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Inter- and intra-city networks: how networks are shaping China's film industry

Hu Wen^a, Qiangguo Zhang^b, Shengjun Zhu^c  and Yongyuan Huang^d

ABSTRACT

While existing studies have mapped out various networks with some visualization techniques, we move one step forward by examining if city/firm performance is dependent not only on intra-city networks, as proposed by the clustering literature, but also on inter-city networks, the core concept in the world city network literature. Our second contribution is to investigate the complementarity between inter- and intra-city networks, and how it could affect the performance of firms and cities. In doing so, we provide some preliminary evidence that studies on clustering and the world city network could benefit from having more dialogues with each other.

KEYWORDS

intra-city network; inter-city network; film industry; performance

JEL D22, D83, L23, L25

HISTORY Received 19 September 2019; in revised form 21 July 2020

INTRODUCTION

Networks between firms enable firms to collaborate and exchange knowledge (Marshall, 1920; Rosenthal & Strange, 2001), and thus have become the foundation for understanding why firms network with each other and why networked firms tend to outperform their counterparts (Giuliani & Bell, 2005; Gordon & McCann, 2000; Sørensen, 2003). Such network features are created and reinforced by geographical proximity because the latter facilitates face-to-face interactions and the transfer of tacit knowledge between firms (Storper & Venables, 2004). The clustering literature has therefore stressed the importance of firm networks within a small geographical area, such as a single city, and how such intra-city networks often have an important local dimension (Sturgeon et al., 2008).

As cities become more connected by new technologies, another strand of the literature on the world city network has emerged (Derudder & Taylor, 2016), and sought to direct our attention from the internal dynamics of a single city to the conceptualization of the interconnectedness


between pairs of cities in economic globalization (Beaverstock et al., 2000). The importance of cities in the current economic and production system is thus dependent not only on local clusters of economic activities embedded within cities (intra-city networks) but also on how cities are connected to each other via the networks formed between firms across these clusters (inter-city networks) (Derudder & Taylor, 2016; Sassen, 1991; Scott, 2012).

The world city network literature has first focused on the intra-firm networks in one particular industrial sector – advanced producer service (APS) – as well as some other sectors with trans-local reach, such as the global media industry (Hoyler & Watson, 2013; Mould, 2008). However, the intra-firm network approach has been critiqued for failing to capture the diverse ways in which cities are related with one another via more flexible and complex economic organization between different specialized firms in some industrial sectors, such as creative industries (Grabher, 2002). One major change in this strand of the literature is thus to move from the intra-firm network approach, which stresses the centrality of large firms, towards the inter-firm network perspective where more


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complex organizational configurations translate into new patterns of connectivity between cities (Hoyler & Watson, 2019). This change is also necessary as in many sectors (e.g., the film industry) the production tasks have been increasingly carried out through the co-production of several specialized firms, which are often located in different cities, rather than by one vertically integrated large corporation (Gereffi et al., 2005; Storper & Christopherson, 1987). Those co-producing firms in various cities can be seen as important city network makers.

The emergence of the world city network literature does not mean the decline of the clustering literature. Instead, those two strands of the literature coexist, but rarely speak with one another. This paper seeks to provide some preliminary evidence that studies on clustering and the world city network could benefit from having more dialogues with each other. First, the current literature on the world city network tends to map out the networks of firms in various cities as a proxy of inter-city networks and to examine the positions of different cities in such networks (Derudder & Taylor, 2016; Hanssens et al., 2014; Hoyler & Watson, 2019; Zhang et al., 2018). It is often descriptive with some visualization techniques to show the features of city networks and the functional differentiation between cities, whereas the cluster literature has been much more analytical, and one long-lasting issue in this strand of the literature is if networks within a single city or cluster promote firm performance. Here, we move one step forward to investigate if the performance of firms and cities is shaped not only by intra-city networks, as revealed by the cluster literature, but also by inter-city networks, as the latter can serve as trans-local pipelines for knowledge and resources to flow among cities.

Second, and more importantly, we argue that those two types of networks complement each other in pushing forward the performance of firms and cities. The intensive-knowledge transfer via firm networks in a single city has been seen as one of the key reasons for the existence of clusters as well as for their outstanding economic success (Maskell & Malmberg, 2007). Furthermore, cities are connected with each other via the 'space of flows' (Castells, 1996). In this sense, knowledge from city A may flow to city B via inter-city networks. The extent to which external knowledge from city A could further diffuse among firms in city B is dependent on the density and strength of intra-city firm networks in city B. Hence, we should take into account intra- and inter-city networks simultaneously to understand better their complicated roles in promoting the performance of firms and cities. In doing so, we hope to bridge the two strands of the literature.

This paper focuses on the film industry, which has been studied by the clustering literature since the 1980s (Coe, 2001; Storper & Christopherson, 1987). This industry has shifted from one dominated by a handful of vertically integrated large corporations to one where production is increasingly conducted through the collaboration between many smaller and specialized firms (Christopherson & Storper, 1986). The emerging networked geographies of the co-production of specialized firms have become one

of the main driving forces of city networks (Zhang et al., 2018). Some reasons that film firms search for partners within and across cities include technical and creative concerns to take advantage of specific expert skills and creative resources in various cities, and financial reasons to pool financial resources especially as the production of recent films often demands massive investments (Hoyler & Watson, 2019). The low transportation cost of intermediate goods in this industry, most of which are in digital form, also facilitates the formulation of inter-firm networks. Hence, unlike APS, whose production system is characterized by intra-firm networks, the film industry provides an ideal case to examine inter-firm networks within and across cities, as well as their effects on the performance of firms and cities.

INTER- AND INTRA-CITY NETWORKS

Economic activities are always embedded in some social, cultural, historical and institutional contexts (Granovetter, 1985). An inter-firm, relational network is a prevalent form of economic organization, and refers to the contextualized social and economic relations between firms that contain elements of reciprocity in the form of joint problem-solving and knowledge transfer (Castells, 2002; Granovetter, 1985). Hence, the network perspective is central for understanding the emerging networked geographies of the co-production of specialized firms as well as the subsequent new patterns of connectivity between cities.

