Papers in Evolutionary Economic Geography

15.21

Evolution of Production Space and Regional Industrial Structures in China

Qi Guo & Canfei He

Utrecht University
Urban & Regional research centre Utrecht

Evolution of Production Space and Regional Industrial Structures in China

Qi Guo Canfei He*
College of Urban and Environmental Science, Peking University, Beijing, 100871
Corresponding Author: hecanfei@pku.edu.cn

Abstract A growing literature on evolutionary economic geography concludes that regional industrial evolution is path-dependent and is determined by the pre-existing industries. This study applies the co-occurrence approach to calculate the production relatedness and portrays the production space and then examines the impact of production relatedness on regional industrial evolution. The findings report that production relatedness does underscore the regional structure change in China but shows significant regional differences in the evolution path. The coastal region has strong tendency of path dependence in its industrial evolution, while North West and South West break the path-dependent trajectory and transition into high productive sectors distant from their own production network. The results suggest that national policies can play its crucial role in creating new paths in China's regional development. Institutions matter to allow the significant role of industry relatedness in driving regional industrial evolution.

Key words Production space, Industry relatedness, Regional Industrial Evolution, China

Acknowledgement: This work was supported by the Natural Science Foundation of China under Grant No. 41271130; National Science Foundation for Distinguished Young Scholars of China under Grant NO. 41425001.

Evolution of Production Space and Regional Industrial Structures in China

Introduction

To answer the question of why some regions perform better than others has been a great challenge for economists and economic geographers. Neoclassical theory emphasizes the role of exogenous endowments in shaping regional economic performance, arguing that regional growth mainly results from their comparative advantages in the supply of factors such as labor, physical capital, technologies and natural resources (Heckscher and Ohlin 1991). Economists such as Marshall (1920) and urban theorists such as Jacobs (1969) initially focus on the source and effect of agglomeration economies. The debates on the effects of agglomeration economies are concerned with whether regional growth is driven by the clustering of local firms in the same sectors (Marshal's externalities) or by the clustering of local firms in a variety of other sectors (Jacobs' externalities)(Van der Panne and Van Beers, 2006). New Economic Geography (NEG) explains regional economic divergence as an endogenous process by stressing the effect of an endogenous and self-reinforcing process of agglomeration economies (Fujita, Krugman, and Venables 2001), but its ability to explain varieties of spatial-economic dynamics is limited by its restrictive assumptions of general equilibrium models (Storper 2010).

Recently, economic geographers inspired by the work of evolutionary economists (David 1985; Arthur 1989)have viewed the effect of regional path dependence on regional development. Path dependence is one of most important concepts in evolutionary economic geography (Boschma and Martin 2007, 2010). Like NEG, evolutionary economic geography also considers regional development as an endogenous and self-reinforcing process, but it argues that regional and local development is dependent on its historical trajectory and previous competencies such as technologies, institutions, labor skills and industrial structure(Martin and Sunley 2006; Boschma and Frenken 2006; Boschma and Martin 2010). The regional path dependence is theoretically concluded as three themes by Henning et al. (2013): regional path dependence and lock-in; regional branching process; disruptive events and regional path dependence.

First, the “lock-in” model is the canonical model in the path dependence research, arguing that regional industrial path may be locked in the self-reinforcing mechanism because of continuation and conservation of old production modes (Glasmeier 1991; Grabher 1993). The second model emphasizes the endogenous process of new path creation and claims that regions are more likely to branch into industries that are technologically related to the existing industries (Boschma and Frenken 2011; Neffke et al. 2011). The third model stresses the exogenous process of new path creation and finds that the emergence of new industries sometimes is not dependent on the previous regional production competencies, but is ascribed to external shocks or dramatic changes, for example, an institutional revolution, a crisis, or a governmental policy (Meyer-Stamer 1998; Bathelt and Boggs 2003). An exogenous shock has been regarded as a solution to avoid falling into the “lock-in” situation. The second and third models are both considered to be concerned with new path creation. However, whether the regional branching process is new path creation is questionable. Henning et al. (2013) notice the fuzzy border between path continuity and new path creation. Almost consistent with the notion of Henning et al. (2013), the situation when new industries are highly related to incumbent stable regional conditions is defined path continuity (path dependence); the situation when new industries are unrelated to existing regional conditions is defined as new path creation.

Empirical studies on path dependence include two approaches: the qualitative and quantitative approach. In the early empirical studies, case studies are widely used to study the lock-in and path dependence process of a particular region or a particular industry (Glasmeier 1991; Grabher 1993; Bathelt 2001). However, the quantitative studies in regional branching research have proliferated since the introduction of technological relatedness between industries. Initially, the most common way to measure technological relatedness is based on standard sector classifications. If two subsectors belong to the same sector classification, they are defined as related, otherwise, unrelated (Frenken et al. 2007; Boschma and Iammarino 2009). But this measure neglects the situation that high relatedness exists between subsectors that don’t belong to the same sector classification because of input-output linkage or knowledge spillovers between different sectors (Essletzbichler 2013). Another way to measure industrial relatedness is to use input-output tables to calculate similarity between sectors in the use of input factors (Farjoun 1994； Dumais et al. 2002). This measure assumes that if two sectors share similar input mixes, they apply similar production technology. However, there may be a large number of factors that influence the degree of relatedness between sectors, including institutions, infrastructure, combination of productive factors and so forth. Therefore, Hidalgo et al. (2007) use a co-occurrence approach to calculate the "proximity", which is the conditional probability of two products co-exported by the same country.

The contribution of Hidalgo et al. (2007) to evolutionary economic geography is not only that they propose a new measurment of industrial relatedness, but also that they put forward the notion of "product space" and a dynamic evolutionary perspective. Most previous studies consider regional growth as an aggregated and static process in the short run to examine the influence of industrial relatedness (Frenken et al., 2007; Essletzbichler 2007; Bishop and Gripaios 2010; Boschma and Iammarino 2009; Boschma et al. 2012). However, Hidalgo et al. (2007) provide the evidence for path dependence by examining the effect of industry relatedness on evolution of regional industrial structure in the long run (Hidalgo et al. 2007; Neffke et al. 2011). They conclude that the evolution of productive structure at the country level is subject to product space. That is, countries that locate in the core of production network have more opportunities to transition into new comparative advantages by developing goods close to their existing products, but peripheral countries in production network face more challenges to catch up with the core countries for lack of links with product space (Hausmann and Klinger 2007).

