PLC Working Paper

w033

2009.01

北京大学-林肯研究院 城市发展与土地政策研究中心

PEKING UNIVERSITY - LINCOLN INSTITUTE

Center for Urban Development and Land Policy

# Dynamic Externalities and City Industry Growth in China: A Perspective of Economic Transition

**PLC WORKING PAPER SERIES NO.033**

http://www.plc.pku.edu.cn/en_publications.aspx

**2009.01**

Canfei He

College of Urban and Environmental Sciences, Peking University

Peking University-Lincoln Center

Fenghua Pan

College of Urban and Environmental Sciences, Peking University

Leo KoGuan Building, Suite 508, Peking University, Beijing 100871, China

---

# Dynamic Externalities and City Industry Growth in China: A Perspective of Economic Transition

Canfei He and Fenghua Pan

Department of Urban and Regional Planning, College of Urban and Environmental Sciences, Peking University, Beijing, 100871
Peking University-Lincoln Institute Center for Urban Development and Land Policy
E-mail: hecanfei@urban.pku.edu.cn

**SUMMARY.** Using data on two digit manufacturing industries at the prefecture level cities during the period of 2000 -2005, this study found a significant nonlinear relationship between dynamic externalities and local industrial growth. Industrial specialization and local competition may help city industry growth but hurt local growth when they exceed a certain level. Diversity helps industry growth but only when it reaches a certain level. This study also found that liberalized, globalized and protected industries are more likely to benefit from dynamic externalities. Industries located in cities with greater authorities and responsibilities are also found to grow faster. Regions which are largely liberalized and globalized are more likely to adapt to dynamic externalities, especially competition externalities.

# Economic Transition, Dynamic Externalities and City Industry Growth in China

## Introduction

Recent advances in the theories of economic growth highlight the role of agglomeration economies as a crucial factor leading to industrial growth. The literature takes the view that dynamic externalities such as knowledge spillovers or learning by doing are the driving force for long run economic growth (Romer, 1986; Lucas, 1988). Following Glaeser et al. (1992), studies distinguish among three types of dynamic externalities. The Marshall-Arrow-Romer (MAR) externalities concern knowledge spillovers among firms within an industry, and predict that industrial concentration in a region helps growth of that industry. Like MAR, Porter (1990) argued that knowledge spillovers in specialized, geographically concentrated industries stimulate their growth, but that local competition fosters innovation and the dissemination of knowledge. Local competition thereby helps industrial growth. Jacobs (1969) however believed that the most important knowledge transfers occur among different industries. As a result, the variety and diversity of geographically proximate industries promote innovation. Industries located in areas that are highly industrially diversified should grow faster. A large volume of empirical research has tried to identify the roles of MAR externalities, Jacobs externalities and Porter externalities in local growth and innovation (Henderson et al., 1995; Henderson, 1997; Bradley and Gans, 1998; Bivand,1999; Barkley et al., 1999; Combes, 2000; Batisse, 2002; Dekle, 2002; De Lucio et al., 2002; Forni and Paba,2002;Van der Panne, 2004; Acs and Armington,2004; Gao, 2004; Shearmur and Polese, 2005; Van Soest et al.,2006). Existing literature however remains rather inconclusive regarding which dynamic externalities contribute to local industrial growth.

Economic reforms in China have resulted in an unprecedented economic growth since the late 1970s. One of the key features has been the rapid expansion of industrial production (Batisse, 2002; Gao, 2004); in particular, the accession to WTO in 2001 has made China the World Factory, with many sectors gaining significant market shares in the global market. During the period 2000-2005, the annual growth rate of GDP at the 1978 fixed price was 9.54%. Industrial GDP in China increased from 4003 billion RMB in 2000 to 7691billion RMB at the current price (SSB, 2006). Several studies have examined determinants of industrial growth in China based on the proposition of dynamic externalities. Exploring a sample of 23 industrial sectors in seven coastal provinces over the period of 1985-1989, Mody and Wang (1997) found a negative impact of specialization and a positive effect of competition on local growth. Battisse (2002) confirmed the results generated by Mody and Wang (1997) using data on 30 manufacturing industries across 29 provinces over the period 1988-1994. Their findings are consistent with the Jacobs hypotheses and tend to contradict those asserted in MAR externalities. Using 32 two-digit Chinese industries in 29 provinces over 1985-1993, Gao (2004) only found weak evidence of impacts of dynamic externalities on regional industrial growth. Local competition is positively

correlated to regional industrial growth and industry overrepresentation tends to hurt growth. Bo (2007), using data on 25 two-digit manufacturing industries in Chinese provinces over 1994-2003, found a nonlinear relationship between diversity and regional industrial growth. Diversity positively contributes to industrial growth only when it reaches a certain level.

The finding that specialization hurts regional industrial growth in China occurs inconsistent with the theory and the reality. The remarkable industrial growth in China since the 1990s has been attributed to specialization and concentration of industries in the coastal provinces such as Guangdong, Zhejiang, Jiangsu, Fujian and Shandong (He et al., 2007). On the one hand, while the growth literature assumes that agglomeration economies operate at the aggregate or national level, dynamic externalities are fairly localized (Rosenthal and Strange, 2003; van Soest et al., 2006). The application of Chinese provinces as the spatial unit of analysis in the existing studies may partially explain the inconsistency.

On the other hand, the impact of dynamic externalities may be conditional on institutional environments since China has experienced a triple process of marketization, globalization and decentralization, which gradually introduced market and global forces into the Chinese economy, and granted local governments more authorities and responsibilities to develop local economies (Wei, 2000； He et al., 2007). Economic transition has certainly reshaped China's economic geography. For instance, Fan and Scott (2003) argued that industries and spaces that are undergone economic liberalization and globalization are those most prone to the formation of agglomeration economies. Battisse (2002) reported that interior provinces have not yet benefited from economic reform to the extent enjoyed in coastal regions. Anderson and Ge (2004) provided evidence that economic reforms played an important role in accelerating urban growth. Growth in China is found to be negatively associated with the relative magnitude of the state sector and positively related to the openness to foreign direct investment and exports, and the development of private sectors (Berthelemy and Demurger, 2000; Chen and Feng, 2000; Zhang, 2001; Lin and Song, 2002;Gao, 2004; Phillips and Shen, 2005; Yao, 2006). Administrative and fiscal decentralization has been fundamental to China's economic success (Qian and Weingast, 1996; Zhao and Zhang, 1999; Lin and Liu, 2000; Shi and Zhou, 2007).

As economic transition proceeds in China, agglomeration effects may be more phenomenal in sectors and spaces that have experienced economic liberalization, globalization and decentralization. The impact of dynamic externalities on industrial growth in China may be localized and conditional on the process of economic transition. The theoretically predicated positive association between dynamic externalities and regional industrial growth may hold in liberalized and globalized sectors and at a finer spatial scale. Furthermore, the relationship may be nonlinear, and dynamic externalities positively contribute to industrial growth only when they reach a certain level. Using data on two-digit manufacturing industries at prefecture level cities in China during the period of 2000-2005, this study attempts to test the theoretical propositions and explores the determinants of city industrial growth in

China. Statistical results generate sufficient evidence to support that dynamic externalities have significant impacts on city industry growth in China, and economic transition has created conditions to facilitate the role of dynamic externalities. The impacts of dynamic externalities on city industry growth differ significantly across sector and region. Economically liberalized and globalized regions and sectors are more likely to benefit from dynamic externalities.

Following this introduction, the next session discusses the theoretical effects of dynamic externalities on industrial growth in the context of China's economic transition. The third part will discuss the data and method applied in this study, followed by empirical analysis describing the growth pattern of Chinese industries and reporting the statistical results. This paper concludes with a summary of major findings and some discussions.

## Dynamic Externalities and Industrial Growth in the Context of Transitional Economies

**Dynamic Externalities and Industrial Growth.** Recent explanations of economic growth focus on increasing returns to scale external to the firm as a source of increasing productivity (Romer, 1986; Lucas, 1988). There are static externalities and dynamic externalities. Static externalities are seen as being based on immediate information spillovers about current market conditions. Dynamic externalities deal with the role of prior information accumulations in the local area on current productivity and hence employment (Henderson et al., 1995). The static externalities explain the existing concentration but are unable to generate a process of economic growth.

Dynamic externalities explain simultaneously the existing local industrial structure and economic growth. Using the terminology of Glaeser et al. (1992), there are three types of dynamic externalities, the Marshall-Arrow-Romer (MAR) externalities, Jacob externalities and Porter externalities. The MAR externalities suggest that increased concentration and specialization of a particular industry within a specific geographic area would facilitate knowledge spillovers among firms within the same industry. This idea of Marshall (1898) was formalized first by Arrow (1962) and more recently by Romer (1986). Geographical proximity of firms reduces transaction costs, and stimulates the share of common knowledge. Knowledge spillovers can either occur through the direct exchange of ideas or through movements of qualified employees between firms. MAR externalities which are maximized in cities represent the positive role of industrial specialization on industrial growth.

In contrast, Jacobs (1969) argued that the most important externalities are those resulting from interactions between firms from different industries within a particular area. Jacob externalities derive from a buildup of knowledge or ideas associated with historical diversity. It is the variety or differentiation of local industrial structure rather than specialization that stimulate the transmission of knowledge externalities and innovations, thereby promoting local industrial growth. Jacobs' theory predicts that industries located in areas that are highly industrially diversified should grow faster. Cities with a diversified economic structure tend to grow faster than specialized

territories (Quigley, 1998).

Two theories are not necessarily mutually exclusive (Shearmur and Polese, 2005) . Like MAR, Porter (1990) proposed that knowledge spillovers are more likely to occur in specialized, spatially concentrated industries than between geographically isolated firms, and that industrial concentration is good for growth of specialized industries and of the cities they are in. However, they differ on the role of local competition for knowledge spillovers. Porter (1990) agreed with Jacobs (1969) that local competition rather than local monopoly is better for growth because ruthless competition between local competitors leads to rapid adoption of the innovations of others and to improvement on them and generate industrial growth.

