcher collected tweets referring to the Occupy Central Movement in Hong Kong. The most used hashtag during the event #occupycentral was used as the search query. The data collection started on September 30, 2014, shortly after the protest escalated, proceeded in real time as the movement evolved, and stopped on November 4, 2014. This resulted in a dataset of 231,722 tweets, each including the name of the author, name(s) of other user(s) mentioned, time stamp, text, language, geoinformation, and times zones.

Since this study focuses on cross-country/territory connectivity and interaction, geolocations are of particular importance. The researcher first generated a list of users ( $N = 62,843$ ) from the total collected tweets, including those who posted tweets and those who were mentioned in the tweets. Among them, 31,650 users have location information, including a small subset of users with precise latitude and longitude coordinates and a large subset of users with self-reported location. For the latter, country/territory information was coded and checked against the language and time zone. Five thousand one hundred and ninety two users could not have their country/territory information inferred from their self-reported locations. In the end, the coding yielded a list of 26,458 users (42.11% of the sample) with country/territory information.

**Country/territory attributes data.** This study uses country/territory-level secondary data for measuring each country/territory's attributes. The pertaining data were obtained from Beevolve (<http://www.beevolve.com/twitter-statistics/>), the World Bank's World Development Indicators database of 2013, and the Worldwide Governance Indicators project's 2013 dataset. The physical distance between a country/territory and Hong Kong is calculated with the online tool DistanceFromTo (<http://www.distancefromto.net>).

### Country/Territory Communication Network

A communication network is built with retweets, replies, and mentions. The singletons (i.e., those that are not retweets, replies, or mentions) are excluded from analysis. First, a user-level communication network is built with 20,536 users and 92,822 edges. The network is grouped based on each node's (individual user's) country/territory information, yielding 148 groups (countries/territories) and 1421 group edges (pairs of countries/territories that interacted through tweet exchange). On this basis, a country/territory-level communication network is built with 148 nodes and 1421 edges. The width of an edge is determined by the frequency of communication between users from two countries/territories (i.e., the number of tweets exchanged;  $\text{Min} = 1$ ,  $\text{Max} = 12,725$ ,  $M = 40.71$ ,  $SD = 405.41$ ). It is a directed network, which means when users from country/territory A retweet tweets posted by users from country/territory B, reply to or mention users from country/territory B, a link is established directing from country/territory A to B.

## Variables and Measures

**Gross national income (GNI) per capita.** Previous studies have found that national income-based method is a sound approach to delineating the zones of the world economy (e.g., Babones, 2005). This study thus uses GNI per capita (converted to U.S. dollars using the World Bank Atlas method) as an indicator of a country/territory's position in the world system. Data are obtained from the World Bank's (2013) World Development Indicators database (US\$, Min = 600.00, Max = 102700.00,  $M = 20537.35$ ,  $SD = 23032.31$ ).

**Internet connectivity.** The variable of Internet connectivity is measured as Internet penetration rate. Data are obtained from World Bank's 2013 database (% , Min = 5.90, Max = 95.05,  $M = 53.74$ ,  $SD = 25.84$ ).

**Economic grievances.** The variable of economic grievances is gauged with Gini coefficients with data obtained from World Bank' 2013 database (Min = 24.00, Max = 63.10,  $M = 38.54$ ,  $SD = 8.79$ ).

**Political grievances.** The variable of political grievances is measured as the political and civil rights conditions of each country/territory in 2013. Specifically, this study uses the Voice and Accountability dimension of governance evaluated by World Governance Indicators. It captures "perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media" (Kaufmann, Kraay, & Mas-truzzi, 2011, p. 223). The original values are inversed, so that a large score denotes a high level of political grievances (Min = -1.82, Max = 1.76,  $M = -.27$ ,  $SD = .96$ ).

**Centrality.** The measurement of centrality is a composite of closeness centrality and information centrality, estimating a country/territory's structural centrality and discourse domination in the international communication network formed on Twitter.

**Closeness centrality.** Closeness centrality score measures the average shortest distance from one node to another in the network. A small average distance implies that the node is "directly connected or 'just a hop away' from most others" (Hansen, Shneiderman, & Smith, 2010, p. 41). In this study, a node's closeness centrality indicates a country/territory's central-peripheral location in the Twitter communication network. A central location in the network implies a high capacity for receiving and passing messages to others and thereby influencing the spread of the social movement in the international community. Closeness centrality is inversed, so that higher values indicate a more central position (Min = .0033, Max = .0061,  $M = .0037$ ,  $SD = .0004$ ).