From a dynamic perspective, Neffke et al. (2011) also find that industries are more likely to enter a region where they are highly related with their current industries, and are more likely to exit from a region where they are unrelated with local industries. Most empirical studies confirm the existence of regional path dependence, particularly in developed countries. If peripheral regions could only follow their own industrial trajectory and develop goods that are close to those they have competitive advantages in, that is, the lock-in situation occurs, then peripheral regions would never catch up with the core regions with much denser industrial links, and divergence between core regions and periphery regions would remain forever.

However, the rapid growth of China as one of developing countries may be a counterexample to the path-dependent approach. The outstanding performance of China's economic growth during the last decades is mainly attributed to a series of national policies on economic reform and openness to international trade and FDI (Felipe et al 2013). Since economic reform and opening in 1978, China has gradually transformed from a relatively poor country based on some agriculture and heavy industries into a world factory hosting a great variety of industries. However, these favorable policies are only available to coastal regions rather than inland regions during the initial period, leading to rising regional economic inequality in China (Chen and Fleisher 1996; Wei 1999; Fan and Sun 2008; Fleisher et al. 2010). China's governments have paid increasing attention to regional inequality since the beginning of 21th century. Narrowing the regional gap has been a crucial objective in China's regional strategies since the Ninth Five-Year Plan (1996–2000). Hence, the "Western Development Project" was proposed in 1999 and implemented in 2000 in order to promote the economic development in South West and North West. At the same time, scholars also investigate the magnitude of regional inequality (Kanbur and Zhang

2005; Lu and Wang 2002; Fujita and Hu 2001) and its determinants (Démurger 2001; Zhang and Zhang 2003; Jones and Chen 2003). Most studies focus on the trend of inequality index and the impact of one or more factors on regional inequality in China, but few studies demonstrate the evolution of regional productive structure to explore the regional economic development paths from an evolutionary perspective.

Following Hidalgo et al. (2007), this study represents the evolution of China's production space and regional transformation in the production space. More importantly, the study empirically answers the question of how regional productive structure evolves in China and further testifies whether regional industrial evolution is influenced by industrial relatedness in the production space. Our results do not fully confirm regional path-dependence. There are substantial regional differences in the regional evolution path. The evolution of regional productive structure in Coastal regions is significantly influenced by historical productive capability, while North West and South West break the path-dependent trajectory and develop into sectors distant from their own production networks.

The rest of the paper is structured as follows. Section 2 shows how China's production space and regional industrial structure changes using the co-occurrence approach put forward by Hidalgo et al. (2007). Section 3 examines the relationship between density and regional industrial evolution. Section 4 concludes the paper with discussions and policy implications.

The evolution of production network

The measurement of industrial relatedness

In this paper, production space is defined as the network of production relatedness between sectors, which not only reflects technological relatedness but also reflects all other underlying conditions behind industrial co-occurrence, such as institutions, infrastructure, combination of productive factors and so forth. Following Hidalgo et al. (2007), we calculate the inter-sector "proximity", which stands for production relatedness between four-digit manufacturing sectors in China. The formula used to calculate is as follows:

$$\emptyset_{ij} = min\{P(RCA_{ci} > 1 | RCA_{cj} > 1), P(RCA_{cj} > 1 | RCA_{ci} > 1)\}$$

Where,

$$RCA_{ci} = {Employment_{ci} / \sum_i Employment_{ci}} \Big/ {(\sum_c Employment_{ci} / \sum_{c,i} Employment_{ci})}$$

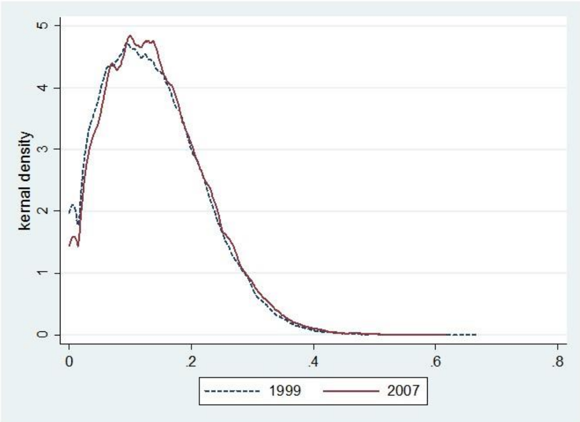
Where RCA stands for revealed comparative advantage of sector i in city c. $P(RCA_{ci} > 1 | RCA_{cj} > 1)$ is the conditional probability of specializing in sector i for city c on condition that city c specializes in sector j. If $\emptyset_{ij}$ is high then sector i and j frequently locate at the same prefecture-level city, implying that their production relatedness is high. If $\emptyset_{ij}$ is low then they rarely locate together, implying that their production relatedness is low. Data used in this study is compiled from the Annual Survey of Industrial Firms (ASIFs) provided by State Statistical Bureau in China during 1999-2007. The dataset includes all state-owned industrial enterprises and non-state-owned enterprises with sales revenues greater than 5 million Yuan in mining, manufacturing and power generating industries. The dataset provides detailed information about enterprises' identification, starting year, location, capital structure, total employees, exported shipments, intermediate inputs, among others. This study focuses on manufacturing industries.

We define the production space as the set of all relatedness measures, which consist of a 424*424 matrix whose entries are the production relatedness between four-digit manufacturing sectors. Every row and column of this matrix represents a particular sector. Thus, we achieve symmetric relatedness matrix.

The evolution of China's production space

Figure 1 shows the distribution and statistic index of production relatedness in 1999 and 2007. The distribution of production relatedness is very left-skewed, suggesting that there are some strong links in the production space, but most links are rather weak. The distribution characteristic is similar to most studies (Hidalgo el at., 2007; Boschma et al., 2012; Neffke et al., 2011). Over 70% of relatedness in 1999 and 2007 is below 0.2, and about 1% are above 0.35. These weak links are not significant, and they can't even prove the existence of links between sectors, so it is necessary to define the links above a threshold as related. We choose 0.35 as threshold, which is more conservative than Boschma et al. (2012) and Neffke et al. (2011). That is, China's production space is composed of industrial links whose proximity is equal or above 0.35. Thus, the 972 and 1264 links remain in the production space in 1999 and 2007, separately (Figure 2 and Figure3).