This is the case especially in industries such as the film industry, as the economic organization of the film industry has been fundamentally transformed in the last few decades. The production of films used to rely on the classical Fordist mass production model, which was dominated by a handful of large studios and corporates (Christopherson & Storper, 1986; Scott, 2002). Those vertically integrated large firms kept a wide range of functions in-house, such as film-making, marketing and the exhibition of films, to rationalize its production process and maximize efficiency (Christopherson & Storper, 1986; Storper & Christopherson, 1987). With the collapse of the mass production model, large firms started to outsource some functions to suppliers. Here we see a dramatic transformation of the film industry from one characterized by large-scale production with higher levels of standardization and routinization to one heavily dependent on non-standardized input-output networks between firms, located in one city or many different cities (Christopherson & Storper, 1986; Hoyler & Watson, 2019; Scott, 2002). This organizational transformation also has some impacts on the geographical configurations of the film industry, as firms outsourced some functions to other firms in the same city or to more peripheral locations with lower production and labour costs and more favourable industrial policies (Christopherson & Righthor, 2010; Scott & Pope, 2007). A network perspective is therefore key to understand how those complex organizational and geographical configurations translate into new patterns of connectivity between firms within a single city or in many cities.

Two strands of the literature have looked into the emerging networked geographies of the co-production of specialized firms, but focused on different aspects of the same story. One focuses on networks within a cluster or city (i.e., intra-city network) and examines how vertical disintegration has created strong clustering tendencies at the local level (Christopherson & Storper, 1986; Storper & Christopherson, 1987). The collapse of the mass production model has triggered the reorganization of the industrial complex, and led to the rise of horizontal integration of production capacity. New geographical patterns have emerged alongside organizational transformation. The clustering literature tends to stress that, after the shift from the 'just-in-case' system to the 'just-in-time' system characterized by more frequent and small-scale transactions, geographical proximity has become more rather than less important (Scott, 1988; Storper, 1997). Firms cluster within a city, as geographical proximity not only reduces transaction and monitoring costs but also facilitates close coordination between firms. Clusters can thus be seen as intra-city networks of specialized firms connected with each other via formal and informal interactions (Maskell, 2001; Maskell & Malmberg, 1999). The network structure of a local cluster is situated in input-output linkages between firms (i.e., traded interdependencies) and also in broader social and economic relations (i.e., untraded interdependencies), acting as a key mechanism underpinning knowledge spillover and information diffusion within the cluster.

The other strand of the literature also adopts a network perspective though at a larger geographical scale. After the collapse of the mass production model, production tasks have been carried out through the collaboration of many specialized firms sometimes located in various cities (Gerfffi et al., 2005; Storper & Christopherson, 1987). As those specialized firms in different cities are connected, cities also become connected through the inter-city networks. It is increasingly acknowledged that in the globalization era, the development of new telecommunication and transportation technologies has integrated the world's main cities into the 'world city network' (Derudder & Taylor, 2016), and led to the rise of several 'world cities' or 'global cities' (Friedmann, 1986; Sassen, 1991). Cities in the networks are interconnected with one another, with intensive exchange of labour, capital, knowledge, technologies and products. Cities have become the 'nodes' in the space of flows connecting different nodes (Castells, 1989, 1999). The role of cities in the new economic system is therefore dependent on their internal dynamics and also on their positions in the inter-city networks and how they are linked to other cities (Derudder & Taylor, 2016; Taylor et al., 2010). Based on this analytical framework, some empirical studies have thoroughly examined the connectivity of cities based on an interlocking network model (Derudder & Taylor, 2016; Derudder et al., 2010).

The clustering literature pays specific attention to how knowledge diffuses via firm networks within a cluster or city, whereas the world city network literature places its emphasis on the interconnectedness between pairs of cities.

This comparison resonates with the distinction between 'local buzz' and 'trans-local pipeline' proposed by Bathelt et al. (2004). 'Local buzz' refers to the idea that dense networks within clusters enhance interaction and knowledge exchange between firms, and has thus been identified as one of the main driving forces for the existence of industrial clusters and their success. However, an overreliance on networks within clusters may lead to the lack of new ideas and information (Boschma, 2005). In response to the concern of the potential risk of lock-in within clusters, Bathelt et al. (2004) have further invented the idea of 'trans-local pipelines' to stress that the most vibrant clusters are those that also build linkages with actors embedded in other clusters to breathe in new, fresh air. It could be said that successful clusters are often characterized by a dense local network as well as intensive interactions with other clusters via trans-local linkages.

Bathelt et al.'s (2004) emphasis on both 'local buzz' and 'trans-local pipeline' reminds us that the clustering literature and the world city network literature may benefit from having more dialogues with each other. First, while the world city network literature is often descriptive with some visualization techniques to show the features of city networks and the positions of different cities in such networks, the clustering literature has been analytical and focused especially on the extent to which networks within clusters are associated with better performance (Gordon & McCann, 2000; Sorensen, 2003). The latter strand of the literature further argues that knowledge is diffused within clusters in a highly uneven way (Giuliani, 2007; Lissoni, 2001). Specifically, agglomeration externalities tend to be greater in regions and cities that have denser local networks, resulting in better performance at the regional and city levels (Ciccone & Hall, 1996). Likewise, firms with more linkages within clusters are likely to outperform their counterparts with fewer linkages (Giuliani, 2006). These arguments lead us to the following hypotheses:

Hypothesis 1a: Cities with denser local networks are likely to have better performance.

Hypothesis 1b: Firms with more linkages within cities are likely to have better performance.

