

1 **Urban spillover or rural industrialisation: which drives the growth of Beijing**

2 **Metropolitan Area**

3 **Abstract:** Two competing forces are traditionally considered to be responsible for the
4 formation and expansion of metropolitan areas. One is urban spillover, which stresses
5 the dispersion of residents from the city centre; the other is rural industrialisation, which
6 focuses on *in situ* industrialisation in peripheries. The traditional idea that these two
7 forces are geographically incompatible and temporarily unchangeable is challenged by
8 this study. By analysing the development trajectories and growth drivers of Beijing
9 Metropolitan Area (BMA), the study shows that the development of this area between
10 1995 and 2010 was driven jointly by both forces. For counties that were already part of
11 BMA in 1995, the dominant growth driver in the following years has shifted from rural
12 industrialisation to urban spillover. For counties joining BMA after 1995, much of their
13 incorporation was first driven by rural industrialisation and later by urban spillover. For
14 all the counties in 2010, those closer to the city core were generally dominated by urban
15 spillover but those farther away were largely by rural industrialisation. These findings
16 confirm that urban spillover and rural industrialisation are neither geographically
17 incompatible nor temporarily unchangeable but can co-shape one metropolitan area.
18 They also suggest that the two forces are actually contingent on local conditions that
19 can vary both across space and over time.

20 **Keywords:** growth driver; urban spillover; rural industrialisation; urban expansion;
21 Beijing Metropolitan Area

1. Introduction

The accelerated processes of technological innovations, economic globalisation and planetary urbanisation in the early 21st century have brought significance to ‘metropolitan regions’ in North America, ‘polycentric megacity regions’ in Western Europe and ‘extended metropolis’ in Asia (Hall & Pain, 2006; Harrison & Hoyler, 2014; Lin, 2018; Nelson & Lang, 2017). Albeit different in scale and internal structure, these spatial forms are similarly composed by metropolitan areas (Castells, 2010). Emerging first from developed countries in the 1950s, metropolitan areas were initially considered ‘a pioneer area in terms of urbanisation’, the features of which will ‘gain later world-wide adoption’ (Gottmann, 1957, 1961, 1966). As predicted, they have later mushroomed elsewhere (Henderson, 2010; Schmid et al., 2018). For the past decades, metropolitan areas in developing countries have overtaken their predecessors in both size and dynamics (Abu-Lughod & Hay, 2013). But these latecomers have hitherto remained surprisingly understudied (Dharmapatni & Firman, 1995; Jones, 2002; McGee, 1991). In what way and with what speed do the rising stars emerge and expand? What are the drivers underneath their emergence and expansion? Are these drivers similar to or different from their predecessors? These are the questions waiting to be answered, the urgency of which grows with the complexity of planetary urbanisation.

Opinions on growth drivers of metropolitan areas abound but divide. For metropolitan areas in Western Europe and North America, their expansion is often believed to be driven by a city-based spillover process. Scholars in this vein often

1 suggest that receiving socio-economic flows from the urban core is the way through
2 which under-developed regions are promoted. This is especially the case when the core
3 is ‘over-loaded’ and the access to the surroundings is improved (Beeson, 2017; Fujita
4 et al., 2001; Parr, 2004). Among all the flows, the forerunner is the movement of
5 residents (Portnov & Schwartz, 2009). This means that the demographic spillover from
6 the urban core into peripheries should be the first driver of the expansion of
7 metropolitan areas (Catalán et al., 2008; Gottmann, 1961; Keys et al., 2007). This driver,
8 however, has been dismissed by scholars studying metropolitan areas in Asia. Critics
9 argue that the development of peripheries does not necessarily have to depend on urban
10 cores but can be promoted by the *in situ* growth of non-agricultural activities (Lin, 1994,
11 2001; McGee, 1989, 1991, 1998; McGee & Greenberg, 1992). Thus non-metropolitan
12 areas can be turned into metropolitan ones by a region-based rural industrialisation.

13 Given the stark contrast between urban spillover and rural industrialisation, the
14 two forces are traditionally considered to be mutually exclusive. This idea is best
15 illustrated by the assumption underpinning almost all metropolitan studies. One
16 metropolitan area is often assumed to be driven consistently by one force, and this
17 specific force is assumed to be contingent on the location of that area. If it is located in
18 Asia, then it is assumed to be driven by rural industrialisation, otherwise by urban
19 spillover. This conventional assumption, we argue, may need a second thought. Is the
20 growth driver determined by geographical divisions *per se* or by local conditions within
21 the divisions? If by local conditions, can these conditions change such that growth

1 drivers can be different over time? If they can, should we still consider the two drivers
2 as geographically incompatible and temporarily unchangeable? If we should not, how
3 can we re-conceptualise the relationship between the two drivers? In answering these
4 questions, we attempt to challenge the conventional assumption in metropolitan studies
5 and hence to advance a more open-minded way in which future studies can be
6 conducted. More importantly, we try to delink urban spillover and rural
7 industrialisation from geographical divisions and relink them to local conditions. This
8 effort not only enables us to better comprehend much recent development of
9 metropolitan areas but also help build a deeper understanding of their growth drivers.

10 For Chinese metropolitan areas, rural industrialisation is generally assumed to be
11 the underlying driver throughout time. ([Chen et al., 2017](#); [Sheng Wu & Sui, 2016](#); [Zhou,](#)
12 [1991](#); [Zhou & Ma, 2000](#)). This assumption may be acceptable for early studies on the
13 Pearl River Delta and Yangtze River Delta where rural population density is high and
14 rural economy is active. But it can be problematic if the latest development is to be
15 comprehended and other Chinese metropolitan areas are to be studied. With a rapid
16 speed of urbanisation and a vast geographical area, China should be expected to show
17 extensive diversities in the ways in which its metropolitan areas arise and expand. These
18 diversities, however, still wait to be discovered. To fill the gap, Beijing Metropolitan
19 Area (BMA) is chosen to be studied here. Being one of the pioneering metropolitan
20 areas in China, BMA has received much less scholarly attention than its counterparts.
21 But its significance to other urban agglomerations is by no means small. Like many

1 emerging metropolitan areas in the developing world, BMA has an astonishing growing
2 speed, a large but under-developed hinterland, and an ambitious local authority with a
3 strong intention to create a mega-region. Hence the experience of BMA may be
4 followed by many other newly emerged metropolitan areas, which gives its research a
5 global relevance. In addition, Beijing is one of the key places that are targeted by the
6 new urbanisation policy in China. In the recent decade, various policies, such as those
7 on Tongzhou new town and Xiong'an new area, have been designed and implemented
8 to promote the region's liveability and competitiveness. However, the aims of these
9 policies may be difficult to achieve without a thorough analysis of how Beijing has
10 become a large metropolitan area. From these perspectives, a study on BMA is
11 necessary, as it can help examine the diversity of Chinese metropolitan areas, shed some
12 light on other emerging metropolitan areas in the world, and provide suggestions for an
13 optimisation of the new urbanisation policy in China.

