No. 1509 [EN]

IMI Working Paper

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FDI and Economic Development: Evidence from China's Regional Growth[*]

By **LIU XIANGBO, LUO YU, QIU ZHIGANG and ZHANG RU**[*]

December 2015

Abstract

By using China's provincial data through 1978 to 2011, this paper examines the exact channels through which FDI affects China'sregional growth and inequality. We find that FDI can facilitate China's economic growth through its impact on physical and human capital accumulation. On the other hand, FDI can have a negative impact on output growth by crowding out domestic investment, reducing local government revenue and increasing opportunity cost of technology innovations. Regarding FDI's impact on regional inequality, we find that it can deliver both positive and negative effects. The imbalance of FDI inflows among regions can widen the interregional growth gap through its impact on physical capital accumulation and technology progress. While it narrows the growth gap between regions through its effects on level of higher education, industrial structure, government revenue, degree of openness and trade surplus.

JEL Classification: F21, F43, C23

Keywords: FDI, Emerging Economies, Economic Growth, China

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[*] Published on *Emerging Markets Finance and Trade 50:sup6, 87-106*

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1. Introduction

China has witnessed a rapid growth since her economic reform taken place in 1978. To investigate the driving forces behind China's rapid growth, many theories and empirical research have shown that globalization and economic integration can significantly contribute to the rapid development and industrialization of the emerging markets (See, among others, Choi, 2004; Pomfret, 1997; Yao and Zhang, 2001; Greenaway, 1998; Fleisher and Chen, 1997). As a result of China's on-going attempts to integrate into the global economy, total inflows of Foreign Direct Investment (FDI) rise dramatically.[1]However, with the rapid growth in the coastal areas, the interior areas in China largely fall behind during these 30 years, resulting in a vast and increasingly widened growth gap. This is an important issue that China needs to face nowadays.

This paper attempts to explore the roles played by FDI in determining China's fast growth and regional inequality. The impact of FDI on economic growth in industrializing economies has been widely studied in recent years. Many empirical studies focus on the effects of FDI on output growth in the host country (See, for instance, Chuang and Hsu, 2004; Lardy, 1995). In these studies, FDI is typically considered as a significant promoter for economic growth in the emerging economies. This is because FDI may help facilitate physical capital stock accumulation, stimulate knowledge spillover, encourage the incorporation of new technologies (Borensztein*et al*., 1998) and advance labor skill acquisition of the host economy through the introduction of management practices and organizational arrangements from the developed world (De Mello, 1997).

However, some studies point out that FDI may lead to negative impacts. For instance, Agosin and Mayer (2000) find the possible "crowdingout" effect of FDI on domestic investment for capital formation and growth in the industrializing countries.Görg and Greenaway (2004) show that the positive knowledge spillovers in the developing economies are not significant; Hu and Jefferson (2002) even finda significant effect of productivity depression rather than improvement for the FDI recipient countries.Herzer*et al*., (2008) find no clear relationship between FDI and per capital income for the developing countries.

Although many existing studies have extensively studied the impact of FDI on economic growth for the emerging economies, the exactchannels through which FDI affects output growth in these rapid growing countries have not been well examined. An exception is Yao and Wei (2007) who analyze how FDI affects the development of the newly industrializing economies from the perspective of improvement of production efficiency and shift of production frontier. However, they do not consider other possible channels beyond technology and efficiency change through which FDI may affects output growth. The objective of our paper is to fill the gap by investigating the exact channels between the FDI inflows and regional economic growth for China from a broader perspective. China provides an ideal example for this empirical study as she has experienced a fast economic growth accompanied with institutional change and market liberalization since the implementation of heropen door policy. We focus on analyzing two important questions.First, through what channels does FDI affect economic growth in China during the reform period?Second, through what mechanisms does FDI affect interregional growth gaps and income inequality in China?

[1]In fact, China surpassed the United States as the largest recipient of FDI in 2003.