There is very small difference between 1999 and 2007 in the distribution of production relatedness. Does it mean that production space hasn't changed? Table 1 shows the result of interannual correlation of pairwise production relatedness. Most correlation coefficients between neighboring years are over 0.9, and decline gradually with distance between years. Taking 2007 as an example, its correlation coefficient with 2006, 2005,…, and 1999 goes down from 0.93 to 0.66, suggesting that China's production space evolves relatively rapidly in the nine years despite of high correlation between neighboring years.



Variable	1999	2007
Obs	172950	174758
Mean	0.1400	0.1446
Std. Dev.	0.0795	0.0808
Min	0.0049	0.0043
Max	0.6667	0.6164

Figure 1 Distribution and statistic index of industry relatedness, 1999 and 2007

Table 1 Correlation coefficients of production relatedness during 1999-2007

	2007	2006	2005	2004	2003	2002	2001	2000	1999
2007	1.00								
2006	0.93	1.00							
2005	0.89	0.93	1.00						
2004	0.85	0.88	0.91	1.00					
2003	0.78	0.80	0.82	0.82	1.00				
2002	0.72	0.74	0.75	0.76	0.85	1.00			
2001	0.70	0.72	0.73	0.74	0.82	0.91	1.00		
2000	0.68	0.70	0.71	0.72	0.80	0.86	0.90	1.00	
1999	0.66	0.68	0.69	0.70	0.78	0.83	0.87	0.92	1.00

Note: all of correlation coefficients are significant at the level of 1%.

To demonstrate the structure of production space, we draw the production networks with the cytoscape 3.2.1.[1] Figure 2 and Figure 3 show the production

[1] To make the network visualization clear, we adopt the edge-weighted spring embedded layout which use a force spring algorithm.

networks in 1999 and 2007. The number of nodes increases from 287 to 319 while the number of edges increases from 972 to 1264, which implies that more sectors and linkages are included in production network in 2007. Figure 4 further supports the result, by showing that the mean value of production relatedness fluctuates before 2002, but increases as a whole during 1999-2007.

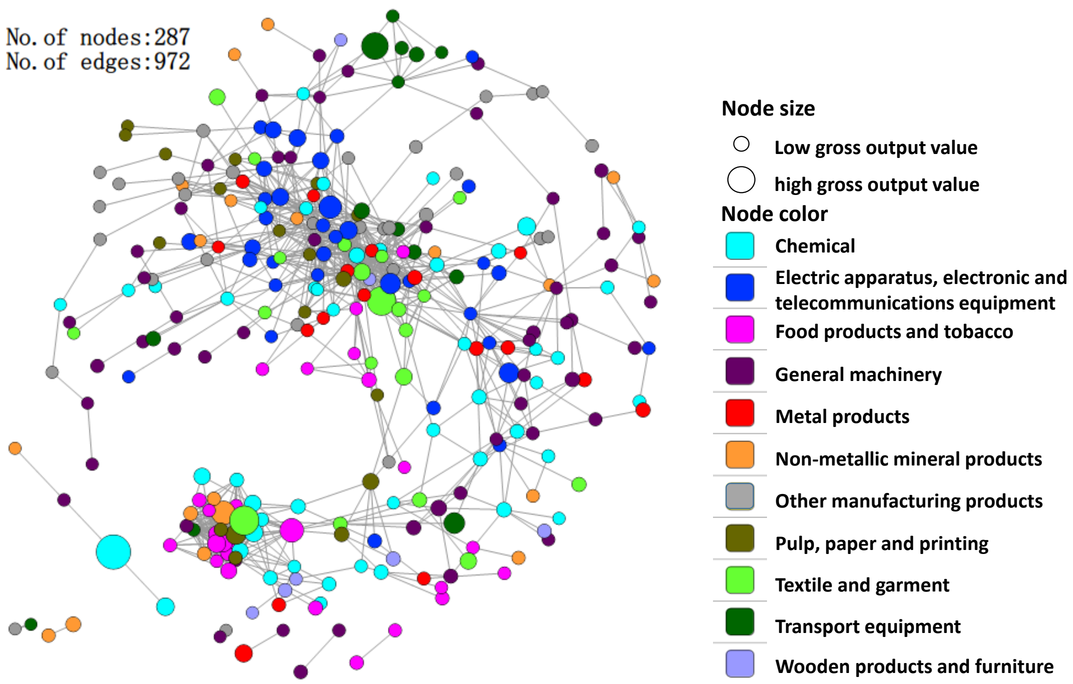


Figure 2 The production network of China, 1999

Note: The number of nodes and edges is 287 and 972, separately; the threshold of relatedness is 0.35

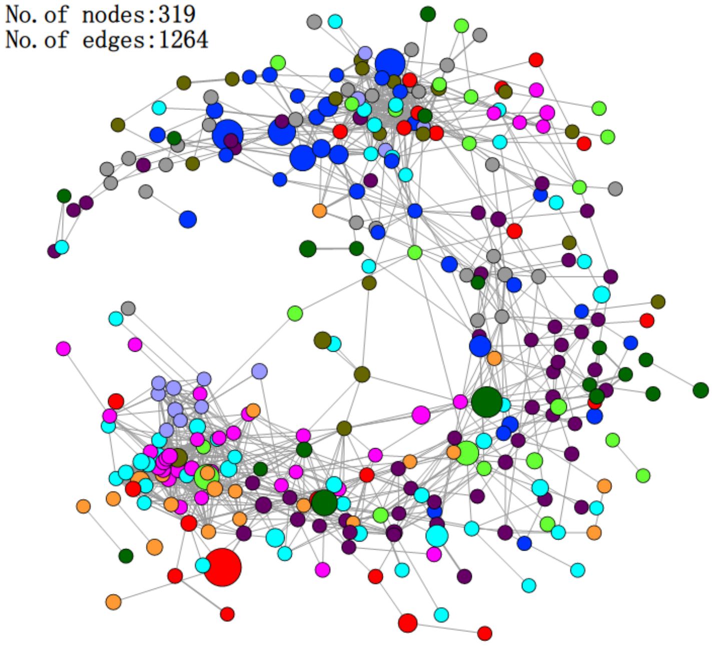


Figure 3 The production network of China, 2007

Note: The number of nodes and edges is 319 and 1264, separately; the threshold of relatedness is 0.35

Figure 2 represents the Core-Periphery structure of China's production space in 1999. There is obviously a major core in the production space, which is mainly based on electric apparatus, electronic and telecommunications equipment. In addition, there is a small cluster that consists of chemical, food products and non-metallic mineral products. The small cluster is linked with the core through some sparse linkages. Besides the core and sub-core cluster, the rest of production space are more emanative and there are many peripheral linkages that seem very easy to split from production network (for example, some subsectors in general machinery).