14 The rest of the paper is arranged as follows. Firstly, the research briefly evaluates
15 existing literature on growth drivers of metropolitan areas and identifies several
16 unsolved issues. Secondly, methodology and data are introduced. Afterwards, the
17 depictions of the growth dynamics in BMA with regard to the geographical coverage
18 and economy are presented, and an investigation into the drivers underlying these
19 dynamics is followed. Finally, major research findings are summarised and their
20 implications are discussed.

2. Literature review

The metropolitan concept was first introduced as metropolitan district in 1910, and later developed into standard metropolitan area in 1950, standard metropolitan statistical area in 1960 and metropolitan statistical area in 1984 (Adams et al., 1999; Berry et al., 1969). Despite these changes, the essence of metropolitan area as an integrated functional unit has remained unchanged, one that is used to draw ‘a correct picture of the massing or concentration of population in extensive urban areas’ (Czyż, 2011; Sly & Tayman, 1980). The essence, however, has seldom been reflected in the existing empirical studies. Much of the current research has delineated metropolitan areas by administrative designations and kept their spatial coverage unchanged in the research period (Lin, 2001; Shen, 2006; Wu et al., 2013; Xu et al., 2007). This treatment not only runs against the functional nature of metropolitan areas but also bypasses the fact that these areas actually expand rapidly and enormously over time. Therefore, to fill the lack of fit between the metropolitan concept and its applications, an empirical analysis of a metropolitan area with a return to its nature in mind is urgently required.

The establishment of metropolitan area as a new spatial form has sparked a discussion over the drivers of their emergence and expansion (Gottmann, 1961, 1966; McGee, 1991). The debut of this discussion, as of metropolitan area, was in Western Europe and North America. In these regions, agglomeration economies have favoured urban concentrations enormously, producing a clear rural-urban dichotomy (Fujita et al., 2001; Harris & Ullman, 1945; Krugman, 1999; Mills, 1967). Hence growth of the

1 backward countryside is often believed to be powered by the more advanced city ([Chen](#)
2 [& Partridge, 2013](#); [Feser & Isserman, 2005](#); [Richardson, 1976](#)). Scholars first argued
3 that cities can benefit the surroundings through ‘trickle down’, where the increased
4 demand in cities for industrial inputs and rural goods brings favourable impacts on
5 peripheries ([Berry, 1970](#); [Parr, 1973](#)). However, later empirical studies have frequently
6 found ‘trickle’ but rarely ‘down’ ([Puga, 2002](#)). An alternative way through which cities
7 can benefit peripheries was then proposed ([Amcoff, 2006](#); [Portnov & Schwartz, 2009](#)).
8 Partly due to diseconomies in cities that have undergone decades of concentration and
9 partly due to the enhanced access to peripheries with an improvement in transportation,
10 peripheries are argued to benefit from a spillover of population from cities, a movement
11 known as ‘suburbanisation’ or ‘counterurbanisation’ ([Berry, 1976](#); [Gordon, 1979](#);
12 [Grimsrud, 2011](#)). This group of people help link nearby units to urban cores and thus
13 contribute to the formation of a functional united entity called a metropolitan area
14 ([Catalán et al., 2008](#); [Keys et al., 2007](#); [Sheng Wu & Sui, 2016](#)). A spatial-economic
15 pattern has emerged accordingly, where most jobs exist in the city core, most residents
16 live in the subordinate peripheries, and the two areas are connected by commuters
17 ([Adams et al., 1999](#); [Lin, 2001](#)). This pattern is evident in Gottmann’s landmark seminal
18 book titled *Megalopolis* and later in the work of his followers focusing on Western
19 urban experiences ([Gottmann, 1961](#); [Hall & Pain, 2006](#); [Short, 2010](#)).

20 Metropolitan areas later mushroomed in Asia. Unsurprisingly, urban spillover was
21 initially used to unravel this new phenomenon ([Firman, 1992](#); [Jones, 1988](#)). But the

1 results were rather unsatisfactory. The failure, according to further investigations,
2 mainly comes from a very distinctive ecological and historical conditions of Asia
3 (Ginsburg et al., 1991). Unlike North America and Western Europe where urban
4 concentrations have extraordinary advantages in both population and economy, the line
5 between urban and rural is rather blurred in Asia (Jones, 2017; Webster et al., 2014).
6 Similar to urban areas, rural areas in Asia also have a high-density population, acting
7 as substantial pools of labour. These pools can be readily tapped by relocating industries,
8 which in turn draws migrants from other rural areas and which results in an
9 extraordinary mixture of agricultural and non-agricultural activities in peripheries (Lin,
10 2007; McGee & Robinson, 2011). Therefore, the development of rural areas in Asia
11 does not necessarily need to be fuelled by urban cores but can be powered by the *in situ*
12 growth of non-agricultural activities. Nor are the outlying counties and the city core
13 necessarily linked by commuters. They can instead be connected by non-agricultural
14 activities. Accordingly, a spatial-economic pattern that is distinctive from the one
15 generated by urban spillover has emerged in Asian metropolitan areas (Ginsburg et al.,
16 1991; Lin, 2001; McGee, 1989; McGee & Greenberg, 1992; Sheng Wu & Sui, 2016).
17 In this pattern, peripheries are dominated by non-agricultural activities rather than by
18 urban residents. These spatial dynamics are best documented by the celebrated book
19 *The Extended Metropolis: Settlement Transition in Asia* and have also been confirmed
20 by later empirical studies in Asia (Firman & Dharmapatni, 1995; Ginsburg et al., 1991;
21 Kelly, 1999; Zheng et al., 2009).

1 In the two contrasting interpretations for the growth drivers of metropolitan areas,
2 two critical issues have remained unsolved. One is how to discern which factor is the
3 main contributor. This question can only be answered by considering the distributions
4 of both jobs and residents. Specifically, one consequence of urban spillover is that a
5 large proportion of residents in peripheries still work in the central city rather than
6 locally. Therefore, for peripheries, the number of residents working in non-agricultural
7 sectors should be larger than that of non-agricultural jobs. An entirely opposite
8 relationship between jobs and residents should be found in places where rural
9 industrialisation dominates. Unfortunately, few empirical studies have explored this
10 simple relationship and compared the employment composition of workforce and that
11 of residents in the building blocks of metropolitan areas. Previous research on Western
12 metropolitan areas has mainly focused on either the economic activities in central cities
13 or the residential patterns in peripheries ([Saks, 2008](#); [Shen, 2001](#); [Taylor & Ong, 1995](#)).
14 Corresponding studies on Asian ones are largely confined to the economic phenomena,
15 with limited attention on residential distributions ([Firman, 1996](#); [Kim et al., 2014](#);
16 [Marton, 2002](#); [Zheng et al., 2009](#); [Zhou et al., 2018](#)). However, it is inappropriate to
17 claim that a specific factor is functional whilst others are ineffective if the analysis is
18 only conducted for either economic or residential aspect. This argument should only be
19 made after a thorough consideration on the relationship between jobs and residents.
20 Therefore, such a relationship, rather than a single aspect should be the focus of studies
21 on metropolitan areas.