2. Interregional Growth Gap and FDI Inflows in China

During the past 30 years, China has maintained a rapid rate of its economic growth. The average annual growth rate of real GDP is 9.4%,and the average annual growth rate of real GDP per capita is 8.2%.[2]However, along with fast economic growth,the widened interregional growth gap and income inequalitybecome an important issue. The east and coast areas have always been growing faster. Their geographical advantages allow them toattract much of the foreign and domestic investment, highly skilled labor as well as the policy priority. Figure 1 shows the changes in provincial real GDP per capita (in natural logarithm) distribution from 1978 to 2011.

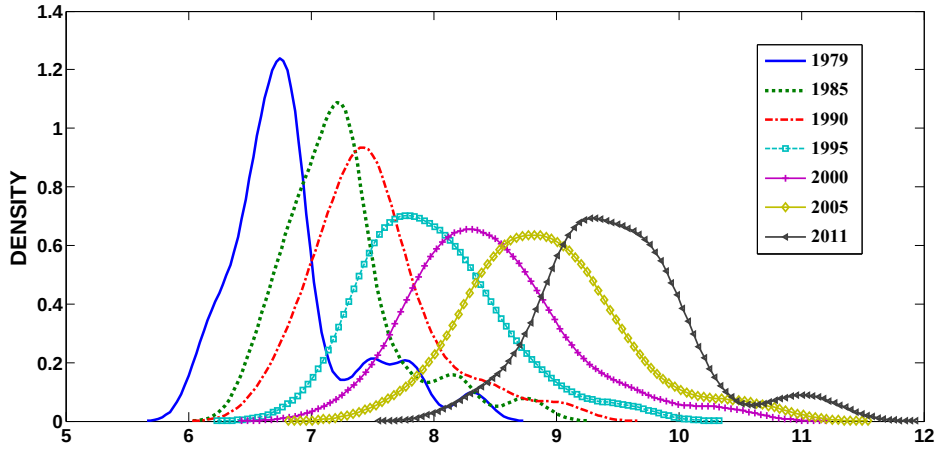

Figure1: Dynamics of Regional Real GDP Per Capita Distribution

Figure 1 shows the change in kernel density of regional real GDP per capita from 1978 to 2011. Data are taken from the annual *China Statistical Year Books*.

As shown in Figure 1, the distribution of per capita GDP is significantly skewed to the right in 1978 and then changes into a bell shape in 1995. In 2011, the curve has significantly long tails on both hand side,and the kurtosis of the curve is smaller, indicating that the range of the extreme values of real GDP per capita is significantly larger than ever before.These changesimplythatthe output distribution has become significantly decentralized during the past 34 years, implyingthat the gap between the poorer and richer areas in China has become increasingly larger over time.

[2]These two growth rates are calculated based on 1978 constant price level.