A growing body of research in recent years has tried to explore the extent and type of dynamic externalities for local industry growth. Glaeser et al. (1992) applied a dataset on large industries in 170 U.S. cities between 1956 and 1987 and found that local competition and urban varieties, but not regional specialization, encouraged employment growth in industries. Henderson et al. (1995) found that MAR externalities worked for mature capital goods industries while both MAR and Jacobs externalities were important for new high-tech industries. In a subsequent paper, Henderson (1997) found that increased concentrations of own industry activities appeared to affect employment levels for five or six years afterwards while diversity effects appeared to persist beyond the seven-year horizon examined. Barkley et al. (1999) reported that industrial employment growth in a non-metro region of the US was associated with the presence of an agglomeration for five of the eight industries examined and industry agglomeration effects on non-metro employment change were present for areas specializing in the industry as well as regions with more diverse economic bases. Using data from the Census Bureau that track all employers in the whole US private sector economy, Acs and Armington (2004) found that diversity among geographically proximate industries was positively associated with growth.

Similar empirical studies have been conducted for other developed economies such as Australia, France, Spanish, Japan, Dutch, Canada and Italy. For instance, Bradley and Gans (1998) examined the determinants of city growth in Australia during 1981 to 1991 and found that city growth is negatively correlated with a city's level of specialization. Combes (2000) tested the roles of dynamic externalities in the employment growth of 341 local areas during 1984-1993 in France and reported different impacts of dynamic externalities for industry and services. Using Japanese data during 1975-1995, Dekle (2002) showed that at the prefecture level, there was considerable heterogeneity among industries in how dynamic externalities affected productivity growth, and found no dynamic externalities of any type in manufacturing; strong MAR externalities, but no Jacobs or Porter externalities for finance; and relatively strong MAR externalities, nonexistent Jacobs externalities and some Porter externalities for the services industry and the wholesale and retail trade industry. Based on data from the Spanish Industry Survey from 1978 to 1992 for 26 manufacturing industries, De Lucio et al. (2002) found evidence of dynamic effects due to specialization that depend on the level of this variable. No clear evidence on the presence of diversity and competition externalities is found for Spanish industries.

Forni and Paba (2002) found that in most cases, specialization and variety matter for growth, but each industry needs its own variety and many dynamic external effects occur between industries linked by input output relations in Italy. Shearmur and Polese (2005) found no clear link between the process of industrial diversification and growth in Canada. Van Soest et al. (2006) examined the extent to which agglomeration economies in one location affect employment growth using data from the Dutch province of South Holland. Their results suggest that within-zip code industrial diversity and within-zip code competition foster employment growth, but within zip code industrial concentration is not an important determinant of employment growth. Overall, results in the market-oriented economies are rather inconclusive regarding. Relationships between dynamic externalities and industrial growth in transitional economies however may be more complicated and also conditional on institutional evolutions associated with the process of economic transition (Bivand, 1999).

**Dynamic Externalities and Industrial Growth in the Transitional China.** Several studies explored the impact of dynamic externalities on regional industrial growth in China using provincial-industrial data during the 1980s and 1990s (Mody and Wang, 1997; Battisse, 2002; Gao, 2004; Bo, 2007). Those studies found weak evidence of dynamic externalities. Specialization of industries hurt industrial growth; diversity and local competition are weakly and positively associated with industrial growth in China. One of the problems in the existing studies is that they simply tested hypotheses derived under the fully developed market economy conditions. As Bivand (1999) argued that new private sector manufacturing firms and restructuring state-owned firms in transitional economies are more likely to adapt to market forces, including potentially dynamic externalities. Impacts of dynamic externalities in China may be conditional since China has experienced two fundamental changes from the late 1970s, that is, the gradual transition from a command economy to a market-driven economy and the transformation from a closed economy to an open economy. Such a process of economic transition has been conceptualized as a triple process of marketization, decentralization, and globalization (Wei, 2000; He et al., 2007). China's economic transition has introduced a new set of institutional and market forces underlying industrial restructuring. Sectors and regions that are undergone economic liberalization and globalization may be prone to the formation of agglomeration economies and would significantly benefit from dynamic externalities (Fan and Scott, 2003).

**Economic Marketization.** China's economic reform is to build a market-oriented economy and allows market forces to play a dominant role in its economy. In the command economy governments distributed resources, firms were executors of state orders, and there were literally no well-functioning markets of goods and factors (Zhao and Zhang, 1999). Factor mobility was largely and strictly limited and there lacked market competition among firms. As a consequence, there were no channels for knowledge spillovers among firms. As economic transition proceeds, market forces and competition are progressively introduced, and markets have played an increasingly important role in allocating resources and goods. Limits on factor

mobility and commodity exchanges have also been gradually lifted. State-owned enterprises are gradually transformed into economic entities which have to compete for markets and factor supplies. Non-state owned enterprises are fully responsible for their own operations. Facing ruthless market competition, enterprises are motivated to geographically cluster to take advantage of business linkages and knowledge spillovers (He et al., 2007). There is some evidence to show that marketization helps regional and industrial growth. For instance, Chen and Feng (2000) found that private and semi-private enterprises led to economic growth in China and the presence of state-owned enterprises reduced growth rates among Chinese provinces. Anderson and Ge (2004) found that the city growth is negatively associated with the relative magnitude of the state sector and positively related to the city's openness to foreign direct investment. Phillips and Shen (2005) reported a robust negative relation between the size of state-owned enterprises and the provincial growth rate. In a word, economic marketization has created conditions that stimulate knowledge and information spillovers among firms within an industry and across industries. Fierce competition has motivated firms to innovate and learn from each other, and therefore promote industrial growth. Sectors and regions undergoing economic liberalization would significantly benefit from dynamic externalities and realize faster growth.

**Economic Globalization.** China has effectively participated in globalization by trading with other economies and by utilizing foreign direct investment (FDI). Both exports and FDI have been found to have strong and positive effects on economic growth in China (Berthelemy and Demurger, 2000; Zhang, 2001; Yao, 2006). Trade liberalization broadens the scope of industrial specialization along the line of comparative advantages and provides trading firms incentives to exploit agglomeration economies. Fujita and Hu (2001) argued that increases in exports have reinforced industrial agglomeration in China's coastal region. He et al. (2007) confirmed that industries with more exports are more geographically concentrated using data from the first economic census conducted in 2004. By spatially clustering, trading firms are likely to benefit from knowledge and information spillovers (Aitken et al., 1997; Malmberg et al., 2000; Manez et al., 2004). For instance, Aitken et al. (1997) and Malmberg et al. (2000) showed that exporting firms may act as an export catalyst, and thus reduce the cost of access to foreign markets for firms situated in the same area. Lovely et al. (2005) argued that exporting requires specialized knowledge of foreign markets, and information spillovers among trading firms should contribute to spatial concentration and therefore stimulate growth. Becchetti and Rossi (2000) proposed that economies of scale in the provision of export services and informal face-to-face exchanges of information about export markets improve export performance of small firms located in Marshallian districts in Italy. In China, trading enterprises fully take advantage of backward and forward business linkages through deeper division of labor to foster the formation of industrial clusters, significantly cutting production costs and transaction costs. Given the significant influence of knowledge and information spillovers on trading firms, we expect that trading activities to allow a larger role of dynamic externalities in the growth of export-oriented industries.

Utilizing FDI stimulates the globalization of Chinese industries and regions. Foreign investors tend to take advantage of information spillovers and network externalities when choosing locations in China, leading to its geographical concentration (Head and Ries, 1996; Belderbos and Carree, 2002; He, 2002, 2003; Amiti and Javorcik, 2008). Dynamic externalities would help to attract new FDI into industries and regions, promoting their growth. Meanwhile, FDI in China has considerable spillover effects within the same industry and across industries through demonstration effects, competition effects, worker mobility and business linkages (Cheung and Lin, 2004; Li et al., 2001; Liu et al., 2001; Liu, 2002, 2008). For instance, Cheung and Lin (2004) argued that FDI can benefit innovation activities via spillover channels and found positive and robust effects of FDI on the number of domestic patent applications in China. Liu (2008) found that an increase in FDI at the four-digit level raises the long term rate of productivity growth of domestic firms in the same industry. Spillovers through backward and forward linkages between industries at the two digit level have similar effects on the productivity of domestic firms, and backward linkages seem to be the most important channel through which spillovers occur. Given the significant technological spillover effects of FDI, we would anticipate that foreign presence in industries and regions would heighten the impact of dynamic externalities on local industrial growth.

**Regional Decentralization.** China's economic transition has resulted in considerable power decentralization from the central government to local governments. As a result, the local governments now have a primary responsibility and authority for local economic development (Qian and Weingast, 1996). Meanwhile China introduced a revenue-sharing system called "fiscal contracting system" in 1980 and the central and provincial governments started to tap different revenue bases. In 1994, the central government initiated a new tax-sharing system, introducing a clear distinction between national and local taxes, and determining that the value added tax (VAT) would become the major indirect tax to be collected by the central government and shared by local governments at a fixed ratio of 75:25. Regional decentralization has triggered serious inter-provincial competition, resulting in rational imitation strategy of industrial policies (He and Zhu, 2007). Competition among provinces provides incentives to replace poorly chosen strategies with those succeeding elsewhere (Thun, 2004). The economic-oriented evaluation system for local officials and a judicious combination of local autonomy, fiscal incentives, and hard budget constraints have created a framework leading local governments to duplicate industries which could rapidly improve local revenues or promote local economic growth, resulting in the geographical dispersion of Chinese industries. Fiscal decentralization has generated conditions that encourage regionalism and provided local governments incentives to protect local industries from interregional competition (Zhao and Zhang, 1999; Young, 2000). Local governments tend to protect industries which are highly value-added and profitable, such as tobacco, food, medical and pharmaceutical products, beverages, and machinery equipment (DRC, 2004). Overall, regional decentralization has led to the fragmentation of the domestic market and discouraged the geographical concentration of industries in China (Bai et al.,

2004; He et al., 2007).

