Because of the economic reform from 1979, China keeps their speed in the economic development. In these years, China’s economic development has become a hot topic over the world, and now she is attracting the most FDI from the other part of world. The benefits of FDI for developing country are remarkable. During 1985-2004, with annual GDP growth of 9.6%, FDI into China has recorded more than 10% growth since 1985. Many studies show that the spatial agglomeration of FDI is able to explain the China’s recent regional growth. Most of the FDI are directed to the coastal area, and the agglomeration of productivity in the coastal area is growing. Regional growth is driven mainly by increases in international trade and FDI. (Fujita and Hu. 2001)

The role of FDI in economic growth has been extensively studied in many countries. Some authors investigate relationship between FDI and economic growth from an econometrical point of view. The discussion about the role of FDI in economic growth is still continuing.

In a theoretical consideration the new growth theory emphasizes the importance of human capital because human capital is the most fundamental condition for a later comer of industrialization to imitate the industrial world through learning by doing and learning by watching as well as developed countries. Education and human capital is also the most fundamental condition for innovation and knowledge creation. According to the new growth theory, the impact of FDI on growth depends upon the existence of production and knowledge externalities. FDI is the most direct and efficient way of acquiring technology created in countries of most advanced economies; and it is an important mechanism of economic convergence. To a great extent, FDI plays a similar role in raising production efficiency because FDI brings with the world’s most advanced managerial and organization skills to those countries with low technical efficiency. (Yao and Wei. 2007)

The impact of FDI inflow on economic growth is still worthy to be investigated. Factors such as market size, prospects for market growth, the degree of development and per capita incomes are
important determinants in MNC\(^1\)'s' location decisions. The region with larger market size, faster economic growth and higher degree of economic development provides better opportunities for attracting FDI inflow. He and Wei (2001) find that the choice of FDI location in China depends on the cost of gathering information, as well as human capital, and other economic variables. Xu and Tan (2003) show that the accumulation of FDI has strong effect on the regional economic growth in China.

This paper examines that FDI and agglomeration economies have positive impacts on GRP (Gross Regional Production) growth. The factors what affect FDI dispersion and regional production is explored. By introducing kinds of variables (such as R&D stock and domestic investment), the simultaneous determination model for FDI dispersion and urban productivity growth is constructed. It differs from existing studies in the following aspects. Firstly, it uses a huge sample of Chinese cross-section. Secondly, this paper conducts active endogenity test for FDI and economic growth. Thirdly, it introduces the interaction of FDI and industrial agglomeration factor into the model.

The remainder of the paper is divided into five sections. The first section is literature review on the FDI and regional growth. The second section specifies a model assess the role of regional industry agglomeration and FDI on growth, while the effects of GRP on FDI are discussed. The third section is about the data description. The forth section is the estimation for the models of urban growth and FDI dispersion. The last section is the conclusion of this paper.

1. Literature Review: FDI and Growth

The impacts of FDI and agglomeration economies on urban growth are manifold. The interaction of FDI and agglomeration economies also is paid attention in theoretical studies. Pan and Zhang (2002) state that there is strong and significant agglomeration economies in Chinese urban areas which come from localization economies, many industries have reached the optimal size. Tuan and Ng (2003) finds that agglomeration economies have significantly facilitated FDI flow in the HK-PRO CP system\(^2\) especially during the 1990s.

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\(^{1}\) Multinational Company

\(^{2}\) About FDI transfer in a core-periphery system of Hong Kong (core)–Guangdong and Pearl River Delta (periphery).
Some studies find that if there was larger land size, lower wages, higher personal incomes, better transport infrastructure, and higher density of other factors related to the manufacture sector in one region, more foreign manufacture firms concentrate in this region. Li and Rugman (2007) suggest that from the standpoint of pursuing business opportunities and generating real options, building a subsidiary in a non-home region could be more beneficial than in a home region. However, high option exercise cost may reduce the option value of a non-home-region location.

About the impacts of FDI on economic growth, Lin and Song (2002) find that the foreign investment, infrastructure and government spending on science and technology are positive to GRP growth. Tuan and Ng (2004) find the dynamics of FDI evolution are closely associated with the process of legal modernization and policy reforms via institutionalization that are required to move toward a market oriented host country.