**Information centrality.** The practice of "retweeting" that passes along original or previously retweeted tweets amplifies information dissemination on Twitter (Lotan et al., 2011). When a user from country/territory A retweets a tweet posted by a user from country/territory B, B acts as a producer, whereas A acts as a consumer. Countries/territories that act more often as information producer than consumer are considered to have higher information centrality. The variable of information centrality is thus estimated as the ratio of in-degree centrality to out-degree centrality. A node's in-degree centrality in terms of retweets refers to the number of tweets from the country/territory being retweeted by users from other countries/territories. A node's out-degree centrality refers to the number of tweets posted by other countries/territories being retweeted by users of the country/territory. A large ratio of in-degree centrality to out-degree centrality indicates a high information centrality score (Min = .00, Max = .94,  $M = .10$ ,  $SD = 1.16$ ).

The variables of closeness centrality and information centrality are significantly correlated with a medium to large effect size ( $r = .44$ ,  $p < .001$ ), confirming that countries/territories at the

core usually dominate the production of information (Price, 2002). The centrality variable is thus computed by taking the mean of the two after standardization ( $\text{Min} = -.61$ ,  $\text{Max} = 6.03$ ,  $M = .00$ ,  $SD = .87$ ).

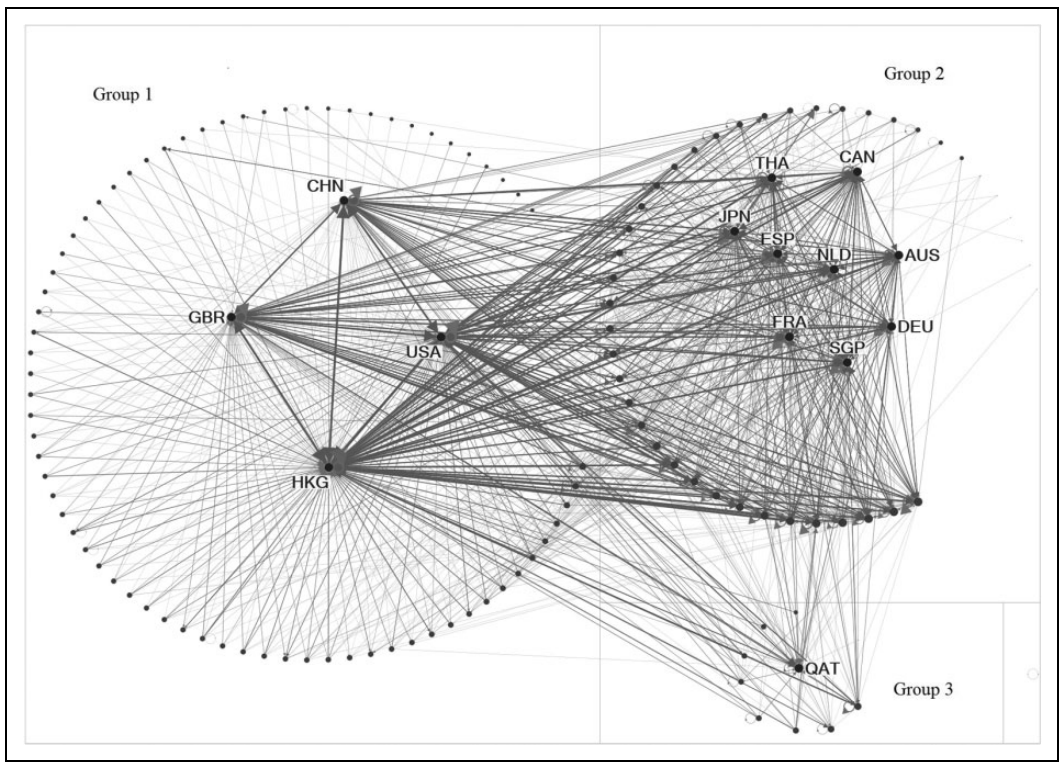
**Control variables.** This study controls for Twitter population and physical distance between Hong Kong and other countries/territories. Twitter population data are obtained from Beevolve (<http://www.beevolve.com/twitter-statistics/>) as ranking data (1–7 where 1 means *very small Twitter population* and 7 means *very large Twitter population*). The exact number of Twitter users by country cannot be found from data released by either Twitter or third party organizations. The physical distance between Hong Kong and any other country/territory is calculated as exact distances in kilometers with the online tool DistanceFromTo (<http://www.distancefromto.net>).