This paper seeks to move one step forward by examining the effect of intra-city networks on the performance of cities and firms, as proposed by the clustering literature, and also by taking into account how the performance of cities and firms is also dependent on inter-city networks, the core concept of the world city network literature. By establishing non-standardized input-output relations with other firms in different cities, firms are able to rationalize their production processes and to take advantage of inter-city knowledge spillovers, which further leads to the improvement of firm performance (Brown et al., 2010; Storper & Christopherson, 1987). Firms can manage their own inter-city networks in order to collaborate with other firms with complementary competencies in various cities (Lüthi et al., 2010; Scott & Pope, 2007; Thierstein

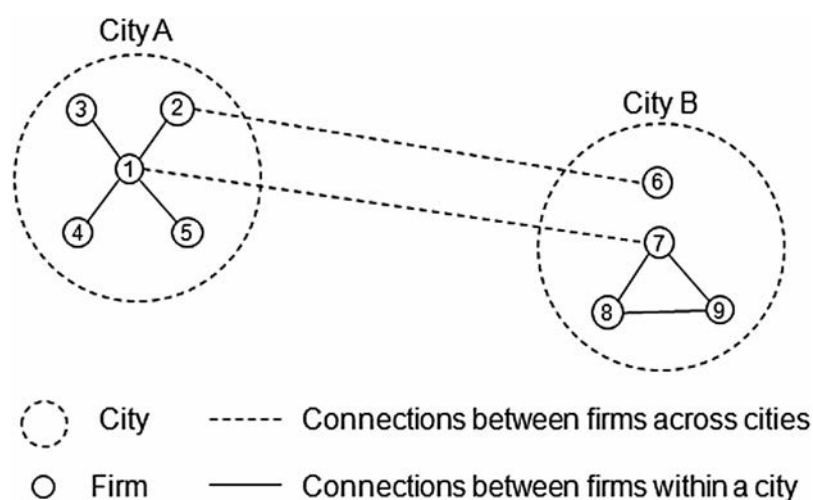


Figure 1. Inter- and intra-city networks.

et al., 2008). Hence, as cities become more connected, inter-city networks allow firms to easily find suitable partners elsewhere and access knowledge from outside. We thus hypothesize that:

Hypothesis 2a: Highly connected cities in inter-city networks are likely to have better performance.

Hypothesis 2b: Firms that have collaborated with many partners in other cities are likely to have better performance.

Incorporating the effects of intra- and inter-city networks in one research represents our first step to bridge those two strands of the literature. Second, and more importantly, we argue that those two types of networks complement each other in promoting the performance of cities and firms. As Bathelt et al. (2004) indicated in their ‘buzz-pipeline’ model, it is crucial to stress further that knowledge flowing from trans-local pipelines to clusters does not necessarily spillover to most firms within clusters. High-quality local buzz that facilitates the internal circulation of knowledge is the foundation for taking advantage of the knowledge channelled from outside. In our case, the complementarity between intra- and inter-city networks thus deserves more attention. As shown in Figure 1, knowledge and information may flow from firm 6 in city B to firm 2 in city A since they collaborate in the production process. Such knowledge and information from firm 6 in city B may further flow from firm 2 to other firms in the same city, such as firm 1 that is also located in city A, via knowledge spillovers within one cluster (Bathelt et al., 2004; Storper, 1997). In this sense, firms may benefit from knowledge spillovers from another city, even if they do not directly collaborate with firms in that city. Specifically, firm 1 in city A can thus take advantage of either direct knowledge spillovers from city B via inter-city network as it collaborates with firm 7 in city B, or indirect knowledge spillovers from city B since it may acquire new ideas and know-how from firm 2 in city A that is connected to firm 6 in city B. In the latter case, inter- and intra-city networks co-work to facilitate indirect knowledge spillovers and allow a firm to obtain

knowledge from other cities even if it does not directly collaborate with firms in those cities. As a result, inter- and intra-city networks could complement each other, by bringing new knowledge from outside to a city and then diffuse it within the city. The extent to which the complementarity between inter- and intra-city networks could impact the performance of firms and cities is dependent on the strength of inter- and intra-city networks. This leads to the following hypotheses,

Hypothesis 3a: Highly connected cities with denser local networks are likely to have better performance.

Hypothesis 3b: Firms in highly connected cities and with more linkages within cities are likely to have better performance.

DATA AND RESEARCH DESIGN

The data are from the China Box Office database compiled by Entgroup, a big consultant firm in China’s media and entertainment industry. The database lists all films whereby Chinese firms are the main producers. We have gathered data on the top 25 films in terms of box office revenue for each year from 2002 to 2017. Overall, our data set includes 400 films and 2236 firms in 102 cities that are involved in the production, distribution, publishing, marketing and exhibition of those films. We only focus on the top 25 films in each year to reduce the complexity and difficulty of data collection and analysis. The lion’s share of box office revenues is often realized by a small number of films, which is consistent with Zipf’s law. In our case, the top 25 films’ box office revenues accounted for more than 70% of the total in all years during 2002–17. Hence, our selection of sample can still provide a good representation of the development of China’s film industry and market. Furthermore, the market reform of China’s film industry was initiated in 2002. Before 2002, only 30% of the total films were released in cinemas. Therefore, our study time period starts from 2002.

We first formulate inter-city networks based on our data set. In inter-city networks, each node is a city. Two cities are seen as connected if firms from those two cities participate in the same film projects. The more collaboration between firms in two cities, the stronger the linkage exists between the two cities. Each film's epilogue, prologue and posters contain information about all firms involved in different stages of this film project. Since only the top 25 films in each year as well as firms that have participated in those films are considered in this paper, we focus on the networks formulated by those main actors, which have contributed the most to China's film industry. We further gather the location information of those firms to identify in which cities those firms are located by searching all firms on Tianyancha, a search platform with a vast repository of Chinese enterprise information.¹ The strength of connectivity between cities i and j (R_{ij}) are calculated as follows:

$$R_{ij} = \sum_{p=1} N_{ip} * N_{jp}, \quad (i \neq j) \quad (1)$$

where N_{ip} is the number of firms in city i involved in film project p ; and N_{jp} denotes the number of firms in city j that participate in film project p . We can then formulate a 102*102 matrix that defines the inter-city network. We then compute the gross network connectivity (GNC) of city i to measure the connectivity of city i in the inter-city network ($City_inter_i$):

$$City_inter_i = \sum_{j=1} R_{ij}, \quad (i \neq j) \quad (2)$$

If this indicator is large, it indicates that city i is highly connected in the inter-city network.

