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THE IMPACT OF INDUSTRIAL AGGLOMERATION ON FIRM EMPLOYMENT AND PRODUCTIVITY IN GUANGDONG PROVINCE, CHINA

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ABSTRACT

This paper examines the impact of industrial agglomeration on productivity and firm employment in Guangdong province, China. As the firstly opened area in China, Guangdong gained most benefits from the economic reform by attracting FDI and expanding trade. Furthermore, due to its adjacency to Hong Kong, a core-periphery mechanism with significant agglomeration effects, as described in spatial economics, had been observed. By carrying out OLS empirical method and using a panel dataset containing 504 samples from 2000 to 2005 at individual firm level, we found that the manufacturing rather than the service industry is playing the most important role in Guangdong; Furthermore, bridge infrastructure, industrial specialization, and FDI significantly affect firm employment and productivity. The empirical results imply that Guangdong should strengthen its technology level for further industrial upgrading.

Keywords: Industrial agglomeration, China, Panel, Growth.

Contribution/ Originality

This study demonstrates the agglomeration mechanism in Guangdong China, and empirically examines impacts of agglomeration by using micro Chinese firm-level panel data.

1. INTRODUCTION

By inserting in the global value chain[1] and undertaking ample labor-intensive assembly line production processes, China had achieved a huge economic development success since its economic reform, which had been launched in 1979. Even though, this economic development was imbalanced (Cai *et al.* (2002), Kanbur and Zhang (2005)), with the coastal regions gained development and the inland regions remained being delayed (Batisse (2002)). Such development imbalance was due to both regional characteristics and inclined industrial policy that permitting

[1] Refer to Gereffi and Korzeniewicz 1994.

some regions become wealthy at first and then be followed by other regions[2]. Meanwhile, the initial developed coastal regions had relied significantly on external relations, i.e. FDI and trade, as well as being underpinned by its competitive local factor endowments (Ng and Tuan, 2004).

Having experiencing nearly 30 years' export-oriented development strategy, those initially developed regions are now facing new challenges of industrial upgrading. As more developing countries/regions newly entering into the global value chain, those original competitive comparative advantages in coastal regions of China, including low wage labor forces and infrastructure readiness, became not as attracting as before. For further development, such coastal regions have to either improve the productivity and product quality, or to change the economic structure with tertiary sector (i.e. service industry) making up more share over the total GDP.

This paper aims to examine factors, which include sector belonging, infrastructure, agglomeration effects, and external relations that affect industrial upgrading and economic growth in the firstly developed regions in China. We have chosen Guangdong province as our study target because of its being the prime opened regions and of it is a region facing "middle-income trap" in China. Besides, similar to other developing countries' experiences, the economic development in Guangdong was a cluster-based development process, with a core-periphery mechanism, as described in spatial economics theories (Fujita *et al.* (1999)). By studying the case of Guangdong, we may be able to confirm how the empirical evidences were matching well to the theoretical model. We are to investigate the impacts brought by agglomeration effects onto firms located in this region. Guangdong province is holding the biggest GDP share within the mainland China in recent years. It is well known as a world production base and industrial agglomeration (cluster) location. In the initial phase of China's economic structure during 1980s, many foreign firms get into Guangdong and this has pulled Guangdong's local employment. The expanded economy in Guangdong has attracted not only workers from Guangdong province but also workers from poorer rural regions in inland China. Due to the low skill level of workers, firms located in Guangdong were majoring in labor-intensive production block which almost have no effect on raising firm productivity. However, during about 30 years economic reform, firms in Guangdong began to recognize the importance of firm productivity and production quality.

Given the existing controversial (Eichengreen and Tong (2006), Cheung and Lin (2004)) arguments about FDI and trade (export and import) effects, we will clarify the external related effects on the local firms' employment and productivity in the region as well. Moreover, we will broadly confirm where our target region is posited over its industrial upgrading process, i.e. manufacture sector leading or service sector leading. Besides, the yearly special characteristics and firm type special characteristics also will be taken into account.

The dataset we used in this paper is a firm-level panel data covering the period from 2000 to 2005. Although most previous literatures used aggregated data, we chose to use firm-level data to avoid the bias brought about by the use of aggregated data. On the other hand, individual firm-level

[2] Refer to Pengfei 2009.

data have many benefits that aggregate data do not have, such as the ability to control for firm heterogeneity. We expect our dataset can give us more reliable estimation results.

The contribution of this paper is we firstly introduced sector belonging variables to test what development phase do the samples are belonging to. Another point is we found FDI did not positively affect firm productivity and firms located in the cluster could not sufficiently exploit agglomeration effects such as specialization and diversity. Due to our small dataset, there may be some estimation bias. Despite of that, our results still imply that Guangdong as well as other Chinese firms should improve their productivity and technology level. The rest of this paper is organized as follows. Section 2 reviews the historical background of Guangdong province. Section 3 introduces theoretical and empirical previous literatures. Section 4 describes the dataset we use in this paper. Section 5 reports estimation results. And concluding remarks will be provided in section 6.

2. HISTORICAL BACKGROUND

2.1. Why Choose Guangdong Province as Study Target Region?

The start point of China's economic reform was symbolized by the opening of four special economic zones (SEZs) in which three of them were located in Guangdong province. Afterward, such SEZs that most of them were located in coastal cities/regions had virtually promoted their economic output. These SEZs-leading regions were given the authority to provide a variety of preferential policies to attract foreign investment. By exploiting the comparative advantage, such regions had linked the domestic inexpensive factor endowments and abroad export markets well. During the economic reform process, Guangdong province seems to have played the best performance among the country (See Table1).

Like cluster-based industrial development that had been seen in some other developing countries (Sonobe and Otsuka (2006; 2011)), the industrial development in Guangdong was also a cluster-based development process. After having experienced quantity expansion process, Guangdong is facing the quality improvement challenge now. This is an interesting point.

Furthermore, it had been observed a core-periphery mechanism that existing between Guangdong and Hong Kong (Ng and Tuan, 2006). It might be meaningful and expected to examine whether the region is in its agglomeration process or dispersion process in light of spatial economics theory. As the pioneer region in China's economic reform, Guangdong's experiences will give some hints and implications to other later-started developing inland regions as well as other developing countries in the world. For the purpose of detecting new development direction for China, the consideration of pioneer Guangdong's case-study also is undoubtedly important.

2.2. Industrial Development History in Guangdong

Guangdong province has been an important driver of China's economic growth. At the beginning of China's economic reform, Guangdong was the fifth biggest GDP holding province in the country. In 1989, ten years after the economic reform, its GDP holding had ranked to the first

and continued to rank first ever since. The total GDP of Guangdong province has increased from 18.5 billion RMB in1978 to 3569.6 billion RMB in 2008 with an annually growth rate of approximately 13.7%. Meanwhile, its composition of GDP also changed a lot with secondary and tertiary industries having made up much more share. The main indicators of Guangdong economy are described in Table1.

Table 1. Main economic indicators in Guangdong 1978-2008

Item	unit	1978		2008		annual avrage growth
		amout	share in country	amout	share in country	
GDP	100 million RMB	185.85	5.1%	35696.46	11.9%	13.7%
primary industry	100 million RMB	55.31	5.4%	1970.23	5.8%	5.5%
secondary industry	100 million RMB	86.62	5.0%	18402.64	12.6%	16.4%
tertiary industry	100 million RMB	43.92	5.0%	15323.59	12.7%	14.4%
Trade (Export&Import)	100 million USD	15.92	7.8%	6834.92	26.7%	22.4%
FDI (actual amout)	100 million USD	na.	na.	191.67	20.7%	na.