The production space in 2007 is significantly different from that in 1999. The electric and electronic cluster remains one of important cores in 2007. The small cluster that was formed by chemical, food products and non-metallic mineral products in 1999 develops into another dense and important core of production space in 2007 (called as the second core). General machinery that located in the periphery in 1999 has played the important role in linking the two cores. The number of emanative linkages clearly declines, implying that production relatedness is increasingly stable. Furthermore, the core role of the two clusters is not so obvious since peripheral links become increasingly denser.

In addition, we find by comparing figure 2 and figure 3 that the sectors which belong to the same classification (the same color) are increasingly close to each other, implying that the linkage within the same classification is stronger. Figure 4 provides more credible evidence to support the graphical results. The average linkage within the same classification is always much stronger than inter-classification linkage during 1999-2007 (Figure 4). The rise of production relatedness between sectors within the same classification is the main source of the rise of total production relatedness, suggesting that the likelihood of subsectors that belong to the same classification co-occurring in the same city goes up. That is, the level of urban production specification increases.

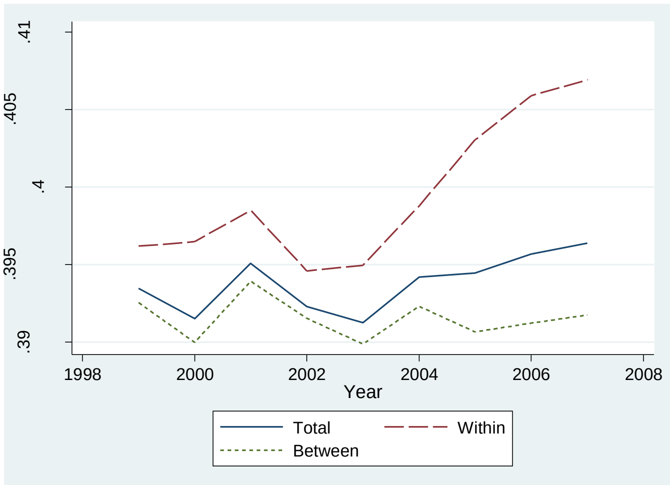


Figure 4 The mean value of industry relatedness for all links (Total), links within the same classification (Within) and between different ones (Between), 1999-2007

The evolution of regional productive structure

To compare the regional differences in production space and study the evolution of regions' position in production space, we hold the production space (Figure 2 and Figure 3) fixed. Figure 5 shows the productive structure of eight different regions in China's production space in 1999. Black solid circles represent the regional comparative advantage sectors (RCA>1) while hollow circles are other sectors.

In 1999, coastal regions except North Coast occupy the core of China's production space, and produce the some peripheral sectors at the same time. North Municipalities and South Coast are the most developed regions in electric apparatus, electronic and telecommunications equipment. In the coastal region, North region including North Municipalities and North Coast are better at developing heavy industries such as general machinery and chemical, but South Coast is better at hosting light industries such as textile and garment, and food products and tobacco. Central Coast develops both types of industries. What is different from the coastal regions is that the advantage sectors of inland regions locate in the sub-core cluster and the periphery of production space are composed of general machinery, chemical and food products and tobacco. The North East and Central China have competitive advantage in transportation equipment.

Table 2 The correlation coefficients of regional advantage industries between 1999 and 2007

Region	correlation of A between 1999 and 2007

South Coast	0.64
Central	0.59
North West	0.58
Central Coast	0.55
North East	0.47
North Coast	0.44
South West	0.44
North Municipalities	0.42

Note: A is equal to 1 if RCA>1.