Theoretically, the devolution of political and administrative power to lower level governments leads to improved economic efficiency in local public service delivery and thus augments economic growth. As Oates (1972, 1993) argued that local governments are better positioned than the national government to deliver public services that match local preferences and needs, and that over time, efficiency gains will lead to faster local as well as national economic growth. In the Chinese case, He (2006) found that power decentralization to cities and provinces during the transition period helps Chinese provinces to attract more FDI. Shi and Zhou (2007) found strong evidence that power decentralization improves economic efficiency based on the analysis on 14 separately-planned cities in China. Lin and Liu (2000) found the theoretically predicated contribution of fiscal decentralization to growth in China. As discussed above, regional decentralization allows a larger role for local governments in developing local economies. Local governments may work hard to attract suppliers to locate near the assembly plants or give economic and political incentives to companies in their jurisdictions to help locally protected industries. Fiscal decentralization leads to local protectionism, hurting industrial specialization and blocking interregional competition, but possibly increasing industrial diversity and local competition. Dynamic externalities associated with specialization may be less significant for protected industries, but may allow Porter and Jacobs externalities to play a larger role in promoting city industry growth.

Overall, recent growth theories stress the role of dynamic externalities in motivating economic growth. MAR externalities propose that industrial specialization facilitate knowledge and information spillovers and contribute to industrial growth. Jacobs externalities contend that industries grow faster in regions with diversified industries and for industries located in an industrially diversified city. Porter externalities highlight the importance of local competition in industrial growth. The dynamic externalities propositions are however derived under fully developed market economy conditions. This study argues that importance of dynamic externalities in local industrial growth is conditional on the process of economic transition in China. Marketization and globalization allow dynamic externalities to play a more significant role in sectors and regions which are largely liberalized and globalized while decentralization may discourage the importance of MAR externalities and magnify the roles of Porter and Jacobs externalities.

**Data and Method**

The following session will employ data from the Annual Survey of Industrial Firms in 2000 and 2005 in China to test the significance of dynamic externalities in city industry growth. The Annual Survey of Industrial Firms (ASIF) is conducted by the State Statistics Bureau of China and covers all Chinese industrial state-owned enterprises and non-state-owned enterprises with annual sales of five millions RMB or more. The dataset provides detailed information on firms' identification, location, capital structure, total profits, total employees, total shipments, exported shipments, and intermediate inputs among others. This study explores the determinants of growth

of all two-digit manufacturing industries at the prefecture level cities during 2000-2005. Dynamic externalities are localized since information spillovers suffer from significant distance decay, and cities are natural laboratory to study externalities. As Henderson (1997) suggested that where no suitable time series of regional manufacturing employment data are accessible, a periodisation to five or six year periods should permit the dynamic externalities effects to be detected. China officially became a member of the WTO at the end of 2001, significantly stimulating the growth of Chinese economy. The period of 2000-2005 also witnessed a remarkable growth in industrial production in China, providing a good opportunity to explore city industry growth.

This study is to test whether dynamic externalities contribute to city industry growth and whether the impact of dynamic externalities on growth is conditional on the triple process of marketization, globalization and decentralization. This study also intends to find out whether there is a nonlinear relationship between city industry growth and dynamic externalities. We therefore postulate that the growth rate of an industry in a given prefecture level city during 2000-2005 is a function of degree of specialization, diversity and competition at both the city level and the provincial level, and also the interactions between dynamic externalities and economic transition controlling for other variables.

The first set of variables represents dynamic externalities. Industrial specialization in 2000 is introduced as a proxy for MAR externalities. Specialization is measured as the location quotient of gross industrial output of in the industry s at the city c or the province p. We test the significance of industrial specialization within the industry s in the city c and in the province p which the city c is situated. Both specialization indices are defined as follows,

$$LQ_{sc} = \frac{OUT_{sc} / OUT_{c}}{OUT_{sn} / OUT_{n}} \qquad LQ_{sp} = \frac{OUT_{sp} / OUT_{p}}{OUT_{sn} / OUT_{n}}$$

where $OUT_{sc}$ and $OUT_{sp}$ are the gross output in the industry *s* at the city *c* and at the province p where the city *c* is located. $OUT_{c}$ and $OUT_{p}$ represent the gross industrial output at the city *c* and at the province *p* where the city *c* is situated. $OUT_{sn}$ is the gross output in the industry s at the national level; $OUT_{n}$ is the gross industrial output at the national level. If LQ is greater than 1, then the city c or province *p* has a relatively high concentration of the industry *s*. Knowledge spillovers in the industry *s* are assumed to be greater when LQ is higher. Industrial specialization at both the city and provincial level are assumed to be positively associated with city industry growth.

Porter externalities are represented by the degree of competition, which is measured as the ratio of the number of firms to total employment in the city-industry or province-industry to the number of firms per worker in the national industry in 2000. We test the impacts of local competition at the city level and the provincial level on city industry growth,

$$LC_{sc} = \frac{NBE_{sc} / EMP_{sc}}{NBE_{sn} / EMP_{sn}} \qquad LC_{sp} = \frac{NBE_{sp} / EMP_{sp}}{NBE_{sn} / EMP_{sn}}$$

where $NBE_{sc}$ and $NBE_{sp}$ are the number of firms in the industry s in the city *c* and in the province *p* where the city *c* is located. $EMP_{sc}$ and $EMP_{sp}$ are the total employment in the industry *s* in the city *c* and in the province *p* where the city *c* is situated. $NBE_{sn}$ and $EMP_{sn}$ are the number of firms and total employment in the industry *s* at the national level. Local competition within the city and the province where the city is located would stimulate innovative activities and promote city industry growth.

Industrial diversity is introduced as a proxy for Jacobs externalities. Similarly, we also test the impact of industrial diversity at the city level and the province level. The index of diversity is the inverse of a normalized Herfindhal index of industrial concentration in 2000,

$$DIV_{sc} = \frac{1/\sum_{s' \neq s}^{S} \left(\frac{OUT_{s'c}}{OUT_c - OUT_{sc}}\right)^2}{1/\sum_{s' \neq s}^{S} \left(\frac{OUT_{s'n}}{OUT_n - OUT_{sn}}\right)^2} \qquad DIV_{sp} = \frac{1/\sum_{s \neq s}^{S} \left(\frac{OUT_{s'p}}{OUT_p - OUT_{sp}}\right)^2}{1/\sum_{s \neq s}^{S} \left(\frac{OUT_{s'n}}{OUT_n - OUT_{sn}}\right)^2}$$

where $OUT_{s'c}$ is the gross industrial output in industries other than the one that is studied in the city *c*, $OUT_{s'p}$ is the gross industrial output in industries other than the one that is studies in the province *p* where the city *c* is located. $OUT_n$ and $OUT_{sn}$ are the gross industrial output at the national level and the gross output in industry s in China. A positive relationship between industrial diversity and the industry's growth in a given city is evidence supporting Jacobs' theory. Note that this indicator represents the industrial diversity faced by the industry s in the city c and in the province p, and is therefore not necessarily negatively linked with the own local specialization of the industry s in the city c.

This study also considers the influence of localization economies, urbanization economies and internal scale economies on city industry growth in China during 2000-2005. Previous studies reported strong and prevailing significant agglomeration effects in Chinese urban areas and the major sources of the agglomeration advantage come from localization economies (Pan and Zhang, 2002). Au and Henderson (2006) found that urban agglomeration benefits are high in China. The externalities which benefit a firm owing to agglomeration within a single industry are referred to as localization economies. The reasons for the existence of these externalities include access to natural resources, transportation advantages, and savings on moving inputs (Marshall, 1898). Localization economies are measured on the basis of gross output within the industry s in the city c in 2000 ($OUT_{sc}$) and are expected to stimulate city industry growth.

Urbanization economies are benefits to firms in all industries located in a city, originating from sharing infrastructure and markets, and easy face to face contact (Duranton and Puga, 2003). Follow Combes (2000), we apply the employment density($DEN_c$), which is the total number of employees divided by the total area in the city c in 2000, to proxy for urbanization economies. A higher employment density would be positively associated with the growth rate of industries located in the city c during 2000-2005.

In order to test for internal economies of scale, this study entertains a variable proxy for the average plant size of the industry s in the city c in 2000, which is then

normalized by the average plant size in the industry s at the national level,

$$SIZE_{sc} = \frac{OUT_{sc} / NBE_{sc}}{OUT_{sn} / NBE_{sn}}$$

where $OUT_{sc}$ and $NBE_{sc}$ are the gross output and the number of firms in the industry s in the city c. $OUT_{sn}$ and $NBE_{sn}$ are the gross output and the number of firms in the industry s at the national level. A larger value of SIZE suggests strong internal economies of scale within the industry s in the city c.

The other set of variables quantify the extent that an industry in a prefecture level city is affected by the triple process of economic transition in China. The process of marketization and globalization allows non-state capital to play an increasing role in developing local industries. Globalization grants Chinese industries access to the global market. Liberalized and globalized industries are found more competitive and more geographically concentrated, and also significantly to benefit from industrial agglomeration (He et al., 2007). Those sectors are more likely to be driven by market forces, including dynamic externalities. We use the ratio of non-state capital to total capital ($LIB_{sc}$) within the industry s in the city c in 2000 to quantify the extent that a city-industry is liberalized. We then include the interactions between $LIB_{sc}$ and the three proxies for dynamic externalities to test whether the impact of dynamic externalities is conditional on the degree of economic marketization.

We apply the ratio of exports in total sales revenue ($GLO_{sc}$) within the industry s in the city c in 2000 to measure the degree that the industry s has been involved in economic globalization. We do not consider foreign investment in the globalization variable because $LIB_{sc}$ also includes foreign capital, and $GLO_{sc}$ is highly correlated with FDI. Similarly, we include the interactions between $GLO_{sc}$ and the three proxies for dynamic externalities to test whether globalization facilitates the importance of dynamic externalities.