Other studies focus on FDI as a determinant of regional growth. FDI is different from domestic investment in two aspects: FDI accelerates the speed of adoption of general purpose technologies in the host countries; FDI is embedded with new technologies and know-how unavailable in the host countries. (Yao and Wei, 2007) Their results show that other than institutional forces, spatial agglomeration and their synergies as well as gravity have directed the patterns of inward FDI and further, induced GRP growth. In their paper, FDI absorption in a region is assumed to be determined by three effects, spatial agglomeration effects by investment, synergy effect generated by the strategic interactions of the firm agglomerations, and institutional effect of frictional distance.

In Tuan and Ng (2003), the explanatory variables which affect the FDI location are described.

\[ FDI_t = f(L_t, U_t, M_t, D_t) \]  \hspace{1cm} (1)

where FDI is FDI inflow in a region; L is the land area; U is the degree of urbanization; M is the market potential; D is the gravity distance from the core; t is the time. In estimating Eq. (1), FDI is represented by the number of foreign firms and the total volume in $ in each region. L, U, and M are measured by land area, population density and GRP per capita, D is the frictional factor of highway distance.

Location decision of a firm is treated as a form of revealed preference for local attributes (He, 2002). The amount of FDI in a city is assumed to be a function of urban attributes, which are
likely to influence its location choices. The function takes the following form:

\[ FDI_t = f(POS_t, LOC_t, POL_t, FFE_t, \]
\[ IND_t, DEN_t, TEL_t, PORT_t, EWA_t) \]

where FDI is FDI flow of a region at time t; the information cost variables include the provincial cities dummy (POS), coastal cities dummy (LOC), opening policy dummy (POL), port city (PORT), and the number of foreign-funded enterprises (FFE). The agglomeration variables include urban population density (DEN), the number of industrial enterprises (IND), the number of telephone (TEL), and effective wage rate (EWA). A log-linear functional form is adopted to transform a likely nonlinear relationship between FDI and the explanatory variables into a linear one. The regression coefficients are measures of the elasticity of FDI with respect to the explanatory variables.

According He’s suggestion, also the equation about the effect of growth on FDI is found.

\[ \Delta \ln \left( \frac{GRP_{it}}{POP_{it}} \right) = f \left( \ln \left( \frac{GRP_{it}}{POP_{it}} \right), \ln POP_{it}, SCH_{it}, \frac{INV_{it}}{GRP_{it}}, \frac{FDI_{it}}{GRP_{it}}, X_{i,t} \right) \]  

\[ \frac{FDI_{i,t}}{GRP_{i,t}} = f \left( \Delta \ln \left( \frac{GRP_{i,t}}{POP_{i,t}} \right), \ln \left( \frac{GRP_{i,t}}{POP_{i,t}} \right), SCH_{i,t}, Trade_{i,t}, X_{i,t} \right) \]

In He’s model (Eq. (3) and (4)) FDI_{i,t} is the FDI flow in city at time t; \( \ln POP_{i,t} \) is the log of population, and \( SCH_{i,t} \) is the initial level of secondary school attainment. \( INV_{i,t} \) is the gross domestic investment. The group of variables X comprises the country-group dummies and policy variables that are mentioned as the determinants of growth in cross-country studies. In Eq. (4) \( Trade_{i,t} \) is the ratio of trade to GRP. The estimation result about this equation shows that FDI inflow and the capital growth are positive to the GRP growth, but the population growth is negative to the GRP growth. Meanwhile, the GRP growth has a significant and positive impact on FDI inflows in the recipient economy. FDI inflow is determined by the market size and the impact of trade openness in the host country.

2. Model

Following models of the new growth theory (Eq.s (1) - (4) mentioned by Tuan and Ng (2003), and He (2002), Li and Liu (2005), the growth equation and the FDI equation are specified.
According to the new growth theory, there are some core explanatory variables for economic growth. They are investment, population growth, initial GDP per capita. However, in this paper, there are differences from those previous studies. The investment variable is divided into two parts. One is foreign investment variable which is FDI inflow; the other is domestic investment which is represented by an indirect proxy variable - the share of domestic enterprises on total industry output. And FDI equation removes the area and the distance variables which are mentioned in Tuan's equation (2003). The further exposition of the model begins with growth equation.

