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Urban Agglomeration, Firm Performance, and Global Value Chain in China

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Abstract: *This study examines the relationship between city agglomeration and firm-level performance of global value chains (GVCs) in China. Using a novel dataset of night-time light data and survey data from Chinese manufacturing firms, the dynamic changes of urban agglomeration in China are studied, analysing their impact on firm-level productivity, GVC participation, and GVC upstreamness. The results highlight that the concentration of economic activity in urban areas can lead to productivity gains for firms, especially in the upstream stages of GVCs, which is characterised by higher value-added activities and better access to knowledge and technology. The study also finds that urban agglomeration promotes industrial specialisation and human capital spillovers, further improving the upstreamness of firms in GVCs. Firms in larger cities also tend to be more productive, participate more in GVCs, and are closer to the final demand of GVCs.*

Keywords: city agglomeration, global value chains, productivity, upstreamness, GVC participation

JEL classification: F14, F23

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1. Introduction

Urban agglomeration occurs when the growth of cities creates linkages and agglomeration activities with urban and sub-urban areas that generate positive externalities and economic development. It is a phenomenon of the growth of cities and surrounding areas to form a larger metropolitan area (Glaeser and Gottlieb, 2009; Fang and Yu, 2017). Dynamic structural transformation is often driven by the clustering of population and economic factors, which increases economic activities and efficiency via city linkages, production and global value chain (GVC) linkages, technology spillovers, human capital dynamics, and economy-of-scale activities (Glaeser and Gottlieb, 2009; Lall, Shalizi, Deichmann, 2004; Yao et al., 2022). As the population and economic activity of a region increase with city agglomeration, firms can share resources and expertise, thereby benefitting from a larger pool of skilled workers, and gain access to backwards and forwards linkages through specialised suppliers and service providers, leading to increased externalities and efficiency. The impact on firms is both direct and indirect in terms of greater productivity performance from innovation and competitiveness within GVCs.

While some evidence supports agglomeration economies, few studies have investigated how agglomeration impacts the GVC performance of firms and sources of these productivity gains (Duranton and Kerr, 2015). This study thus aims to address this important gap by examining the mechanisms underlying the impact of agglomeration economies on firm performance in manufacturing firms in China. In this study, night-time light data are used to measure the dynamic changes of city agglomeration in China. These data help measure the growing number of multi-city agglomerations and identify the centre of urban clusters in China (Gao et al., 2017; Zhang et al., 2021). A spatial Gini index is then adopted to measure the concentration of cities and the index of city primacy to measure the relative importance of the largest city in the urban agglomeration. The measurements analyse the spatial distribution, intensity, and dynamic patterns of lighting activity in various regions of China to identify changing urbanisation and economic growth patterns over time.

The study also examines the impact of city and urban agglomeration on the productive performance of Chinese firms. It seeks to capture GVC participation through a dummy variable equal to 1 if the firm uses imported intermediates to produce exports; gage the share of foreign value-added content in exports (FVAR) as the measurement of backwards GVC participation following Kee and Tang (2016); and examine the upstreamness of firms in GVCs as a proxy for GVC position, which is given by the number of stages that the firms' exports take to reach the final demand (Chor, Li, Yi, 2021).

The night-time light indicators have several advantages in measuring city agglomeration as compared to traditional measures of population clustering. The data provide a more comprehensive way to measure city agglomeration in terms of various aspects of urban development, such as economic growth, city connectedness, and labour pooling. For example, there is a strong correlation between a country's gross domestic product (GDP) growth rate and change in night-time lighting intensity (Henderson, Storeygard, Weil, 2012). Moreover, the growing numbers of multi-city agglomerations seen in night-time lighting data suggest the increasing connectedness of cities. Another advantage of using night-time light data is that they can help assess the degree to which a city grows intensively (i.e. increasing economic activity and density within a city's pre-existing footprint) or extensively (i.e. outward expansion of a city's footprint over time known as city sprawl). In this study, night-time lighting data are used to identify 20 urban agglomerations in China and to capture their dynamic changes over time intensively and extensively.

This study finds consistent evidence that city agglomeration promotes the productivity growth of Chinese manufacturing firms (Rigby and Essletzbichler, 2002; Lin, Li, Yang, 2011; Moretti, 2021). Rigby and Essletzbichler (2002) found that sharing knowledge and resources and the increased competition and collaboration with spatial proximity contribute to productivity growth. Similarly, Lin, Li, and Yang (2011) found that agglomeration economies, such as knowledge spillovers and labour pooling, can increase the competitiveness of firms within urban clusters. Moretti (2021) found that firms in urban agglomerations tend to have higher productivity levels and be more innovative than those outside of clusters, which is due to specialised suppliers, skilled workers, and knowledge spillovers that are more prevalent within the agglomerations. This study finds that industry specialisation, technology upgrading, and human capital spillover effects are the three key channels through which agglomeration economies affect the productive performance of Chinese firms.