Note: There was no data of FDI in year 1978. The earliest data we have of FDI is 0.3074 (100 million USD) in 1979.

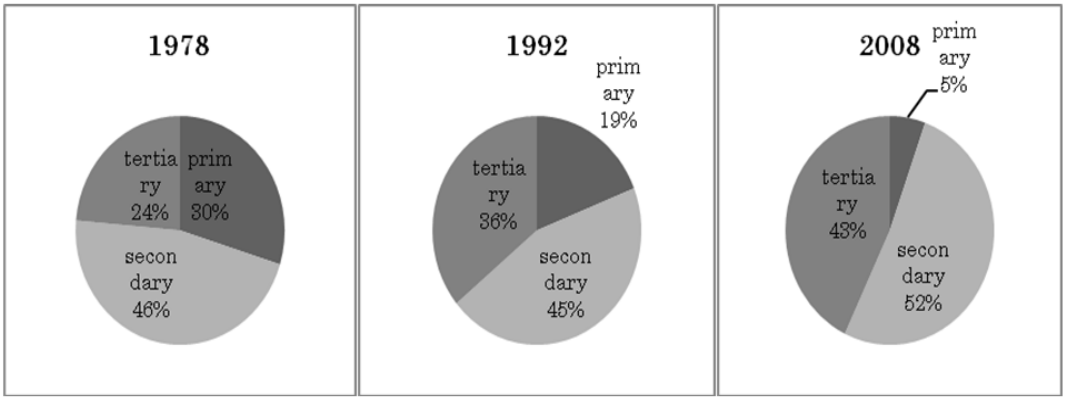
From the table, we can see that in the year of 2008, not only Guangdong's GDP was holding the biggest share in the country, but also the trade and FDI shares were further higher. This implied Guangdong's economic development model was an external oriented model. In the initial development stage, Guangdong has undertaken some light industries which were relocated from Hong Kong. It was due to the soaring land rents and labor costs in Hong Kong as well as the simultaneously newly launched open-door policy in mainland China. The competitive local factor endowments in Guangdong and advanced hardware and software from Hong Kong had made this industry relocation successful. Lucrative profits had been made from the labor-intensive industries, and this performance had induced furthermore Hong Kong firms to shift their production bases into Guangdong. From low value-added production block to high value-added block, the manufacturing production processes had been moved to Guangdong step by step by small and medium firms. These small and medium enterprises have formed an industrial cluster/agglomeration area in Guangdong in which a lot of assembly factories and parts/components makers were located.

In 1990s, following the base sectors' (parts makers and assemblers) agglomeration, some large scale set-maker manufacturers began to enter into Guangdong too. Facing the expansion of the industrial agglomeration, the base sectors (parts makers and assemblers) had been able to provide much more varieties of intermediate inputs such as electronic products, communication products, precision instrument products etc. According to spatial economics theories, this was an agglomeration expansion process. Like previous literature (Ng and Tuan, 2006) arguing, other than the preferential policies, the agglomeration effects had played a critical role in directing economic growth in Guangdong too. We will further confirm such effect in our empirical analysis part.

The cluster-based development model has effectively improved economic structure change in Guangdong. The three industries' composition has shifted from 29.8:46.6:23.6 in year 1978 to 5.5:51.6:42.9 in year 2008 (See Figure1). Industrialization progress in Guangdong has been promoted as same as the style of industrial structure shift that had happened in preceded developed

countries. The consideration of industrial structure shift also will be demonstrated in our empirical analysis part.

Figur-1. Industrial structure shift in Guangdong 1978, 1992, 2008.



2.3. Industrial Specialization and Geographical Concentration in Guangdong

As above mentioned, Guangdong's industry development was a cluster-based model. When transport cost (broadly defined) decreases, the spatial distribution of economic activities will tend to agglomerate (Fujita (2007). To exactly grasp the situation and degree of agglomeration in Guangdong, we have calculated the Herfindahl index (Herfindahl (1959) in terms of both regional aspect and industrial aspect respectively by using city level data from year 2000 to year 2009 in Guangdong province. To make things clarified, we define the term "Industrial specialization" and the term "Geographical concentration" following Aiginger (1999). Specialization is defined as distribution of the weight of an industrial sector i in a specific region r, a region with small/large number of industries is said to be highly specialized/diversified. On the other hand, concentration is defined as distribution of the weight of a region r in a specific industry i in a sector, an industry unevenly/evenly distributed over regions is said to be geographical concentration/dispersion.

The calculation measures for Herfindahl indices are described as follow,

For industrial specialization in a region r: $H_r^s = \sum_i (S_{ir}^S)^2$

For geographical concentration of an industry i: $H_i^c = \sum_r (S_{ir}^C)^2$

In the formulation, subscript S and subscript C means specialization and concentration respectively; Subscript r indicates region and subscript i indicates industry. H stands for Herfindahl index and S stands for output share. The Herfindahl index ranges a space bigger than 0 and smaller than 1. If the index approaches to 1, it means the industry or region is highly specialized or concentrated; if the index approaches to 0, vice versa.

We carried out the calculation by using our dataset from 2000 to 2009 and made a summary about them as the two tables below (See Table2 and Table3).