In some film projects, firms also collaborate with partners from the same city. Such local partnership leads to the formation of intra-city network. We then measure the strength of local collaborations within a single city, that is, the strength of a city's intra-city network:

$$City_intra_i = \frac{L_i}{N_i}, \quad (i \neq j) \quad (3)$$

where N_i is the number of firms in city i ; and L_i is the number of firm pairs that collaborate in the same project. In other words, the former reflects the number of nodes in city i 's intra-city network, while the latter captures the number of linkages in this network.

To examine if intra- and inter-city networks complement each other in promoting the performance of cities, this paper estimates the following model at the city level:

$$\begin{aligned} \ln City_performance_i = & \beta_0 + \beta_1 \ln City_inter_i \\ & + \beta_2 \ln City_intra_i + \beta_3 \ln City_inter_i \\ & * \ln City_intra_i + \gamma Z + \varepsilon_i \end{aligned} \quad (4)$$

The dependent variable is the value of box office revenue of all firms in city i ($City_performance_i$). In addition to two variables on the strength of city i 's intra-city network

($City_intra_i$) and inter-city network ($City_inter_i$), we include the interaction term between them to study the complementarity between those two types of networks. We hypothesize that knowledge from other cities via inter-city networks can diffuse to firms in city i more easily and efficiently when city i has denser intra-city networks. In other words, the effect of inter-city networks on the performance of city i is expected to be reinforced by city i 's intra-city networks. If this is the case, the coefficient of the interaction term should be positive and significant. Some control variables are also included in our model. City i 's gross domestic product (GDP) per capita ($PGDP_i$) is added to control the impact of the city's economic development. Cities with different levels of human and physical capital are likely to have different performance, as those are key input factors of the film industry (Zhu et al., 2017). We use the length of road per capita in city i as a proxy of physical capital and infrastructure ($PCAP_i$). Human capital ($HCAP_i$) is measured as the share of population working in cultural and creative industries, and media and entertainment industries in city i 's total population. We also include a dummy variable, $SCHOOL_i$, taking the value of 1 if city i has universities with degrees on film and drama studies, and 0 otherwise, to capture the potential of the city's human capital.

Similarly, we could perform such analyses at the firm level as well. To investigate if intra- and inter-city networks complement each other in promoting the performance of firms, we estimate the following model at the firm level:

$$\begin{aligned} \ln Firm_performance_f = & \beta_0 + \beta_1 \ln Firm_intra_f \\ & + \beta_2 \ln Firm_inter_direct_f \\ & + \beta_3 \ln Firm_inter_indirect_f \\ & + \beta_4 \ln Firm_inter_indirect_f \\ & * \ln Firm_intra_f + \gamma Z + \delta_f \\ & + \gamma_t + \varepsilon_f \end{aligned} \quad (5)$$

The dependent variable is the value of box office revenue of firm f in city i ($Firm_performance_f$). $Firm_intra_f$ is measured as the times that firm f has collaborated with other firms in the same city, to capture firm f 's connectivity in the intra-city network in city i and the extent to which it could be potentially affected by the intra-city network. $Firm_inter_direct_f$ is the times that firm f has collaborated with firms in other cities in some film projects, to capture firm f 's direct connection with other cities and the extent to which it could be potentially affected by direct knowledge spillovers from the inter-city network. For instance, in Figure 1, firm 1 in city A can take advantage of direct knowledge spillovers from city B via inter-city network as it collaborates with firm 7 in city B.

Furthermore, firm 1 in city A can also benefit from indirect knowledge spillovers from city B since it may acquire new ideas and know-how from firm 2 in city A that is connected to firm 6 in city B. Given this, we calculate $Firm_inter_indirect_f$, which is measured as the times

that firm f 's neighbours in city i have collaborated with firms in other cities. This indicator captures the extent to which firm f 's neighbours in city i are connected to other cities in the inter-city network. Knowledge and information may flow from other cities to firm f 's neighbours in city i , and then diffuse to firm f if there are linkages between firm f and its neighbours in city i . Firm f can thus be affected by knowledge and information from other cities indirectly, and the extent to which this could occur depends not only on how well firm f 's neighbours are connected to other cities in the inter-city network ($Firm_inter_indirect_f$), but also on how well firm f is connected to its neighbours ($Firm_intra_f$). In this sense, we include the interaction of $Firm_inter_indirect_f$ and $Firm_intra_f$ in our model, to capture the effect of indirect knowledge spillovers on firm performance. Its coefficient is expected to be significant and positive.

Firm f 's age (AGE_f), city i 's GDP per capita ($PGDP_i$) and population (POP_i) are also included as control variables. Mature and old firms, which have more experiences, are more likely to have better performance. The success of a film firm may be also dependent on its host city's economic development and population size, as the latter can be as the foundation of the development of the firm and also reflects local market potential.

INTRA- AND INTER-CITY NETWORKS IN CHINA'S FILM PRODUCTION

Inter-city networks

Figure 2 shows the spatial distribution of film firms in Chinese cities as well as the strength of connectivity between those cities. Firms are highly concentrated in a small number of cities. The number of firms in Beijing is 935, accounting for 41.82% of the total. Hong Kong and Shanghai host 12.61% and 8.01% of the total, respectively. In contrast, the shares of other cities are all < 3%. The average strength of connectivity between all city pairs is 8.88 and the standard deviation is 143.15, indicating a huge variation in terms of connectivity strength. Beijing is the obvious centre of the network, since it is involved in 71.29% of all city pairs. Beijing has been the lead producer in 188 films and participated in 281 films, accounting for 47.00% and 70.25% of the total 400 films, respectively.