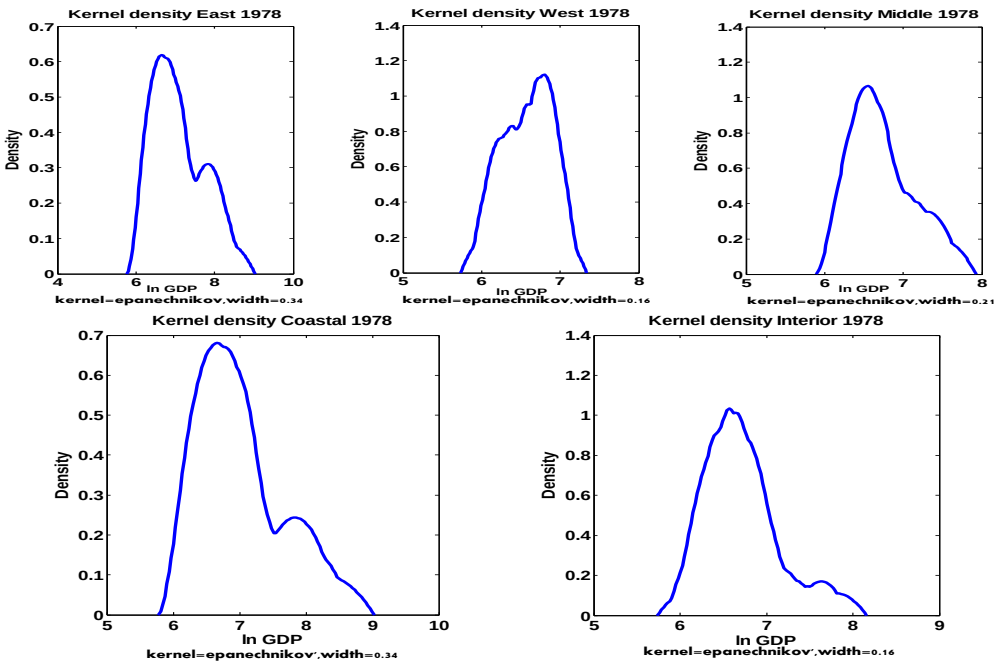

Figure 2: Distribution of Real GDP by Region in 1978

Figure 2 shows the Kernel density of real GDP per capita by region in 1978. Data are taken from the *China Statistical Year Book*.

Figure 2 and 3 compare the Kernel density of real GDP per capita by regions in the year 1978 and 2011.[3] In 1978, most provinces in the east, middle and west have a similar level of the per capita GDP. However, after 34 years' development, the real per capita GDP in the east areas becomes the highest among all three regions. The middle areas have the second highest per capita GDP, whereas that of the west areas is the lowest. Similar results are found in the coastal and interior areas.

[3]We divide the data from 31 provinces and municipalities into three regions as east, middle and west according to their geographical location and China's western-development policy. We also classify the data into coastal and interior areasbecause the opening up policy starts from the coastal areas.

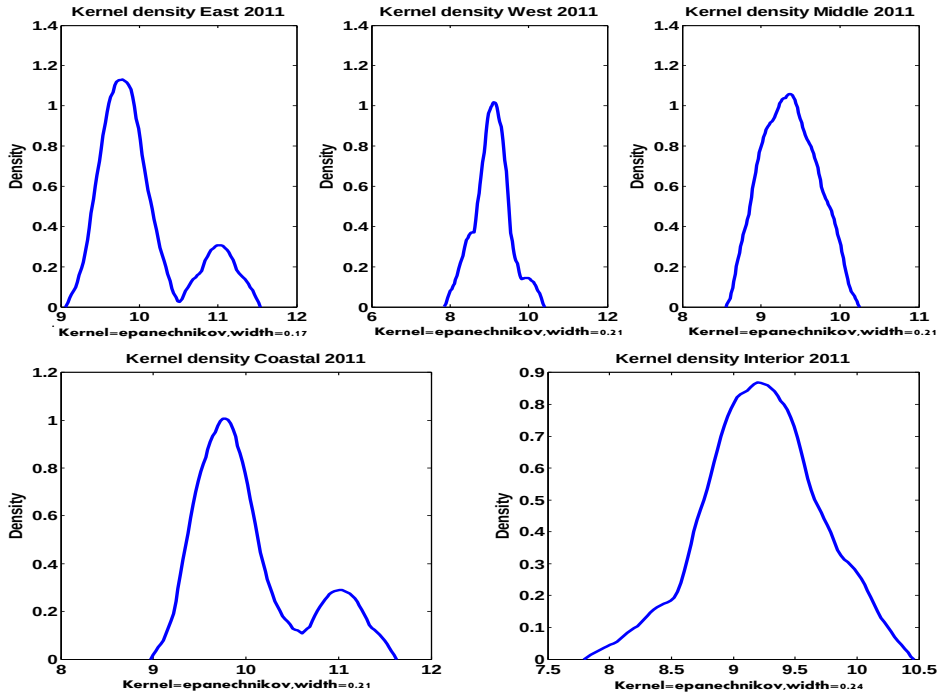

Figure 3: Distribution of Real GDP by Region in 2011

Figure 3 shows the Kernel density of real GDP per capita by region in 2011. Data are taken from the *China Statistical Year Book*.

Figure 4 links between the growth rate of real per capita GDP and FDI inflows from 1984 to 2011 by region.Clearly, we observe a pattern between the growth rate of FDI and the growth rate of GDP: when the inflows of FDI increase (decrease), the real per capita GDP increases (decreases). Therefore, we conjecture that FDI might potentially play an important role in promoting China's economic growth and contributing to the regional disparity. In the rest of the paper, we investigate the channels though which the FDI affects China's economic growth and inequality.