2.1 Growth Equation

Reasons on choosing these explanatory variables for urban growth are given in more detail. Firstly, as part of total investment, FDI inflow is able to show effects of foreign investment on urban growth. Secondly, because of the special status of state-owned enterprise in China, the change of domestic enterprises share of total industry output is able to show industrial agglomeration in Chinese cities; and as the indirect proxy variable of domestic investment, to some degree, it denotes the domestic investment in one region. Thirdly, the log of the initial GRP is an explanatory variable to represents the basic economic situation in a region. Fourthly, there is high relativity of population and local labor force; and to a certain extent, urban population growth shows the concentration of urban population in the region; therefore in this model, population growth is a “core explanatory factor” of urban growth. Fifthly, to discuss the technical improvement effect, policy and human capital variables suggested in previous studies are mentioned as the determinants of growth.

The basic specification for the model is formulated as follows:

\[ \Delta \ln(\text{GRP}_i) = f(\text{FDI}_i, \text{POP}_i, \text{KGDQ}_i, \ln\text{GRP}_{i,0}, \text{SXP}_i, \text{ROAD}_i) \]  

It is a growth function of variables associated with FDI inflow (FDI), the population growth (POP), the change of domestic enterprises share of total industry output (KGDQ), the government expenditure for R&D (SXP), and the log of initial GRP. The variable ROAD represents the infrastructure level; i is the region; t0 is the initial stage.

Because of the data covering only the year of 2000 and 2004, the urban growth is the average annual growth from 2000 to 2004. Therefore the government expenditure for R&D and FDI inflow

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3 FDI inflow is the increase of foreign investment stock during the sample period. The measurement of FDI stock is shown in appendix.
are measured by the average annual growth of gross real utilized stock during the 5 years. POP and KGDQ are measured by the average changes over the sample period. ROAD is the variable of infrastructure in Eq. (4) measured by the average growth of area of road in a region.

2.2 FDI Equation

The following equation is used to assess the effect of agglomeration on FDI:

$$ FDI_i = f(\Delta \ln GRP_i, \ln GRP_{i,t_0}, ROAD_i, KGDQ_i) $$

In this equation, variables have the same meaning as in Eq. (5). They are seen as explanatory variables to support some suggestions in previous studies. Tuan and Ng (2003) suggest that the bigger basic economic situation and the better infrastructure can attract more FDI inflow to one region. So the initial GRP and the ROAD is used in this equation. He (2002) suggests that foreign investors are inclined to favor such locations that could minimize information cost and offer a variety of agglomeration economies. In the FDI equation ROAD is meaning the infrastructure level as well as that in the growth equation ROAD. KGDQ is used to represent agglomeration economies and the domestic investment. Because He (2002) suggests that foreign investors suffer from adverse information asymmetry and face internal and external uncertainties in host economies, thus better channel of information spread and a variety of agglomeration economies could encourage FDI inflow into the region. The KGDQ variable is introduced into the model to examine the effect of the agglomeration economies on FDI inflow.

3. Data

In China, the entire country is divided into provinces, municipality regions, province status “directly administered cities” - Beijing, Chongqing, Shanghai, and Tianjin, whose positions in administrative hierarchy are the same as those for all other provinces. Each province is further divided into cities and counties. Cities have two levels, such as prefecture level cities and county level cities. The prefecture level cities administer county level cities and county. The prefecture level cities represent the urban development of China.¹

¹ See figure 1.
The data is from the urban part of those 286 prefecture level cities. There are two sets of statistical data in the prefecture level, including total data and urban data. In the China's case, the urban situation is consonant with the international definition about city economy.

The primary data is from China City Statistical Yearbook 2001 and 2005, which presents the data in the year of 2000 and 2004. The data set includes the real GRP, actual FDI value, and population, the share of domestic enterprises on total industry output, the government expenditure for R&D, and the area of road. FDI inflow is caught by the increase of FDI stock during the sample period. Monetary values are adjusted by CPI. The GRP in the year of 2000 is used as the initial GRP. The changes of population and road area are the average increasing rate of them during the sample period.

4. Estimation and Results

4.1 Estimation Strategy

The purpose of empirical investigation is to estimate the effects of FDI on economic growth, and to explore the determinants of FDI dispersion. The relationship between urban growth and FDI inflow is estimated by the log-linear functional form with gross section data of 286 cities.