Economic transition has resulted in significant fiscal decentralization and power decentralization. As argued, fiscal decentralization led to ruthless interregional competition, resulting in local protectionism and rational imitation strategy (He et al., 2007). Local governments often protect industries, which generate large profits and taxes and significantly contribute to local revenues (DRC, 2004). We introduce the ratio of value added tax to sales revenue ($DPT_{sc}$) within the industry s in the city c to proxy for the influence of fiscal decentralization. We then include the interactions between $DPT_{sc}$ and the three variables of dynamic externalities to test whether fiscal decentralization affects dynamic externalities.

Economic power decentralization basically follows China's political hierarchy. The higher the status of a local government in the political hierarchy, the more economic power it has. Among the Chinese cities at the prefecture level and above, there are four centrally administered cities, Beijing, Shanghai, Tianjin and Chongqing. There are 15 sub-provincial level cities designated within certain provinces, followed by more than 200 prefecture level cities and hundreds of county level cities (He, 2006). A key measure to shift economic power to the local level was to establish a variety of policy zones in different cities. Four special economic zones (SEZs) were

established, including Shenzhen, Zhuhai, Shantou and Xiamen in 1980; the state opened 14 coastal cities in 1984 and granted the status of SEZs to Hainan in 1988 and to Pudong in Shanghai in 1990. In 1992, the Chinese government opened all inland provincial capitals, 6 major cities along the Yangtze River, 13 border cities in the Southwest and the North. To develop industries, the central government established more than 50 high technology industrial development zones in major Chinese cities. Provincial governments also designated some industrial parks within their territories. To quantify economic power of Chinese cities, we design a variable ($DEP_c$), assigning 3 to centrally administered cities and sub-provincial cities, 2 to provincial capitals, cities with special open status, cities with high-tech industrial development zones or economic and technology development zones at the national level, 1 to those with industrial parks at provincial level and 0 to other prefecture level cities. We then include the interactions between $DEP_c$ and the three variables of dynamic externalities to test whether power decentralization affects dynamic externalities.

Finally, this study controls the growth of capital per worker ($KW_{sc}$) of the industry s in the city c. $KW_{sc}$ is expected to be positively associated with city industry growth. The variables can be summarized in a simple growth model specification as follows,

$$LnG_{sc} = \beta_0 + \beta_1 \ln(KW_{sc}) + \beta_2 \ln(OUT_{sc}) + \beta_3 \ln(DEN_c) + \beta_4 \ln(SIZE_{sc}) + f_1(LQ_{sc}, LC_{sc}, DIV_{sc}, LQ_{sp}, LC_{sp}, DIV_{sp}) + f_2[(LQ_{sc}, LC_{sc}, DIV_{sc}) \times (LIB_{sc}, GLO_{sc}, DPT_{sc}, DEP_c)] + \alpha_s + \varepsilon_{sc}$$

where $G_{sc}$ is the ratio of the gross output of the industry s in the city c in 2000 and 2005. To compute $G_{sc}$, the ex-factory price indexes of industrial products, which are available from *2006 China Urban Life and Price Yearbook* (SSB, 2007), are used to adjust the nominal industrial output in 2005 based on the 2000 constant price. $f_1$ indicates that industrial growth is a function of proxies for dynamic externalities. $f_2$ represents that industrial growth is a function of interactions between dynamic externalities and economic transition. $\alpha_s$ stands for industrial specific error. The following sessions first describe the patterns of local industrial growth in China and then explore the determinants of city industry growth during 2000-2005.

## Empirical Analysis

**Structural and Spatial Patterns of Industrial Growth in China.** During 2000-2005, China's gross industrial output at the 2000 constant price grew by 23.52% annually. Telecommunication and electronic equipment, nonferrous metal smelting and pressing, and furniture making top the industrial list, with annual growth rate greater than 30%, followed by instruments, meters and office machinery, transportation equipment, ferrous metal smelting and pressing, general purpose machinery, and electrical machinery and equipment (Figure 1). These industries are mostly capital and technology intensive and heavily rely on foreign investment. They are also characterized by strong inter and intra-industry linkages, and technological spillovers are likely to occur among related enterprises. Comparatively, beverage manufacturing, tobacco processing, chemical fiber, petroleum refining and coking, clothing and other fiber product, chemical materials and products, printing and

copying experienced slower output growth during 2000-2005. Several industries are typically protected industries such as beverage manufacturing, tobacco processing and petroleum refining and coking (DRC, 2004). Local protectionism may not be conductive for industrial growth since it sacrifices for scale economies and keeps industries away from interregional competition.

The annual growth rate of gross industrial output differs significantly by province (Figure 2). During 2000-2005, Shandong, Neimenggu, Zhejiang, Fujian, Jiangsu and Guangdong experienced the most rapid growth of gross industrial output, with annual growth rate greater than 25%, followed by Jiangxi and Shanxi, with annual growth rate greater than the national level. Neimenggu and Shandong have benefited from the development of heavy industries and energy-intensive and energy-related industries driven by the rapid growth of the Chinese economy. The rapid industrial growth in the coastal provinces may be associated with industrial specialization and fierce market competition. The accession to WTO has further activated the locational and institutional advantages in the coast, stimulating industrial growth. The growth performance in inland provinces such as Hubei, Heilongjiang, Qinghai, Xinjiang and Gansu was much poorer, with annual growth rate smaller than 15%. The geographical disadvantage, insufficient marketization and dominance of state owned economy shall be responsible for the poorer growth performance.

This study intends to explain city industry growth at the prefecture level during 2000-2005. Figure 3 portraits the spatial distribution of gross industrial output by prefecture level cities. In 2000, industrial output in China was heavily concentrated in the Pearl River Delta, the Yangtze River Delta, the Shandong Peninsula, the Liaoning Peninsula, and the Beijing-Tianjin area. Industries were also scattered in cities located in a few inland provinces, including Jilin, Heilongjiang, Sichuan and Hubei. During 2000-2005, Chinese industries grew remarkably and have been increasingly agglomerated along the coastal region. In 2005, almost all prefecture level cities along the coastal region generated industrial output of more than Yuan 100 billion. The Bohai Rim Area, the Yangtze River Delta and the Pearl River Delta became the industrial cores. The Northeast stood out as an important industrial base due to the revitalization strategy launched in 2003 by the central government. Meanwhile, the central region has been largely industrialized since 2000.

Figure 4 maps the spatial distribution of industrial output growth by prefecture level cities. The growth pattern of city industry in China is rather diversified. On the one hand, there are some fast growing prefecture level cities along the coastal provinces such as Zhejiang, Guangdong, Jiangsu and Shandong and its neighboring region, which have concentrated the majority of industrial activities. On the other hand, there are also prefecture level cities experiencing rapid industrial growth in the inland region. Those cities are mainly situated in Neimenggu, Henan, Shanxi, Sichuan and Hunan. They typically had a smaller size of industrial activities in 2000. This study is to explain why some cities grow faster than others.

**Determinants of City Industry Growth in China.** The correlation analysis indicates that explanatory variables are weakly related. To test the nonlinear relationship between dynamic externalities and city industry growth, we include the

squared index of specialization, competition and diversity in the models. To test whether the impact of dynamic externalities on industrial growth is conditional on the process of economic transition, we entertain the interactions between proxies for dynamic externalities and economic transition. We have an unbalanced panel data structure since industries are distributed in different cities. We estimate the results applying the fixed effects model (FEM). The inclusion of industry dummies would control the unobserved industrial variations in city industry growth. Results from different model specifications are reported in Table 1.

The models are fairly powerful in explaining city industry growth, with R-squares around 0.20 and highly significant F tests. The estimated results are corrected for heteroskedasticity since the Breusch-Pagan tests indicate the existence of heteroskedasticity. The controlling variables are highly significant and have important explanatory power for city industry growth in China during 2000-2005. The coefficients on LnKW are positive and highly significant, and a 1% increase of capital per worker during 2000-2005 is associated with more than 0.32% of city industry growth, indicating that industrial investment is largely responsible for industrial growth. The size of city industry (LnOUT) and the standardized average plant size of city industry (SIZE) are negatively associated with city industry growth, suggesting that smaller industries dominated by small and medium enterprises might have grown faster. Static externalities associated with localization economies and internal scale economies occur not to explain industrial growth. Results however suggest that industries located in a city with a higher employment density grew faster. Coefficients on LnDEN range from 0.1335 to 0.1972, suggesting that a 1% increase of employment density in a city would lead to 0.13-0.20% of city industry growth. Cities with dense manufacturing employments would provide conditions to generate a variety of agglomeration economies, which would attract new industrial investments and also make existing enterprises more productive and competitive in their markets, stimulating city industry growth.

Statistical results provide evidence to show that dynamic externalities do significantly affect city industry growth during 2000-2005 in China, and the impacts of dynamic externalities are indeed conditional on economic transition. Model 1 - Model 6 tests the significance of MAR externalities, Porter externalities and Jacob externalities, separately. Model 7 and Model 8 test the significance of dynamic externalities simultaneously. In Model 1, both $LQ_{sp}$ and $LQ_{sc}$ are positive and highly significant but squared $LQ_{sc}$ is negative and weakly significant. Industrial specialization in the province where the city is located helps the growth of city industry, indicating MAR externalities may go beyond the border of the prefecture level cities. Forward and backward industrial linkages and worker turnovers among enterprises within a province would facilitate technological spillovers beyond a city's borders. Industrial specialization within the prefecture level city may initially stimulate city industry growth while it would hurt growth when specialization exceeds a certain level. This is a finding complementary to the existing studies which found that industrial specialization hurt industrial growth (Mody and Wang, 1997; Battisse, 2002; Gao, 2004). However, when introducing interactions between $LQ_{sc}$ and proxies

for economic transition, the coefficients on $LQ_{sc}$ and squared $LQ_{sc}$ turn negative as shown in Model 2. That indicates, the argument that industrial specialization hurt industrial growth may be strongly conditional on how economic transition works for industrial growth in China. The existing studies fail to discuss the negative impact of industrial specialization on industrial growth.