Table2. Herfindahl index for industrial specialization

industry	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Processing of Farm and Sideline Food	0.113	0.120	0.117	0.111	0.112	0.115	0.122	0.133	0.115	0.104
Manufacture of Food	0.194	0.215	0.225	0.194	0.190	0.185	0.178	0.195	0.150	0.154
Manufacture of Beverage	0.144	0.155	0.226	0.167	0.172	0.175	0.172	0.204	0.163	0.192
Tobacco Products	0.337	0.411	0.193	0.284	0.283	0.288	0.269	0.275	0.279	0.273
Textile Industry	0.113	0.102	0.099	0.107	0.104	0.111	0.110	0.113	0.112	0.118
Manufacture of Textile Garments, Footwear and Headgear	0.103	0.108	0.136	0.109	0.112	0.117	0.117	0.115	0.108	0.109
Leather, Fur, Feather, Down and Related Products	0.180	0.155	0.204	0.133	0.132	0.126	0.118	0.120	0.110	0.105
Timber Processing, Bamboo, Cane, Palm Fiber & Straw	0.136	0.138	0.164	0.111	0.111	0.101	0.106	0.104	0.105	0.100
Manufacture of Furniture	0.119	0.124	0.113	0.144	0.148	0.168	0.171	0.169	0.161	0.159
Papermaking and Paper Products	0.122	0.122	0.115	0.126	0.123	0.146	0.154	0.157	0.156	0.134
Printing and Record Medium Reproduction	0.121	0.121	0.110	0.133	0.129	0.163	0.145	0.143	0.124	0.113
Manufacture of Cultural, Educational and Sports Articles	0.148	0.142	0.138	0.142	0.137	0.140	0.135	0.135	0.121	0.109
Petroleum Refining, Coking and Nuclear Fuel Processing	0.430	0.450	0.390	0.388	0.404	0.341	0.306	0.337	0.296	0.228
Manufacture of Raw Chemical Materials and Chemical Products	0.220	0.231	0.217	0.244	0.283	0.230	0.186	0.250	0.173	0.179
Manufacture of Medicines	0.182	0.179	0.165	0.168	0.157	0.146	0.145	0.169	0.131	0.127
Manufacture of Chemical Fibers	0.229	0.139	0.152	0.129	0.135	0.123	0.314	0.207	0.258	0.244
Rubber Products	0.247	0.237	0.274	0.236	0.227	0.194	0.178	0.164	0.153	0.126
Plastic Products	0.119	0.119	0.118	0.119	0.118	0.126	0.130	0.136	0.127	0.125
Nonmetal Mineral Products	0.125	0.157	0.152	0.170	0.181	0.199	0.204	0.214	0.200	0.177
Smelting and Pressing of Ferrous Metals	0.237	0.264	0.221	0.190	0.195	0.172	0.189	0.130	0.170	0.176
Smelting and Pressing of Nonferrous Metals	0.194	0.250	0.296	0.300	0.289	0.269	0.264	0.291	0.207	0.200
Metal Products	0.120	0.116	0.121	0.124	0.128	0.130	0.130	0.146	0.139	0.152
Manufacture of General-purpose Equipment	0.172	0.152	0.143	0.134	0.171	0.151	0.143	0.129	0.147	0.157
Manufacture of Special-purpose Equipment	0.113	0.127	0.125	0.127	0.133	0.159	0.162	0.176	0.162	0.169
Manufacture of Transport Equipment	0.335	0.411	0.446	0.486	0.490	0.475	0.484	0.519	0.453	0.475
Manufacture of Electrical Machinery and Equipment	0.172	0.180	0.172	0.164	0.159	0.167	0.167	0.190	0.175	0.179
Manufacture of Communication Equipment, Computers and	0.266	0.297	0.297	0.311	0.311	0.372	0.389	0.351	0.380	0.361
Manufacture of Instruments, Meters and Machinery for	0.280	0.312	0.270	0.216	0.220	0.201	0.206	0.208	0.209	0.218
Handicraft and Other Manufactures	0.118	0.128	0.117	0.130	0.123	0.180	0.176	0.150	0.210	0.206

Table3. Herfindahl for geographical concentration

location	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
guangzhou	0.055	0.060	0.066	0.078	0.084	0.087	0.092	0.122	0.098	0.115
shenzhen	0.276	0.342	0.420	0.418	0.435	0.422	0.441	0.312	0.405	0.410
zhuhai	0.126	0.118	0.147	0.196	0.211	0.183	0.199	0.171	0.181	0.170
shantou	0.069	0.061	0.062	0.068	0.065	0.064	0.067	0.070	0.070	0.072
foshan	0.107	0.114	0.105	0.110	0.104	0.099	0.099	0.097	0.091	0.088
shaoguan	0.146	0.156	0.154	0.187	0.213	0.194	0.171	0.147	0.185	0.143
heyuan	0.105	0.107	0.107	0.119	0.122	0.119	0.109	0.109	0.095	0.100
meizhou	0.131	0.124	0.128	0.141	0.164	0.149	0.137	0.235	0.119	0.127
huizhou	0.318	0.369	0.432	0.445	0.425	0.408	0.311	0.214	0.286	0.274
shanwei	0.164	0.183	0.183	0.186	0.251	0.250	0.264	0.335	0.182	0.145
dongguan	0.150	0.173	0.200	0.181	0.185	0.144	0.140	0.106	0.118	0.121
zhongshan	0.069	0.081	0.084	0.082	0.084	0.082	0.083	0.086	0.090	0.095
jiangmen	0.064	0.067	0.071	0.075	0.076	0.080	0.075	0.079	0.074	0.074
yangjiang	0.127	0.143	0.177	0.137	0.141	0.166	0.172	0.171	0.174	0.183
zhanjiang	0.111	0.148	0.169	0.182	0.209	0.194	0.200	0.175	0.189	0.158
maoming	0.515	0.535	0.374	0.389	0.570	0.554	0.563	0.474	0.521	0.463
zhaoqing	0.069	0.064	0.064	0.069	0.068	0.078	0.085	0.079	0.090	0.082
qingyuan	0.103	0.087	0.105	0.092	0.101	0.078	0.085	0.112	0.108	0.101
chaozhou	0.149	0.132	0.145	0.136	0.148	0.153	0.167	0.193	0.186	0.189
jieyang	0.139	0.110	0.103	0.083	0.082	0.082	0.076	0.076	0.086	0.088
yunfu	0.122	0.143	0.156	0.126	0.126	0.127	0.119	0.119	0.125	0.123

From Table2 and Table3, we can see that the most clustered cities are Shenzhen, Maoming, Huizhou; and the most agglomerated industries are Petroleum and coal products, Transportation equipment and ordnance, Communication equipment. Overall, the industrial specialization degree and geographical concentration degree were high in Guangdong province. We will also take the above regions and industries into account by including regional dummy variables and industrial dummy variables in our econometric analysis part.

3. PREVIOUS LITERATURE REVIEW AND HYPOTHESES SUGGESTION

3.1. Theoretical Literatures

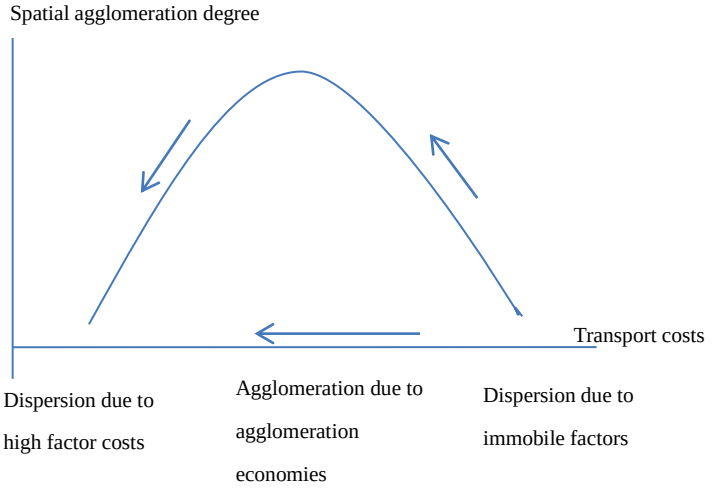
Economic theories to explain agglomeration has had a long history and various advocacies. The earliest argument was thought as the comparative advantage argument Ricardo (1963), Jones

(1965), which considers the underlying characteristics i.e. fixed factor endowment such as geography, resources, technology, are the key determinants of agglomeration and location. This framework postulated the model under constant returns and perfect competition without mobile productive factors. Comparative advantage theory could explain a static trade/agglomeration model, but failed to explain the agglomeration of economic activities in a dynamic and borderless economy. Recent trends of global market expansion and regional economic integration had posed a new question to academic world to ask why even though the priori same two regions can become to totally different ones in terms of agglomeration, why some regions were agglomerated with a variety of firms while other regions do not, and why economic integration can change the industries' locations within that region.