## Results

### Social Network Analysis Results

As Figure 1 shows, the international network formed via Twitter communication around the Occupy Central Movement in Hong Kong has a giant connected component consisting of all the nodes except for one (Senegal). It suggests a high level of cross-country/territory online connectivity. The node size represents the closeness centrality of the country/territory and the edge width represents the number of tweets exchanged between the two countries/territories. Hong Kong, the United States, the United Kingdom, and China are the four countries that generate the largest volumes of tweets. Hong Kong has a self-loop with the largest edge width followed by the United States, indicating that a large proportion of the tweets are disseminated within itself. In terms of cross-country/territory interaction, Hong Kong and the United States share the largest volume of tweets, followed by Hong Kong and the United Kingdom, and Hong Kong and China. In total, 49.34% of the edges are reciprocal. The network is then clustered using the Clauset–Newman–Moore clustering algorithm, yielding three interconnected groups and a single-node isolate (modularity score = .21).

The center of Group 1 consists of the four most active countries/territories (i.e., Hong Kong, the United States, the United Kingdom, and China). Hong Kong, the United States, and the United Kingdom belong to the Tier-1 core zone in the world system (Babones, 2005). Hong Kong being the host of the Occupy Central Movement and the former colony of the United Kingdom explains the two countries/territories' prominent positions. The central role of the United States in the network is consistent with the previous finding that it occupies the center of the network emerged on Twitter around the unrest in Syria (Crooks et al., 2014). China, although a semi-peripheral country, also acts as a central node in the group. It can be explained by China's intrinsic link to the Occupy Central Movement as well as its rising power on the global stage in the past decade (Fravel, 2010). Besides, although officially censored in mainland China, Twitter is often used by Chinese activists to draw international attention to their struggles (Lim, 2011). In comparison, the rest of the nodes are relatively inert. They have few self-loops, meaning that they rarely communicate within their own countries/territories. They do not interact with each other but only with the central nodes. The majority of them, such as Portugal, Bulgaria, South Africa, Saudi Arabia, Mongolia, Pakistan, Sri Lanka, Peru, and so on, also connect to the center of Group 2. They are a mix of countries/territories belonging to the Tier-2 and Tier-3 zones in the world system with some exception (e.g., Denmark; Babones, 2005). The countries/territories that only connect to the core of Group 1 consist mostly of small, less-developed Middle Eastern (e.g., Lybia, Oman), Southeast Asian (e.g., Myanmar, Laos), African (e.g., Uganda, Rwanda), and Latin American (e.g., Honduras) countries/territories. Moreover, the connection between the center and the edge is mostly unidirectional that information flows from the



**Figure 1.** Country/territory-level communication network visualization.

core to the semi-peripheral and peripheral but rarely the other way around. Interaction between the semi-peripheral and peripheral countries/territories is missing.

According to network properties reported in Table 1, despite the largest number of nodes ( $n = 84$ ) and edges ( $n = 254$ ), Group 1 has the lowest reciprocity rate (0.15), highest average geodesic distance (1.98), and lowest density score (0.03) among the three groups. It supports the visual description that reciprocal interaction mainly concentrates in the core countries/territories and that communication between the center and periphery is vertical. In general, the composition of and interaction within Group 1 follow the existing order of the world system and the international relations described in Galtung's (1971) Structural Theory of Imperialism to a large extent.

Group 2 has a nearly fully connected core, comprising France, Germany, Netherlands, Spain, Japan, Thailand, Singapore, Australia, and Canada that mostly belong to Tier-1 zone of the world economy except for Thailand. The rest of the nodes are connected to the centers of both Group 2 and Group 1, most of which involve reciprocal interaction. Group 2 exhibits the highest level of interconnectivity (density score = .22) and reciprocity (reciprocated edge ratio = .53). Group 2 primarily consists of continental European, Asian-Pacific, and South American countries/territories of the core and semi-periphery with some exceptions such as Thailand, India, and the Philippines. Thailand in particular joins the core of this subnetwork. It is geographically close to Hong Kong and has a decades-long history of political unrest and a divided citizenry. Antigovernment protests took place calling for democratic reform of the political system during November 2013 and May 2014 (McKirdy, 2014), which was extensively covered by global news media.