Coefficients on the interactions LIB*$LQ_{sc}$, GLO*$LQ_{sc}$, DPT*$LQ_{sc}$ and DEP*$LQ_{sc}$ are positive and significant at 0.05 level. Those interactions remain positively associated with city-industry growth in Model 8. The positive coefficients on LIB*$LQ_{sc}$ and GLO*$LQ_{sc}$ imply that the concentration of industries which are largely liberalized and globalized has promoted their growth. Cities specialize in industries which are heavily protected or favored by local governments may grow faster, shown by the positive coefficient on DPT*$LQ_{sc}$. Fiscal decentralization has granted local government great incentives to protect or favor industries which generate large local revenues, facilitating the growth of protected industries. Industries concentrated in cities which have more authorities in economic matters also occur to grow faster. The results support our research hypothesis that the triple process of economic transition generates conditions allowing MAR externalities to play a positive role in stimulating city industry growth.

Model 3 and Model 4 test the impact of competition externalities on city industry growth. The statistical results show that local competition may stimulate city industry growth when local competition is at the lower level. When it exceeds a certain level, local competition actually hurts city industry growth. This is shown by the positive coefficient on $LC_{sc}$ and the negative coefficient on the squared $LC_{sc}$. The existing studies have not found the nonlinear relationship between local competition and industrial growth. Fiercer local competition squeezes profits, reducing investments for innovation meanwhile it motivates strict intellectual property protection among related enterprises, moderating technological spillovers within city industry in question. Moreover, intensive intra-industry competition in the province where the city is located would possibly hurt city-industry growth. Enterprises within an industry in a province compete for markets, materials and qualified labor. More competition from outside would impose great pressure on enterprises located in the city. The impact of local competition on city industry growth is also found affected by economic transition. In Model 4, more local competition in liberalized industries may hurt city industry growth, which is consistent with the argument that fiercer local competition discourages industry growth. Liberalized industries are much more competitive compared with other industries. However, more local competition within globalized and protected industries results in faster city industry growth, indicating that globalization and fiscal decentralization motivates Porter externalities to stimulate globalized and protected industries to grow. Coefficient on DEP*$LC_{sc}$ is statistically insignificant. The effects of proxies for local competition remain the same in Model 7 and Model 8.

Model 5 and Model 6 test the significance of Jacob externalities. The existing studies report a weak positive association between industrial diversity and industrial growth at the provincial level. We however found a nonlinear relationship between

diversity and city industry growth. The coefficient on $DIV_{sc}$ is negatively significant and the squared $DIV_{sc}$ is positively associated with city industry growth, indicating that industrial diversity would contribute to city industry growth only when it reaches a certain level. As a matter of fact, a lower level diversity hurts city industry growth. Interestingly, more diversity in a province where a city is situated also hurts the city industry growth, shown by the significant negative coefficient on $DIV_{sp}$. That suggests that more intensive inter-industry competition may not be conductive for city industry growth. Enterprises in different industries may compete for energy, resource inputs, transportation and communication infrastructure, professional and producer services. Too much inter-industry competition may heighten production costs and alleviate enterprises' competitive advantages.

Statistical results show that the triple process of marketization, globalization and decentralization enhances the importance of Jacob externalities in driving city industry growth. In model 6, coefficients on the interactions between DIVsc and the four proxies for economic transition are all positive and significant. They remain highly positive and significant even after introducing other variables in Model 8. Liberalized and globalized industries are driven by market forces and technological spillovers are more likely to occur across them. We also found that liberalized and globalized industries situated in a more diversified industrial environment have grown faster during 2000-2005, which is indicated by the significant and positive coefficient on $LIB*DIV_{sc}$. The significant and positive coefficient on $DPT*DIV_{sc}$ suggests that protected industries grow faster when they face a diversified industrial structure. Similarly, industries located in cities with greater power in economic matters and facing a more diversified industrial structure expand much more rapidly. With regional decentralization, local governments may give enterprises from other industries economic or political incentives to help the development of locally protected industries. For instance, to develop the industry of transportation equipment manufacturing industry, local governments would attract producers of parts and components or related industries to their jurisdictions and may require them to make business linkages with the assembly plants (Thun, 2000). Local governments often establish certain types of industrial parks to cluster enterprises from locally protected industries, and the geographical proximity may facilitate technological spillovers across industries and promote the growth of protected industries in China (Wang, 2001). In a word, economic transition has created conditions to allow Jacobs externalities to play a significant role in stimulating industry growth in China.

**Regional Differences in Determinants of City Industry Growth.** Statistical results from the full sample produce sufficient evidence to support that dynamic externalities have significant impacts on city industry growth in China, and economic transition has generated conditions to facilitate the positive role of dynamic externalities. There may be structurally different in the coefficients of proxies for dynamic externalities among different regions since China adopted regional-oriented strategy of economic transition (He, 2006). Regions which have undergone economic liberalization and globalization are more likely to benefit from dynamic externalities. We therefore re-estimate the results based on the samples of coastal, central and

western cities. The regression results indicate significant regional differences regarding how dynamic externalities affect city-industry growth (Table 2). However, the influence of controlling variables is not significantly different from results based on the full sample. The log of growth of capital per worker is significantly and positively associated with city industry growth while log of gross industrial output in 2000 is significantly and negatively related to city industry growth in all regions. Similarly, industries situated in densely populated cities grow more rapidly no matter where the cities are located. In the coastal region, industries populated with smaller enterprises grow faster while in the inland cities, industries dominated with large and medium enterprises, are likely to grow more rapidly. Internal scale economies may contribute to city industry growth in inland regions while external scale economies matter for industrial growth in the coast. The developed market economies in the coast speak for the differences between the coast and inland regions.

The coefficients on $LQ_{sc}$ in the coastal model specifications are positive, indicating that industrial specialization in the coastal region may have promoted city industry growth. However, specialization would hurt industrial growth when it exceeds a certain level. In the central and western regions, no significant specialization effects are observed within the city considered. In the central region, industrial specialization within the province where the city is situated occurs to significantly stimulate city industry growth. Comparatively speaking, the coast region in China is much more economically liberalized and globalized and also granted with more authorities in economic matters. The western region however remains heavily influenced and controlled by the State, with a low level of industrial specialization and a weak market system. The institutional environment in the coastal region allows MAR externalities to play a more significant role in driving industrial growth while the west region lacks conditions to activate MAR externalities. In fact, the competitive industrial clusters along the coastal provinces provide strong evidence to support the findings.

Local competition appears to facilitate city industry growth in the coastal and central regions but too much competition may hurt city industry growth, especially in the central region. Industries in the coastal region are largely driven by market forces and global forces. Related enterprises compete fiercely for energy, materials and labor, and also domestic and international markets. The intensive competition would motivate enterprises to innovate or reduce costs through geographical proximity, resulting in faster city industry growth. The coefficients on $LC_{sc}$ , squared $LC_{sc}$ and $LC_{sp}$ in the west model are statistically insignificant. Given the less liberalized and competitive economy in China's western region, competition externalities may not be in shape. More intra-industry competition within a province which the city is situated may discourage city industry growth in the coastal region but stimulate industry growth in the central region. Enterprises in the same industry located in the same province may compete for the same market and similar factor inputs. Too much competition in the coastal region makes enterprises more difficult to survive, discouraging city industry growth. Compared with the coastal region, intra-industry competition within a province is not so intensive in the inland regions. Gradual

introduction of competition in the central region would give enterprises economic incentives to expand their markets and pursue more profits by innovating, thereby contributing to city industry growth.

Results indicate that industrial diversity in the coastal cities may hurt industry growth, shown by the negative and significant coefficients on $DIV_{sc}$ and $DIV_{sp}$. One possible explanation is that fierce inter-industry competition within a city and within a province in the coastal region may harm city industry growth. It is likely to be true since the coastal region is largely liberalized and globalized and with a relatively good market system. Enterprises in the costal compete with each other ruthlessly for markets and inputs. In the inland region, industrial diversity is likely to help city industry growth, especially when industrial diversity reaches a certain level. Unfortunately, the coefficients are statistically insignificant in both the central and west models. Overall, due to the inter-industry competition, no significant competition externalities are found statistically in the coastal region while potential competition externalities are expected in the inland regions.

**Conclusions and Discussions**

New theories of economic growth stress the role of dynamic externalities in driving economic growth. Three types of dynamic externalities, including MAR externalities, Porter externalities and Jacob externalities, are tested in a variety of empirical studies although results are rather inconclusive. We argue that in transitional economies such as China, the impact of dynamic externalities on local growth may be conditional on the triple process of marketization, globalization and decentralization, which has successfully introduced market and global forces into the economy, and granted local governments more authorities in economic matters. This study tests the propositions using data on two digit manufacturing industries at the prefecture level cities during the period of 2000 -2005.

This study makes important contribution to related literature. First, this study found a significant nonlinear relationship between dynamic externalities and local industrial growth. The nonlinear relationships significantly differ among MAR externalities, Porter externalities and Jacob externalities. Industrial specialization and local competition may help city industry growth but hurt growth when specialization and competition reach a certain level. Diversity helps industry growth but only when it exceeds a certain level. Second, this study found that externalities could go beyond the city boundary. Negative competition and diversity externalities within a province where a city is located are found to influence city industry growth while specialization at the provincial level would help city industry growth. Third, we found that liberalized, globalized and protected industries are more likely to benefit from dynamic externalities. Industries located in cities with greater authorities and responsibilities are also found to grow faster. The results clearly suggest that economic transition has created conditions to allow more significant roles of dynamic externalities in driving city industry growth. Finally, the way that dynamic externalities affect city industry growth differs across regions and sectors. Regions and sectors which are sufficiently liberalized and globalized are more likely to respond to dynamic externalities, especially competition externalities.