This study also supports new empirical evidence on the impact of city agglomeration to reshape the GVC performance of firms, especially in developing countries. Caineli, Ganau, and Giunta (2018) found that spatial clustering increases the labour productivity of firms for suppliers but not the final firms[1] of GVCs in Italy and Spain. Some studies have further suggested that city agglomeration increases the concentration of GVC activities, while the centre city tends to specialise in headquarters activities – such as research and development,

[1] Final firms are producers that serve end-markets, and suppliers that sell to other firms.

management, and marketing – while most of the other regions are specialised in fabrication activities (Timmer, Minoudot, de Vries, 2019; Haddad and Araújo, 2021). However, these studies did not examine the impacts of city agglomeration on GVC participation and the positioning of firms in the GVC. This study thus examines the direct effects of city and urban agglomeration on firm-level GVC positioning and identifies the possible mechanisms.

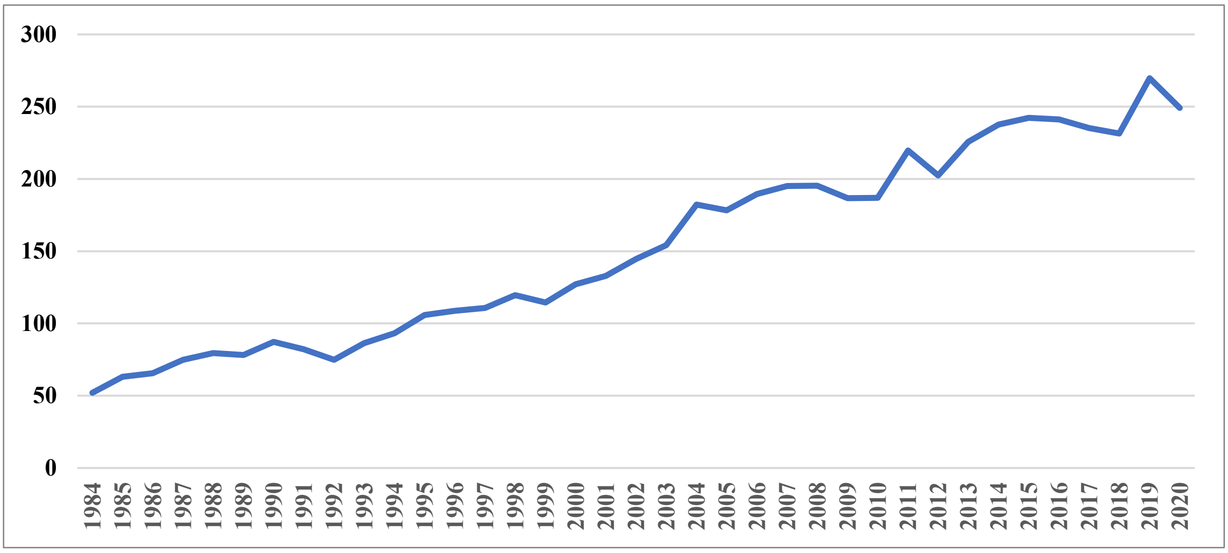
This study does not find any significant direct effects of city agglomeration on GVC participation of firms. However, city agglomeration affects the upstreamness of firms in a GVC, as it tends to facilitate Chinese manufacturing firms to move to more upstream sectors in GVCs. As a result, spatial clustering – a key characteristic of urban agglomerations – can lead to external benefits such as labour pooling, sharing of new ideas, and specialisation, which contribute to increased productivity and GVC upgrading.

The next section introduces the current trends of urban agglomeration measured by the novel night-time light data. Section 3 presents measurements and datasets. Section 4 describes the empirical strategy and results. Section 5 concludes with policy discussions.