Another unsolved issue is whether rural industrialisation is a long-lasting process or simply a transitional phenomenon, and whether it can evolve into urban spillover and *vice versa* (Firman & Fahmi, 2017; Lin, 2001; McGee, 1991). The fact that the two growth drivers are very distinctive from each other naturally leads to a conception that they are mutually exclusive. This conception is evident in the current research where a specific growth driver is often taken as *a priori* condition. Consequently, many studies have found only one growth driver for a metropolitan area and hence claimed the persistence of that driver throughout time (McGee & Greenberg, 1992). However, this claim has been challenged by new urban phenomena. For example, Lin (2007) has found a transition of urbanisation from rural to city-based in the recent development of Chinese metropolitan areas. Many Western suburbs nowadays are also found to be dominated by economic activities that are decentralised from the nuclei (Henderson, 2018; Li & Monzur, 2018). These new findings indicate that the conventional conception that conceives the two drivers as mutually exclusive may be erroneous. Instead, metropolitan areas may be driven by many forces, and the dominant force can change from one to another with the changing local conditions. In this sense, neither urban spillover nor rural industrialisation should be confined to a specific region. Nor should they be conceived as the unchanging path that is constantly followed by metropolitan areas. Both processes can happen in any metropolitan areas and can change from one to another through their development. The validation of this hypothesis requires further empirical investigation. Therefore, this study, by analysing

1 the relationship between jobs and residents in Beijing Metropolitan Area (BMA), tries
2 to answer the following questions. What are the development trajectories of BMA?
3 What is the growth driver of these trajectories? Is the development of BMA driven by
4 urban spillover or rural industrialisation? Can it be driven by both simultaneously and
5 by different forces over time?

6 **3. Methodology and data**

7 *3.1. Designation of study area*

8 Beijing, the capital city of China, had a population of 21.7 million and an
9 urbanisation rate of 86.5% by the end of 2017. In the past 30 years or so, Beijing has
10 experienced rapid population growth, dramatic industrial transformation and large-
11 scale urban land expansion. The continuous attraction of people and economic activities
12 to Beijing has contributed to the city's evolution into a metropolitan area and its
13 enormous spatial expansion ([Akiyama, 2017](#); [Cao & Shi, 2015](#)). Despite its rapid
14 expansion, existing geographical definitions of BMA are still confined to either the
15 entire administrative area of the Beijing Municipality or all its administrative districts
16 except for four exurban ones¹ ([Feng & Zhou, 2003, 2008](#); [Long et al., 2013](#); [Sun, 1992](#);
17 [Zhou et al., 2014](#)). This lack of fit between the dynamic, functional expansion of BMA
18 and its static, jurisdictional definitions hinders the exploration into the fine aspects of
19 its development. Therefore, the study area here is not restricted to the conventionally
20 used Beijing Municipality. It instead covers a broad, open and dynamic region

¹ These are Yanqing, Huairou, Miyun and Pinggu.

1 consisting of the Beijing Municipality (or only some of its districts) and its adjacent
2 counties (or even beyond these counties). Specifically, a wide region, including the
3 Beijing Municipality and all its adjacent prefectures, is used as a preliminary study area
4 to collect data. Then, results from our analyses will delineate the spatial coverage of
5 BMA, which will be the ‘accurate’ study area (Fig. 1). Through this process, the
6 dynamics of the spatial range of BMA can be captured, which is one of the primary
7 purposes of this study.

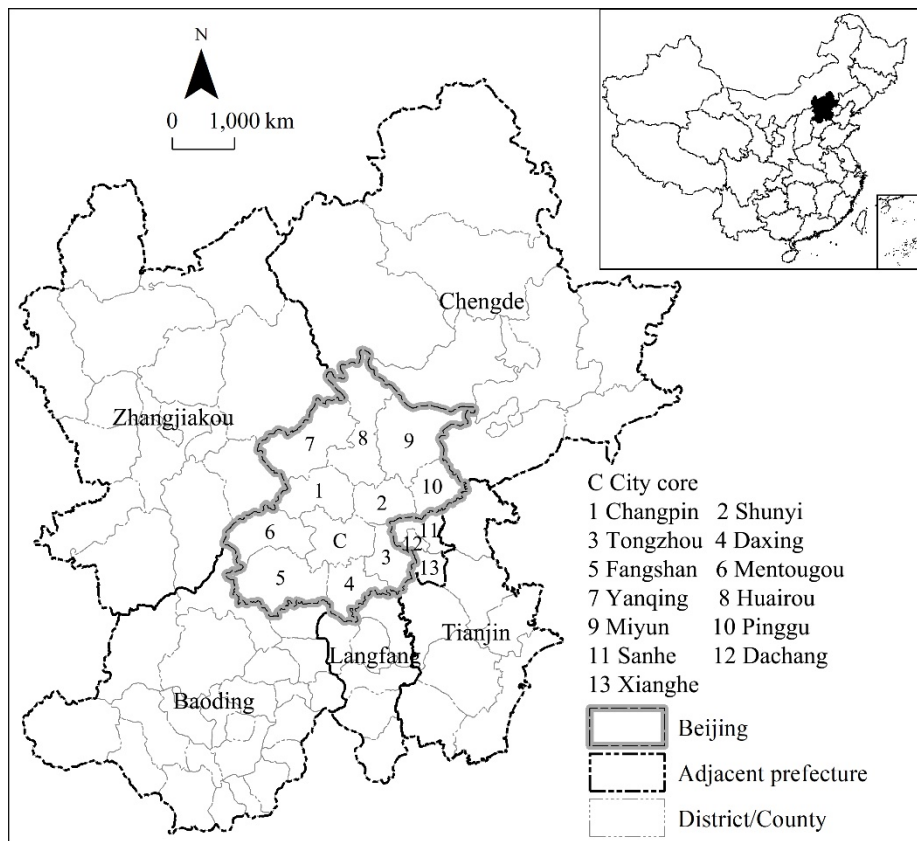


Fig. 1. Preliminary study area

3.2. Delineation of metropolitan areas

To identify an ‘accurate’ study area, a clear criterion based on which metropolitan areas are delineated is needed. For metropolitan areas in the developed world where