Chinese manufacturing industries have grown rapidly since the entry of WTO in 2001. The large inflows of foreign investment and easy access to international markets have certainly stimulated industrial growth. Meanwhile this study found evidence to support the new theories of economic growth in a transitional economy, suggesting that static and dynamic externalities significantly contribute to industrial growth in China. Positive competition and diversity externalities are more phenomenal at the city level, suggesting that smaller spatial unit of analysis is necessary to test dynamic externalities. As suggested by Lucas (1988), cities provide a natural laboratory to study dynamic externalities because they facilitate communications among economic agents. Evidence suggests such externalities are localized and decay significantly with distance (Henderson, 1997). The triple process of economic transition in China has also significantly shaped China's economic geography. Studies reported that regions and sectors expericing economic liberalization and globalization are more likely to adapt to market forces, including static externalities and therefore are more geographically concentrated (He et al., 2007, 2008). This study argues that economic transition would generate conditions to allow firms to benefit from dynamic externalities and to facilitate city industry growth in China. On the one hand, this study confirms the moderate applicability of theoretical propositions derived under market economy conditions in China. On the other hand, it should bear in mind that economic transition has its critical role in moderating the mainstream theories.

## REFERENCES


Acs, Z. J. and Armington, C. (2004) Employment growth and entrepreneurial activity in cities, *Regional Studies,* 38(8), pp. 911-927.

Aitken, B., Hanson, G. H. and Harrison, A. E. (1997) Spillovers, foreign investment and export behavior, *Journal of International Economics,* 43, pp. 103-132.

Amiti, M. and Javorcik, B. S. (2008) Trade costs and location of foreign firms in China, *Journal of Development Economics,* 85, pp. 129-149.

Anderson, G. and Ge, Y. (2004) Do economic reforms accelerate urban growth? The case of China, *Urban Studies,* 41(11), pp. 2197-2210.

Arrow, K. J. (1962) The economic implications of learning by doing, *Review of Economic Studies,* 29, pp. 155-173.

Au, C. and Henderson, J.V. (2006) Are the Chinese cities too small? *Review of Economic Studies,* 73, pp. 549-576.

Bai C, Du Y, Tao Z, Tong S. (2004) Local protectionism and regional specialization: evidence from China's industries, *Journal of International Economics,* 63, pp. 397-417.

Barkley, D. L., Henry, M.S. and Kim, Y. (1999) Industry agglomerations and employment change in non-metropolitan areas, *RURDS,* 11(3), pp. 168-186.

Batisse, C. (2002) Dynamic externalities and local growth: a panel data analysis applied to Chinese provinces, *China Economic Review,* 13, pp. 231-251.

Becchetti, L. and Rossi, S. P.S. (2000) The positive effect of industrial district on the export performance of Italian firms, *Review of Industrial Organization,* 16, pp. 53-68.

Belderbos, R. and Carree, M. (2002) The location of Japanese investments in China: agglomeration effects, Keiretsu, and firm heterogeneity, *Journal of the Japanese and International Economies,* 16, pp. 194-211.

Berthelemy, J. and Demurger, S. (2000) Foreign direct investment and economic growth: theory and application to China, *Review of Development Economics,* 4(2), pp. 140-155.

Bivand, R. S. (1999) Dynamic externalities and regional manufacturing development in Poland, *Tijdschrift voor Economische en Sociale Geografie,* 90(4), pp. 347-362.

Bo, W. (2007) Externalities and industrial economic growth-evidence from Chinese provincial panel data, *Chinese Industry Economy,* 226, pp. 37-44 (in Chinese).

Bradley, R. and Gans, J.S. (1998) Growth in Australian cities, *The Economic Record,* 74, pp. 266-278.

Cheung, K. and Lin, P. (2004) Spillover effects of FDI on innovation in China: evidence from the provincial data, *China Economic Review,* 15, pp. 25-44.

Chen, B. and Feng, Y. (2000) Determinants of economic growth in China: private enterprise, education and openness, *China Economic Review,* 11, pp. 1-15.

Combes, P. (2000). Economic structure and local growth: France, 1984-1993, *Journal of Urban Economics,* 47, pp. 329-355.

De Lucio, J. J., Herce, J.A. and Goicolea, A. (2002) The effects of externalities on productivity growth in Spanish industry, *Regional Science and Urban and Economics,* 32, pp. 241-258.

Dekle, R. (2002) Industrial concentration and regional growth: evidence from the prefectures, The *Review of Economics and Statistics,* 84(2), pp.310-315.

DRC (Development Research Center), the State Council. (2004) A report on local protection in China. *References for Economic Research,*18, pp. 31-38 (in Chinese).

Duranton, G. and Puga, D. (2003) *Micro-foundations of Urban Agglomeration Economies.* Working Paper 9931, NBER, Cambridge, MA.

Fan, C. and Scott, A. (2003) Industrial agglomeration and development: a survey of spatial economic issues in East Asia and a statistical analysis of Chinese regions, *Economic Geography,* 79, pp. 295-319.

Fujita, M. and Hu, D. (2001) Regional inequality in China, 1985-1994: the effects of globalization and economic liberalization, *Annals of Regional Science,* 35, pp. 3-37.

Forni, M. and Paba, S. (2002) Spillovers and the growth of local industries, The *Journal of Industrial Economics,* L (2), pp. 151-171.

Glaeser, E. L., Kallal, H.D., Scheinkman, J.A. and Shleifer, A. (1992) Growth in cities, *The Journal of Political Economy,* 100(6), pp. 1126-1152.

Gao, T. (2004) Regional industrial growth: evidence from Chinese industries, *Regional Science and Urban Economics,* 34, pp. 101-124.

He, C. (2002) Information costs, agglomeration economies and the location of foreign direct investment in China, *Regional Studies,* 36(9), pp. 1029-1036.

He, C. (2003) Location of foreign manufacturers in China: agglomeration economies and country of origin effects, *Papers in Regional Science* 82(3): 351-372.

He, C. (2006) Regional Decentralization and Location of Foreign Direct Investment in China, *Post-Communist Economies,* 18(1), pp. 33-50.

He, C and Zhu, S (2007) Economic transition and regional industrial restructuring in China: structural convergence or divergence? *Post Communist Economies,* 19, pp. 321-346.

He, C., Wei, Y. and Pan, F. (2007) Geographical Concentration of Industries in China: the Importance of Spatial and Industrial Scale, *Eurasian Geography and Economics*, 48 (5), pp. 603-625.

Head, K. and Ries, J. (1996) Inter-city competition for foreign investment: static and dynamic effects of China's incentive areas, *Journal of Urban Economics*, 40, pp. 38-60.

Henderson, V., Kuncoro, A. and Turner, M. (1995) Industrial development in Cities, *Journal of Political Economy*, 103, pp. 1067-1085.

Henderson, V. (1997) Externalities and industrial development, *Journal of Urban Economics*, 42, pp. 449-470.

Jacobs, J. (1969) *The Economy of Cities*, New York: Vintage.

Lin, J.Y. and Liu, Z. (2000) Fiscal decentralization and economic growth in China, *Economic Development and Cultural Change*, 49(1), pp.1-21.

Lin, S. and Song, S. (2002) Urban economic growth in China: theory and evidence, *Urban Studies*, 39(12), pp. 2251-2266.

Liu, Z. (2002) Foreign direct investment and technology spillover: evidence from China, *Journal of Comparative Economics*, 30, pp. 579-602.

Liu, Z. (2008) Foreign direct investment and technology spillovers: theory and evidence, *Journal of Development Economics*, 85, pp. 176-193.

Li, X., Liu, X. and Parker, D. (2001) Foreign direct investment and productivity spillovers in the Chinese manufacturing sector, *Economic Systems*, 25, pp. 305-321.

Liu, X., Parker, D., Vaidya, K. and Wei, Y. (2001). The impact of foreign direct investment on labor productivity in the Chinese electronics industry, *International Business Review*, 10, pp. 421-439.

Lovely, M. E., Rosenthal, S. S. and Sharma, S. (2005) Information, agglomeration and the headquarters of U.S. exports, *Regional Science and Urban Economics*, 35, pp. 167-191.

Lucas, R. E. (1988) On the mechanics of economic development, *Journal of Monetary Economics*, 22, pp. 3-42.

Malmberg, A., B. Malmberg and P. Lundequist. (2000). Agglomeration and firm performance: economies of scale, localization and urbanization among Swedish export firms, *Environment and Planning A*, 32, pp. 305-321.

Manez, J. A., Rochina, M. E. and Sanchis, J. A. (2004) The decision to export: a panel data analysis for Spanish manufacturing, *Applied Economics Letters*, 11, pp. 669-673.

Marshall, A. 1898. *Principles of Economics*, London: Macmillan.

Mody, A. and Wang, F. Y. (1997) Explaining industrial growth in coastal growth: economic reforms…and what else? *World Bank Economic Review*, 11, pp. 293-325.

Oates, W. E. (1972) *Fiscal federalism*, Harcourt Brace Jovanovich, New York.

Oates, W. E. (1993) Fiscal decentralization and economic development, *National Tax Journal*, XLVI (2), pp. 237-243.

Pan, Z. and Zhang, F. (2002) Urban productivity in China, *Urban Studies*, 39(12), pp. 2267-2281.

Phillips, K. L. and Shen, K. 2005. What effect does the size of the state-owned sector have on regional growth in China, *Journal of Asian Economics* 15: 1079-1102.

Porter, M. (1990) *The Competitive Advantage of Nations*. New York: The Free Press.

Qian, Y., and Weingast, B. (1996) China's transition to markets: market preserving federalism, *Journal of Policy Reform*, 1, pp. 140-185.

Quigley, J. M. (1998) Urban diversity and economic growth, *Journal of Economic Perspectives*, 12(2), pp. 127-138.

Romer, P. M. (1986) Increasing returns and long run growth, *Journal of Political Economy*, 94, pp. 1002-1037.

Rosenthal, S., S. and Strange, W. C. (2003) Evidence on the nature and sources of agglomeration economies. In *Handbook of Urban and Regional Economics*, ed. J. V. Henderson, and J-F. Thisse. Amsterdam: North-Holland.

Shearmur, R. and Polese, M. (2005) Diversity and employment growth in Canada, 1971-2001: can diversification policies succeed? *The Canadian Geographer*, 49 (3), pp. 272-290.