2. Background of City Agglomerations in China

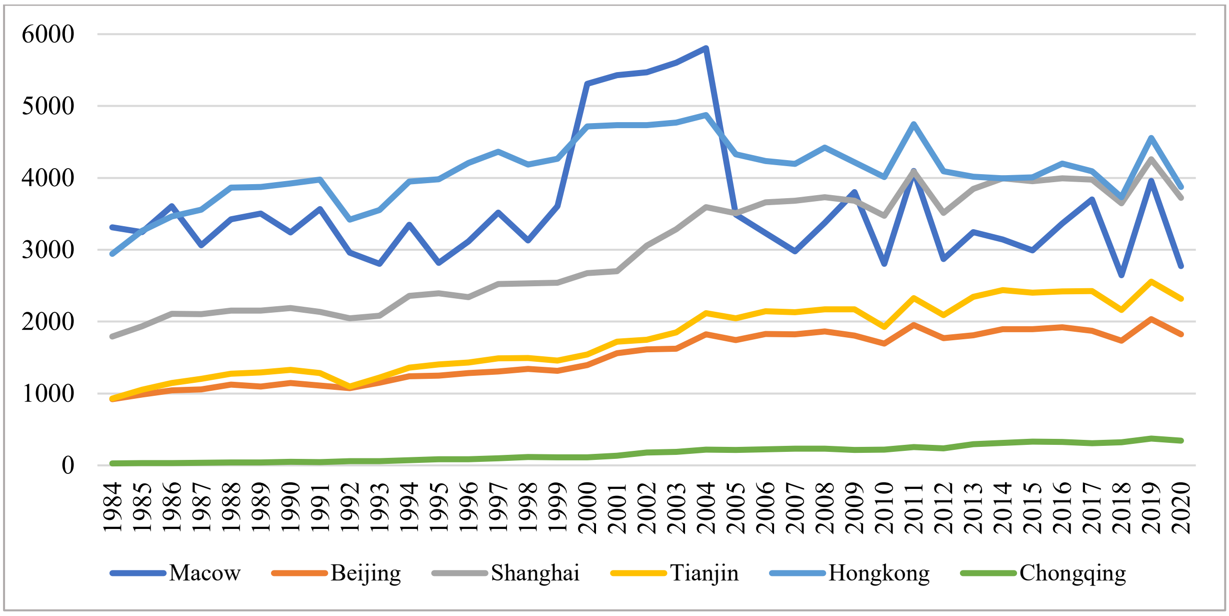
China's urbanisation is having a profound impact on the country's geography and economy. The trend of urban agglomeration is becoming more prominent as cities become more clustered, creating vast metropolitan areas. This clustering has led to the need for indicators to measure the dynamic changes of city agglomeration in China, such as night-time light intensity, which has been used in previous studies to measure economic activity and urbanisation. As night-time light data can provide comprehensive information on economic growth, city connectedness, and labour pooling, the changes in night-time light across cities and time trace the dynamic pattern of city agglomeration spatially and temporally.

Figure 1: Average Night-Time Lighting Intensity of Cities in China, 1984–2020
(pixel value)



Note: The intensity of light is often represented by an 8-bit value, ranging from 0 to 255, where 0 is the darkest (black) and 255 is the brightest (white). The combination of these intensity values for each channel determines the overall color and brightness of the pixel.
Source: Authors using data sourced from the Resources and Environment Science Data Registration and Publication System of China.

Figure 2: Average Night-Time Lighting Intensity of Top Six Cities in China, 1984–2020
(pixel value)