A very good theory emerged then, that could explain well the above questions, which is called new economic geography or spatial economics (we call it as "spatial economics" below). The framework of spatial economics includes increasing returns, imperfect competition, transport costs (broadly defined), and mobile productive factors, in which a general equilibrium model is supposed. A pioneering work in this field was the core-periphery model Krugman (1991a; 1991b). The article showed that the interaction of labor migration across regions with increasing returns and trade costs creates a tendency for firms and workers to cluster together. They also showed regions which are priori similar, or even identical, can endogenously differentiate into rich core regions and poor peripheral regions. If factors are mobile between counties/regions, the pressure put on those factors by the concentration of economic activities will be eased. Even if regions are priori identical, they can become endogenously differentiated into an industrialized core and a deindustrialized periphery (Krugman (1991b).

The spatial economics theory had become one of the most exciting areas of contemporary economics. A masterpiece of this approach was the book: The Spatial Economy: Cities, Regions and International Trade Fujita *et al.* (1999), authored by Fujita, Krugman and Venables. They have not only considered the agglomeration (centripetal) process, but also the dispersion (centrifugal) process. The essence of their arguments can be described in an inversed U-shape curve (See Figure2).

Figure-2. The process of agglomeration and dispersion (Fujita (2007))



Other than spatial economics, there are some other theories as well to explain the effects of geographical concentration / industrial specialization onto regional economic (or employment) growth. The former is represented by Marshall (1920) and Romer (1990) who strengthened the industrialization effects are important and think the externalities within an industry is good for firms in that industry. In contrast, the latter is represented by Jacobs (1969) who suggested that competition and industry varieties were more important for economic growth. Usually, the former is called localization or MAR externalities and the latter is called urbanization or Jacobs' externalities. In this paper, they are corresponding to industrial specialization and geographical concentration indices, respectively.

3.2. Empirical Literatures

Empirical studies about the agglomeration effects had been conducted almost in developed countries. But recently, this kind of study has started to be carried out in developing countries, such as China, too. The earliest literature in this field was carried out by Hanson. Hanson (1996) examined demand links between U.S. and Mexican border cities over the period 1974-1989. Regression analysis has been made between regional employment growth and some location factors (including wage rate, regional total personal income, industrial employment, export assembly plants' employment at the region (city) level, etc.) in the USA. They found that the regional employment growth in the U.S. border cities is positively affected by manufacturing agglomeration in the US-Mexico border region. Glaeser *et al.* (1992) used the regional employment dataset from 1956 to 1987 in 170 cities in USA to estimate agglomeration effects at city level. They found a positive effect of Jacobs' externalities to employment growth in the US.

Batisse (2002) conducted regression analysis for local value-added growth in Chinese provinces by using region-level panel data of China. Their study contains 30 industries of a time period from 1988 to 1994. They found diversity (Jacobs' externalities) and competition had a positive influence on local value-added growth, but specialization (MAR externalities) had a negative impact. They also found the different development levels (inequality) for coastal provinces and inland provinces in China. bApart from agglomeration effects, the external related factors also play an important role in firm employment/productivity growth as well as firm location choice. Belderbos and Carree (2002) studied locational choices by Japanese electronics manufacturers in China's regions and provinces during 1990-1995 and confirmed positive effects of agglomeration in both industrial level and keiretsu-specific level. Resmini (2003) explored regional employment growth factors in the EU east enlargement process. Economic integration will induce new agglomeration spots/clusters, the agglomeration benefits would usually be accompanied in such process, similarly to the facts we have observed in Guangdong province. The paper found that original agglomeration spot (the country capital) has weakened their centripetal forces, on the other hand, border regions, especially borders connected to current EU countries had grew fast. With respect to previous literatures that address Guangdong, the same target area with this paper, Ng and Tuan (2006) studied spatial agglomeration process in Guangdong. By using

2SLS estimation method, they found positive relations between FDI and agglomeration effects and between GDP and agglomeration effects, FDI. Their study verified again that Guangdong's development process was a cluster based one.

For the confirmation of which stage the cities in Guangdong are along their industrial upgrading ladder, I introduced a broad estimation method that is to use three industries' share as explanatory variables. This is just a broad estimation method, we expect that newly increased employment will positively related with the industry to which they belong.

For other summaries about empirical previous literature, refer to Table4 below.

Table-4. Summary of some previous literatures

Dependent variable	Independent variable	Literature	Estimate method
Regional FDI and GDP	Local Chinese firms' herfindahl and foreign firms' herfindahl	(Ng and Tuan, 2006)	2SLS
Regional employment share, growth of share	Wage, distant, FDI, road, service	Resmini (2003)	OSL (pooled, FE)
Probability of location	Plants number in log, GDP, telephone lines, wage, distance, seaport, SME dummy	Belderbos and Carree (2002)	Conditional Logit
Employment growth	Personal income, industry employment, export employment, state wage	Hanson (1996)	OLS
Wage rate	Distance, border dummy, year dummy	Hanson (1997)	OLS
Value added	Capital, specialization, diversity, competition	Batisse (2002)	FE
Employment	Wage, employment growth, industry share	Glaeser *et al.* (1992)	OLS

3.3. Hypotheses Made in this Paper

Based on the theoretical review and empirical previous facts, we pose the following hypotheses in our paper.

Hypotheses1: The secondary industry variable will be positive if the secondary industry provides more job opportunities to absorb labor force. The same is tertiary industry.

Hypotheses2: Highway and bridge readiness will positively affect firm employment and productivity.

Hypotheses3: The industrial specialization effects (MAR externalities) and geographical concentration effects (Jacobs' externalities) will have positive effects onto firm employment and productivity.

Hypotheses4: Trade and FDI will positively affect firm employment and productivity.

Based on such hypotheses, we construct our regression model as follows (Note: The following four regression models are not one to one in corresponding to the above hypotheses.):

$$\log(labor_{i,t}) = \log(wage_{r,t}) + log(prima_{r,t}) + log(secon_{r,t}) + log(tertia_{r,t}) + log(hway_{r,t}) + log(bridge_{r,t}) + log(freight_{r,t}) + log(regionher_{r,t}) + log(indusher_{r,t}) + log(export/import/fexport/fimport_{r,t}) + log(fdi_{r,t}) + \varepsilon_{i,t}$$

$$\log(produc_{i,t}) = \log(wage_{r,t}) + log(prima_{r,t}) + log(secon_{r,t}) + log(tertia_{r,t}) + log(hway_{r,t}) + log(bridge_{r,t}) + log(freight_{r,t}) + log(regionher_{r,t}) + log(indusher_{r,t}) + log(export/import/fexport/fimport_{r,t}) + log(fdi_{r,t}) + \varepsilon_{i,t}$$

$$\log(labor_{i,t}) = \log(wage_{r,t}) + log(prima_{r,t}) + log(secon_{r,t}) + log(tertia_{r,t}) + log(hway_{r,t}) + log(bridge_{r,t}) + log(freight_{r,t}) + log(regionher_{r,t}) + log(indusher_{r,t}) + log(export/import/fexport/fimport_{r,t}) + log(fdi_{r,t}) + indusdummy + regiondummy + \varepsilon_{i,t}$$

$$\log(produc_{i,t}) = \log(wage_{r,t}) + log(prima_{r,t}) + log(secon_{r,t}) + log(tertia_{r,t}) + log(hway_{r,t}) + log(bridge_{r,t}) + log(freight_{r,t}) + log(regionher_{r,t}) + log(indusher_{r,t}) + log(export/import/fexport/fimport_{r,t}) + log(fdi_{r,t}) + indusdummy + regiondummy + \varepsilon_{i,t}$$

Here, "i" stands for firm, "r" stands for region (city), and "t" stands for year, respectively.