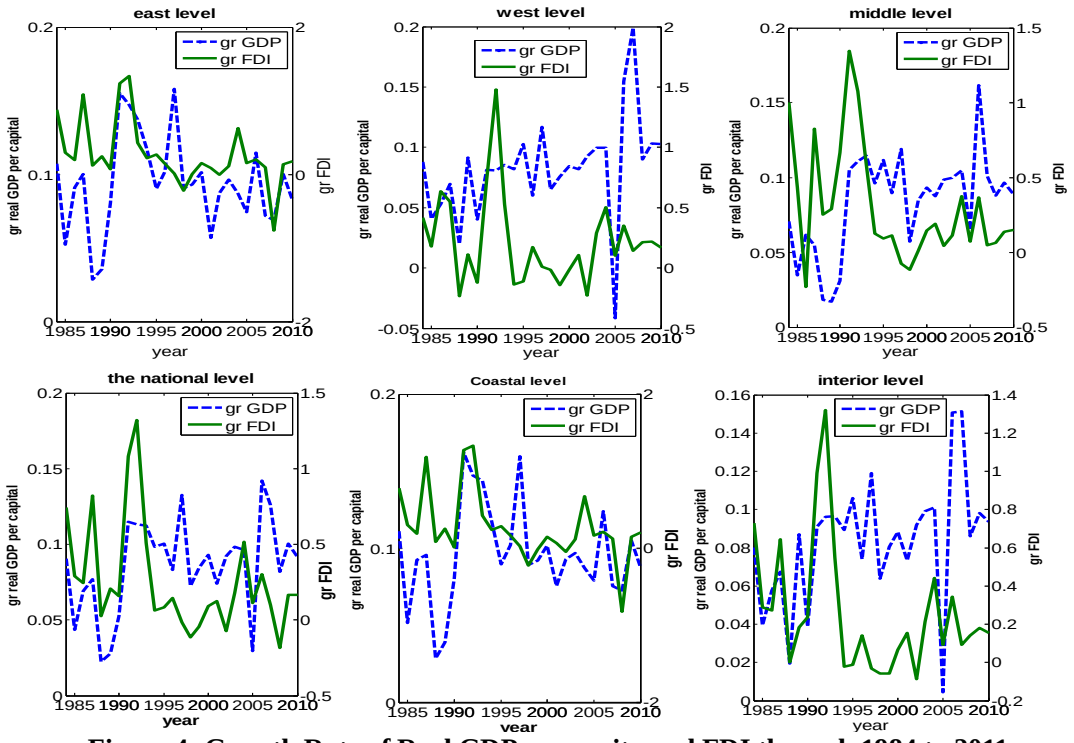

Figure 4: Growth Rate of Real GDP per capita and FDI through 1984 to 2011

Figure 4 describes the relationship between the growth rate of real GDP per capita and FDI from 1984 to 2011. Data are taken from the *China Statistical Year Books*.

3. Methodology

3.1 Hypothesis

FDI may play multiple roles in affecting the economic growth and development of China's regional markets. First, as a source of physical capital accumulation in the production process, FDI has a similar impact on output growth as domestic investment (DI). However, the competition between foreign-invested enterprises and domestic ones may make FDI a substitute of DI since FDI would preempt the investment opportunities in thedomestic market. In this case, FDI would have a "CrowdingOut" effect on DI. On the other hand, FDI may also stimulate more domestic investment in the recipient country through the trade of intermediate goods or forward and backward industrial linkages. This is the "Crowding In" effect of FDI on DI, which could prompt the phase of industrialization and economic growth of the emerging markets. Agosin and Mayer (2000) study the "Crowding Out" and "Crowding In" effects of FDI on DI in the developing countries and find that FDI can strongly crowds in DI in Asian countries.

Another aspect that FDI differs from DI is that the former is possible to enable the host country to take advantage of the advanced technologies in the developed countries. By technology diffusion, import of intermediate goods and "learning by doing", the recipient countries are possibly able to adopt advanced technologies and hence achieve a higher level of productivity. Moreover, the intense competition between foreign and domestic invested firms can lead to an improved allocation of recourses so as to reduce the inefficiency in production. Therefore, FDI may affect economic growth through promoting the advancement of technologies in the developing countries. On the other hand, the possibility to adopt foreign technology will increase the opportunity cost of

domestic firm to invest in research and development of their own technology, which may prevent the host country from further technology progress.