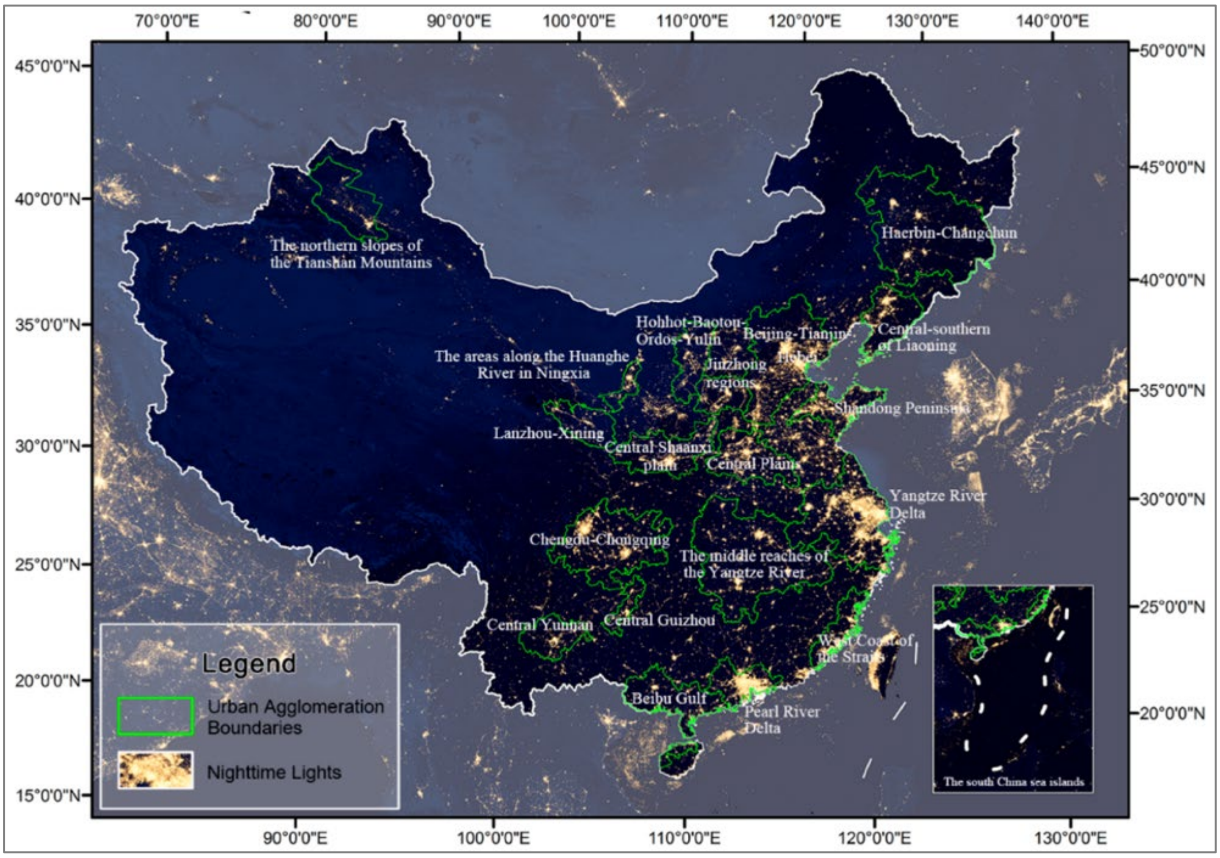


Note: The intensity of light is often represented by an 8-bit value, ranging from 0 to 255, where 0 is the darkest (black) and 255 is the brightest (white). The combination of these intensity values for each channel determines the overall color and brightness of the pixel.
Source: Authors using data sourced from the Resources and Environment Science Data Registration and Publication System of China.

Figure 1 shows that the average night-time lighting intensity of cities keeps increasing, suggesting a growing intensity of economic activities in China over the past 3 decades. Figure 2 lists the top six cities with the brightest lighting intensity in China, which traces a dramatic trend of urbanisation and economic growth in mainland China, especially when the light intensity in Shanghai exceeded that of Hong Kong in 2018.

Moreover, the night-time lighting intensity is used to approximate the primacy of cities in city agglomerations, through which the increasing roles of Shanghai in the Yangtze River Delta Megalopolis and Tianjin in the Jing-Jin-Ji Megalopolis are observed.

Figure 3: Urban Agglomeration in Terms of Night-time Lightning Density in China



Source: Tian (2020).

As shown in Figure 3, the night-time light intensity is a good proxy for city agglomerations, as the bright areas almost align with megapolis administrative boundaries.[2] Multi-city agglomerations are also emerging within China; the Yangtze River Delta and Pearl

[2] China included 19 city clusters in its 13th Five-Year Plan, which accounted for 90% of the national GDP (Government of China, 2016).

River Delta are bright areas in China. These agglomerations are characterised by high levels of economic activity and urbanisation and increasing levels of connectedness. The growth of these agglomerations suggests that China's urbanisation process is accelerating as more people move from rural areas to cities in search of economic opportunities.

However, not all parts of China are experiencing the same level of development. Dimming towns are concentrated in China's western region, which has significant migrant outflows and poor economic performance. Cities there are struggling to attract investment and to create jobs, which has led to an exodus of young people and a population decline. As a result, there is regional inequality in city agglomerations in China, with most cities clustered in the eastern and southern coastal areas.

3. Data and Measurement

3.1. Data

This study adopted two datasets to examine city agglomeration impacts on firm-level performance. County-level night-time light intensity was used to capture the dynamic changes of city agglomeration in China. Data were collected from the National Tibetan Plateau Data Centre between 1984 and 2020. The night-time light intensity is a good proxy for economic activities, allowing detection of urban and economic development spatial patterns. The primacy of cities can also be identified in the agglomerations by the brightness of their night-time lights, and single-city clusters can be distinguished from multi-city agglomerations.

Survey data of Chinese manufacturing firms from the National Bureau of Statistics were also used to measure firm-level performance indicators. This dataset contains all state-owned and above-scale, non-state-owned manufacturing firms in China. Brandt, Van Biesebroeck, and Zhang (2014) was followed to deal with measurement issues in the database. To capture firm performance in GVCs, following Yu (2015), firm-level National Bureau of Statistics data were matched with transactional-level trade data from China Customs to obtain a unique database of Chinese manufacturing firm trade behaviours. Data were matched with the city-level night-time light dataset using the addresses of firms. It is an unbalanced panel with a sample period between 2000 and 2013.

3.2. Measurement of City Agglomeration

To capture the trend of city clustering and their roles in agglomeration, two indicators were used. The first is the spatial Gini coefficient. As shown in Equation (1), following Kanur and Venables (2005), the spatial Gini coefficient is calculated as follows:

$$G = \frac{1}{2n(n-1)\mu} \sum_i^n \sum_j^n |CSI_i - CSI_j| \qquad (1)$$

where:

CSI_i and CSI_j are the night-time light intensity of city i and city j as proxies for city sizes (i and j belong to the same urban agglomeration area);

n is the number of cities in the urban agglomeration; and

μ is the average night-time lightning intensity of all cities in a specific urban agglomeration.

The spatial Gini coefficient varies from 0 to 1, as does the traditional Gini coefficient. The higher the score, the higher the degree of concentration.

The index of primacy was also introduced to measure the relative importance of the largest city in an urban agglomeration. The index is calculated in Equation (2) as follows:

$$PI = \frac{CSI_1}{\sum_i^n CSI_i} \qquad (2)$$

where:

CSI_1 is the night-time lighting intensity of the largest city in an urban agglomeration.