The endogenous interaction between GRP growth and FID should be checked by the Durbin-Wu-
Hausman test. The DWH test indicates that there is an endogenous relationship between FDI inflow and GRP growth. The variable of FDI is not independent to the error term. Therefore, to eliminate the bias in the OLS estimation, the estimation is carried out by 2SLS as well as OLS. Hence in the application of 2SLS, the independent variables are ranked again in the instrumental variables list.

4.2 Estimation Results

The result is shown in table 1. FDI stock is positive to regional economic growth, though the concentration variable has the largest positive coefficient in urban growth equation. It is seen that FDI inflow and GRP growth have significant impacts on each other in this estimation process. The population growth has its expected positive effects on GRP growth; it shows that the urban concentration accelerates urban growth. On the contrary, the share of domestic enterprise on total output is negative to urban growth. The positive coefficient of infrastructure changes indicates the importance of infrastructure construction in urban development. On the other hand, market size (initial GRP), market potential (GRP growth) and infrastructure are positive to FDI dispersion; the share changes of domestic enterprise decrease FDI inflow into a region. The interpretation of the estimation results are analyzed as follows.

Table 1 Effects of FDI on GRP growth and effects of GRP growth on FDI in China: Results from OLS and 2SLS regression

<table>
<thead>
<tr>
<th>Variable</th>
<th>Growth Equation</th>
<th>FDI Equation</th>
<th>OLS</th>
<th>2SLS</th>
<th>OLS</th>
<th>2SLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.291***</td>
<td>0.296***</td>
<td>-12.21***</td>
<td>-22.53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FDI</td>
<td>0.007***</td>
<td>0.005***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POP</td>
<td>0.640***</td>
<td>0.647***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial GRP</td>
<td>-0.022***</td>
<td>-0.022***</td>
<td>0.013***</td>
<td>0.020</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SXP</td>
<td>0.011***</td>
<td>0.014***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROAD</td>
<td>0.097***</td>
<td>0.104***</td>
<td>0.003</td>
<td>0.020*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KGDQ</td>
<td>-0.005</td>
<td>-0.216</td>
<td>-0.024*</td>
<td>-1.047</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GRP Growth</td>
<td>0.082***</td>
<td>0.079</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In Table 1, the estimated coefficient of FDI indicates that the regional economy get the benefits from FDI inflow. The result supports Liu and Li's paper suggesting that FDI has the tremendous role in promoting regional economic growth in China. With the access of foreign investment, a large number of advanced technology and excellent management method have emerged in these regions. Under the information spillover effects, the local enterprises are able to finish technical and managerial improvement. It improves local enterprises overall market competitiveness and technological level of production.

Secondly, initial GRP shows the negative effect on the GRP growth. There is a decreasing gap between cities with low GRP and that with higher GRP. The finding is suggesting that at least during the estimation period there is a convergence trend across cities.

Thirdly, the government expenditure for R&D is significant positive to the GRP growth. The estimated coefficient varying around 0.013 means that 1% rise of the expenditure for R&D raises the growth rate by 1.3% per year. Though the sample span is very short, it can be found the importance of R&D to the economic development. In the endogenous growth theory, Paul Romer identifies technological progress with increases in the stock of knowledge, that is, with new knowledge on how to produce more efficiently. This includes scientific discoveries as well as the know-how to us them in production. The estimate result also shows that high R&D accumulation and human capital stock are associated with the high growth rate of GRP

Fourthly, there is an excepted finding about the infrastructure level that the estimated coefficient is positive to GRP growth, and the coefficient is larger than FDI. The better economic environment is good for business and regional growth; the investment to infrastructure is an important driving force of the regional economic development during the sample span.

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Fifthly, the share of domestic enterprises on total industry output is negative to regional economic growth. In contrast with foreign enterprises cluster, the domestic enterprises have less advantage. Most of them have lower productivity efficiency and prodigal production method. The cluster of domestic enterprises is not able to promote the urban productivity efficiency.

Lastly, the growth of urban population is favorable for urban growth. The urban concentration gives benefit to urban development. The impact of urban population for regional growth needs further consideration. It is the next theme of my study.

The results of the growth equation show that a high urban concentration, a high infrastructure level, and a high level of FDI inflow are associated with a fast growth in GRP. The domestic enterprise does not take better role in the regions development.