FDI might help produce and export manufacturing goods, as most FDI in the developing economiesintends to take advantage of cheap unskilled labor. Due to this, FDI can result in an increase in job creations in the emerging markets and theimprovedjob opportunitieswill then affect people's decision of higher education and human capital investment. On one hand, human capital will accumulate through working in foreign-invested enterprises, yet on the other hand, the attractiveness of higher education such as college and graduate degree is reduced and this will impede the human capital accumulation in the long run. This is another channel through which FDI may affect output growth.

Finally, it is also important to notice how FDI may spur institutional changes and market liberalization and thus influence output growth. Many large emerging markets have recently implemented economic reformsin order to increase international trade and foreign investments, their attempts to integrate into the global economy have made the institutional structures in those countries change significantly.

As classic growth theories suggest that economic growth could be accounted as the contributions of factor inputs, productivity and other institutional factors, FDI may affect economic growth in the emerging markets through several channels as shown in Figure 5. We will follow atwo-step approachdescribed in Figure 5to examine the determinants of output growth and then test the specific impact of FDI on those determinants. To this end, we impose the following seven hypotheses.

Hypothesis 1: FDI can affect total amount of investment by either stimulating more domestic investment through a "Crowding In" effect or as a substitute to "Crowd Out" domestic investment, thus affect physical capital accumulation.

Hypothesis 2: As FDI in the labor intensive industries can change the opportunity cost for higher education, it can thereforeaffectpeople's education decisions and hence human capital accumulation.

Hypothesis 3: The imbalance of FDI inflows into different industries can directly have an impact on the industrial structure as well as the phase of industrialization.

Hypothesis 4: The preferential policy for FDI adopted bylocal governments can affect government revenue, which in turn will affect the strength of government intervention to the economy and economic growth.

Hypothesis 5: Foreign invested enterprises affect the degree of openness of the economy by either stimulating more international trade or as analternative of trade between the home country and the host country. Therefore, degree of integration into the global market and role in international specialization will affect domestic output growth for the recipient country.

Hypothesis 6: As FDI may affect degree of openness, it will also impact balance of trade, which directly affects level of domestic output and economic growth.

Hypothesis 7: FDI may also have a spillover effect on technology progress or increasing the opportunity costof R&D activities and innovations in the domestic invested enterprises, which may help or prevent the recipient country to improve its productivity and efficiency and thus level of growth.

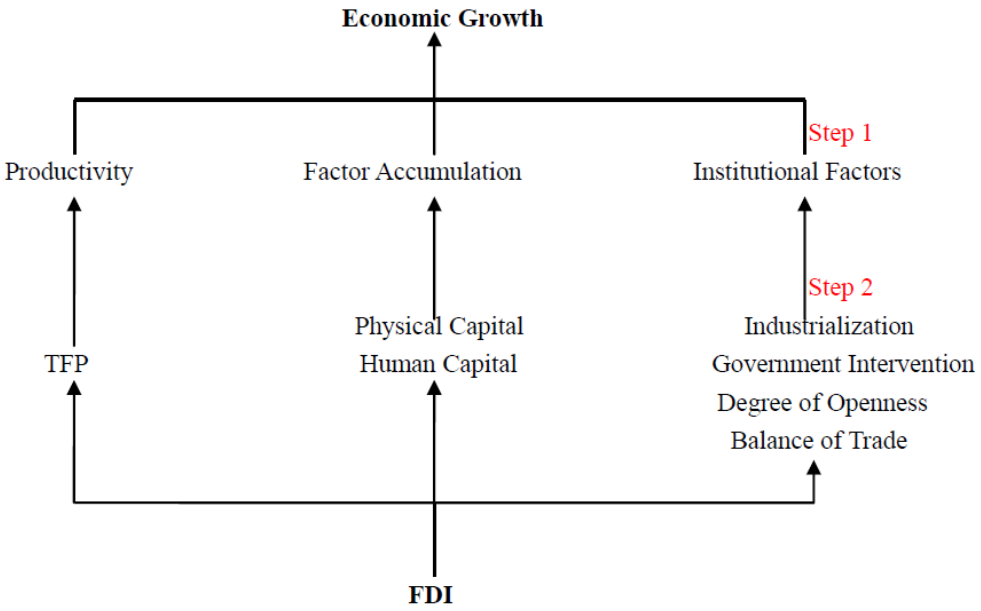

Figure 5: Possible Channels between FDI and Economic Growth

3.2 Empirical Models

Followingthe steps described in Figure 5, we employ the following equations (1) and (2) to test the general effects of FDI on output level and its growth rate of the host country.