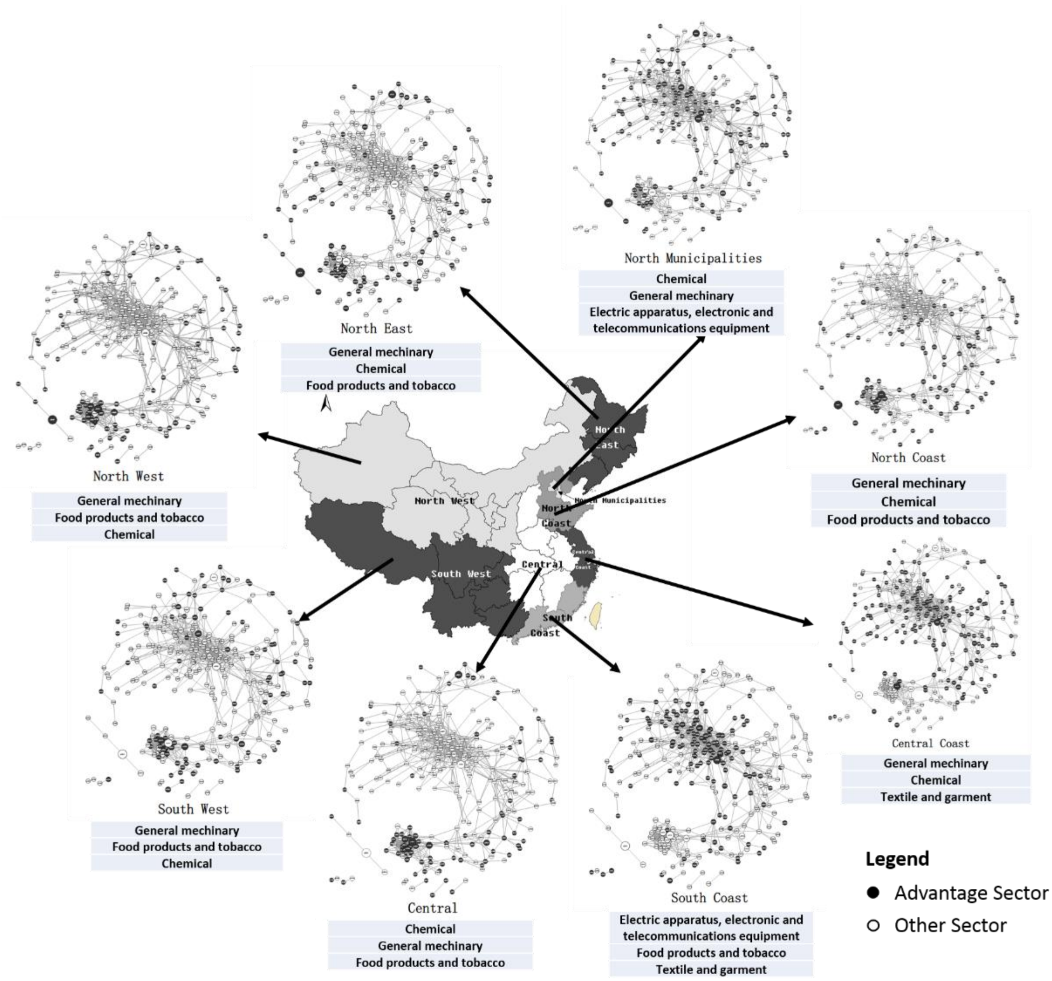


Figure 5 Localization of the productive structure for different regions in the production space of China, 1999

Note: (1) The top three advantage industry classifications in 1999 are shown below the corresponding regions

(2) North East contains Liaoning, Jilin and Heilongjiang province; North West contains Xinjiang, Qinghai, Gansu, Ningxia, Shannxi and Inner Mongolia province; North Municipalities contain Beijing and Tianjin; North Coast contains Hebei and Shandong province; Central Coast contains shanghai, Jiangsu and Zhejiang province; Central China contains Shanxi, Henan, Anhui, Hubei, Hunan and Jiangxi province; South Coast contains Fujian, Guangdong and Hainan province; South West contains

Guangxi, Yunnan, Guizhou, Chongqing, Sichuan and Tibet.

To first examine the magnitude of regional structure change in China during 1999-2007, we compute the correlation coefficients of regional advantage industries between 1999 and 2007 (Table 2). During the eight years, China's regions undergo substantial structural change, and the magnitude of the change varies across regions. Figure 6 further shows the evolution of regional productive structure during 1999-2007. The Solid Square stands for the existing advantage sectors in 1999, and Solid Triangle stands for the new emerging advantage sectors in 2007. The overall pattern of regional productive structure in 2007 has also changed. The coastal regions except North Coast still occupy the first core that is mainly composed of electric apparatus, electronic and telecommunications equipment, but they extend their advantage into periphery of their links at the same time. The inland regions and North Coast occupy the second core that is composed of chemical, food products and non-metallic mineral products, but they also extend their advantage into the first core of production space.

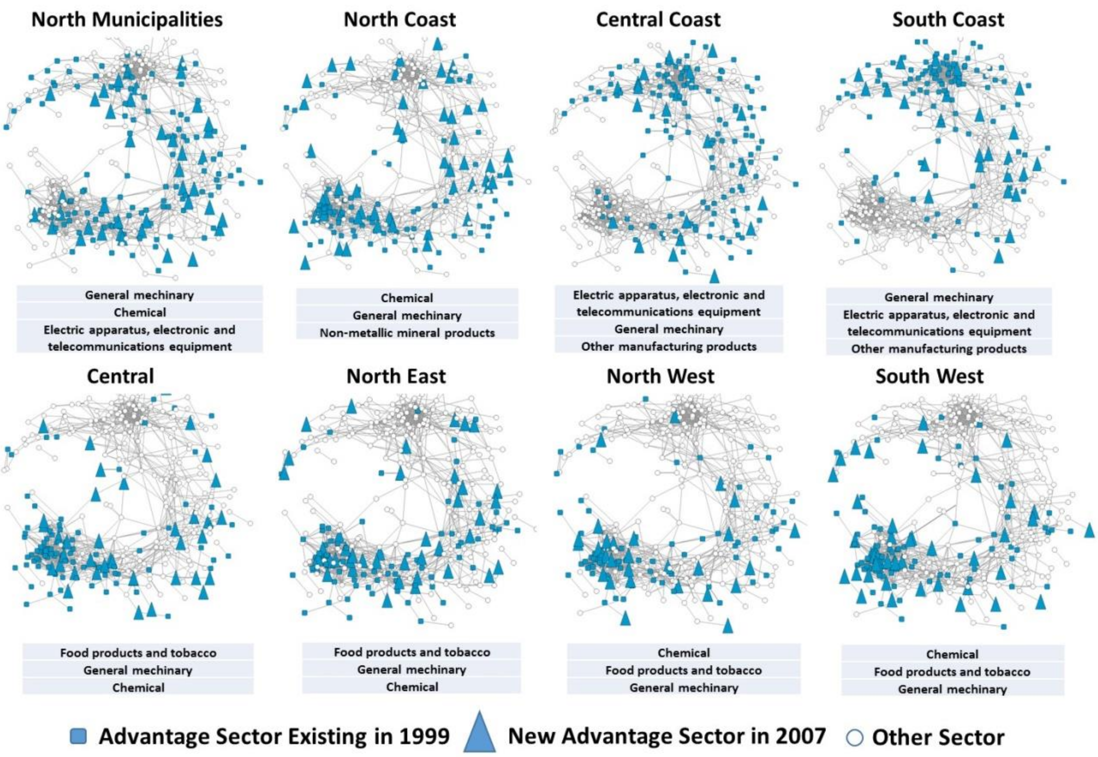


Figure 6 The productive structure of different regions in the production space in China, 2007

Note: The top three new advantage industry classifications during 1999-2007 are shown below the corresponding regions.