1 demographic spillover is considered to be the growth driver, the widely used criterion
2 is built up from population and commuting data (Adams et al., 1999; Frey & Spear,
3 1988). However, this criterion can hardly be fully applied to China. For one thing,
4 current data on commuting links are mostly derived from public transport by
5 crowdsourcing and can barely reflect the complete commuting patterns in China (Long
6 et al., 2012). For another, non-agricultural activities, instead of commuters, are still
7 generally acknowledged as the initial impetus for the development of Chinese
8 metropolitan areas (Guo et al., 2013; Sun, 1992). Accordingly, Hu, Zhou and Gu (2000)
9 developed a criterion that considers both the concept of the definition in the West and
10 the particularities of data and urbanisation in China. They defined the city core of a
11 metropolitan area as a group of traditional districts² with more than 200,000 urban
12 residents. They also described outlying counties as those contiguous ones with over 60%
13 of the total workforce employed by non-agricultural sectors and over 75% of the total
14 value added created by non-agricultural activities (Hu et al., 2000). Although this
15 China-specific criterion was proposed nearly two centuries ago, rarely has it been
16 updated. Nor have new ones been created to replace it. Thus, this concept is still widely
17 adopted by current Chinese studies (Hu, 2003; Ning, 2011). Moreover, this criterion,
18 although proposed in 2000, is appropriate for delineating the metropolitan area for the

² As many newly developed districts in China are those transformed from counties by administrative measures, the traditional districts are equivalent to the concept of 'city' in the Western context. See Chung & Lam (2004) and Zhou & Shi (1995) for further detailed information. In Beijing, these districts are Dongcheng, Xicheng, Chongwen (incorporated into Dongcheng in 2010), Xuanwu (incorporated into Xicheng in 2010), Haidian, Chaoyang, Fengtai and Shijingshan. They are merged into one entity in Fig.1. for convenience.

period in question, which is 1995 – 2010. Therefore, this criterion is adopted in our study.

3.3. *Differentiation of growth drivers*

The relationship between jobs and residents is used to differentiate between urban spillover and rural industrialisation, and this is expressed below:

$$\frac{r_{in}/R_i}{j_{in}/J_i} = \begin{cases} > 1 & \text{Urban spillover} \\ < 1 & \text{Rural industrialisation} \end{cases}$$

where r_{in} = number of residents in place i engaging in non-agricultural activities; R_i = number of total residents in place i ; j_{in} = number of non-agricultural jobs in place i ; J_i = number of total jobs in place i . One the one hand, as mentioned previously, urban spillover results in a spatial-economic pattern where many of those living in peripheries are commuters who work in urban cores. Hence under this scenario, one should observe a higher level of non-agricultural employment among residents than that among jobs. This means that the value of the above formula should be above one. Rural industrialisation, on the other hand, indicates a concentration of non-agricultural activities in outlying counties. Its dominance should thus be declared if the share of non-agricultural jobs in the total jobs exceeds that of residents engaging in non-agricultural activities in the total residents. In other words, the value of the formula should be under one.

3.4. *Data source*

Data on industrial structure come from the China Statistical Yearbook for

1 Regional Economy. Data on employment structure come from two sources. The first
2 source is the Statistical Yearbooks of the districts in Beijing³ and the Economic
3 Statistical Yearbooks of the adjacent prefectures. Employment data in these yearbooks
4 are collected through a survey on a sample of economic entities. The other source is the
5 Population Census, which collects employment information by surveying a sample of
6 residents. Hence whereas the yearbook tells us the employment structure of workforce,
7 the census shows that of residents. This difference, which is produced by statistical
8 calibre, enables us to explore the relationship between residents and jobs. Moreover,
9 the earliest census that we can obtain is the 1995 1% Sample Census while the latest
10 one is the 2010 Population Census. The availability of census data thus restricts our
11 study period to 1995–2010. Although BMA has been showing some new patterns since
12 2010, its development trajectories before 2010 are still understudied. Furthermore, even
13 though the period of 1995–2010 is not the most updated one, it can still serve our
14 purpose of untangling the relationship amongst different growth drivers in one
15 metropolitan area.

16 **4. Development trajectories of BMA**

17 *4.1. Spatial expansion*

18 By 2010, 13 outer counties became part of BMA: six made up an integrated part
19 before 1995, and seven were incorporated between 1995 and 2010. Specifically, BMA

³ Owing to the lack of access to the 2001 Statistical Yearbooks, the employment data for Beijing in 2000 are retrieved from the 2002 Statistical Yearbooks.

1 covered a wide area that is inclusive of the city core and its six adjacent districts in
2 1995. This geographical range expanded slightly in 1995–2000 with the incorporation
3 of Miyun in the north and Sanhe in the east. The speed of the spatial expansion
4 accelerated between 2000 and 2005, with Pinggu, Daxing, Yanqing and Dachang the
5 newly added outer counties. This speed later slowed down between 2005 and 2010
6 when only Xianghe was integrated into the already fully developed BMA (Fig. 2). The
7 spatial pattern that is characterised by large coverage in 1995 and slow expansion in
8 2005–2010 verifies the pioneering status of BMA among Chinese metropolitan areas.
9 The drivers underlying the spatial expansion will be further analysed in the next section.

10 The spatial range of BMA has transcended the administrative boundaries of the
11 Beijing Municipality as early as 2000, reflecting the functional concept of metropolitan
12 areas. In 1995, all outer counties of BMA were within the boundaries of the Beijing
13 Municipality. However, this situation changed in 2000. At that time, Sanhe, a county
14 under the jurisdiction of the Langfang Prefecture, was included in BMA, although three
15 districts in Beijing failed to meet the metropolitan criterion. This expansion progressed.
16 Another two counties in the Langfang Prefecture, Dachang and Xianghe, were further
17 incorporated in 2000–2005 and 2005–2010 respectively. The continued spatial invasion
18 into adjacent jurisdictions shows that the city core of BMA has strong influence over a
19 wide geographical area, one that goes beyond its administrative boundaries. It confirms
20 the hypothesis that the spatial coverage of metropolitan areas is only partially dependent
21 on jurisdictions and should therefore be analysed beyond the administrative lens.