4. DATA AND DESCRIPTIVE STATISTICS

The main dataset is a publicly available dataset came from the webpage of Japan Center for Economic Research (See http://www.jcer.or.jp/report/asia/detail3735.html). This dataset includes four countries' listing firms, the dataset containing terms as labor (employment), capital, industry, productivity, input, output, etc. In dataset of China, 7837 samples of Chinese firms are available. Among them, we had taken samples that located in Guangdong province from the dataset exclusively. 587 samples were chosen out as our database, which were individual firm level panel dataset ranged a time period from year 1999 to year 2005.

After drop out imbalanced samples from the dataset, we have finally got 504 samples ranged from year 2000 to year 2005 that located in 13 industries and 12 cities in Guangdong province. The industries and regions (cities) that finally have been used in this paper are summarized as following (See Table5).

The two dependent variables, which are employment (man-hours) of the firm and productivity of the firm, we used in this paper are from this data set. When we use the employment data, we just follow the figures in the original dataset; and when we use the productivity (TFP) data, we complied with the calculation method that provided in the same website (see Fukao (2008)).

Table5. Descriptive statistics of industries and regions

Industry	Obs.	Percent	dummy var
Food and kindred products	12	2.38	1
Textile mill products	30	5.95	2
Petroleum and coal products	6	1.19	3
Chemicals	48	9.52	4
Stone clay glass	12	2.38	5
Primary metal	18	3.57	6
Fabricated metal	12	2.38	7
machinery non-elect	6	1.19	8
Transportation equipment and ordnance	36	7.14	9
Electrical utilities	162	32.14	10
Communication	30	5.95	11
Instruments	6	1.19	12
Other private services	126	25	13
	504	100	

Location	Obs.	Percent	dummy var
dongguan	24	4.76	1
foshan	24	4.76	2
guangzhou	84	16.67	3
jiangmen	18	3.57	4
maoming	6	1.19	5
meizhou	12	2.38	6
shantou	6	1.19	7
shaoguan	12	2.38	8
shenzhen	294	58.33	9
zhaoqing	12	2.38	10
zhongshan	6	1.19	11
zhuhai	6	1.19	12
	504	100	

The calculation functions of TFP:

$$\ln TFP_{f,t,j,m} = \left(\ln Q_{f,t,j,m} - \overline{\ln Q_{t,j,m}}\right) - \sum_{i=1}^{n} \frac{1}{2}\left(S_{f,i,t,j,m} + \overline{S_{i,t,j,m}}\right)\left(\ln X_{f,i,t,j,m} - \overline{\ln X_{i,t,j,m}}\right)$$

where Q is real output, X is real input, S is cost share of production factor; f is firm, t is year, i is production factor, j is industry and m is country.

Explanatory variables are from Guangdong Statistical Yearbooks (1999-2005). We used these data at a regional (city) level. The variable wage represents the average wage rate of the city in which firms located. We expect this variable have a negative sign, i.e. higher the wage rate, smaller the employment. Since wage rate is suspected to be linearly related with productivity, we will drop this explanatory variable when putting productivity as the dependent variable.

Explanatory variables lprima, lsecon, and ltertia stand for the share of primary sector, secondary sector and tertiary sector in the yearly regional (city) GDP from 2000 to 2005. By using these three variables, we broadly estimate, which point Guangdong province is posited in its industrial upgrading process. According to the development experience had been observed in some previous developed countries, when a country goes its way on upgrading the primary sector will become smaller and tertiary industry will become bigger. If it is true, we expect the sign of lprima will be negative, lsecon and ltertia will be both positive; or lsecon to be negative and ltertia to be positive for labor (employment) as well as productivity as independent variables.

Considering the infrastructure facilities are important for economic development, especially for the initial phase of development, we also included highway (km), bridge (m), and freight

variable[3] (ton*km). We expect both positive and negative possibilities of signs for these variables; it is because infrastructure usually positively affects economic growth in the first stage of development but may not necessarily be effective in the further upgraded phase.

With respect to the industrial specialization effect and geographical concentration effect, we introduced regional Herfindahl index in an industry and industrial Herfindahl index in a region. As we will introduce in our empirical previous study part, these two variables may have different signs according to the dependent variables and development process.

Last part is about the external trade relations, which including exports (100 million USD), imports(100 million USD), foreign exports(100 million USD), foreign imports(100 million USD), as well as regional FDI inflow amount (USD10000) and trade share out of regional GDP. Since Guangdong is an external oriented economic development model, we expect signs of those variables are positive. We also created industrial dummy variables and regional dummy variables to clarify what are the base characteristics for each industry / region.

5. ESTIMATION RESULTS

We report our empirical results in Table6 - Table10. Firstly, we have a look at the three industries' effects. Due to Multicollinearity problem, we do not include three of them at onetime, instead we include either two of them from the three industries. Results showed that compared with that three industries do not have significant impact on firm's productivity; they do have impacts on employment (labor) growth. We can see the primary industry had significant negative impact, the secondary industry had significantly positive effect, and the tertiary industry' coefficient was significantly negative. These imply that during the time period 2000 to 2005, the primary has not absorbed so many labors, in the other words, main employment growth were not occurred in the agriculture sector. Alternatively, the secondary industries absorbed a vast number of labor force during the same time period according to the big coefficient value. The tertiary industry seems to be still in its middle-income trap yet, a little exception from hypothesis1. According to previous developed countries experiences (like the US and Japan), as a country goes through its development process, the share of agriculture would become smaller step by step, the manufacture would become bigger as well as the service industries. In a mature developed country, the tertiary industry, i.e. the service industry will account for the biggest share in the country's GDP. Our results implied that Guangdong province is in the midst of its middle-income trap phase in which the secondary industry making up the biggest share. This result was also corresponding to our assumption in hypothesis1. Yet, the tertiary industry's negative coefficient suggests that Guangdong should further expand the service sector.

[3] Freight (ton-kilometers) represents total transported goods amount times the length they've been delivered. It can also be thought as a proxy for logistics within the city. A better infrastructure level will bring a better development base to the city. So, we expect this variable to be positive.

As for the proxy for infrastructure, we introduced three variables which are highways, bridges, and freight. These variables will represent transportation condition on the road, on the ocean, and in terms of length times by weight, respectively. The results shows highway was not significant but bridges did have significantly positive impact on labor. On the other hand, highways had significantly negative effects on firm productivity and bridges were significantly positive. While freight has a positive effect on productivity, it has negative effect on labor with both of the coefficient values small. These results imply that bridge is important for both labor and productivity, highway only affects productivity negatively. Corresponding to the reality, industries like export assembly may rely heavily on transportation measure, but industries like R&D and IT may do not rely heavily on infrastructure due to the prevalence of the Internet and convenient new communication method. This result hints to policy makers in Guangdong that to further develop the tertiary industry, soft infrastructure are needed instead of hard infrastructure.