Further, the many new advantage sectors have links with the existing ones for all eight regions, suggesting that the regional industrial evolution, to some extent, is a path-dependent process. In other words, regional development can be subject to previous productive structure. Interestingly, inland regions and North Coast seem to be a little different from coastal regions in terms of industrial evolution. Coastal regions are more restricted by the production network, but inland regions successfully extend some new advantage sectors into those far away from their links. Does it imply that some regions can break the path-dependence? To answer this question, the next section is to empirically examine the effect of production space on regional industrial evolution.

Production space and regional industrial evolution

To accurately examine the effect of production space, we calculate "density" as a measure of the link of one sector with regional productive structure:

$$\omega_j^k = \frac{\sum_i x_i \emptyset_{ij}}{\sum_i \emptyset_{ij}}$$

Where ω_j^k is the density of links around sector j with a set of advantage sectors in city k, and x_i=1 if RCAi >1 and 0 otherwise. A higher ω_j^k indicates that sector j is closer to productive advantage of city k.

To examine how current transition is influenced by the previous density, we compare the kernel distribution of density in 1999 for "transition sectors" and "undeveloped sectors" in 2007 (Figure 7). The former is defined as those with RCA rising from below 1 to above 1 during 1999-2007, while the latter is defined as those with RCA below 1 both in 1999 and 2007. Other observations are neglected. Contrary to our expectation, the distribution of undeveloped sectors is on the right side of distribution of transition sectors. That is, for high density levels, the probability of undeveloped sectors are higher than the probability of transition sectors, implying that transition sectors are not closer to regional productive structure than undeveloped sectors are. Moreover, the difference between two distributions is highly significant (reject the null hypothesis of ANOVA test which is that two distributions are statistically not different).

As noted by Martin and Sunley (2006), "in many important aspects, path dependence and 'lock-in' are place-dependent processes, and as such require geographical explanation". To explore why the density of undeveloped sector is higher, we decompose the overall distribution into different regions (Figure 7). There exists a significant regional variation in the distribution of density. The density of either undeveloped sectors or transition sectors in coastal regions is much higher than the density of those in inland regions, leading to unexpected results for China as a whole. In North Coast, Central Coast and North East, the density of transition sectors is significantly higher than the density of undeveloped sectors, implying that transition sectors are more dependent on the existing productive structure. A path-dependent process significantly influences industrial evolution of North Coast and Central Coast. However, North West and South West observe an opposite result. The density of transition sectors is significantly lower than that of undeveloped sectors, suggesting that industrial evolution of North West and South West is not subject to their previous productive structure.

Distribution diagram cannot control for the heterogeneity of sectors, so we estimate a fixed effect probit panel model to accurately examine the effect of density on industrial evolution. The dependent variable is a dummy one, 1 for transition sectors, 0 for undeveloped sectors. The independent variable is "density" at the city-sector level, controlling for the heterogeneity of sectors and cities. The results support the above distribution analysis (Table 3). The effect of density on structural transition in North West and South West is negative, suggesting sectors with lower density are more likely to transition into advantage industries in North West and South West.

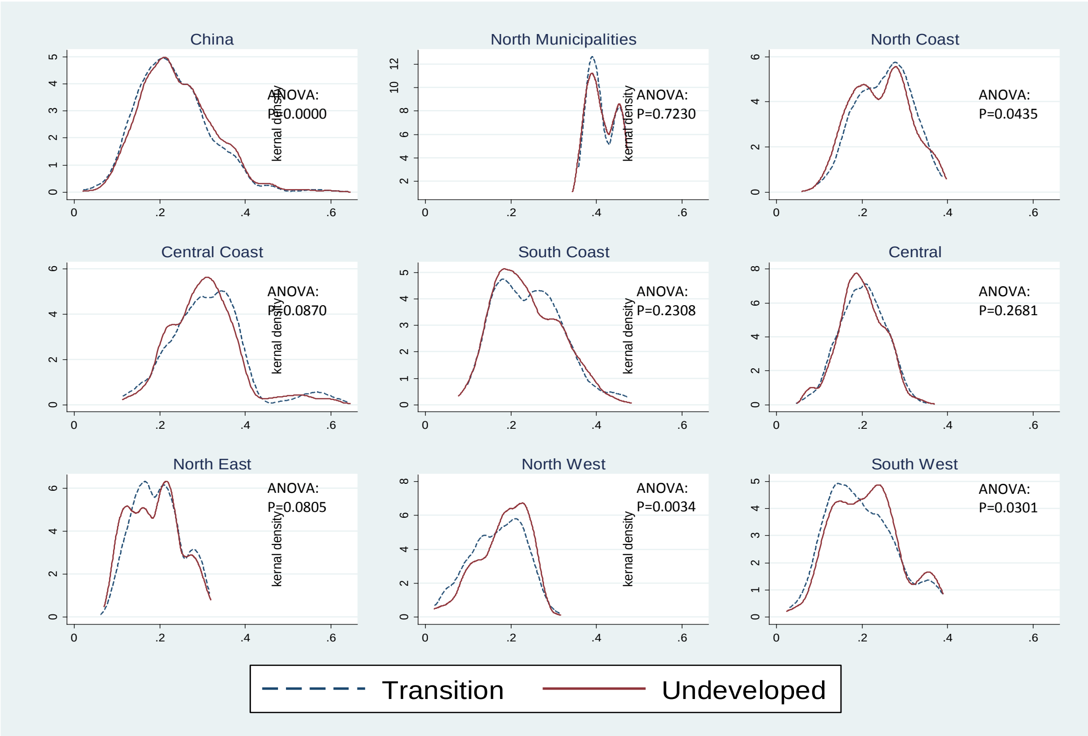


Figure 7 Distribution of density for transition sectors and undeveloped sectors during 1999-2007

Table 3 the effect of density on industrial evolution by estimating probit panel models

	Total	North Municipalities	North Coast	Central Coast	South Coast	Central	Northeast	North West	South West
density	0.929*	15.67***	2.022**	5.435***	6.528***	0.716	3.716***	-0.448	-0.307
Constant	-0.686***	-7.216***	-1.051***	-2.337***	-2.190***	-0.611***	-1.054***	0.0447	-0.297
City fixed	include	include	include	include	include	include	include	include	include
Sector fixed	include	include	include	include	include	include	include	include	include
Observations	11,961	339	1,776	2,498	1,780	2,782	1,183	576	1,027
Number of city	303	2	28	25	31	83	36	46	52

Note: (1) Robust standard errors are in parentheses; (2) *** p<0.01, ** p<0.05, * p<0.1

In order to promote the industrial development in South West and North West, the Chinese government proposed the "Western Development Project" in 1999. Hence, a series of infrastructure construction and favorable policies are developed and implemented to attract new industries to enter into western regions. These policies may change firms' production condition in North West and South West, driving sectors far away from local productive structure to transition into advantage industries.