We then map out the inter-city network of China's film production (Figure 3). Each node represents a city. Dark grey nodes are domestic cities, while light grey ones are foreign cities. The size of each node denotes the degree centrality of a city, that is, the number of nodes directly connected with the node under consideration. In total, there are 102 nodes (i.e., cities) and 1228 edges in the network, among which 71 nodes represent Chinese cities and 31 nodes are foreign cities. Figure 3 shows a clear core-periphery structure of the network. One large core (Beijing) and two small cores (Shanghai and Hong Kong) form the centre of the network, surrounded by a large number of second-, third- and fourth-tier cities. Figures 2 and 3 both show the extreme inequality in terms of cities' significance in the network. One reason is that those three cities

are the main cultural centres in north, east and south China, respectively. Creative industries are inherently place based in their nature, whose success relies heavily on their embeddedness in a vibrant metropolitan cultural environment (Scott, 2006).

Second, the film industry is a highly capital-intensive one, and demands massive investments especially in stages such as filming, editing, post-production, marketing and distribution. Beijing, Shanghai and Hong Kong are the most developed cities in China, and thus have the necessary economic foundation for the development of such a capital-intensive industry. Finally, before the reform of the film industry, the production of films was monopolized by eight state-owned enterprises (SOEs), among which two were located in Beijing (i.e., August First Film Studio and Beijing Film Studio) and one in Shanghai (i.e., Shanghai Film Studio). Hence, the dominance of Beijing and Shanghai in the network can be partly attributed to the legacy of the planning economy. One caveat is that since we focus on firms that are involved in films mainly produced in mainland China, our visualizations only show the network structures as well as the roles of foreign and Chinese cities in China's film production.

Intra-city networks

In our data set, 70,669 pairs of firms have collaborated with each other during the study period, among which 24,911 firm pairs are located in the same city while 45,758 firm pairs are in different cities. In other words, there are more inter- than intra-city linkages. Nonetheless, the intra-city network still matters, since it enables knowledge from other cities via inter-city networks to diffuse more easily and efficiently to firms in a city. Figure 4 shows four cities' intra-city network. The size of each node denotes the degree centrality of a firm. Cities differ from one another drastically in terms of not only their significances in the inter-city network (Figure 3), but also the complexity of their intra-city networks (Figure 4). For instance, the strength of intra-city network, measured as $City_intra$, is 21.98, 10.46, 2.87 and 0.54 in Beijing, Hong Kong, Shanghai and Guangzhou, respectively. It is around 1 in other cities. This is in line with Zipf's law.

Beijing and Hong Kong as two cores in China's film industry have dense intra-city networks. All 935 firms in Beijing have local partners. On average, each firm has collaborated with 44 firms during our study period. Similarly, 96% of Hong Kong's film firms have local partners, and the average number of partners of each firm is around 21. On the one hand, local collaboration is possible since those two cities have the largest number of film firms specialized in various stages of the value chain. On the other hand, firms in those two cities also have a broad range of inter-city linkages, as the ratio between the number of intra-city linkages in a city and the number of the focal city's inter-city linkages is around 0.63 and 0.22 in the cases of Beijing and Hong Kong, respectively. For instance, Hong Kong's collaboration with firms in mainland China has surged especially after the announcement of the Mainland and Hong Kong Closer Economic Partnership

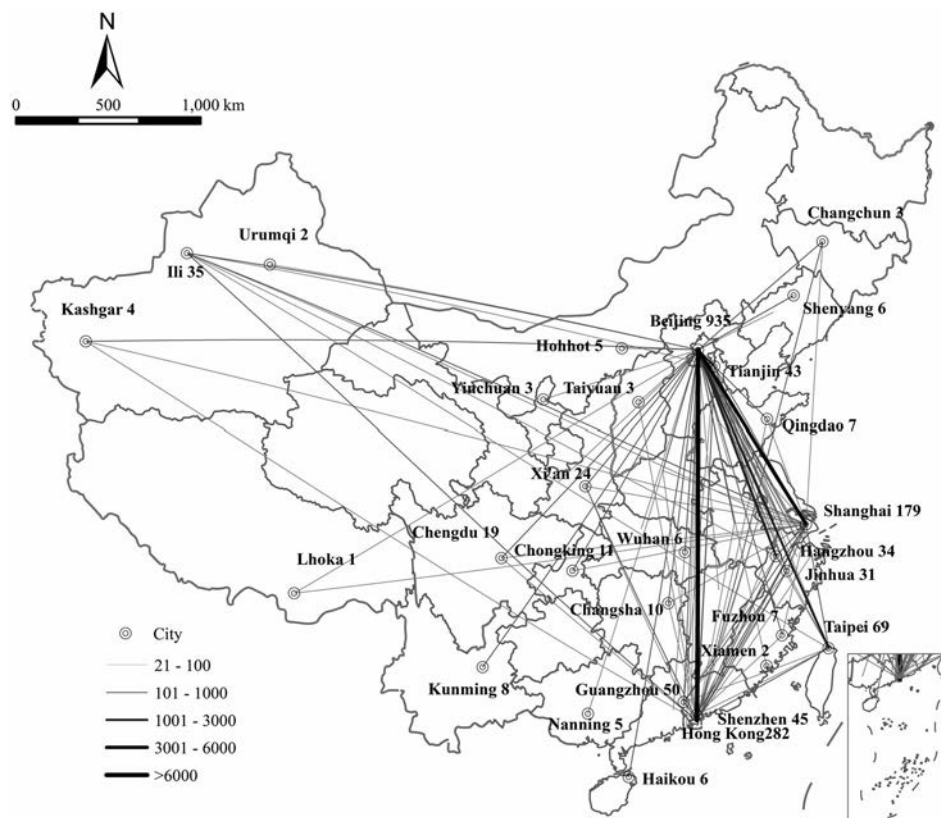


Figure 2. Spatial distribution of film firms in Chinese cities, 2002–17).