Group 3 consists of a small number of countries including Qatar, Jordan, United Arab Emirates, Lebanon, Indonesia, Bangladesh, Kenya, Nigeria, and Afghanistan, which share certain cultural

**Table 1.** Network Properties of the Three Groups in the International Communication Network.

|    | No. of Nodes | No. of Edges | No. of Self-Loops | Reciprocated Edge Ratio | No. of Connected Components | Average Geodesic Distance | Density |
|----|--------------|--------------|-------------------|-------------------------|-----------------------------|---------------------------|---------|
| G1 | 84           | 254          | 16                | .15                     | 1                           | 1.98                      | .03     |
| G2 | 52           | 614          | 40                | .36                     | 1                           | 1.73                      | .22     |
| G3 | 11           | 19           | 6                 | .08                     | 1                           | 1.62                      | .12     |

similarity and geographical proximity. Qatar occupies the center of the communication in the group, well connected to the core of Group 1 with reciprocal ties. But it is connected to the center of Group 2 with only unidirectional ties that Qatar sends information out but does not receive information in return. Qatar is one of the world's richest countries (Aridas, 2013), and headquarter of Al Jazeera, one of the world's largest news organizations. The pattern of its interaction with the other two groups indicates that Al Jazeera may be the main actor within Qatar; it mainly interacts with the core countries/territories of Group 1, where first-hand information about the event comes (e.g., Hong Kong and China) and other major media organizations are based (e.g., the United States and the United Kingdom), and acts as a news source for other countries/territories.

Figure 2 shows the connectivity and interactivity among the center countries/territories in the communication network emerged on Twitter around Occupy Central Movement. They primarily belong to the Tier-1 zone of the world system and share large volumes of interactivity between each other except for Qatar.

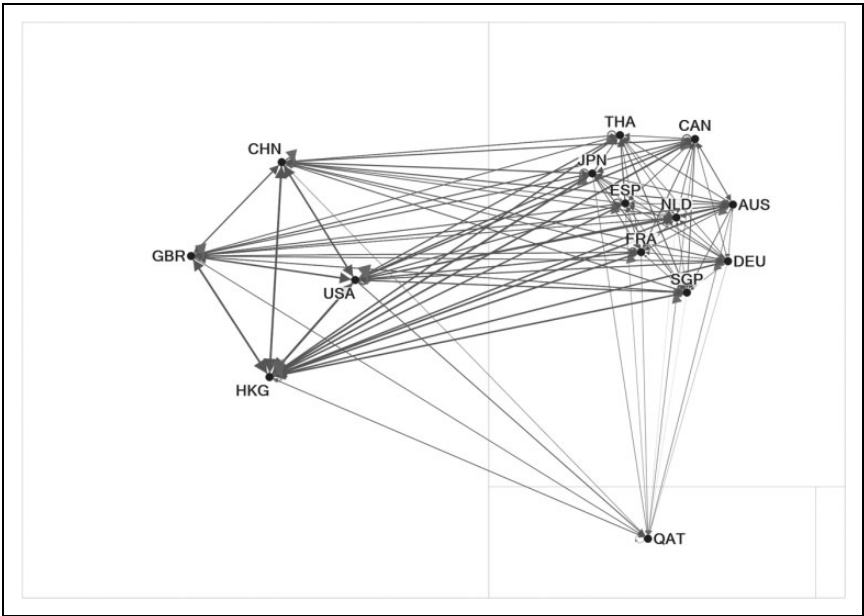
### Multivariate Analysis

To test the four hypotheses, a multivariate ordinary least squares (OLS) regression is conducted regressing centrality against GNI per capita, Internet connectivity, economic grievances, and political grievances, when controlling for Twitter population and physical distances. Hong Kong is excluded from the analysis, as it is the host of the event and a natural center of the network, which would skew the results. UCINET 6's "node-level regression" is used to generate significance levels based on permutations of the dependent variable.