Shi, Y. and Zhou, L. (2007) Regional decentralization and economic efficiency: evidence from separate planning cities in China, *Economic Research*, 1, pp. 17-28 (in Chinese).

State Statistical Bureau. (2006) *China Statistical Yearbook 2006*, Publishing House of State Statistical Bureau, Beijing.

State Statistical Bureau. (2007) *2006 China Urban Life and Price Yearbook*, Publishing House of State Statistical Bureau, Beijing.

Thun, E. (2004) Keeping up with the Jones': decentralization, policy imitation and industrial development in China. *World Development*, 32, pp. 1289-1308.

Van der Panne, G. (2004) Agglomeration externalities: Marshall versus Jacobs, *Journal of Evolutionary Economics*, 14, pp. 593-604.

Van Soest, D. P., Gerking, S. and van Oort, F. G. (2006) Spatial impacts of agglomeration externalities, *Journal of Regional Science*, 46(5), pp. 881-899.

Wang, J. (2001) *Innovative Space: Enterprise Clusters and Regional Development.* Press of Peking University, Beijing. (in Chinese).

Wei, Y. (2000) *Regional Development in China: States, Globalization, and Inequality*, London: Routledge.

Yao, S. 2006. On economic growth, FDI and exports in China, Applied Economics 38: 339-351.

Young, A. (2000) The razor's edge: distortions and incremental reform in the People's Republic of China. Quarterly Journal of Economics, 115, pp. 1091-1135.

Zhang, K. H. (2001) How does foreign direct investment affect economic growth in China? Economics of Transition, 9(3), pp. 679-693.

Zhao, X. and Zhang, L. (1999) Decentralization reforms and regionalism in China: a review. International Regional Science Review, 22, PP. 251-281.

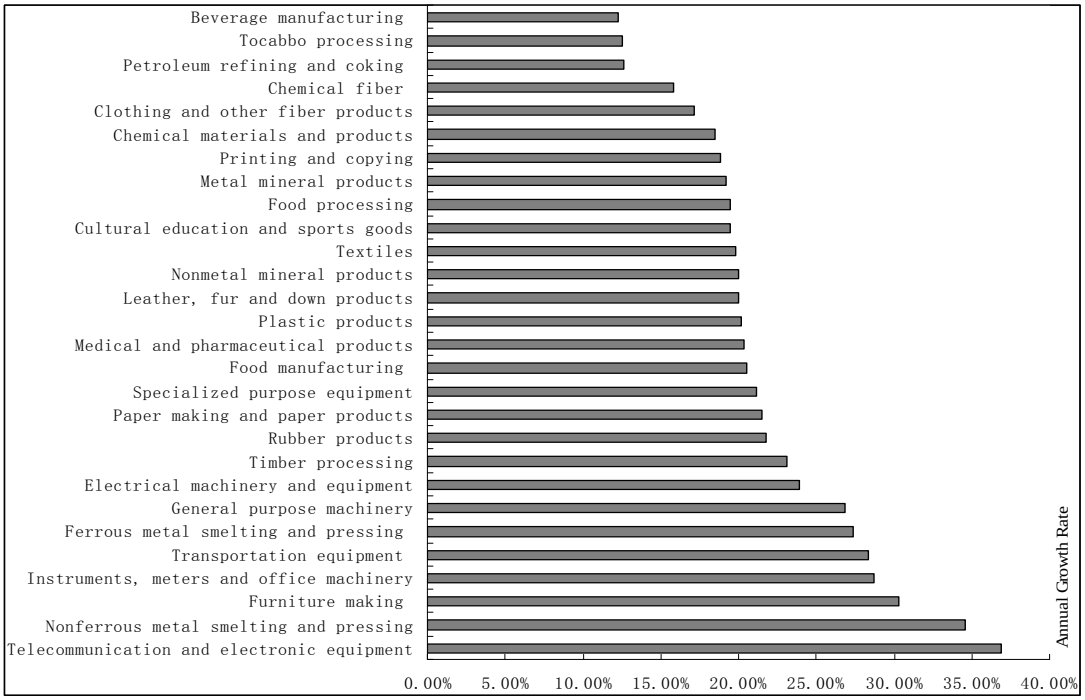


Figure 1. Annual Growth Rate of Chinese Manufacturing Industries by Industry during 2000-2005

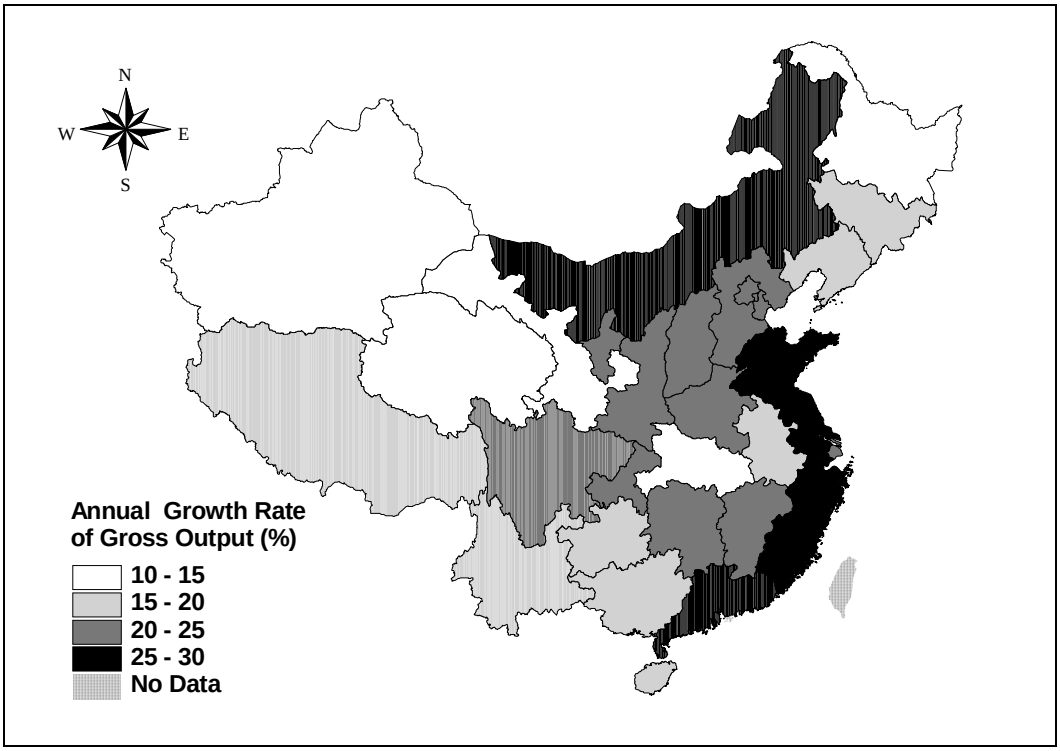


Figure 2. Annual Growth Rate of Chinese Manufacturing Industries by Province during 2000-2005

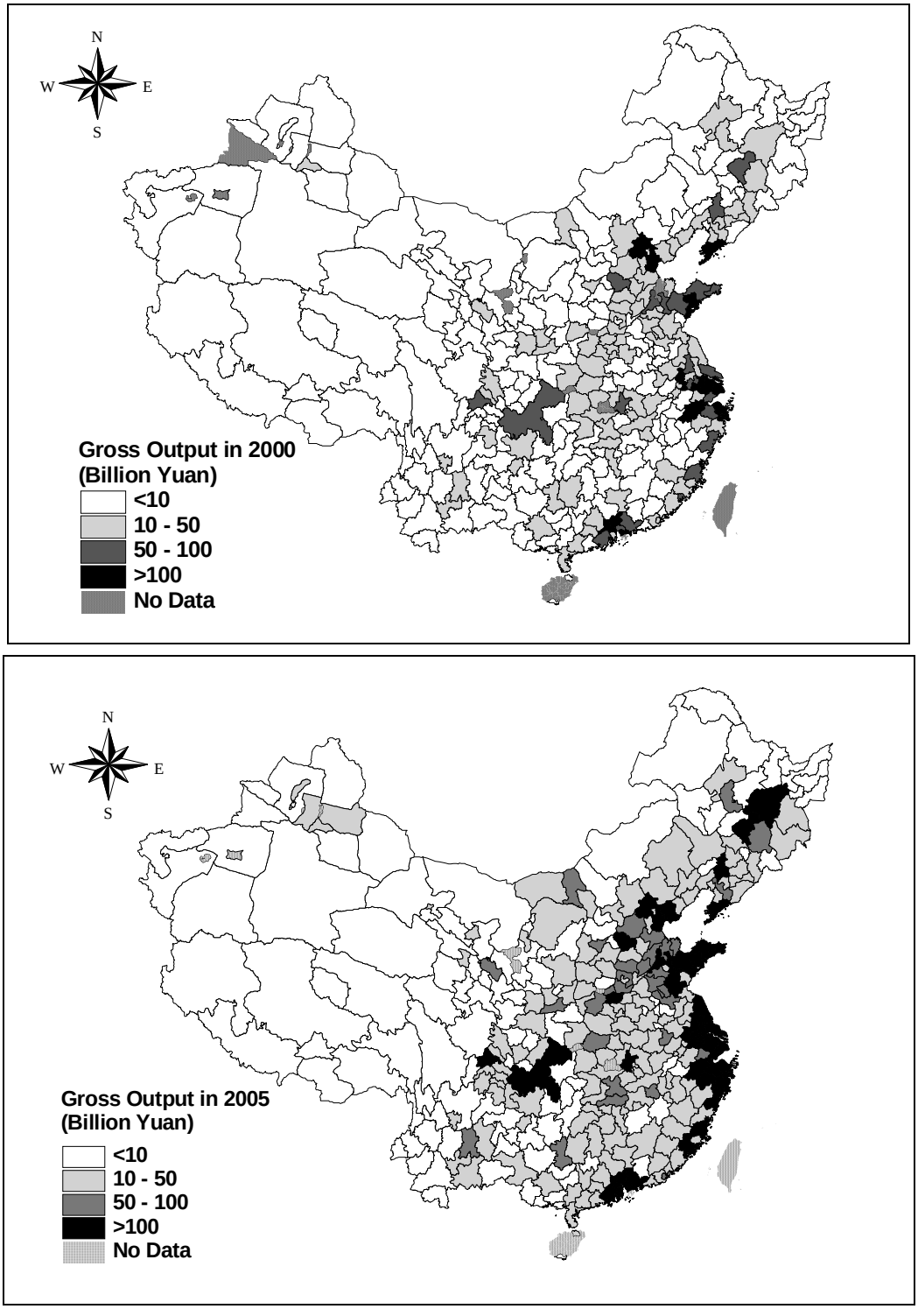


Figure 3. Distribution of Gross Industrial Output in China's Prefectures in 2000 (upper) and 2005 (bottom)