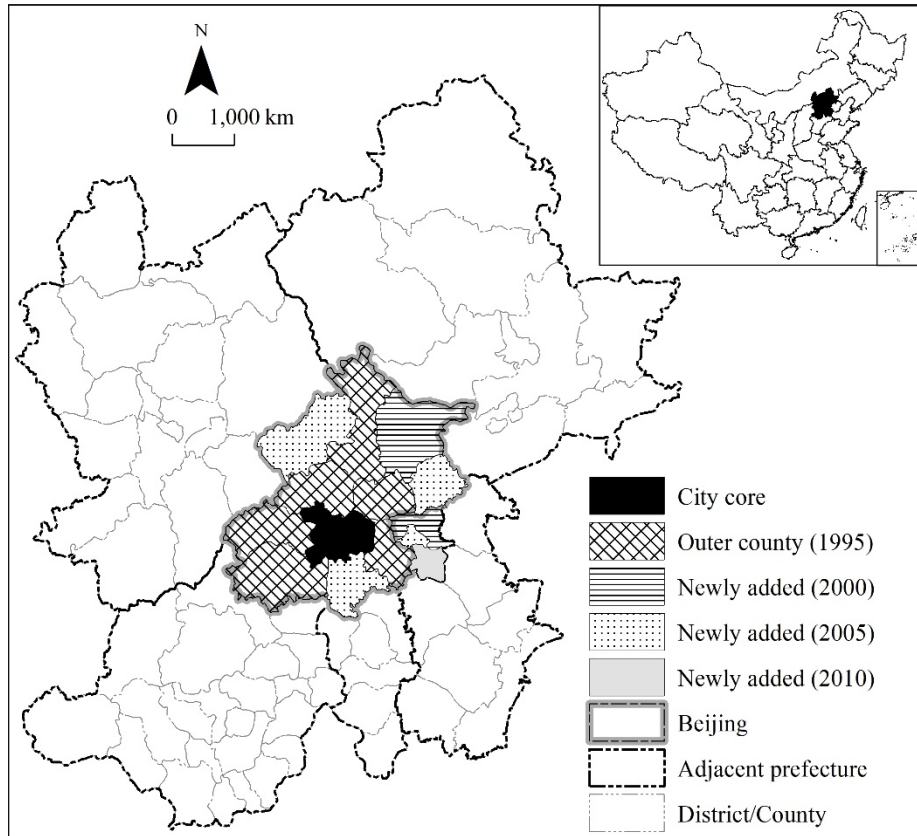


Fig. 2. Spatial growth of BMA, 1995–2010

4.2. *Economic growth*

BMA has undergone continuous economic growth throughout 1995–2010, with the city core consistently making the largest contribution. The years 2000–2010 signal a key period, in which the relationship between the city core and peripheries seems to have changed dramatically (Tab. 1). Specifically, the gross domestic product of BMA was 44.4 billion *yuan* in 1995, 53.7% of which was derived from the city core. A similar contribution was made by the city core (53.9%) in 2000 when the total output of BMA reached 100.5 billion *yuan*. After 2000, the city core's contribution soared, along with the total output *per se*⁴. In 2005, BMA's gross domestic product reached 628.4 billion

⁴ Admittedly, the huge increase in the total output from 2000 to 2005 should partly be attributed to the national revision of product account statistics based on the findings of the 2004 Economic Census (Holz, 2008).

1 *yuan*, with the city core accounting for 77.4%. This economic dominance remained as
2 the city core continued to share 75% of the total output in 2010. The dramatic increase
3 in economic power of the city core during 2000–2005 and its consistent dominance in
4 the subsequent five years imply that the new century might see a change in the
5 relationship between the city core and outer counties. Since 2000, residents in
6 peripheries may be more likely than before to work in the urban core rather than locally.

7 **Tab. 1. Gross domestic product in BMA, 1995 – 2010**

	1995		2000		2005		2010		Change (Billion yuan)		
	Billion yuan	%	Billion yuan	%	Billion yuan	%	Billion yuan	%	1995–2000	2000–2005	2005–2010
City core	23.9	53.7	54.2	53.9	486.1	77.4	985.8	75.0	30.3	432.0	499.7
Outer counties	20.5	46.3	46.3	46.1	142.2	22.6	329.3	25.0	25.7	95.9	187.1
Total	44.4	100.0	100.5	100.0	628.4	100.0	1315.1	100.0	56.0	527.9	686.7

8 Source: China Statistical Yearbook for Regional Economy

9 Despite their relatively small contribution to the total economy, outer counties
10 have been increasingly dominated by non-agricultural activities, and their economic
11 structures have become increasingly similar. On average, the peripheries had their share
12 of non-agricultural output in the total economy increased by 12% between 1995 and
13 2010, but the standard deviation of this share among the outlying counties decreased
14 from 6 to 5. Given that outer counties in the west have already had about 90% of the
15 total output coming from non-agricultural sectors in 1995, the closing gap among the
16 outer counties regarding the economic structure was achieved mainly by the rapid

For Beijing, the gross domestic product in 2004 was revised upward by 41% (Fang, 2006; Holz, 2008). However, as this revision was applied to the entire country, it largely affected the amount of local economy with limited influence on the share. The pre-economic census output for Beijing also remained as large as 428.3 billion in 2004, which shows its fast growth since 2000. Considering these figures, claiming that the total output *per se* has soured is not exaggerated.

1 industrialisation of those in the east (Fig. 3). During 1995–2000, the north-east saw a
 2 large increase in the share of output from non-agricultural sectors. Then the south-east
 3 outpaced others in the subsequent five years. This share increased rather equally for
 4 outer counties in the east during 2005–2010. Consequently, by 2010, all the outer
 5 counties of BMA have shared a very similar economic structure, one that is dominated
 6 by non-agricultural sectors. This structural shift might be driven by the dispersion of
 7 city residents who promoted the local consumption, or by the springing of enterprises
 8 that created new non-agricultural jobs, or by both, which is the focus of the next section.

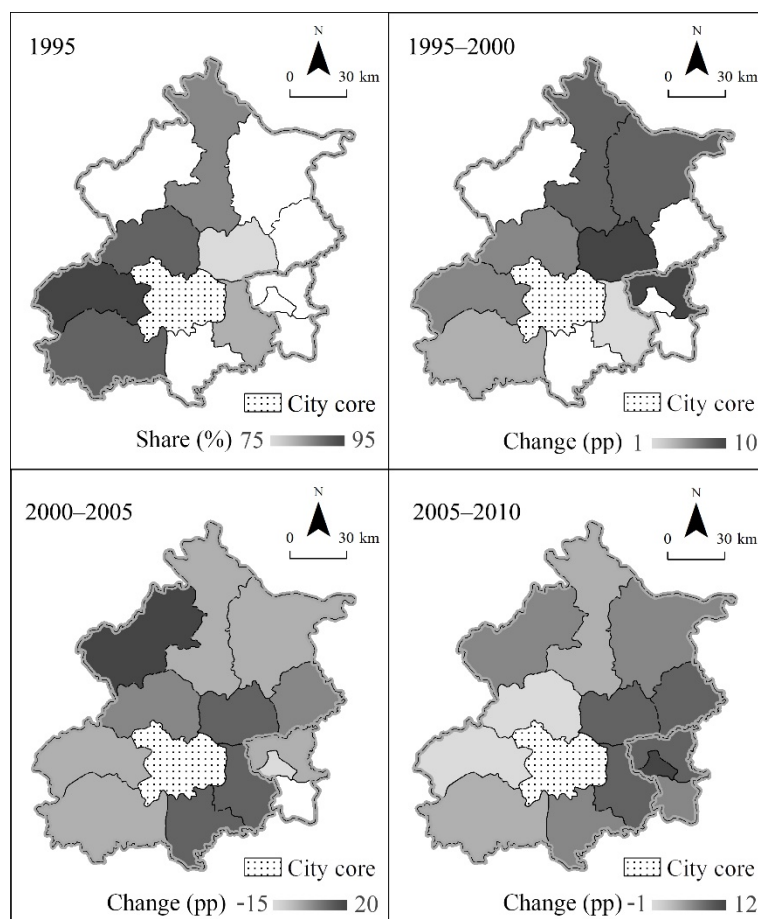


Fig. 3. Share of output from non-agricultural sectors and percentage point changes, 1995–2010