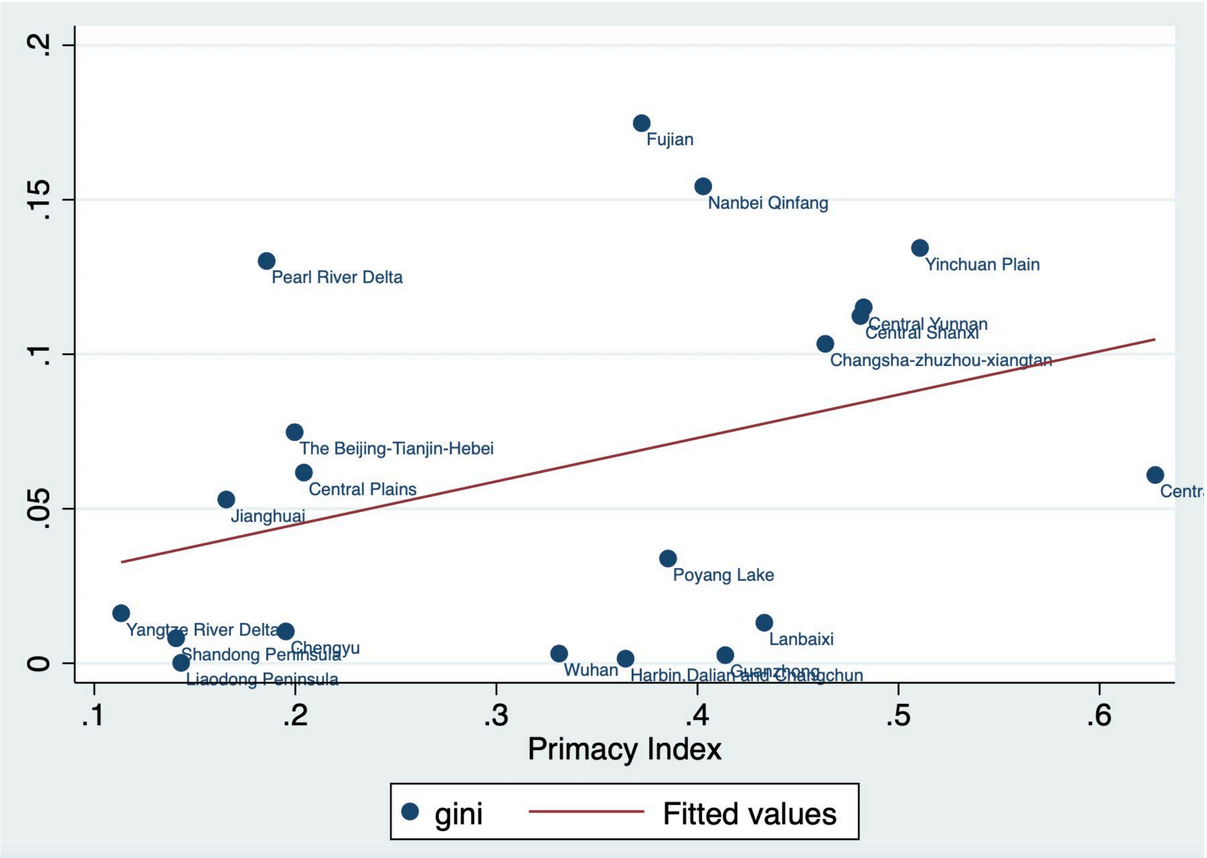
The higher the primacy index, the higher the primacy city's importance in the city agglomeration.

In this study, urban agglomerations can take on different structures depending on the distribution of cities within them. The index of primacy is an indicator that reflects the internal structural characteristics of urban agglomerations, while the spatial Gini coefficient measures the concentration of cities within the urban agglomeration. These two indicators are highly complementary, as they provide information on the number and distribution of cities within an agglomeration.

When both are high, this indicates that the urban agglomeration has a single-centre urban agglomeration structure, with one dominant city playing a central role in the economy of the agglomeration. However, if the spatial Gini coefficient is high while the index of primacy is low, it can be a double-centre or multi-centre urban agglomeration, with multiple cities playing significant roles in the agglomeration. When the spatial Gini coefficient and index of primacy are low, there is no city centre in the urban agglomeration; the urban agglomeration is in a decentralised spatial structure, meaning that the economic activity is more evenly distributed throughout the urban agglomeration with no one city playing a dominant role.

As shown in Figure 4, cities are clustered differently throughout various regions of China. In economically developed areas such as the Yangtze River Delta and Shandong Peninsula Economic Zone, cities tend to be decentralised and evenly distributed within the city clusters, with no clear centre of dominance. However, in economically less-developed regions in central and western China, a single dominant city often serves as the centre of economic activity within an urban agglomeration, such as in the Fujian city clusters and Shaanxi-Gansu-Ningxia City clusters. Another interesting example is the Pearl River Delta, in which cities are closely clustered with a high spatial Gini coefficient, but there is no prominent centre in the agglomeration, as each city in this area is well developed with a low index of primacy.