However, we do not know whether the transition sectors with lower density are “good” or “bad”. Here, high productive sectors are considered as “good” ones, while low productive sectors are considered as “bad” ones. Figure 8 shows the relationship between the density and total factor productivity for the transition sectors. The horizontal line above the horizontal axis is the mean value of all sectors’ productivity, and the vertical line on the right side of the vertical axis is the mean value of density. Both intersecting lines divide the graphical space into four parts. We find that transition sectors in coastal regions such as North Municipalities and Central Coast have higher density, but many transition sectors in North West and South West have lower density. Fortunately, many transition sectors in North West and South West are located in the top left area, implying that they are productive sectors though their density is very low. We believe new emerging high productive advantage sectors can be beneficial for regional economic growth. From Figure 9 which is the enlarged view of the top left area in Figure 8, we find that the transition sectors of North West and South West with low density and high productivity include general machinery, special equipment, automobile manufacturing and so on. If these sectors as “good” mutations can branch into other “good” sectors through industrial relatedness, then North West and South West enter a virtuous cycle and have more opportunities to catch up with coastal regions.

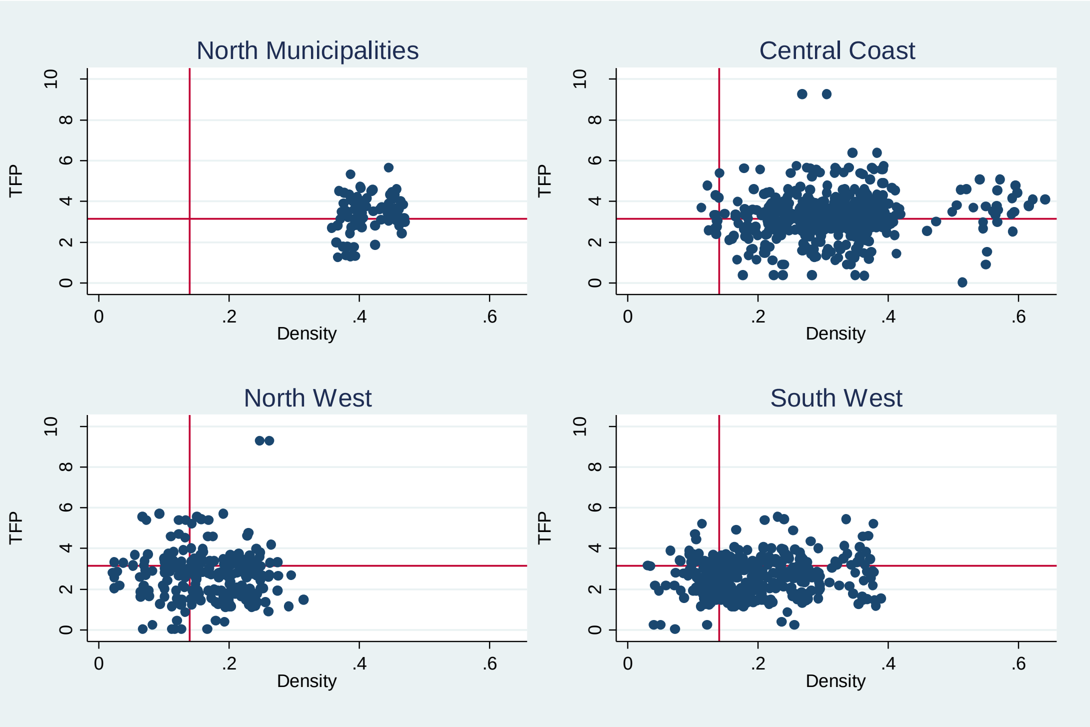


Figure 8 The relationship between density and sectoral productivity for the transition sectors

Note: The horizontal line above the horizontal axis is the mean value of all sectors' productivity (3.15), and the vertical line on the right side of the vertical axis is the mean value of density (0.14).

Figure 9 The transition sectors with low density and high productivity in North West and South West.

Note: This figure is the enlarged view of the top left area in Figure 8; The number in the graph is the code of SIC four-digit sectors.

Conclusion and Discussion

Economic development is not only a process of the output growth, but also is a process of structural transformation. Hidalgo et al. (2007) recently put forward the notion “product space” to explore economic development paths. They argue that history matters. That is, regional economic growth is a path-dependent process and rooted in the pre-existing economic structure (Boschma et al, 2012; Neffke et al., 2011). Regional structure evolves by attracting or branching into industries related to local productive advantages.

To testify if regional development follows the path-dependent process, this study examines the impact of production space on regional industrial evolution in China. Based on firm level data during 1999-2007, we found that China’s production space evolves rapidly and has changed from one core structure to two core structure. More sectors are embedded in the production space, and the magnitude and stability of the inter-sector relatedness are on the increase. The Coastal regions except North Coast occupy the core of China’s production space, composed of electric apparatus, electronic and telecommunications equipment, while inland regions occupy the sub-core cluster and periphery of production space, composed of general machinery, chemical and food products and tobacco. Statistical analysis indicates that the evolution of regional productive structure in Coastal regions is significantly influenced by historical productive capability, while North West and South West break the path-dependent trajectory and transition into sectors distant from their own production network.

The findings on the evolution of regional productive structure can help policymakers answer the questions of how regions should develop and what they can do to promote growth and avoid recession. The “Western Development Project” can be referred to as a shock for the western regions. A series of favorable policies improve their production conditions to attract “good” industries even though the industries are not related to the current productive structure. The good industries with low density can be considered as industrial “mutation” in the evolutionary procedure. If they as “good” mutations can branch into other “good” industries through industrial relatedness, North West and South West enter a virtuous cycle and have more opportunities to catch up with coastal regions. If it is true, we believe that policy intervention can provide poor regions better opportunities to break the path-dependent process and improve their position in the production space.