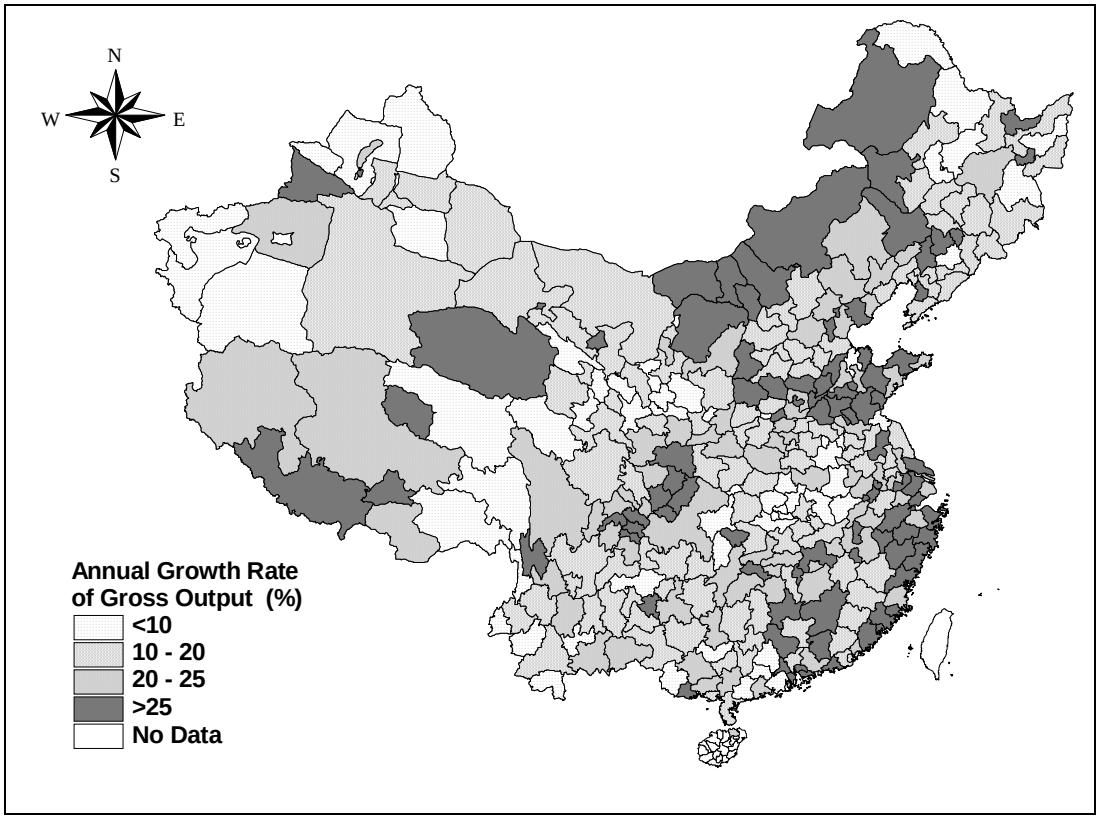


Figure 4. Spatial Patterns of Annual Growth Rate of Gross Industrial Output in China during 2000-2005.

Table 1. Regression Results from different model specifications

| Variable | Model1 | Model2 | Model3 | Model4 | Model5 | Model6 | Model7 | Model8 |
|---|---|---|---|---|---|---|---|---|
| LnKW | 0.3279*** | 0.3279*** | 0.3509*** | 0.3625*** | 0.3241*** | 0.3315*** | 0.3480*** | 0.3590*** |
| LnOUT | -0.2141*** | -0.2143*** | -0.1485*** | -0.1454*** | -0.2078*** | -0.2196*** | -0.1793*** | -0.1859*** |
| SIZE | -0.0221 | -0.0325* | -0.0121 | -0.0131 | -0.0088 | -0.0056 | -0.0072 | -0.0157 |
| LnDEN | 0.1972*** | 0.1894*** | 0.1645*** | 0.1612*** | 0.1529*** | 0.1335*** | 0.1559*** | 0.1357*** |
| $LQ_{sp}$ | 0.0375*** | 0.0265* | | | | | 0.0340*** | 0.0217* |
| $LQ_{sc}$ | 0.0286** | -0.0424** | | | | | 0.0229** | -0.0190 |
| $LQ_{sc}^2$ | -0.0010* | -0.0004 | | | | | -0.0008** | -0.0005 |
| $LC_{sp}$ | | | -0.0560 | -0.0582 | | | -0.0410** | -0.0405** |
| $LC_{sc}$ | | | 0.0715*** | 0.0631*** | | | 0.0673*** | 0.0785*** |
| $LC_{sc}^2$ | | | -0.0005*** | -0.0006*** | | | -0.0005*** | -0.0006*** |
| $DIV_{sp}$ | | | | | -0.0706*** | -0.0966*** | -0.0666*** | -0.0991*** |
| $DIV_{sc}$ | | | | | -0.0757*** | -0.1527*** | -0.0642*** | -0.1259*** |
| $DIV_{sc}^2$ | | | | | 0.0031** | 0.0042*** | 0.0025** | 0.0034*** |
| LIB*$LQ_{sc}$ | | 0.0281** | | | | | | 0.0157 |
| GLO*$LQ_{sc}$ | | 0.0773*** | | | | | | 0.0455* |
| DPT*$LQ_{sc}$ | | 0.5404*** | | | | | | 0.4817*** |
| DEP*$LQ_{sc}$ | | 0.018** | | | | | | 0.0076 |
| LIB*$LC_{sc}$ | | | | -0.0184 | | | | -0.0315*** |
| GLO*$LC_{sc}$ | | | | 0.1296*** | | | | 0.0826*** |
| DPT*$LC_{sc}$ | | | | 0.2440*** | | | | 0.1652*** |
| DEP*$LC_{sc}$ | | | | 0.0050 | | | | -0.0019 |
| LIB*$DIV_{sc}$ | | | | | | 0.0255** | | 0.0284*** |
| GLO*$DIV_{sc}$ | | | | | | 0.1031*** | | 0.0601*** |
| DPT*$DIV_{sc}$ | | | | | | 0.5110*** | | 0.2646*** |
| DEP*$DIV_{sc}$ | | | | | | 0.0193*** | | 0.0187*** |
| Industry Dummies | Included | Included | Included | Included | Included | Included | Included | Included |
| Obs. | 6534 | 6534 | 6534 | 6534 | 6534 | 6534 | 6534 | 6534 |
| $R^2$ | 0.1869 | 0.1923 | 0.2007 | 0.2108 | 0.1940 | 0.2068 | 0.2102 | 0.2297 |
| F | 43.93 | 40.70 | 48.00 | 45.64 | 46.01 | 44.56 | 43.21 | 37.16 |
| AIC | 2.928 | 2.923 | 2.911 | 2.900 | 2.919 | 2.905 | 2.901 | 2.880 |
| Std. Dev. | 1.04 | 1.04 | 1.03 | 1.03 | 1.04 | 1.03 | 1.03 | 1.02 |
| Breusch-Pagan | 1882.94 | 1925.98 | 1866.33 | 1866.30 | 1862.08 | 1820.45 | 1904.05 | 1876.02 |

[a] * donetes significance at the p< 0.10 level; ** donetes significance at the p<0.05 level, *** donetes significance at the p<0.01 level;

[b] Resulted are corrected with heteroscedasticity.

Table 2. Regressions for city-industry in the coastal, central and western region

| Variable | Coast | Center | West |
|---|---|---|---|
| LnKW | 0.4033*** | 0.3251*** | 0.2343*** |
| LnOUT | -0.2089*** | -0.2057*** | -0.2721*** |
| SIZE | -0.0898** | 0.0227* | 0.0553 |
| LnDEN | 0.1984*** | 0.0763*** | 0.1927*** |
| $LQ_{sc}$ | 0.0833*** | 0.0207 | 0.0205 |
| $LQ_{sc}^2$ | -0.0034*** | -0.0003 | -0.0009 |
| $LQ_{sp}$ | 0.0040 | 0.1155*** | 0.0093 |
| $LC_{sc}$ | 0.0389** | 0.0864*** | -0.0061 |
| $LC_{sc}^2$ | -0.0002 | -0.0006*** | 0.2350 |
| $LC_{sp}$ | -0.1342** | 0.1991*** | -0.0500 |
| $DIV_{sc}$ | -0.0662** | -0.0200 | -0.0442 |
| $DIV_{sc}^2$ | -0.0001 | 0.0014 | 0.0009 |
| $DIV_{sp}$ | -0.5108*** | -0.0590** | 0.0211 |
| Industry dummies | Included | Included | Included |
| Obs. | 2773 | 2399 | 1362 |
| $R^2$ | 0.2687 | 0.2464 | 0.2771 |
| F | 25.10 | 19.28 | 12.66 |
| Std. error | 0.969 | 0.978 | 1.084 |
| AIC | 2.789 | 2.810 | 3.028 |
| Breusch-Pagan | 1167.94 | 681.24 | 469.62 |

[a] * donetes significance at the p< 0.10 level; ** donetes significance at the p<0.05 level, *** donetes significance at the p<0.01 level;

[b] Resulted are corrected with heteroscedasticity.