(2) Results of FDI Equation
The effect of FDI inflow on GRP growth has been analyzed in the former part. In this part, the effect of GRP growth on FDI inflow will be discussed. The results of FDI equation also are represented in Table 1.

From Table 1, except the agglomeration variable, other explanatory variables have positive contribution to FDI inflow into cities. It means that a higher per capita income and a higher urban growth attract more FDI coming into the cities. Generally, when a region's GRP growth rate is higher than which in other regions, it means that the region's personal income is increasing faster than other regions. To the multinationals, it means larger market potential as well. The multinationals enterprises choose developing countries to do invest by considering the market scale and the production cost. The higher initial GRP indicates a bigger market. A higher GRP growth rate implies a better future of the local market.

The contribution of infrastructure to FDI inflow is viable. Because the data about road area is chosen to represent initial infrastructure level, it also stands for the information cost. The multinational firms make the investment decision according to several reasons as follows. Access to host-country markets for processed goods is an important factor for investing in the manufacturing sectors of developing countries. The lower cost is another more important reason. The better infrastructure condition can bring better market operation environment and lower information cost.
If one region had larger market potential, it can make international investor to found product center directly in this region to save kinds of transport costs and find out local market needs directly. With the lower local production cost together, the multinational enterprises can gain much benefit.

The coefficient of domestic industrial enterprise output is negative in FDI equation. In the view of market chose, the large the domestic enterprises share of total output means the strong competition power of domestic enterprises, thus it is difficult for multinational enterprises to gain the expected profit; and FDI inflow would not be unfeasible in those cities.

4.3 FDI Location and GRP Growth across Regions

The statistic model analysis is showing the certain finding that the regional economy get the benefits from FDI inflow. In the figure of the FDI stock and GRP growth during 2000-2004, there is a more visual result on the relationship between GRP growth and FDI inflow. The lateral axis is FDI accumulation until 2004 (the initial year is 1999); the vertical axis is the GRP growth from 2000 to 2004. An obvious trend line is shown in Figure 2, meaning the positive relationship between FDI and GRP growth. However, there are different FDI location situation across three large regions. The Eastern region get the opening policy firstly, thus it gets the most benefit from FDI inflow; the situation of western region is similar to the middle region.

As shown in Figure 3, it is an interesting result from the data analysis that the provinces with higher ratio FDI to GRP growth are distributing in the eastern China which also are with faster economy development. The economic boom in the eastern region benefits from the export business. A large part of export goods is produced by the foreign enterprises. On the contrary, the middle and west region growth has been still inward-looking economies, which means the local original comparative advantages take the important role in the economic development, but not FDI inflow.
5. Conclusion

From the above discussion, the interaction of FDI and urban growth has been explored. By introducing kinds of variable (such as R&D stock and domestic investment), the simultaneous determination model for FDI location and urban growth has been found. Applying statistical
analysis with Chinese urban data during 2000 to 2004, some useful results are gotten as follows.

Firstly, FDI takes an important role in urban growth. With the access of foreign capital, a large number of advanced technology and excellent management method have emerged in these regions. FDI inflow gives the regional development strong support.

Secondly, the determining factors of FDI location have discussed in details. The regional economic development has positive effects on FDI inflow directly. FDI into a region depends on this region's market scale and investment environment. A higher per capita income and a higher urban growth attract FDI inflow into the cities.

Lastly, the domestic investment effect should be noticed specially. It has negative impact on FDI location and regional production. There are some reasons such as low productivity efficiency, prodigal production method and so on. It leaves room for a variety of interpretation.

Appendix
The measurement process of the stock of FDI and FDI flow in this study:

\[ SFDI_t = (1 - \delta)SFDI_{t-1} + FDI_t \]  \hspace{1cm} (a.1)
\[ SFDI_0 = \frac{FDI_0}{(g + \delta)} \]  \hspace{1cm} (a.2)
\[ FDI_t = SFDI_t - (1 - \delta)SFDI_{t-1} \]  \hspace{1cm} (a.3)

SFDI: the direct foreign investment stock;
FDI: the direct foreign investment flow;
\( \delta \): depreciation rate (5%);
\( g \): average increase rate of total investment in the initial stage.

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