Note: A number after a city name indicates the number of firms in the corresponding city. The width of the line between cities represents the strength of connectivity between cities.

Arrangement in 2003 (Entgroup, 2016). Furthermore, after the 1998 financial crisis, the traditional market of Hong Kong's film industry in Southeast Asia shrank dramatically. Hence, Hong Kong firms also sought to tap into the emerging film market in mainland China, resulting in more collaborations between firms in Hong Kong and other cities. In contrast, intra-city networks in Shanghai and Guangzhou are less dense. Firms have local partners, but they still need to seek out for collaborations with firms in other cities. One possible explanation is that firms in Shanghai and Guangzhou could not cover all stages on the value chain. This is more evident in other cities with even fewer firms, where the ratio between the number of intra-city linkages in a city and the number of the focal city's inter-city linkages is around 0.01–0.02.

EMPIRICAL RESULTS

First, we plot the relationship between intra-/inter-city networks and city performance in Figure 5. Each point on the scatter plot corresponds to one city. We observe a clear positive relationship between intra-/inter-city networks and city performance. This confirms our hypothesis that cities with denser intra-city networks tend to have better performance, and highly connected cities in inter-city networks tend to outperform their poorly connected counterparts. It provides some preliminary evidence to support our arguments.

Next, we use regression analysis to examine if intra- and inter-city networks complement each other in promoting the performance of cities. The dependent variable is the value of box office revenue of all firms in a city. The ordinary least squares (OLS) model is used in our estimation. The log forms of the dependent variable, $City_intra_i$, $City_inter_i$, $PGDP_i$ and $HCAP_i$ have been adopted. All variables have been deflated using appropriate price indexes. Table 1 presents the empirical results and robust standard errors are also reported. Correlation analysis indicates that the correlations of most independent variables are moderate or low (see Table A1 in Appendix A in the supplemental data online). A multicollinearity diagnostic test states that the highest variance inflation factor (VIF) is 2.76, below the critical point of 10, suggesting that the multicollinearity is insignificant. First, the parameter of $PGDP_i$ is positive and significant in some models, indicating that the film industry is likely to have better performance in developed cities. The coefficient of $HCAP_i$ is positive and significant in some models. Human capital could provide labour force, and thus support the development of the film industry. Investments in human capital would foster the formulation of a favourable environment for entrepreneurial activities, resulting in better performance.

In model 1, the parameter of $City_inter_i$ is positive and significant, indicating that highly connected cities in inter-city networks tend to outperform their poorly connected counterparts. This confirms Hypothesis 2a. Firms can

collaborate with other firms with complementary competencies in various cities (Lüthi et al., 2010; Thierstein et al., 2008). Such trans-local ‘pipelines’ that breathe new air from outside to a city could potentially trigger innovation and promote firms’ competitive advantage and firm performance (Bathelt et al., 2004). In model 2, the parameter of *City_intra_i* is positive and significant, suggesting that cities with denser intra-city networks tend to have better performance (Hypothesis 1a). Dense intra-city networks facilitate the interaction among firms, and knowledge flows appear to be more intensive in such networks (Maskell & Malmberg, 2007). Finally, and more importantly, we include the interaction term between *City_inter_i* and *City_intra_i* in model 3. Its coefficient is positive and significant, implying that highly connected cities with denser local networks tend to achieve better performance (Hypothesis 3a). The effect of inter-city networks on city performance could be reinforced by intra-city networks, as intra-city networks enable knowledge from other cities via inter-city networks to diffuse more easily and efficiently to firms in a city.

been deflated using appropriate price indexes. Firm and year dummies are included to control firm- and time-specific characteristics, respectively. Table 2 presents the empirical results and robust standard errors are also reported. Correlation analysis indicates that there is no significant multicollinearity issue (see Table A2 in Appendix A in the supplemental data online). The highest VIF is 3.21, indicating that multi-collinearity is not severe. The parameter of AGE_f is positive and significant, suggesting that old and mature firms tend to have better box office revenues. The first mover advantage is quite evident in the film industry. In the Chinese context, first movers include SOEs, firms that have already run business in Hong Kong for years before penetrating into the mainland China market, and some private firms that were established even before the market reform of China's film industry.

In model 1, the parameter of *Firm_intra_j* is positive and significant, indicating that firms with more linkages within cities tend to accomplish better performance (Hypothesis 1b). Intra-city networks are important for local knowledge flows because it reduces transaction costs between co-located firms and enhances the easiness of mutual learning (Maskell, 2001; Maskell & Malmberg, 1999). In model 2, the coefficient of *Firm_inter_direct_j* is significant and positive, indicating that firms with strong direct connections with other cities in the inter-city network tend to have high levels of box office revenues. This is consistent with our theoretical prediction that participating in trans-local,