As for the two proxies for agglomeration, we found geographical concentration (MAR externality) was significantly positive for firm employment and industrial specialization (Jacobs' externality) was non-significant. And for productivity, industrial specialization (Jacobs' externality) was significantly negative and geographical concentration (MAR externality) was non-significant. The result implies that, for firm employment, the localization externality makes sense rather than urbanization externality, i.e. firms would benefit from other firms in the same industry. On the other hand, for productivity, the industrial specialization seems negatively affect firm productivity rather than geographical concentration, i.e. the more the number of industries in a region the higher the productivity. This result implies that firms would raise their productivity by benefiting from Jacobs' externality. Result of productivity is combined with Glaeser *et al.* (1992) and Batisse (2002). With respect to the external-related estimators, FDI has significant positive effects on firm employment but has significant negative effects on firm productivity. This result corresponds to the aforementioned reality as well, that is, FDI may have improved the employment growth of labor-intensive industry but not the same for firm productivity. FDI has a negative effect on productivity may imply the facts of export assembly industry that the precision parts / components were imported from abroad rather than from local Chinese firms. So we can get information from this result that industrial upgrading requires local Chinese firms to undertake much more technical part when they involve in foreign direct investment.

The export and foreign export parameter were significantly negative and import parameter was significantly positive for the local firm employment as independent variable. The result of export is different from our hypothesis; we can consider it as some of the export industries may not export labor-intensive goods. On the other hand, for the firm productivity as dependent variable, foreign export was significantly positive and foreign import was significantly negative, the other two variables were statistically non-significant. This may imply that foreign firm procure some parts and components from local firms and export the assembled goods which contain those parts and components. Yet, foreign firm import core parts from abroad induced to the negative impact on local firm productivity. That is to say, local firms did not benefit spill-over effects from foreign

import firms. Trade share variable means the sum of regional export and import to be divided by regional GDP. This variable seems to be irrelevant with both firm employment and productivity.

To further observe the impacts on different industries and regions, we introduced industry dummy variable, regional variable, and interaction terms too. As for industry dummy variable to put labor as dependent variable, only the primary metal industry (industry dummy 6) has a positive sign, and petroleum and coal products (industry dummy 3), communication machinery industry (industry dummy 11), and other private service industry (industry dummy 13) were negative. This implies that compared with primary metal industry needs a number of labor force, communication and other private service do not need so many labor force. As for region dummy variables, only region dummy 2 (Foshan) significant positive and other regions non-significant.

When we put the firm productivity as dependent variable, industry 2, 4, 5, 6, 10, 12 were negative significant and industry dummy 3 was positive. This shows that almost firms / industries in Guangdong province are still in a low productivity level, especially for textile mill products, chemicals, stone clay glass, primary metal, electrical utilities, and instruments industries. Only the petroleum and coal products industry has high productivity relative to food and kindred products industry. And the regional dummy variables, only region Zhongshan was positive and others were non-significant with Dongguan as the reference.

6. CONCLUSION REMARKS

From the above analysis, we can find that Guangdong is a region in the midst of its middle-income trap. Secondary industry has created most job openings yet the tertiary industry has not played its role yet. Industrial agglomeration effects are important for Guangdong too, as had been observed in other countries, but with different types of externalities. Compared to labor-intensive industries prefer to localization externality, firms aiming at raising productivity seem enjoyed from variety and competition. For the purpose of industrial agglomeration upgrading, the region's government have to make effective policies to improve productivity and product quality, and to promote the development style to be a capital intensive and human-resource intensive one with service industries making much more share in total GDP.

Infrastructure related variables it seems that bridge rather than highway positively affect firm employment and productivity. Bridge may be more important than highway for local firms at the study time period. Industrial agglomeration effects are not as same as our hypothesis. Geographic concentration (Jacobs) effect negatively affect employment and had no impact on productivity; Industrial specialization (MAR) had nothing with employment and negatively affect productivity. These results shows that local firms have not enjoyed the agglomeration effects sufficiently yet.

And for the external-relationship, FDI positively affect employment but negatively affect local firm productivity. On the other hand, trade got a very interesting result. Import and foreign import positively affect employment yet export and foreign export were negative; Import and foreign import negatively affect productivity yet export and foreign export were positive. It seems that local firms get benefit from import in terms of employment and get benefit from export in terms of

productivity. With respect to the industry dummy variables and region dummy variables, we got the following results. In terms of firm employment, petroleum, communication, and other private service industries have smaller employment than food; Foshan city has more employment than Dongguan. In terms of firm productivity, petroleum is higher than food, textile, chemicals, primary metal, electrical utilities, instruments are lower than food; Zhongshan city is higher than Dongguan.

All of the above results indicate the technology and innovation are key points for Guangdong's industrial upgrading. Due to data limit, we do not have such kind of factors in this paper and we plan to introduce the proxy for R&D and innovation in our future research. When we put the story of Guangdong into a typical production function, the capital and labor parts had already been done a lot. So now, the challenge to which the policy makers and local people are facing is just to do the best to improve total factor productivity.

Table 6. Results of three industries' impacts (labor as dependent var.)

	model1 b/t	model2 b/t	model3 b/t	model4 b/t	model5 b/t	model6 b/t	model7 b/t
lwage	−2.54 [−2.78]***	−2.45 [−2.71]***	−2.57 [−2.80]***	−2.23 [−2.47]**	−1.7 [−2.45]**	−1.02 [−1.68]*	−0.92 [−1.52]
lprima	−1.64 [−1.41]		−2.56 [−2.25]**	−2.2 [−1.95]*			
lsecon	5.54 [1.84]*	14.72 [2.14]**			6.65 [2.29]**		
ltertia		8.29 [1.29]	−5.18 [−1.89]*			−4.15 [−1.53]	
lhway	0 [0.00]	0.01 [0.04]	0 [−0.00]	0.06 [0.19]	0.13 [0.46]	0.24 [0.86]	0.26 [0.94]
lbridge	0.73 [2.44]**	0.74 [2.47]**	0.73 [2.43]**	0.71 [2.35]**	0.84 [2.87]***	0.89 [3.04]***	0.86 [2.92]***
lfreight	−0.13 [−0.81]	−0.15 [−0.91]	−0.13 [−0.78]	−0.2 [−1.21]	−0.23 [−1.57]	−0.33 [−2.31]**	−0.36 [−2.57]**
lregionher	0.73 [3.35]***	0.73 [3.33]***	0.74 [3.37]***	0.65 [3.02]***	0.74 [3.38]***	0.7 [3.20]***	0.63 [2.94]***
lindusher	0.11 [0.65]	0.11 [0.66]	0.11 [0.65]	0.12 [0.71]	0.11 [0.64]	0.11 [0.65]	0.12 [0.71]
lexport	−0.38 [−0.94]	−0.37 [−0.90]	−0.39 [−0.96]	−0.19 [−0.47]	−0.34 [−0.83]	−0.22 [−0.54]	−0.07 [−0.18]
limport	0.43 [1.12]	0.42 [1.11]	0.43 [1.12]	0.42 [1.10]	0.37 [0.96]	0.32 [0.85]	0.33 [0.86]
lfexport	−0.42 [−1.25]	−0.42 [−1.25]	−0.42 [−1.24]	−0.49 [−1.47]	−0.42 [−1.26]	−0.46 [−1.37]	−0.52 [−1.54]
lfimport	0.46 [1.38]	0.47 [1.39]	0.46 [1.37]	0.52 [1.55]	0.5 [1.48]	0.55 [1.63]	0.58 [1.75]*
lfdi	0.5 [2.29]**	0.49 [2.23]**	0.51 [2.31]**	0.34 [1.69]*	0.41 [1.95]*	0.27 [1.40]	0.16 [0.89]
ltrshare	−0.2 [−0.49]	−0.21 [−0.51]	−0.19 [−0.46]	−0.33 [−0.85]	−0.2 [−0.49]	−0.26 [−0.66]	−0.38 [−0.95]
_cons	8.22 [0.54]	−63.1 [−1.45]	51.46 [3.03]***	27.15 [2.45]**	−8.13 [−0.84]	26.12 [2.05]**	9.03 [1.48]
R-squared	0.12	0.12	0.12	0.11	0.12	0.11	0.11
Adj-R-squared	0.10	0.09	0.10	0.09	0.09	0.09	0.09
N	504	504	504	504	504	504	504