Note: pp in the figure is the abbreviation of percentage point.

5. Growth drivers of BMA

The previous section has revealed that BMA not only expanded enormously in space but also saw significant economic growth within the area. Whether these development trajectories are driven by urban spillover or by rural industrialisation or by both is investigated in this section. The following part first explores how the six outer counties that were already part of BMA in 1995 (pre-1995 outer counties) *developed* into maturity and then investigates how those that joined BMA after 1995 (post-1995 outer counties) were *incorporated* into BMA. In doing so, the hypothesis that growth drivers of metropolitan areas should not be geographically and temporally restrictive but can be different across outer counties and over time is tested.

5.1. Pre-1995 outer counties

Both urban spillover and rural industrialisation were functional in the development of the pre-1995 outer counties. In Fig. 4, the employment structure of workforce and that of residents for each county over time are compared. Points above the dotted diagonal line are counties where the share of workers employed by non-agricultural sectors lags behind that of residents. This means the dominance of urban spillover in the development. By contrast, points below the line are those where rural industrialisation leads the development. Among the 24 points, 14 situate above the line whereas the rest 10 below the line. This means that neither urban spillover nor rural industrialisation is the only mechanism that underlies the development. Instead, both forces have made a roughly equal contribution to the maturity of this area. Therefore,

1 urban spillover and rural industrialisation are not contingent on geographical divisions,
2 as most previous studies assumed. This finding calls for a change in the manner by
3 which existing metropolitan research has largely been conducted, one that takes a
4 specific growth driver as *a priori* condition.

5 Almost all the pre-1995 outer counties have had their growth drivers being
6 changed at least once between 1995 and 2010. This is especially the case for Tongzhou,
7 the line of which has crossed the diagonal line three times. Interestingly, for those outer
8 counties that have experienced any change in growth drivers, their dominant driver in
9 1995 was rural industrialisation, but that in 2010 was urban spillover. In addition, three
10 outer counties have experienced similar changes in growth drivers between 1995 and
11 2010. In 1995, their development was mainly driven by *in situ* industrialisation. This
12 dominance of rural industrialisation was weakened between 1995 and 2000,
13 strengthened between 2000 and 2005, and reduced again between 2005 and 2010. These
14 results validate the hypothesis that growth drivers underlying the development of a
15 specific outer county can change over time, and this change can happen several times
16 during the evolution of metropolitan areas.

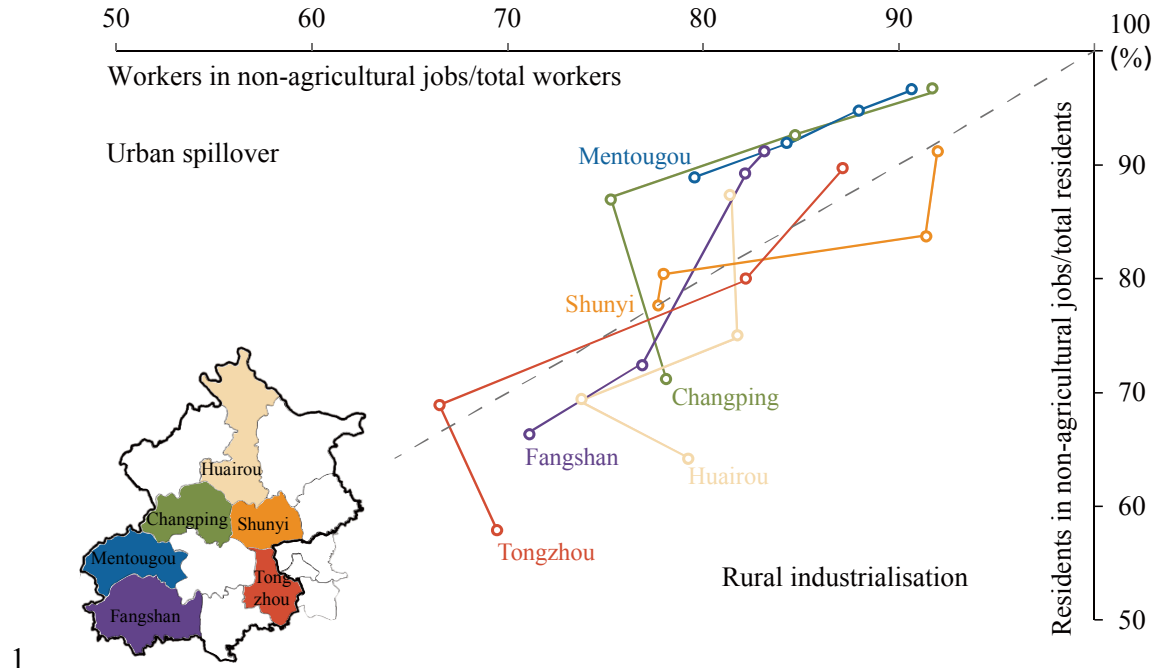


Fig. 4. Growth drivers underlying the development of pre-1995 outer counties, 1995–2010

Note: Each point represents a specific outer county at a specific time.

Several factors are responsible for the dominance of rural industrialisation in 1995. Initially, rural industrialisation in the outer counties was led by the Beijing government who asked heavy pollution enterprises in the city core to relocate to the outer counties, and this requirement was even written into Beijing's 1983 Master Plan (Feng et al., 2008). The influence of the local authority in rural industrialisation has continued into the 1990s. In this period, a fever of setting up Economic Development Zones (EDZ) swept Beijing. Of its 16 province-level EDZs which are all situated outside the central city, 11 were established in 1992, and only two were set up after 2000. Also in 1992, market began to play a role in rural industrialisation. In that year, Beijing replaced the free land-use system with the paid land-use one (Ding, 2004; Gao et al., 2014). This replacement has stimulated numerous manufacturing firms, especially those with poor

1 financial statements, to relocate their high-priced plants in the city core to the suburbs,
2 where industrial land was readily available at a low price. Under these forces, rural
3 industrialisation has prevailed throughout the late 1980s and early 1990s, which
4 explains its dominance in the pre-1995 outer counties in 1995 ([Yang et al., 2015](#)).