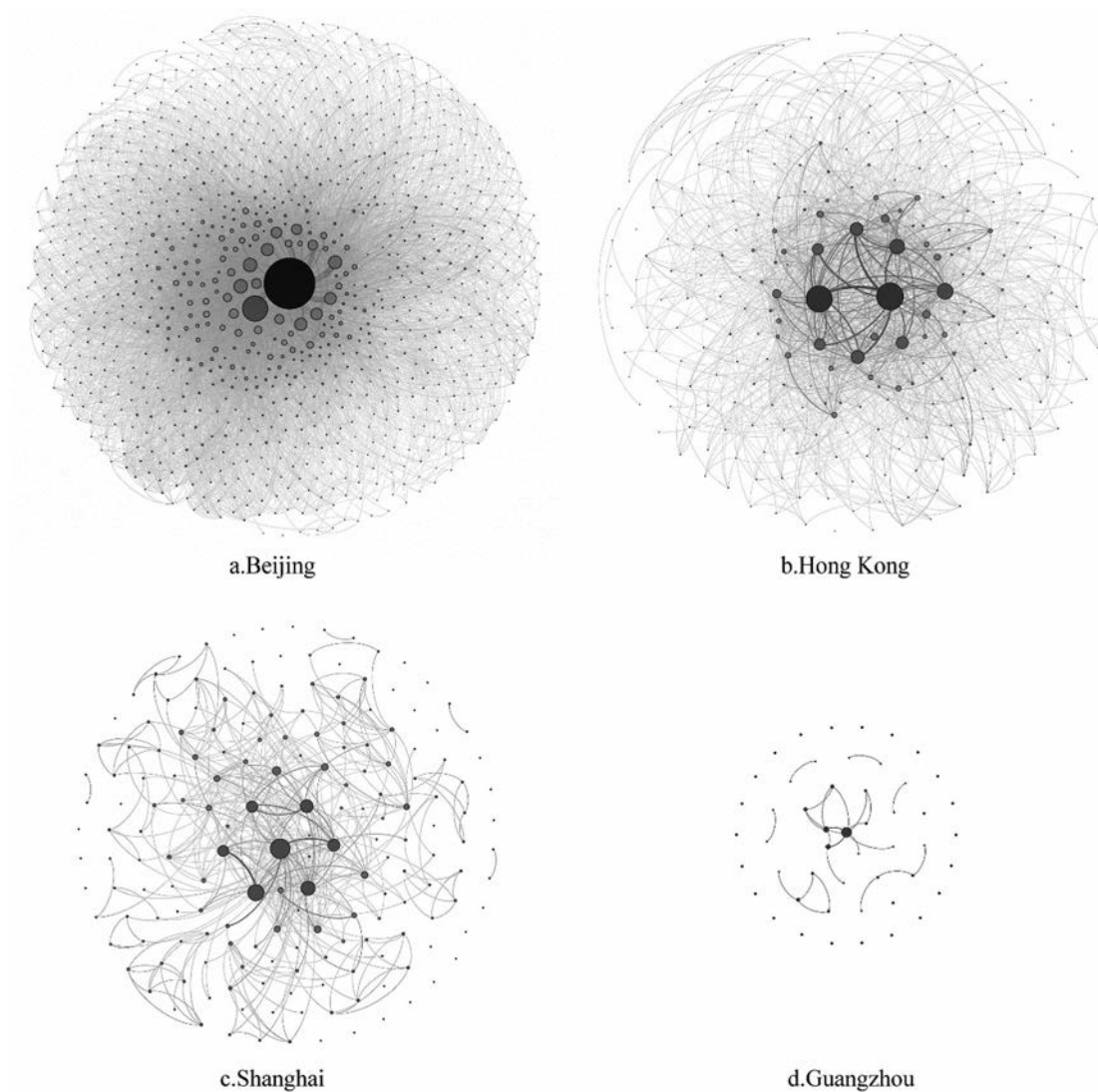


Figure 4. Four cities' intra-city networks.

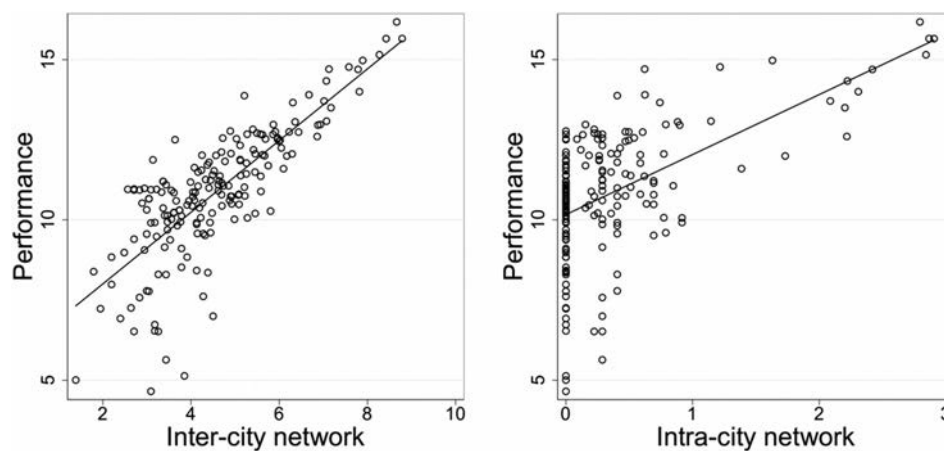


Figure 5. Relationship between intra-/inter-city networks and city performance.

inter-city networks enables firms to rationalize their production processes and to take advantage of inter-city knowledge spillovers, which further leads to the improvement of firm performance. Firms can benefit from inter-

city networks, by collaborating with other firms with complementary competencies (Hypothesis 2b).

The parameter of *Firm_inter_indirect_{it}* is negative and significant. This indicator captures the extent to which

Table 1. Empirical results (at the city level).

Dependent variable: <i>City_performance_i</i>	(1)	(2)	(3)
$\ln \text{City_inter}_i$	1.190*** (0.078)		1.164*** (0.104)
$\ln \text{City_intra}_i$		2.044*** (0.208)	-2.225*** (0.745)
$\ln \text{City_inter}_i * \ln \text{City_intra}_i$			0.307*** (0.083)
$\ln \text{PGDP}_i$	0.539* (0.280)	1.337*** (0.396)	0.505* (0.302)
PCAP_i	0.002 (0.017)	0.046 (0.029)	-0.001 (0.016)
$\ln \text{HCAP}_i$	0.396** (0.194)	0.189 (0.306)	0.430** (0.186)
SCHOOL_i	0.183 (0.279)	0.110 (0.396)	0.180 (0.275)
Constant	-3.378 (3.972)	-6.650 (5.895)	-2.971 (4.132)
Observations	181	181	181
R^2	0.653	0.438	0.669

Notes: Robust standard errors are shown in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.**Table 2.** Empirical results (at the firm level).