Table 2 reports the results for predictors of countries/territories centrality in the international communication network formed on Twitter. Based on 5,000 random permutations using quadratic assignment procedure (QAP), it is found that the model explains a significant amount of the variance in the countries/territories' centrality,  $F(6, 70) = 22.68, p < .01, R^2_{\text{Adjusted}} = .63$ . When controlling for physical distance and Twitter population, GNI per capita is a significant predictor of centrality ( $\beta = .49, p < .05$ ). It suggests that countries/territories belonging to the core of the world economy tend to have higher centrality in the international communication network formed on Twitter, supporting Hypothesis 1 and the visual description of the network structure. Among the grievances variables, level of economic grievances is positively related to centrality but without statistical significance ( $\beta = .16, p = .21$ ), rejecting Hypothesis 2. A country/territory's level of political grievances is predictive of its centrality in the network ( $\beta = .59, p < .01$ ), supporting Hypothesis 3. Moreover, it is the largest factor predicting centrality, superseding national income. Internet penetration is also found predictive of centrality ( $\beta = .36, p < .05$ ), supporting Hypothesis 4. However, its explanatory power is smaller than that of the national income factor.

### Conclusions and Implications

Drawing on the world system theory and existing literature on social movement, this study examines the structure of the international communication network formed on Twitter around the Occupy



**Figure 2.** Center country/territory network visualization.

**Table 2.** OLS Regression.

|                           | Centrality<br>$\beta$ (SE) |
|---------------------------|----------------------------|
| Twitter population        | .47 (.08)**                |
| Physical distance         | -.09 (.00)                 |
| GNI per capita            | .49 (.00)*                 |
| Economic grievances       | .16 (.01)                  |
| Political grievances      | .59 (.15)**                |
| Internet penetration rate | .36 (.01)*                 |
| Adjusted $R^2$            | .63                        |
| N                         | 77                         |

*Note.* Based on 5,000 random permutations using quadratic assignment procedure (QAP). Standardized regression coefficient, OLS = ordinary least squares, SE = standard error, GNI = gross national income.  
\* $p < .05$ . \*\* $p < .01$ .

Central Movement in Hong Kong. It also estimates the factors contributing to a country/territory's centrality in the network structure and information production.

Result of the social network analysis suggests that the international network formed on Twitter is still arrayed along a core-periphery dimension with the few core countries including the United States, the United Kingdom, wealthy Western European and Asian countries at the center, and less-developed countries on the edge. Although social media communication is believed to be largely citizen driven, the globalization of social movements on social media is still circumscribed by the existing authoritative institutions that favor the countries/territories at the core of the world system. By occupying the center of the network, they can channel the international attention, exert great influence over the global discourse, and further affect the development of the social movement domestically and its presentation internationally. A social movement originating from the semi-periphery and periphery is thus likely to

be interpreted by the international community with the core countries' ideas and values. However, this study focuses its analysis on a social movement originating from a Tier-1 territory. Whether the finding can be generalized to the events of the other two zones needs to be further tested.

On the other hand, the results show that a country/territory's position in the world system is not the most prominent factor determining its centrality in the international network. Instead, the level of political grievances is the largest predictor. In the globalization of a social movement, citizens of countries/territories with political disenfranchisement are likely to resonate with the social movement, relate it to the local situations, express their opinions, and calling for domestic and international support. Their active participation on social media can move the country/territory toward the center of the network and to some extent mitigate the core countries' power in steering the development of social movements.

However, inconsistent with the existing findings that economic grievances play an important role in conflicts and collective actions (Cederman et al., 2011; Kanbur, 2007), the results show that a country/territory's level of economic grievances does not predict its centrality in the international network. There are several plausible explanations. First, the Occupy Central Movement in Hong Kong is foremost a political movement and is largely presented by international news organizations as a prodemocracy movement. Since economic grievances do not appear to be a strong factor in the occurrence of the movement, citizens in countries/territories with high economic grievances may not consider the movement relevant to their domestic issues and thus pay less attention. Second, it may be also because how economic grievances are measured in this study. Although economic inequality in Hong Kong is deeply rooted in its social hierarchy and limited upward social mobility in the system, locals widely believe that immigrants and investors from the mainland China are responsible for the situation. It may thus be perceived as intergroup inequality more than individual inequality. Gini coefficient that is used to measure economic inequality in this study is however an indicator of individual economic inequality.