$$\ln GDP_{i,t} = \alpha_0 + \alpha_1 FDI_{i,t} + \alpha_2 FDI_{i,t-1} + \alpha_3 FDI_{i,t-2} + \alpha_4 \ln GDP_{i,t-1} + \varepsilon_{i,t} \quad (1)$$

$$d\ln GDP_{i,t} = \beta_0 + \beta_1 FDI_{i,t} + \beta_2 FDI_{i,t-1} + \beta_3 FDI_{i,t-2} + \beta_4 \ln GDP_{i,t-1} + \beta_5 d\ln GDP_{i,t-1} + \mu_{i,t} \quad (2)$$

where i and t denote province and time, respectively. We then use equation (3) to examine the important factor inputs that determine a province's economic growth.

$$\ln GDP_{i,t} = \gamma_0 + \gamma_1 \ln k_{i,t} + \gamma_2 edu_{i,t} + \gamma_3 ind_{i,t} + \gamma_4 gov_{i,t} + \gamma_5 open_{i,t} + \gamma_6 netex_{i,t} + \nu_{i,t} \quad (3)$$

Finally, we test the specific impact of FDI on those determinant factors in (3) to see how FDI affects growth through those channels.

4. Data and Variables

Panel data from 1978 to 2011 of 30provinces in China are used for empirical analysis.[4] To study the regional growth disparity, we divide 30 provinces into three regions, the east, the middle and the west. We also consider a second way of division, i.e., the coastal and the interior areas.[5] The variables are described in Table 1.

[4] We collect data from annual *China Statistical Year Books, Comprehensive Statistical Data and Materialson 50 Years of New China, CCER database and database of National Bureau ofStatistics of China*.

[5] See Table 1 in Appendix for more detailed information.

Table 1: Description of Variables

Variables	Descriptions
FDI	inflow of FDI, the proportion of FDI (in RMB Yuan) to GDP
lnGDP	level of real Gross Domestic Product (GDP) per capita, real GDP per capita taken in natural logarithm, calculated in 1978 constant prices
dlnGDP	growth rate of real GDP per capita, the first difference of real GDP per capita taken in natural logarithm
lnk	physical capital accumulation, real physical capital stock taken in natural logarithm, calculated in 1978 constant prices
edu	level of education, number of total enrollment of students in institutions of higher education in every 100 employed employees
ind	industrial structure, proportion of added value of the tertiary industry to GDP
gov	degree of government intervention, proportion of government revenue relative to GDP
open	degree of openness or dependence on foreign trade, proportion of the value of exports and imports relative to GDP
netex	balance of trade, difference of the value of net exports relative to GDP
inv	level of investment, ratio of total investment of fixed assets to GDP
TFP	Total Factor Productivity, estimated from the residual term of growth decomposition
patent	number of patents, natural log of the number of patents granted
R&D	R&D expenditure, proportion of expenditure on R&D to GDP

5. Empirical Results

In order to specify the regional difference for the effects of FDI on output growth, we first consider regressions using the whole data sample covering 30 provinces in 34 years, and then consider regressions that use a sub-sample covering the provinces in a certain region. The regression method is the dynamic panel estimation. We apply the system GMM method introduced by Arellano and Bover (1995), Blundell and Bond (1998) and Roodman (2006). When choosing the suitable number of lags for each model, we consider the Sargan test and Arellano-Bond test results, as well as the purpose of making models comparable between regions and among channels. The purpose of this paper is to study the possible channels between FDI and growth, and whether such effect will widen or narrow the growth gap between regions are the concerns of the paper. The magnitude of the effect is not our main concern.