5 Between 1995 and 2010, the main driver has changed from rural industrialisation
6 to urban spillover, and several factors are responsible for this change. First, population
7 growth in Beijing has accelerated significantly since 1995. The annual growth between
8 1990 and 1995 was 177 thousand. This number, by contrast, was 344 thousand between
9 1995 and 2000, 391 thousand between 2000 and 2005, and 846 thousand between 2005
10 and 2010. The city core, with an area of 1,381 km², is obviously unable to accommodate
11 all these population increases, which leads to a demographic spillover into the outer
12 counties. Second, in 1998, housing allocation by work units was abolished and
13 commodity housing market was established in urban China ([Shi et al., 2016](#); [Zhao,](#)
14 [2017](#)). This housing reform gives residents the freedom to choose where to live, enables
15 real estate developers to build houses in suburbs, and allows house prices in the city
16 core to be much higher than those in the suburbs ([Feng et al., 2008](#)). With the additional
17 contribution of the major road improvement, increase in car ownership and expansion
18 of subway system, residents now are more willing than before to move out of the city
19 core ([Huang & Clark, 2002](#); [Li, 2004](#)). Third, the local authority also plays an important
20 role in the demographic spillover. It has relocated residents from the city core to
21 peripheries through renewal programmes of old urban areas and construction of

1 affordable housing in suburbs (Liu & Wong, 2015). Under these factors, a change in
2 the growth driver from rural industrialisation to urban spillover for the pre-1995 outer
3 counties is not a surprise.

4 5.2. *Post-1995 outer counties*

5 Drivers for the development of the post-1995 outer counties differ over time and
6 across locations. For BMA, its expansion was driven by rural industrialisation between
7 1995 and 2005 and by urban spillover in 2005–2010 (Fig. 5). Albeit sharing a highly
8 similar geographical location, Xianghe was driven by urban spillover when it became
9 part of BMA between 2005 and 2010, but Sanhe and Dachang were incorporated into
10 BMA before 2000 through rural industrialisation. This difference indicates that the
11 expansion of metropolitan areas can be driven by different factors at different times. In
12 addition, of the seven post-1995 outer counties, only three served as the residential
13 ‘breathing spaces’ in 2010, and the rest four still remained short of commuters and
14 relied heavily on non-agricultural activities to connect with the city core. These
15 ‘breathing spaces’ are generally closer to the city core than their counterparts, which
16 indicates that distance to the city core is a major reason for the difference in growth
17 drivers. Taken together, the growth drivers for the expansion of metropolitan areas can
18 vary over time, and the current growth drivers in metropolitan areas can differ across
19 outer counties with different locations.

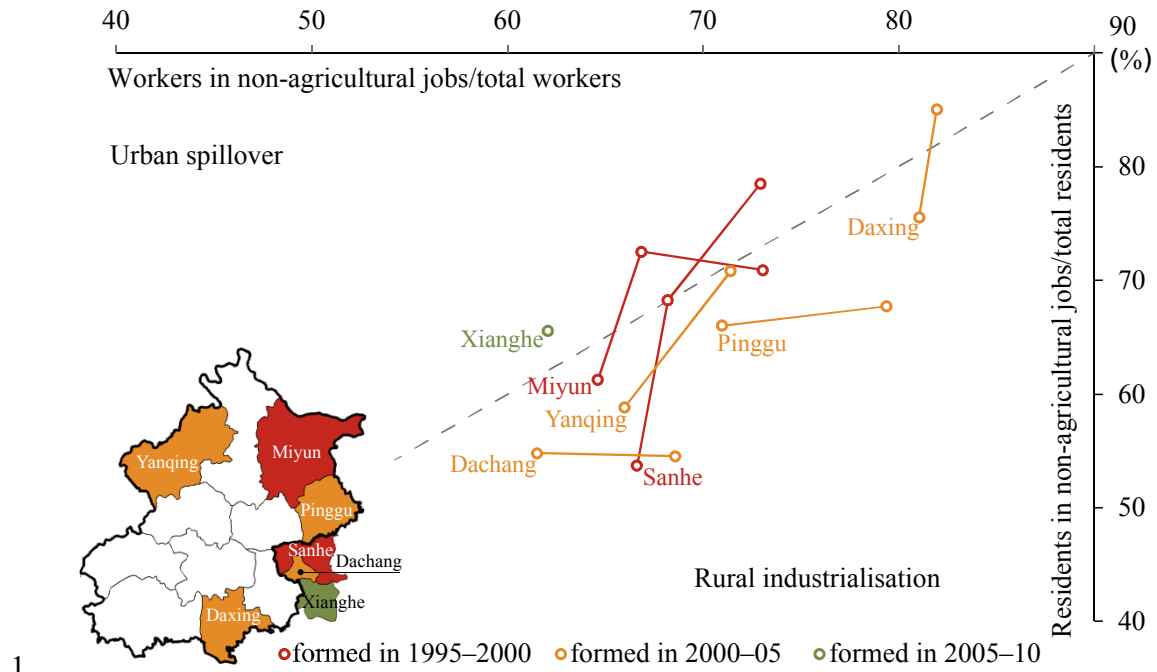


Fig. 5. Growth drivers underlying the development of the post-1995 outer counties, 1995–2010

Note: Each point represents a specific outer county at a specific time

The experience of Xianghe has challenged the conventional conception on the expansion of Asian metropolitan areas. Although urban spillover has recently been acknowledged to be functional in Asian metropolitan areas, rural industrialisation is still generally believed to be the major reason underlying their expansions (Chen et al., 2017; Feng et al., 2008; Lin, 1994; McGee, 1991). But for BMA, its expansion between 2005 and 2010 was not driven by rural industrialisation but by urban spillover. This unexpected result can be explained when we take a step back and think about the conditions on which rural industrialisation and urban spillover arise. Unlike rural industrialisation that mainly conditions on densely populated peripheries and blurred rural-urban divide, urban spillover largely comes from a huge advantage of the city core over peripheries in population and economy and a convenient connection between these

1 two areas. Given that in 2005 the population and gross domestic product in Xianghe
2 were only 3.2% and 1.3% of those in the city core and that the transportation barriers
3 across administrative boundaries have been lowered in recent years, the relationship
4 between Xianghe and the city core is more similar to that underlying urban spillover
5 than that underlying rural industrialisation (Cao & Shi, 2015). In this regard, urban
6 spillover and rural industrialisation actually come from different conditions, such as the
7 relationship between the city core and peripheries, rather than different regions. If the
8 local conditions in Asia become similar to those in the West, urban spillover can also
9 become an important driver for the expansion of the metropolitan areas therein.
10 Therefore, research concerning metropolitan areas should not be parochial but can be
11 more universal if we embrace the idea that growth drivers are dependent on local
12 conditions that actually vary both across space and over time.