In addition, a country/territory's Internet connectivity is found to be predictive of its centrality in the network, yet with an effect size smaller than other predictors. It indicates that, to some extent, Internet connectivity can play an equalizing role, reducing the core countries/territories' monopoly on the international communication network and bringing those at the semi-periphery and even periphery to the fore. This may be particularly relevant given the current trend that the gap between developed and developing countries in Internet adoption is narrowing down (Chinn & Fairlie, 2010). Moreover, it extends the existing findings that Internet use can promote participation at the individual level to the country/territory level and supports the conclusion that the effect of Internet use on participation is relatively small (Boulianne, 2009).

Findings of this study are based on the social movement in Hong Kong that belongs to the core zone of the world system. Future studies could focus on social movements occurring in the semi-peripheral and peripheral in order to test if the current findings still stand. In addition, traditional news media, especially the major news organizations, have been penetrating social media space for the production and dissemination of news. It is beyond the scope of this study to test the influence of such media practice on the connectivity and interactivity in the citizen-driven international network. However, given the logic of preferential attachment, we can expect that such media practice can skew the attention on social media and thus affect the formation of the network. Future studies could differentiate news media's social media accounts and posts from the common users', and also test if the news media's coverage of events on social media contributes to the network structure following the pattern of the world system.

### **Declaration of Conflicting Interests**

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Funding

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

## References

- Aridas, T. (2013, June 14). The world's richest and poorest countries. *Global Finance*. Retrieved from <http://www.gfmag.com/global-data/economic-data/worlds-richest-and-poorest-countries>
- Babones, S. J. (2005). The country-level income structure of the world-economy. *Journal of World-Systems Research*, 11, 29–55. Retrieved from <http://jwsr.pitt.edu/>
- Backstrom, L., Boldi, P., Rosa, M., Ugander, J., & Vigna, S. (2012, June). Four degrees of separation. In *Proceedings of the 3rd annual ACM web science conference* (pp. 33–42). New York, NY: ACM.
- Barnett, G. A., & Choi, Y. (1995). Physical distance and language as determinants of the international telecommunications network. *International Political Science Review*, 16, 249–265. doi:10.1177/019251219501600305
- Barnett, G. A., & Park, H. W. (2005, October). The structure of international Internet hyperlinks and bilateral bandwidth. *Annales des Télécommunications*, 60, 1110–1127. doi:10.1007/BF03219838
- Boulianne, S. (2009). Does Internet use affect engagement? A meta-analysis of research. *Political Communication*, 26, 193–211. doi:10.1080/10584600902854363
- Castells, M. (2009). *Communication power*. Oxford, England: Oxford University Press.
- Castells, M. (2012). *Networks of outrage and hope: Social movements in the Internet age*. Cambridge and Malden, MA: Polity Press.
- Cederman, L. E., Weidmann, N. B., & Gleditsch, K. S. (2011). Horizontal inequalities and ethnonationalist civil war: A global comparison. *American Political Science Review*, 105, 478–495. doi:10.1017/S0003055411000207
- Chang, T. K. (1998). All countries not created equal to be news: World system and international communication. *Communication Research*, 25, 528–563. doi:10.1177/009365098025005004
- Chang, T. K., Himelboim, I., & Dong, D. (2009). Open global networks, closed international flows: World system and political economy of hyperlinks in cyberspace. *International Communication Gazette*, 71, 137–159. doi:10.1177/1748048508100910
- Chang, T. K., Lau, T. Y., & Hao, X. (2000). From the United States with news and more: International flow, television coverage and the world system. *International Communication Gazette*, 62, 505–522. doi:10.1177/0016549200062006004
- Chinn, M. D., & Fairlie, R. W. (2010). ICT use in the developing world: An analysis of differences in computer and Internet penetration. *Review of International Economics*, 18, 153–167. doi:10.1111/j.1467-9396.2009.00861.x
- Crooks, A., Masad, D., Croitoru, A., Cotnoir, A., Stefanidis, A., & Radzikowski, J. (2014). International relations: State-driven and citizen-driven networks. *Social Science Computer Review*, 32, 205–220. doi:10.1177/0894439313506851
- Fravel, M. T. (2010). International relations theory and China's rise: Assessing China's potential for territorial expansion. *International Studies Review*, 12, 505–532. doi:10.1111/j.1468-2486.2010.00958.x
- Galtung, J. (1971). A structural theory of imperialism. *Journal of Peace Research*, 8, 81–117. Retrieved from <http://jpr.sagepub.com>
- Gamson, W. A. (1992). *Talking politics*. New York, NY: Cambridge University Press.
- Garrett, R. K. (2006). Protest in an information society: A review of literature on social movements and new ICTs. *Information, Communication & Society*, 9, 202–224. doi:10.1080/13691180600630773
- Golan, G. J. (2008). Where in the world is Africa? Predicting coverage of Africa by US television networks. *International Communication Gazette*, 70, 41–57. doi:10.1177/1748048507084577
- González-Bailón, S., Borge-Holthoefer, J., & Moreno, Y. (2014). Online networks and the diffusion of protest. In G. Manzo (Ed.), *Analytical sociology: Actions and network* (pp. 261–278). New York, NY: John Wiley. doi:10.1002/9781118762707.ch10