Figure 4: Correlation between Spatial Gini Coefficient and Index of Primacy, 2020



Source: Authors.

3.3. Measurement of Firm-Level Performance

To analyse the relationship between city agglomeration and firm performance in GVCs, firm-level performance was captured by measuring productivity, GVC participation, and GVC upstreamness. Firm productivity is a crucial determinant of firm performance in GVCs. This study used Olley and Pakes (1996) and Levinsohn and Petrin (2003) to measure firm-level productivity. Olley and Pakes (1996) suggested using a production function approach to estimate productivity, while Levinsohn and Petrin (2003) proposed a method that involves evaluating a demand function for firm output. Using both methods, the results could be compared, uncovering the relationship between city agglomeration and firm productivity.

Moreover, several indicators of firm-level GVC performance were provided. The dummy variable for GVC participation is equal to 1 if the firm uses imported intermediates to produce exports. Additionally, the share of FVAR was used as a proxy of backwards GVC participation following Kee and Tang (2016), which measures the proportion of a firm's exports that contain foreign value-added inputs. Following Chor, Li, and Yi (2021), the upstreamness of firms in the GVC was measured as a proxy for GVC position. The upstreamness measure indicates how many stages a firm's exports take to reach the final demand. Firms in the upstream stages are more likely to engage in higher value-added activities and have better access to knowledge and technology. Using this measure, the extent to which firms are located in the upstream stages of GVCs could be assessed as well as how city agglomeration affects their GVC positions.

4. Empirical Model and Results

4.1. Empirical Model

This study used the following empirical model to analyse the relationship between city agglomeration and firm performance in GVCs:

$$Y_{ijt} = \beta CSI_{jt} + \beta_1 \boldsymbol{X'}_{ijt} + \gamma_i + \rho_t + \varepsilon_{ijt} \tag{3}$$

The model includes firm-level total factor productivity (TFP) or firm-level GVC performance indicators as the dependent variable, denoted as Y_{ijt}. The independent variable is the city agglomeration index, represented by CSI_{jt}, which can be the spatial Gini coefficient or the index of primacy. The model also includes firm-level control variables denoted by $\boldsymbol{X'}_{ijt}$, which includes firm size, age, ownership, employment, productivity, and other related variables. In addition, the model controls for city-level control variables, such as GDP per capita, population, education amenities, health amenities, climate indicators, transport infrastructure, trade, and foreign direct investment. These city-level control variables are included to account for other factors that could affect firm performance in GVCs.

Furthermore, the model includes time- and firm-fixed effects to control for unobserved heterogeneity across firms and time. Time-fixed effects control for time-specific factors affecting firm performance in GVCs, such as macroeconomic shocks or policy changes. Meanwhile, firm fixed effects control for heterogeneity across firms, such as firm-level productivity or ownership structure differences. By including various control variables and fixed effects, the model can help isolate the effects of city agglomeration on firm performance in GVCs and provide insights into the underlying mechanisms driving this relationship.

4.2. Impacts of City Concentration on Firm-Level Performance

Table 1: Baseline Results of Spatial Gini Index

	(1)	(2)	(3)	(4)
	lnTFP_OP	lnTFP_LP	lnFVAR	lnF_up
lngini	0.009***	0.020*	0.007	0.003*
	(0.000)	(0.086)	(0.732)	(0.092)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
R^2	0.181	0.060	0.171	0.223
Obs	2.89e + 05	1.86e + 05	1.40e + 05	2.54e + 05

FE = fixed effects.
Notes:
1. p-values in parentheses.
2. * p < 0.1, ** p < 0.05, *** p < 0.01.

Source: Authors.

Table 1 shows a positive relationship between the spatial Gini coefficient and firm productivity, as measured by lnTFP_OP and lnTFP_LP, suggesting that city agglomeration improves firm productivity. As shown in Column (1), the coefficient for lnGini for lnTFP_OP is 0.009, indicating that a 1-unit increase in lnGini (i.e. a more concentrated urban agglomeration) is associated with a 0.9% increase in firm productivity. Similarly, the model for lnTFP_LP shows a significantly positive relationship between lnGini and firm productivity, with a coefficient of 0.020, indicating that a more concentrated urban agglomeration is associated with a 2% increase in productivity.

These findings are consistent with the previous literature that suggested that city agglomeration positively affects firm productivity. One possible explanation is Marshallian externalities, which refer to the effect of greater industrial specialisation due to city agglomeration on productivity growth (Klein and Crafts, 2015). Moreover, city amenities can promote the sharing, matching, and learning of factors that raise productivity (Combes and Gobillon, 2014). Sharing mechanisms include the distribution of indivisible facilities, gains from various input suppliers, and a finer division of labour or sharing risks. Matching consists of better-than-expected quality or a higher probability of matches, especially between employers and workers in a larger labour market pool. Learning relates to the diffusion and accumulation of knowledge, including tacit knowledge, which is enhanced by the proximity of other producers. All of these mechanisms suggest that the concentration of economic activity in urban areas can lead to productivity gains for firms.