* p<0.1, ** p<0.05, *** p<0.01

Table 7. Results of external impacts (labor as dependent var.)

	model1 b/t	model2 b/t	model3 b/t	model4 b/t	model5 b/t	model6 b/t	model7 b/t
lwage	-2.45 [-2.71]***	-2.4 [-2.67]***	-1.62 [-1.98]**	-2.24 [-2.50]**	-2.13 [-2.54]**	-1.67 [-2.04]**	-1.72 [-2.07]**
lsecon	14.72 [2.14]**	15.77 [2.32]**	14.29 [2.11]**	12.79 [1.93]*	13.45 [1.99]**	13.99 [2.06]**	12.24 [1.80]*
ltertia	8.29 [1.29]	8.89 [1.40]	7.22 [1.14]	7.45 [1.18]	7.48 [1.18]	7.71 [1.21]	6.35 [1.00]
lhway	0.01 [0.04]	0.01 [0.03]	0 [0.01]	0.15 [0.53]	0.05 [0.17]	0.09 [0.31]	0.1 [0.36]
lbridge	0.74 [2.47]**	0.66 [2.29]**	0.74 [2.57]**	0.5 [1.82]*	0.76 [2.76]***	0.6 [2.25]**	0.62 [2.30]**
lfreight	-0.15 [-0.91]	-0.16 [-0.97]	-0.1 [-0.62]	-0.29 [-1.93]*	-0.15 [-1.03]	-0.16 [-1.14]	-0.21 [-1.49]
lregionher	0.73 [3.33]***	0.64 [3.09]***	0.63 [3.06]***	0.47 [2.51]**	0.72 [3.62]***	0.54 [2.92]***	0.52 [2.83]***
lindusher	0.11 [0.66]	0.07 [0.43]	0.07 [0.43]	0.07 [0.39]	0.13 [0.77]	0.07 [0.44]	0.07 [0.41]
lexport	-0.37 [-0.90]	-0.6 [-1.89]*	-0.36 [-1.21]				
limport	0.42 [1.11]	0.68 [2.09]**		0.46 [1.50]			
lfexport	-0.42 [-1.25]				-0.66 [-2.52]**	-0.12 [-0.98]	
lfimport	0.47 [1.39]				0.67 [2.33]**		0.03 [0.25]
lfdi	0.49 [2.23]**	0.53 [2.47]**	0.7 [3.46]***	0.45 [2.13]**	0.52 [2.64]***	0.64 [3.37]***	0.59 [3.01]***
ltrshare	-0.21 [-0.51]	-0.23 [-0.58]	0.21 [0.61]	-0.64 [-1.87]*	-0.11 [-0.55]	-0.04 [-0.19]	-0.2 [-1.07]
_cons	-63.1 [-1.45]	-69.92 [-1.63]	-61.63 [-1.44]	-59.16 [-1.39]	-57.51 [-1.33]	-64.34 [-1.48]	-53.95 [-1.24]
R-squared	0.12	0.12	0.11	0.11	0.12	0.11	0.11
Adj-R-squared	0.09	0.09	0.09	0.09	0.1	0.09	0.09
N	504	504	504	504	504	504	504

* p<0.1, ** p<0.05, *** p<0.01

Table 8. Results of three industries' impacts (productivity as dependent var.)

	model1 b/t	model2 b/t	model3 b/t	model4 b/t	model5 b/t	model6 b/t	model7 b/t
lwage	2.11 [2.53]**	2.05 [2.49]**	2.13 [2.55]**	1.88 [2.29]**	1.79 [2.83]***	1.34 [2.41]**	1.26 [2.28]**
lprima	0.63 [0.60]		1.32 [1.27]	1.05 [1.02]			
lsecon	-4.1 [-1.49]	-7.33 [-1.17]			-4.53 [-1.71]*		
ltertia		-2.88 [-0.49]	3.84 [1.54]			3.31 [1.34]	
lhway	-0.34 [-1.26]	-0.35 [-1.30]	-0.34 [-1.26]	-0.38 [-1.43]	-0.39 [-1.52]	-0.46 [-1.84]*	-0.47 [-1.90]*
lbridge	0.38 [1.37]	0.37 [1.35]	0.38 [1.37]	0.39 [1.44]	0.34 [1.26]	0.29 [1.10]	0.33 [1.22]
lfreight	0.18 [1.19]	0.19 [1.27]	0.18 [1.16]	0.23 [1.53]	0.22 [1.61]	0.28 [2.16]**	0.3 [2.39]**
lregionher	-0.04 [-0.18]	-0.03 [-0.17]	-0.04 [-0.20]	0.03 [0.15]	-0.04 [-0.19]	-0.02 [-0.11]	0.04 [0.18]
lindusher	-0.38 [-2.45]**	-0.38 [-2.45]**	-0.38 [-2.45]**	-0.38 [-2.50]**	-0.37 [-2.45]**	-0.38 [-2.45]**	-0.38 [-2.50]**
lexport	-0.33 [-0.88]	-0.34 [-0.90]	-0.32 [-0.86]	-0.47 [-1.31]	-0.35 [-0.93]	-0.41 [-1.12]	-0.53 [-1.49]
limport	0.01 [0.04]	0.02 [0.05]	0.01 [0.04]	0.02 [0.05]	0.04 [0.11]	0.07 [0.20]	0.06 [0.18]
lfexport	0.72 [2.33]**	0.72 [2.34]**	0.71 [2.33]**	0.77 [2.52]**	0.72 [2.34]**	0.74 [2.40]**	0.78 [2.56]**
lfimport	-0.74 [-2.42]**	-0.74 [-2.43]**	-0.74 [-2.41]**	-0.78 [-2.56]**	-0.75 [-2.47]**	-0.78 [-2.57]**	-0.81 [-2.68]***
lfdi	-0.37 [-1.86]*	-0.36 [-1.83]*	-0.38 [-1.89]*	-0.26 [-1.38]	-0.34 [-1.77]*	-0.26 [-1.45]	-0.17 [-1.03]
ltrshare	0.36 [0.99]	0.36 [1.00]	0.35 [0.96]	0.46 [1.29]	0.36 [0.99]	0.39 [1.08]	0.48 [1.35]
_cons	2.97 [0.22]	28.39 [0.71]	-29.06 [-1.88]*	-11.03 [-1.09]	9.28 [1.06]	-16.05 [-1.39]	-2.4 [-0.43]
R-squared	0.10	0.10	0.10	0.09	0.10	0.09	0.09
Adj-R-squared	0.07	0.07	0.07	0.07	0.07	0.07	0.07
N	504	504	504	504	504	504	504