References

Arthur, W. B. (1989). Competing technologies, increasing returns, and lock-in by historical events. *The economic journal*, 116-131.

Bathelt, H. (2001). Regional competence and economic recovery: divergent growth paths in Boston's high technology economy. *Entrepreneurship & Regional Development, 13(4)*, 287-314.

Bathelt, H., & Boggs, J. S. (2003). Toward a reconceptualization of regional development paths: is Leipzig's media cluster a continuation of or a rupture with the past? *Economic Geography, 79(3),* 265-293.

Bishop, P., & Gripaios, P. (2010). Spatial externalities, relatedness and sector employment growth in Great Britain. *Regional Studies, 44(4),* 443-454.

Boschma, R. A., & Frenken, K. (2006). Why is economic geography not an evolutionary science? Towards an evolutionary economic geography. *Journal of economic geography, 6(3),* 273-302.

Boschma, R., & Frenken, K. (2011). The emerging empirics of evolutionary economic geography. *Journal of Economic Geography, 11(2),* 295-307.

Boschma, R., & Iammarino, S. (2009). Related variety, trade linkages, and regional growth in Italy. *Economic Geography, 85(3),* 289-311.

Boschma, R., & Martin, R. (2007). Editorial: Constructing an evolutionary economic geography. *Journal of Economic Geography, 7(5),* 537-548.

Boschma, R., & Martin, R. (Eds.). (2010). The handbook of evolutionary

economic geography. *Edward Elgar Publishing*.
Boschma, R., Minondo, A., & Navarro, M. (2012). Related variety and regional growth in Spain. *Papers in Regional Science, 91(2)*, 241-256.
Chen, J., & Fleisher, B. (1996). Regional income inequality and economic growth in China. *Journal of Comparative Economics, 22(2)*, 141–164.
David, P. A. (1985). Clio and the Economics of QWERTY. *The American economic review*, 332-337.
Dumais, G., Ellison, G., & Glaeser, E. L. (2002). *Geographic concentration as a dynamic process. Review of economics and Statistics, 84(2)*, 193-204.
Essletzbichler, J. (2007). Diversity, stability and regional growth in the United States, 1975–2002. in Frenken K. (Ed.) *Applied evolutionary economics and economic geography*, pp. 203–229. Edward Elgar, Cheltenham.
Essletzbichler, J, & Essletzbichler. (2015). Relatedness, industrial branching and technological cohesion in us metropolitan areas. *Regional studies, 49(5)*, 752-766.
Fan, C. C., & Sun, M. (2008). Regional inequality in China, 1978–2006. *Eurasian Geography and Economics, 49(1)*, 1–17.
Farjoun M. (1994). Beyond industry boundaries: Human expertise, diversification and resource-related industry groups. *Organization science, 5(2)*, 185–199.
Felipe, J., Kumar, U., Usui, N., & Abdon, A. (2013). Why has China succeeded? And why it will continue to do so. *Cambridge journal of economics, 37(4)*, 791-818.
Fleisher, B., Li, H., & Zhao, M. Q. (2010). Human capital, economic growth, and regional inequality in China. *Journal of development economics, 92(2)*, 215-231.
Frenken, K., Van Oort, F., & Verburg, T. (2007). Related variety, unrelated variety and regional economic growth. *Regional studies, 41(5)*, 685-697.
Fujita, M., & Hu, D. (2001). Regional disparity in China 1985–1994: the effects of globalization and economic liberalization. *The Annals of Regional Science, 35(1)*, 3-37.
Fujita, M., Krugman, P. R., & Venables, A. J. (2001). The spatial economy: Cities, regions, and international trade. *MIT press*.
Hausmann, R., & Klinger, B. (2007). The structure of the product space and the evolution of comparative advantage. *Center for International Development at Harvard University*.
Heckscher, E. F., & Ohlin, B. G. (1991). Heckscher-Ohlin trade theory. *The MIT Press*.
Hidalgo, C. A., Klinger, B., Barabási, A. L., & Hausmann, R. (2007). The product space conditions the development of nations. *Science, 317(5837)*, 482-487.
Jacobs J. (1969). The economy of cities. *New York: Vintage Books*.
Jones, D. C., & Cheng, L. (2003). Growth and regional inequality in China during the reform era. *China Economic Review, 14(2)*, 186-200.
Kanbur, R., & Zhang, X. (2005). Fifty years of regional inequality in China: a

journey through central planning, reform, and openness. *Review of development Economics, 9(1)*, 87-106.

Lu, M., & Wang, E. (2002). Forging Ahead and Falling Behind: Changing Regional Inequalities in Post-reform China. *Growth and Change, 33(1)*, 42-71.

Marshall A. (1920). Principles of Economics, 8th edition. Macmillan, London.

Martin, R., & Sunley, P. (2006). Path dependence and regional economic evolution. *Journal of economic geography, 6(4)*, 395-437.

Meyer-Stamer, J. (1998). Path dependence in regional development: persistence and change in three industrial clusters in Santa Catarina, Brazil. *World development, 26(8)*, 1495-1511.

Neffke, F., Henning, M., & Boschma, R. (2011). How do regions diversify over time? Industry relatedness and the development of new growth paths in regions. *Economic Geography, 87(3)*, 237-265.

Santarelli, E., & Sterlacchini, A. (1994). New firm formation in Italian industry: 1985–89. *Small Business Economics, 6(2)*, 95-106.

Storper, M. (2010). Why do regions develop and change? The challenge for geography and economics. *Journal of Economic Geography*, lbq033.

Van der Panne, Gerben and Van Beers, Cees. (2006). On the Marshall-Jacobs controversy: it takes two tango, *Industrial and Corporate Change, 15(5)*, 877-890.

Wei, Y. D. (1999). Regional inequality in China. *Progress in Human Geography, 23(1)*, 49-59.

Zhang, X., & Zhang, K. H. (2003). How does globalization affect regional inequality within a developing country? Evidence from China. *Journal of Development Studies, 39(4)*, 47-67.