However, as shown in Column (3), city agglomeration has no significant effect on the share of FVAR. This finding suggests that the concentration of urban agglomerations does not significantly affect the extent to which firms participate in GVCs. In Column (4), firms in more concentrated city clusters tend to situate in more upstream sectors of GVCs, with a positive and significant coefficient of 0.003. This finding suggests that a more concentrated urban agglomeration is associated with upstream positions in GVCs, characterised by higher value-added activities and better access to knowledge and technology.

Several factors may facilitate manufacturing firms to move to more upstream sectors in GVCs in city agglomerations. First, the spread of new ideas and innovations across cities – typically called knowledge spillovers or agglomeration externalities – can benefit firms in urban areas. Locating close to other firms and research institutions can increase the likelihood of serendipitous encounters and knowledge sharing, leading to the diffusion of new ideas and development of new technologies. Second, the availability of specialised products and factors – such as labour – can benefit firms located in urban areas. Urban areas tend to have a more diverse and specialised labour force, which can provide firms with access to the specific skills and knowledge that they need to succeed. Finally, firms located in urban areas can benefit from closer backwards and forwards linkages to local markets with better city connectivity and amenities (Fujita, Krugman, Venables, 2001). For example, city clusters tend to have better transport infrastructure, which can facilitate the movement of goods and people and better access to services and amenities, such as restaurants, cultural institutions, and entertainment venues, which can make urban areas more attractive to labour and industries and promote the upgrading of firms in GVCs.

4.3. Possible Mechanisms

In this section, the possible mechanisms through which city agglomerations affect firm performance are further explored. As shown above, city agglomeration increases industrial specialisation through Marshallian externalities, by which firms close to each other are more likely to specialise in more specific production stages with higher efficiency. The upstreamness of firms may increase with more stages in GVCs.

To examine this effect, the Herfindahl-Hirschman Index was used as a proxy for industrial specialisation and included its interaction with city agglomeration in the estimation. The Herfindahl-Hirschman Index was measured as follows:

$$H = \sum_{j=1}^{N} Z_j^2 = \sum_{j=1}^{N} \left(X_j/X\right)^2 \; (j = 1,2,3 \ldots n) \quad (4)$$

where:

X_j is the employment of firm j in industry X;

X is the total employment of industry X;

N is the total number of firms in X; and

X_j/X is the share of employment of firm j in the industry.

The estimation results are shown in Table 2. The spatial Gini coefficient is still positively and significantly correlated with firm-level productivity, suggesting that the concentration of economic activity in urban areas can lead to productivity gains for firms. However, the interaction between the spatial Gini coefficient and city agglomeration is insignificant. As shown in Column (4), firms tend to locate in more upstream sectors in GVCs in city agglomerations, which is consistent with the baseline results. Moreover, industrial specialisation increases the upstreamness of firms in GVCs. The coefficient of interaction between the Herfindahl-Hirschman Index and city agglomeration index is significant and positive, suggesting that the concentration of cities facilitates industrial specialisation, which further improves firm upstreamness in GVCs.

Table 2: Possible Mechanism – Industrial Specialisation

	(1)	(2)	(3)	(4)
	lnTFP_OP	lnTFP_LP	lnFVAR	lnF_up
Lngini	0.009***	0.043**	0.021	0.009***
	(0.000)	(0.016)	(0.459)	(0.000)
lnHHI	–0.001	0.012	0.025*	0.006***
	(0.212)	(0.304)	(0.080)	(0.000)
lngini *lnHHI	0.000	0.006	0.003	0.002***
	(0.667)	(0.104)	(0.446)	(0.000)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
R-squared	0.181	0.060	0.171	0.223
Obs	2.89e + 05	1.86e + 05	1.40e + 05	2.54e + 05

FE = fixed effects, HHI = Herfindahl-Hirschman Index.

Notes:

1. p-values in parentheses.
2. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Source: Authors.

In addition, city agglomeration can promote the sharing, matching, and learning of factors that increase firm performance. A human capital spillover index was constructed to capture these mechanisms following Fleisher, Li, and Zhao (2008):

$$HCS_i = h_i[\frac{1}{d_{\max\_i}}(\frac{y_{max}-y_{it}}{y_{it}})] \quad (5)$$

where:

h_i is the proportion of the population that attained the minimum university education in city *i*;

y_{it} is the GDP per capita in the city *i* at time *t*;

y_{max} is the city with the highest GDP per capita in the city cluster at time *t*;

d_{maxi} is the distance between city *i* and the largest city in the city cluster that has the highest GDP per capita; and

HCS_i is 'human capital spillovers' (if *i* = max, then the spillover value is 0).

The higher *HCS* is, the higher the spillover effect of human capital from the centre of the city agglomeration to the other cities. The city-level GDP and distance data were collected from the Chinese City Statistical Yearbooks.