13 **6. Conclusion and discussion**

14 The metropolitan area is a prevailing spatial form of the current urban age and has
15 attracted enormous scholarly attention. Its formation and expansion are believed to be
16 driven by two very different processes. One is urban spillover and the other is rural
17 industrialisation. Here, urban spillover is a process in which urban residents move from
18 the city core to peripheries, and this process is dependent on a huge advantage of the
19 core in both economy and population. By contrast, rural industrialisation is a process in
20 which non-agricultural activities are agglomerated in rural areas, and this process is
21 conditioned on densely populated peripheries such that their development can rely on

1 themselves rather than on urban cores. Given this stark contrast, the two processes are
2 usually considered neither geographically compatible nor temporarily changeable.
3 Instead, existing studies typically assume that one metropolitan area should consistently
4 be driven by one process. Our study, which examines the development trajectories and
5 growth drivers of BMA, challenges this conventional wisdom and argues for the
6 pluralities of growth drivers in one metropolitan area.

7 Results show that the spatial coverage of BMA has expanded continuously since
8 1995, although its speed has slowed down in recent years. At the same time, its spatial
9 coverage is not limited by the administrative boundaries of the Beijing Municipality
10 but has transcended these boundaries by as early as 2000. This spatial pattern verifies
11 that the metropolitan area is, in essence, a dynamic and functional entity. In other words,
12 analyses on metropolitan areas should take the functional rather than administrative
13 entity as a study area. In addition, similar to other metropolitan areas, BMA has an ever
14 stronger economy, to which the city core is consistently the biggest contributor.
15 Between 1995 and 2000, the city core shared roughly half of the gross domestic product
16 of BMA, and this share has soared to around three quarters between 2000 and 2010.
17 This dramatic increase implies that the development within BMA is not static but rather
18 dynamic. Furthermore, the outer counties in the east have closed their gap with those
19 in the west in terms of the extent of industrialisation between 1995 and 2010. At the
20 end of the study period, the outer counties in BMA shared a similar economic structure
21 that is dominated by non-agricultural activities.

Contrary to previous research, our study found that both urban spillover and rural industrialisation were functional in BMA. This finding should be attributed not only to our effort of a departure from the conventional assumption for an open-minded view, but also to our focus on the relationship between jobs and residents rather than on a single aspect. Having these points in mind, we found that, of the six pre-1995 outer counties in BMA, the growth driver of five has changed from rural industrialisation to urban spillover between 1995 and 2010; that the expansion of BMA was driven by rural industrialisation before 2005 but by urban spillover after 2005; and that in 2010 counties closer to the city core were dominated by urban spillover whereas those farther away still relied on rural industrialisation. These findings show that urban spillover and rural industrialisation can change from one to another in the development of one outer county, are influential to the expansion of metropolitan areas, and can co-exist in one metropolitan area simultaneously. Therefore, neither urban spillover nor rural industrialisation should be confined to a specific geographical region or a particular time period. Instead, they can contribute to the formation and development of one metropolitan area simultaneously and change iteratively from one to another.

Several reasons have been suggested for the broad change in growth drivers from rural industrialisation to urban spillover in BMA. First, the city core of BMA saw a dramatic increase in population since 1995, which gives it an enormous population advantage over peripheries and thus strengthens the core-periphery divide. Second, for the past decades, road and subway system have expanded, car ownership has increased,

1 and transportation barriers across administrative boundaries have lowered, which all
2 contribute to a much more convenient connection than before between the city core and
3 the adjacent counties. Third, continuous reforms and deregulations have swept China
4 for the past decades, which enables the market to play an increasingly important role in
5 shaping the urban profiles. These factors together have changed the core-periphery
6 relationship in BMA from one that is underpinning rural industrialisation to one that is
7 underpinning urban spillover. The relationship now is characterised by a huge
8 advantage of urban core over peripheries and a convenient connection between them.
9 In this sense, changes in growth drivers actually come from the dynamic nature of local
10 conditions, and thus urban spillover and rural industrialisation should not be separated
11 by regions but can be conceptualised within one framework.

12 Our research has several practical and theoretical implications. Practically, BMA
13 is situated in the Beijing-Tianjin-Hebei region, the coordinated development of which
14 has been targeted by the recent new urbanisation policy in China. In this sense, Beijing
15 is very likely to strengthen its connections with the surrounding prefectures *and vice*
16 *versa*, which tends to foster a new core-periphery relationship in this region. If this
17 outlook materialises, not only the growth drivers for the development of BMA will be
18 changed, but also its spatial coverage will be highly stretched to counties in other
19 prefectures. Consequently, the emergence of a super-metropolitan area or extended
20 megalopolis in this region is possible if BMA continues the spatial expansion such that
21 it coalesces with other metropolitan areas. One clue to this future is the establishment

1 of the Xiong'an New Area in 2017, which has received an unprecedented national
2 priority (Zou & Zhao, 2018). Under these circumstances, constant follow-up studies on
3 BMA or broadly on the Beijing-Tianjin-Hebei region are urgently required.

4 Methodologically, our research calls for a change in the manner by which
5 metropolitan areas are studied. First, a dynamic, functional entity, rather than a static,
6 administrative one, should be used as the study area for metropolitan research. Second,
7 studies on metropolitan areas should move from a biased focus on either the economic
8 or social field to a relational perspective. In other words, both economic and social
9 aspects should be taken into account and their relationships should be analysed. Third,
10 the assumption that one metropolitan should be driven by one process constantly, which
11 underpinning almost all previous studies, should be abandoned. Instead, an
12 acknowledgement of several growth drivers in one metropolitan area should be made
13 such that future research should be more about exploring growth drivers than about
14 confirming a specific one.

15 Theoretically, our research challenges the link between growth driver in one
16 metropolitan area and the region in which it is located and argues for that between
17 growth driver and local condition instead. As the local condition, such as the core-
18 periphery relationship, changes in one metropolitan area, the growth driver therein will
19 adjust accordingly. In this sense, rather than separating growth drivers by regions, the
20 possibility of their co-existence in one metropolitan area should be acknowledged,
21 given that the local conditions can vary over time and space. In so doing, changes in

growth drivers observed in this study can be easily understood because the local conditions of outer counties in BMA vary according to development stages and geographical locations. This conceptualisation is also in accordance with the current complexity of planetary urbanisation, through which the diversified, dynamic and complex urban landscapes can be well comprehended.

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