Dependent variable: <i>Firm_performance_f</i>	(1)	(2)	(3)	(4)
$\ln \text{Firm_intra}_f$	0.516*** (0.119)			-0.328 (0.271)
$\ln \text{Firm_inter_direct}_f$		0.694*** (0.086)		0.558*** (0.087)
$\ln \text{Firm_inter_indirect}_f$			-0.193** (0.083)	-0.201*** (0.077)
$\ln \text{Firm_inter_indirect}_f * \ln \text{Firm_intra}_f$				0.078** (0.038)
AGE_f	0.216*** (0.058)	0.216*** (0.057)	0.322*** (0.060)	0.203*** (0.058)
$\ln \text{PGDP}_i$	-0.026 (0.746)	-0.187 (0.711)	-0.497 (0.579)	-0.103 (0.654)
$\ln \text{POP}_i$	-0.642 (1.109)	0.288 (0.874)	1.036 (0.894)	-0.163 (0.967)
Constant	12.108* (7.151)	6.268 (4.340)	7.092 (5.634)	9.812* (5.689)
Firm dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Observations	941	941	941	941
R^2	0.413	0.473	0.371	0.496

Note: Robust standard errors are shown in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

firm f 's neighbours in the same city are connected to other cities in the inter-city network. One possible explanation is that if firm f 's neighbours have collaborated more with outsiders in other cities, they tend to have relatively less

collaboration with firm f . In this sense, the outside collaborators of firm f 's neighbours can be seen as firm f 's competitors. As cities become more connected, firms may have to face direct competition with outsiders, since their

neighbours may search for partners via inter-city networks rather than just in their home cities. Nonetheless, the parameter of the interaction term between *Firm_inter_indirect_f* and *Firm_intra_f* is positive and significant (model 4), indicating that firms that are well-connected in intra-city networks and located in well-connected cities in inter-city networks are likely to have better firm performance. Knowledge may flow from other cities to firm *f*'s neighbours in city *i*, and then diffuse to firm *f* if there are linkages between firm *f* and its neighbours in city *i*. Firm *f* can thus be indirectly affected by knowledge spillovers from other cities, and the extent to which this could occur is dependent not only on how well firm *f*'s neighbours are connected to other cities in the inter-city network (*Firm_inter_indirect_f*), but also on how well firm *f* is connected to its neighbours in city *i* (*Firm_intra_f*). This confirms Hypothesis 3b.

CONCLUSIONS

As the film industry becomes more vertically disintegrated and transaction-intensive, the corresponding literature has directed its attention from the internal dynamics of industrial clusters of film firms to the emerging networked geographies of the co-production of specialized firms as well as how cities and firms are connected to each other. Two strands of the literature have examined the new geographical and organizational configurations, but via different lenses. One stresses the strong clustering tendencies at the local level after vertical disintegration and the rise of intra-city networks. The other pays more attention to the collaboration of many specialized firms located in various cities and the connectivity of cities. Those two coexist, but unfortunately rarely engage with one another. We thus want to provide some preliminary evidence that studies on clustering and the world city network could benefit from having more dialogues with each other.

First, the world city network literature has already mapped out the networks of firms in various cities, while one of the long-lasting debates in the clustering literature is the relationship between networks and the economic performance of firms and cities. This paper moves step forward to investigate if city/firm performance has been shaped not only by intra-city networks as proposed by the clustering literature, but also by inter-city networks, the core concept in the world city network literature. Our second contribution is to examine the complementarity between knowledge spillovers via inter- and intra-city networks and how it could affect the performance of firms and cities. In doing so, we hope to bridge those two strands of the literature. This also speaks with the literature on Bathelt et al.'s (2004) 'Buzz-pipeline' model. So far, plenty of empirical evidence has been marshalled to support the importance of either local or non-local knowledge. However, this strand of the literature has cast insufficient light on the complementarity of those two and their impacts on the performance of firms and cities. Our findings show that we should take into account both types of networks simultaneously, to better understand the whole

picture of the emerging networked geographies of the co-production of specialized firms.

Armed with one data set on China's film projects, we analyse how networks are shaping the film production in China. First, we map out how cities are connected. The inter-city networks of China's film industry are centred on one large core (Beijing) and two small cores (Shanghai and Hong Kong), which also have dense intra-city networks. The formation of such a core-periphery structure has been driven by cultural, economic and institutional factors. Empirical results show that inter-city networks could connect actors inside and outside clusters, and enable firms to increase the variety of knowledge, resources, and capabilities available to them by importing new knowledge and state-of-the-art technologies from outside, which further leads to the improvement of city/firm performance. Furthermore, participating in intra-city networks enables firms to rationalize their production processes and to take advantage of local knowledge spillovers, which also leads to the improvement of firm performance. More importantly, those two types of networks complement with one another and co-shape the performance of cities and firms, and thus confirm our hypotheses.

We see great future research potential along the path linking those two strands of the literature, including their theories, perspectives, and methods, together, and formulating new analytical frameworks by incorporating different types of networks at different geographical scales. Finally, since only the top 25 films in each year as well as firms that have participated in those films are considered in this paper, this paper indeed focuses on the main players in China's film industry, which are often successful, large corporations. However, the roles of small firms and the networks formulated by them have been overlooked in this paper and may unfold in different ways. We leave this for future research.

DISCLOSURE STATEMENT

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NOTE

1. See www.tianyancha.com. Of course, not all parts of the whole production process have been fulfilled in those locations, such as shooting activities, which may be completed outdoors. However, we can still know where the main actors are concentrated, and the location of key centres in the film industry. Furthermore, the data set only provides information on where firms register. The real production sites of a firm and its registration location may not be the same. We acknowledge this limitation.

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