* p<0.1, ** p<0.05, *** p<0.01

Table 9. Results of external impacts (productivity as dependent var.)

	model1 b/t	model2 b/t	model3 b/t	model4 b/t	model5 b/t	model6 b/t	model7 b/t
lwage	2.05 [2.49]**	2 [2.43]**	1.52 [2.03]**	1.97 [2.41]**	1.98 [2.59]**	1.5 [2.01]**	1.6 [2.12]**
lsecon	−7.33 [−1.17]	−8.79 [−1.41]	−7.89 [−1.27]	−8.33 [−1.38]	−8.18 [−1.33]	−8.73 [−1.41]	−7.09 [−1.15]
ltertia	−2.88 [−0.49]	−3.58 [−0.62]	−2.56 [−0.44]	−3.36 [−0.58]	−2.87 [−0.50]	−3.1 [−0.53]	−1.85 [−0.32]
lhway	−0.35 [−1.30]	−0.33 [−1.25]	−0.33 [−1.23]	−0.35 [−1.37]	−0.27 [−1.05]	−0.31 [−1.19]	−0.32 [−1.23]
lbridge	0.37 [1.35]	0.49 [1.85]*	0.44 [1.68]*	0.51 [2.03]**	0.27 [1.06]	0.42 [1.74]*	0.39 [1.57]
lfreight	0.19 [1.27]	0.2 [1.37]	0.17 [1.15]	0.22 [1.65]*	0.12 [0.92]	0.14 [1.05]	0.18 [1.38]
lregionher	−0.03 [−0.17]	0.1 [0.55]	0.11 [0.56]	0.13 [0.76]	−0.11 [−0.61]	0.08 [0.47]	0.07 [0.43]
lindusher	−0.38 [−2.45]**	−0.31 [−2.06]**	−0.31 [−2.06]**	−0.31 [−2.05]**	−0.37 [−2.44]**	−0.32 [−2.08]**	−0.32 [−2.09]**
lexport	−0.34 [−0.90]	0.09 [0.32]	−0.06 [−0.21]				
limport	0.02 [0.05]	−0.42 [−1.40]		−0.38 [−1.38]			
lfexport	0.72 [2.34]**				0.6 [2.50]**	0.05 [0.44]	
lfimport	−0.74 [−2.43]**				−0.68 [−2.61]***		−0.11 [−0.86]
lfdi	−0.36 [−1.83]*	−0.43 [−2.17]**	−0.53 [−2.88]***	−0.42 [−2.16]**	−0.43 [−2.42]**	−0.56 [−3.22]***	−0.5 [−2.79]***
ltrshare	0.36 [1.00]	0.41 [1.12]	0.14 [0.45]	0.47 [1.52]	0.1 [0.55]	0.03 [0.15]	0.18 [1.06]
_cons	28.39 [0.71]	37.37 [0.95]	32.3 [0.83]	35.73 [0.92]	29.56 [0.75]	36.51 [0.92]	26.34 [0.66]
R-squared	0.10	0.09	0.08	0.09	0.10	0.08	0.08
Adj-R-squared	0.07	0.06	0.06	0.07	0.07	0.06	0.06
N	504	504	504	504	504	504	504

* p<0.1, ** p<0.05, *** p<0.01

Table 10. Results of industrial/regional dummy (Model 1&2 put labor and Model 3&4 put productivity as dependent var.)

	model1 b/t	model2 b/t	model3 b/t	model4 b/t
lwage	−2.11	−0.72	1.85	1
	[−2.57]**	[−0.42]	[2.38]**	[0.63]
lsecon	7.94	8.77	0.01	−5.27
	[1.19]	[0.45]	[0.00]	[−0.29]
ltertia	3.28	6.43	2.68	−2.7
	[0.54]	[0.39]	[0.47]	[−0.18]
lhway	−0.11	−0.34	−0.28	0.1
	[−0.42]	[−0.39]	[−1.13]	[0.12]
lbridge	0.86	−0.14	0.29	−0.03
	[3.16]***	[−0.18]	[1.12]	[−0.04]
lfreight	−0.13	−0.1	0.19	0.18
	[−0.87]	[−0.22]	[1.35]	[0.44]
lregionher	0.79	0.03	−0.22	0.39
	[3.83]***	[0.03]	[−1.13]	[0.45]
lindusher	−0.34	0.16	−0.13	−0.39
	[−0.60]	[0.94]	[−0.25]	[−2.51]**
lexport	−0.13	0.02	−0.54	−0.14
	[−0.34]	[0.02]	[−1.48]	[−0.16]
limport	0.56	−0.13	−0.26	0.23
	[1.47]	[−0.15]	[−0.73]	[0.30]
lfexport	0.53	−0.17	−0.16	0.25
	[1.14]	[−0.24]	[−0.37]	[0.39]
lfimport	−0.54	0.22	0.22	−0.25
	[−1.12]	[0.29]	[0.49]	[−0.36]
lfdi	0.23	0.08	0	0.06
	[1.00]	[0.16]	[0.00]	[0.14]
ltrshare	−0.55	0.12	0.85	−0.09
	[−1.37]	[0.10]	[2.26]**	[−0.08]
indusdummy2	−0.23		−1.4	
	[−0.42]		[−2.68]***	
indusdummy3	−2.68		2.34	
	[−1.96]*		[1.82]*	
indusdummy4	0.45		−1.41	
	[1.06]		[−3.53]***	
indusdummy5	0.33		−1.82	
	[0.62]		[−3.63]***	
indusdummy6	1.47		−0.96	
	[2.99]***		[−2.08]**	
indusdummy7	0.27		0.42	
	[0.50]		[0.81]	
indusdummy8	0.03		−0.66	
	[0.04]		[−1.09]	
indusdummy9	0.58		−0.93	
	[0.94]		[−1.60]	
indusdummy10	0.3		−0.78	
	[0.76]		[−2.11]**	
indusdummy11	−1.58		−0.61	
	[−3.12]***		[−1.27]	
indusdummy12	0.3		−2.22	
	[0.46]		[−3.67]***	
indusdummy13	−0.82		−0.09	
	[−1.81]*		[−0.21]	
regiondummy2		2.36		−0.42
		[2.31]**		[−0.45]
regiondummy3		0.74		−0.39
		[0.25]		[−0.14]
regiondummy4		0.89		0.24
		[0.60]		[0.18]
regiondummy5		0.22		1.62
		[0.06]		[0.47]
regiondummy6		0.5		0.67
		[0.16]		[0.23]
regiondummy7		−1.45		0.65
		[−0.63]		[0.31]
regiondummy8		1.92		0.14
		[0.72]		[0.06]
regiondummy9		−0.09		−0.95
		[−0.05]		[−0.50]
regiondummy10		1.15		−0.05
		[0.53]		[−0.03]
regiondummy11		−2.2		2.71
		[−1.31]		[1.74]*
regiondummy12		0.43		0.02
		[0.23]		[0.01]
_cons	−24.51	−30.97	−14.88	19.64
	[−0.58]	[−0.27]	[−0.38]	[0.19]
R-squared	0.32	0.19	0.25	0.14
Adj-R-squared	0.28	0.15	0.21	0.09
N	504	504	504	504

continuing……

* p<0.1, ** p<0.05, *** p<0.01

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