Table 3: Possible Mechanism – Human Capital Spillover Effects

	(1)	(2)	(3)	(4)
	lnTFP_OP	lnTFP_LP	lnFVAR	lnF_up
Lngini	0.011***	0.016	–0.006	0.002
	(0.000)	(0.363)	(0.835)	(0.283)
lnHCS	–0.001*	–0.002	0.002	0.001*
	(0.054)	(0.803)	(0.850)	(0.057)
lngini*lnHCS	0.001***	0.002	0.003	0.000**
	(0.002)	(0.260)	(0.342)	(0.019)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
R-squared	0.144	0.044	0.133	0.453
Obs	1.54e + 05	1.07e + 05	93,877.000	1.21e + 05

FE = fixed effects.

Notes:

1. p-values in parentheses.
2. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Source: Authors.

The human capital spillover index was included in the baseline estimation, and it interacts with the spatial Gini coefficient to examine whether city agglomeration affects firm performance through the human capital spillover effect (Table 3). In Column (1), the interaction between human capital spillover and the spatial Gini coefficient is significantly positive, suggesting that firms in city agglomerations tend to benefit from more human capital spillover effects and productivity gains. Yet the same impact on long-term productivity and GVC participation is not observed. Moreover, the concentration of economic activity with city agglomeration promotes human capital spillover across cities, further raising firm upstreamness in GVCs. This result has important implications for GVC upgrading of manufacturing firms in GVCs, as most of the manufacturing firms in China are locked in the 'low value-added trap'.[3]

4.4. Impacts of City Primacy on Firm-Level Performance

Whether city primacy affects firm performance in GVCs was then examined (Table 4). As shown in Columns (1) and (2), firms in larger cities tend to be more productive on average, which can be attributed to the firm selection and city agglomeration effects. The selection effect

[3] The low value-added trap refers to the fact that China's participation in international production networks is primarily concentrated in low-value-added segments of GVCs.

suggests that larger cities toughen competition, leading to more efficient allocation of resources and allowing only the most productive firms to survive, resulting in higher average productivity in these cities. Yet the city agglomeration effect also refers to the benefits that firms can gain from being close to other firms in urban areas. As firms interact, they can learn from each other's experiences and innovations, leading to the diffusion of new ideas and the development of new technologies, which gives firms in primacy cities a competitive advantage in GVCs by allowing them to innovate more quickly than those in small cities.

Table 4: Impacts of City Primacy Index on Firm Performance

	(1)	(2)	(3)	(4)
	lnTFP_OP	lnTFP_LP	lnFVAR	lnF_up
lnPP	0.092***	0.359**	0.388**	–0.072***
	(0.000)	(0.016)	(0.019)	(0.000)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	0.117	0.046	0.197	0.245
Obs	81,473	44,462	73,544	1.00e + 05

FE = fixed effects.
Notes:
1. p-values in parentheses.
2. * p < 0.1, ** p < 0.05, *** p < 0.01.

Source: Authors.

In Column (3), it is seen that firms in primacy cities tend to participate more in GVCs. Megacities have better access to human capital, which makes it easier for firms to acquire the necessary human resources needed for the different stages of production in GVCs. Moreover, city amenities are another possible reason for firms to participate more in GVCs in primacy cities. For example, megacities are well-connected with efficient transport systems, communication networks, and other necessary infrastructure, which are essential for trade with other countries. The market size of primacy cities is vast, allowing firms to access different markets worldwide. Moreover, primacy cities have a higher concentration of research and development centres, which leads to innovation and technological advancements and enables firms to participate more in GVCs.

Column (4) suggests that firms are closer to final demand on average in larger cities. One possible reason is the accessibility of the market. Larger cities have a higher concentration of potential customers, which makes it easier for firms to access the market and to sell their products. Another possible reason is city amenities. Larger cities tend to have better infrastructure, such as transport networks, telecommunications systems, and utilities, which can help firms reduce the costs of accessing upstream suppliers and remain profitable in the downstream sectors.

5. Conclusion

This study examined the relationship between city agglomeration and firm performance in GVCs in China. Findings suggest that the concentration of economic activity in urban areas can lead to productivity gains for firms, especially in the upstream stages of GVCs, characterised by higher value-added activities and better access to knowledge and technology. Moreover, city agglomeration promotes industrial specialisation and human capital spillovers, further improving firm upstreamness in GVCs. Additionally, the impacts of city primacy on firm performance in GVCs was explored, finding that firms in larger cities tend to be more productive, participate more in GVCs, and are closer to final demand.

These findings have important policy implications for upgrading Chinese manufacturing firms in GVCs in China. This study contributes to the literature on city agglomeration and GVCs by providing insights into the direct effects of city agglomeration on firm-level GVC positions and highlighting the possible mechanisms. Policymakers should note the development of city agglomerations and focus on promoting industrial specialisation and human capital spillovers to enhance firm upstreamness in GVCs further.

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