- Griffiths, J. (2014, October 02). 'We belong to Hong Kong': Thousands gather at solidarity events in 64 cities around the world. *South China Morning Post*. Retrieved from <http://www.scmp.com/news/hong-kong/article/1607584/we-belong-hong-kong-thousands-gather-solidarity-events-64-cities>
- Gurr, T. R. (1970). *Why men rebel*. Princeton, NJ: Princeton University Press.
- Hansen, D., Shneiderman, B., & Smith, M. A. (2010). *Analyzing social media networks with NodeXL: Insights from a connected world*. Burlington, MA: Morgan Kaufmann.
- Harold, S. (2014, September 8). Big trouble in little China. *Foreign Affairs*. Retrieved from <http://www.foreign-affairs.com/articles/141968/scott-harold/big-trouble-in-little-china>
- Himmelboim, I. (2010). The international network structure of news media: An analysis of hyperlinks usage in news web sites. *Journal of Broadcasting & Electronic Media*, 54, 373–390. doi:10.1080/08838151.2010.499050
- Himmelboim, I., Chang, T. K., & McCreery, S. (2010). International network of foreign news coverage: Old global hierarchies in a new online world. *Journalism & Mass Communication Quarterly*, 87, 297–314. doi:10.1177/107769901008700205
- Howard, P. N., & Hussain, M. M. (2011). The role of digital media. *Journal of Democracy*, 22, 35–48. Retrieved from <http://www.journalofdemocracy.org>
- Hu, F., & Yun, M. (2013, September 30). Hong Kong poverty line shows wealth gap with one in five poor. *Bloomberg Business*. Retrieved from <http://www.bloomberg.com/news/articles/2013-09-29/hong-kong-poverty-line-shows-wealth-gap-with-one-in-five-poor>
- Hussain, M. M., & Howard, P. N. (2013). What best explains successful protest cascades? ICTs and the fuzzy causes of the Arab Spring. *International Studies Review*, 15, 48–66. doi:10.1111/misr.12020
- Juris, J. S. (2004). Networked social movements: Global movements for global justice. In M. Castells (Ed.), *The network society: A cross-cultural perspective*, (pp. 341–362). Northampton, MA: Edward Elgar.
- Kaufmann, D., Kraay, A., & Mastruzzi, M. (2011). The worldwide governance indicators: Methodology and analytical issues. *Hague Journal on the Rule of Law*, 3(2), 220–246. doi:10.1017/S1876404511200046
- Kamath, K. Y., Caverlee, J., Cheng, Z., & Sui, D. Z. (2012, October). Spatial influence vs. community influence: Modeling the global spread of social media. In *Proceedings of the 21st ACM international conference on information and knowledge management* (pp. 962–971). Maui, HI: ACM.
- Kanbur, R. (2007). Poverty, inequality and conflict: The inequality link. *Coping with crisis working paper series*. Retrieved from International Peace Academy website: [http://www.ipinst.org/wp-content/uploads/2015/06/mgs\\_povr.pdf](http://www.ipinst.org/wp-content/uploads/2015/06/mgs_povr.pdf)
- Lee, D. (2014, October 30). The role of social media in Occupy protests, on the ground and around the world. *South China Morning Post*. Retrieved from <http://www.scmp.com/news/hong-kong/article/1628305/role-social-media-occupy-protests-ground-and-around-world>
- Lei, Y. W. (2011). The political consequences of the rise of the Internet: Political beliefs and practices of Chinese citizens. *Political Communication*, 28, 291–322. doi:10.1080/10584609.2011.572449
- Lim, L. (2011, October 28). Chinese activists turn to Twitter in rights cases. *National Public Radio*. Retrieved from <http://www.npr.org/2011/10/28/141606687/chinese-activists-turn-to-twitter-in-rights-cases>
- Lim, M. (2012). Clicks, cabs, and coffee houses: Social media and oppositional movements in Egypt, 2004–2011. *Journal of Communication*, 62, 231–248. doi:10.1111/j.1460-2466.2012.01628.x
- Lotan, G., Graeff, E., Ananny, M., Gaffney, D., Pearce, I., & Boyd, D. (2011). The Arab Spring| The revolutions were Tweeted: Information flows during the 2011 Tunisian and Egyptian Revolutions. *International Journal of Communication*, 5, 31. Retrieved from <http://ijoc.org/index.php/ijoc/article/view/1246>
- McKirdy, E. (2014, February 21). Thailand in crisis: What's happening on the ground and why. *CNN*. Retrieved from <http://edition.cnn.com/2014/02/19/world/asia/thailand-explainer-post-election/>
- Mills, C. W. (1959). *The sociological imagination*. Oxford, England: Oxford University Press.
- Nisbet, E. C., Stoycheff, E., & Pearce, K. E. (2012). Internet use and democratic demands: A multinational, multilevel model of Internet use and citizen attitudes about democracy. *Journal of Communication*, 62, 249–265. doi:10.1111/j.1460-2466.2012.01627.x