5.1 Effects of FDI on Growth

Table 2 in the appendix shows the regression results of equation (1). The effect of FDI on economic growth is ambiguous. On the national level, one and two period lags of FDI have significant impacts on output growth, but their effects are opposite. The current FDI has the positive effect on the output growth in the next year, but has negative effect of a similar magnitude on real GDP growth in one year after. This implies that the positive effect of FDI on growth is reversed one year later. These interesting results leads us to discover further for the question that through what channels FDI could affect growth.

For the regional disparity effect, current FDI has significant affect on all regions, one period lag of FDI has a stronger positive impact on the growth in the west and the interior areas than in the east and coastal areas. However, the two period's lag of FDI has a stronger negative effect on growth in the west and interior regions. Table 3 in the appendix shows the estimated results of the effect of FDI on output growth rate in equation 2. The lagged FDI values affect real per worker GDP growth rate on the national

level but in opposite direction. The effects are more significant in the west area than in the east. This implies the effect of FDI on economic growth will reverse after one year as well.

The purpose of this paper is to find out the exact channel through which FDI would affect economic growth and inequality in China, we consider the direction of each channel as well as whether such channel would widen or narrow the growth gap between regions, yet the magnitude of the effect is not our concern.

5.2 Growth Decomposition

Table 4 in the appendix reports the empirical results of growth decomposition in equation (3). On the national level, factors except the openness and balance of trade all have significant positive impacts on the growth of real GDP. Level of education has a negative effect on the growth of real GDP. Intuitively, the expected benefit of education will be realized in the future, yet it is regarded as a cost for production at current period. Since if the number of people went to college is increasing, the number of labor force in the production will be decreased, which contributes to the negative effect.

In the east areas, both the level of education and industrial structure have negative effects on growth, which indicates that output growth in the east does not directly come from the development of the tertiary industry. Instead, it is the development of manufacturing industry that contributes to the fast growth of the east areas. In west areas, the level of education and government interventions are both negatively related to the output growth, indicating a higher level of government revenue leads to a lower level of output growth. In the middle areas, the government intervention and balance of trade have negative impact on growth. It means that a higher level of government revenue, the increase of the foreign trade and the trade surplus has a negative effect on the output growth in the middle areas.

In the coastal areas, all the coefficients are positive, and the signs of the coefficients for the interior areas are similar to those in the west areas. Moreover, we calculate the correlation of the level of TFP[6] with the level of growth. We can see from the table that the correlation between TFP and growth is highest for the west and lowest for the east, which implies that the growth of west areas depend more on technology progress than the east areas. Based on the results from the growth decomposition, we can identify the determinant factors of economic growth. If FDI does affect the economic growth; we should expect that such effect must pass through one or several of those channels. Thus, we test how FDI affects economic growth through those channels in the following subsection.

5.3 Channels between FDI and Growth

Channel 1: "Crowd In" or "Crowd Out" Effects on DI?

Equation (4) is applied to test hypothesis 1. In this model, the explained variable is the level of investment, including both domestic investment (DI) and foreign direct investment (FDI). The explanatory variables in the model include level of FDI, output growth, lags of the explained variable as well as the control variables of the institutional factors.

[6]We use the residual term in the models which stands for the level of total factor productivity (TFP) indicated by Solow residual.

$$inv_{i,t} = a_0 + a_1 FDI_{i,t} + a_2 FDI_{i,t-1} + a_3 FDI_{i,t-2} + a_4 \ln GDP_{i,t} + a_5 \ln GDP_{i,t-1} + a_6 edu_{i,t} + a_7 open_{i,t} + a_8 gov_{i,t} + a_9 ind_{i,t} + a_{10} netex_{i,t} + a_{11} inv_{i,t-1} + a_{12} inv_{i,t-2} + \upsilon_{i,t} \quad (4)$$

In order to specify the effects of FDI on DI, for each model,a β indicator in equation 5is used according to Agosinand Mayer (2000). This indicator shows the elasticity of total investment with respect to FDI. If $\beta = 1$, then FDI is expected to have no significant effect on DI, so one percent increase of FDI will lead to an equal amount increase of total investment. If $\beta < 1$, then FDI is expected to have a "Crowd Out" effect on DI, which means that one percent increase of FDI will lead to a decrease of DI, so thelevel of total investment will be increased by less than one percent. On the contrary, if $\beta > 1$, then FDI is expected to have a "Crowd In" effect on DI, indicating that one percent increase of FDI will also promote level of DI so that the total investment will increase more than one percent.