- Pew Research Center. (2012, December 12). *Social networking popular across globe*. Retrieved October 23, 2015, from <http://www.pewglobal.org/2012/12/12/social-networking-popular-across-globe/>
- Price, M. E. (2002). *Media and sovereignty: The global information revolution and its challenge to state power*. Cambridge, MA: MIT Press.
- Quercia, D., Capra, L., & Crowcroft, J. (2012, May). The social world of Twitter: Topics, geography, and emotions. In *Proceedings of the 6th international AAAI conference on weblogs and social media* (pp. 298–305). Dublin, Ireland.
- Said, E. (1982). *Covering Islam*. New York, NY: Pantheon Books.
- Smelser, N. (1963). *Theory of collective behavior*. New York, NY: Free Press.
- South China Morning China Post. (2014, August 31). *NPC Standing Committee decision on Hong Kong 2017 election framework*. Retrieved from <http://www.scmp.com/news/hong-kong/article/1582245/full-text-npc-standing-committee-decision-hong-kong-2017-election>
- State, B., Park, P., Weber, I., Mejova, Y., & Macy, M. (2013). *The mesh of civilizations and international email flows*. Retrieved from <http://arxiv.org/pdf/1303.0045.pdf>
- Takhteyev, Y., Gruz, A., & Wellman, B. (2012). Geography of Twitter networks. *Social Networks*, 34, 73–81. doi:10.1016/j.socnet.2011.05.006
- Tufekci, Z. (2013). “Not this one”: Social movements, the attention economy, and microcelebrity networked activism. *American Behavioral Scientist*, 57, 848–870. doi:10.1177/0002764213479369
- Tufekci, Z., & Freelon, D. (2013). Introduction to the special issue on new media and social unrest. *American Behavioral Scientist*, 57, 843–847. doi:10.1177/0002764213479376
- United Nations Development Programme. (2013). *Education index*. Retrieved from <http://hdr.undp.org/en/content/education-index>
- Verba, S., Schlozman, K. L., & Brady, H. E. (1995). *Voice and equality: Civic voluntarism in American politics*. Cambridge, MA: Harvard University Press.
- Wallerstein, I. (1974). The rise and future demise of the world capitalist system: Concepts for comparative analysis. *Comparative studies in society and history*, 16, 387–415. Retrieved from <http://journals.cambridge.org>
- World Government Indicators. (2013). *Full dataset*. Retrieved from <http://info.worldbank.org/governance/wgi/index.aspx#home>
- Yip, P. (2014, June 5). Wealth gap will break Hong Kong if we don't change the economic order. *South China Morning Post*. Retrieved from <http://www.scmp.com/comment/article/1525874/wealth-gap-will-break-hong-kong-if-we-dont-change-economic-order?page=all>

## Author Biography

**Qinfeng Zhu** is a doctoral student at the Department of Media and Communication, City University of Hong Kong. She holds a MA degree in communication from the National University of Singapore and a BA degree from the School of Journalism and Communication, Nanjing University, China. E-mail: qinfenzhu3-c@my.cityu.edu.hk