$$\hat{\beta}_i = \frac{\sum_{i=1}^{3} a_i}{1 - \sum_{j=11}^{12} a_j} \quad (5)$$

Table 5 in the appendix shows the estimated results of equation (5). On the national level, in the last 34 years, foreign investment in China facilitates domestic investment in the current year, however, it is a substitute to the domestic investment rather than a promoter after the first year. FDI has significant "Crowd In" effect in the current year where local industry build facilities to accommodate foreign investment, however, in the following years, when the foreign investment begins to produce, it will crowd out domestic effect as a substitute.

The implied β for five of the models are all far less than 1, which implies that on the national level and regions other than the middle area, FDI has crowd out effect on DI. On the national level, one percent increase of FDI will lead to the level of total fixed asset investment increase about 0.09 percent, in other words, 0.91 percent of domestic investment has been crowded out by FDI. So in the last 34 years, the role of foreign investment in China is a substitute to the domestic investment rather than a promoter in general.

Moreover, the magnitude of the crowd out effects is diverse among regions. For the east area, the crowd out effect is about 0.6, indicating one percent increase of FDI will lead to 0.6percent decrease of DI. For the middle area, the first "Crowd In" and then "Crowd Out" effect is similar to the national level. However, the total effect is crowd in since β is bigger than one, which means that one percent increase of FDI can crowd in about 3.5 percent of DI and lead to a increase of the total level of investments.For the west area, the implied β is even negative, which means that increase of FDI will crowd out an even bigger amount of domestic investment and thus lead to a decrease in the total level of investment. While such effects are not significant for the west areas, which may be due to the fact that the ability for the west areas to build facilities accommodation is limited, so the effect of FDI to DI is not significant. The "Crowd Out"effect is bigger in

the coastal areas than the interior areas. So taken into account of the "Crowd Out" effect FDI has on DI as its substitute, its expected effect on output growth issignificantly weakened. For the middle and western areas, increase of FDI discouraged physical capital accumulation and thus was harmful for output growth.

To sum up, FDI in China have significant first "Crowd In" and then "Crowd Out" effects during the reform period through 1978 to 2011 on the national level, but in total, the crowd out effect is bigger than crowd in. When FDI increases, it first attracts more DI through creating a promising environment, then in later years, the effect is reverse that it "Crowd Out" DI as a substitute, its expected effect on output growth is significantly weakened. This may explain why FDI in general has reverse effects on growth for different lags as well.

Channel 2: Human Capital Accumulation

Equation (6) is applied to test the impact of FDI on the education level and human capital accumulation in the recipient country.

$$\begin{aligned} edu_{i,t} &= b_0 + b_1 FDI_{i,t} + b_2 FDI_{i,t-1} + b_3 FDI_{i,t-2} + b_4 \ln GDP_{i,t} + b_5 \ln GDP_{i,t-1} \\ &+ b_6 inv_{i,t} + b_7 open_{i,t} + b_8 gov_{i,t} + b_9 ind_{i,t} + b_{10} netex_{i,t} + b_{11} edu_{i,t-1} + \omega_{i,t} \end{aligned} \tag{6}$$

Table 6 in the appendix shows the estimated results. The effect of FDI on education level is complicated. Five of the models except the west area indicate a strong negative relationship between FDI and the education level. Generally speaking, the negative effect about the similar level for the east and middle areas, as well as coastal and interior areas.

Similar to (5), we can also calculate a β -coefficient which indicates the exact effect of FDI on level of education. On the national level, for every 100 employers, there is a decrease of around 3 students enrolled into higher education institutions with one percent increase of FDI. For the east and middle, the number is 5. For the west area, with one percent increase of FDI, around 1 more student will be enrolled into higher education.

Intuitively, FDI to the labor-intensive manufacturing industries increases the demand for low-skilled workers in the labor market, and increases the number of total employed workers and attract people from higher education. If the increase of FDI causes more low-cost unskilled labor agglomerating to the coast from the interior and leads to a lower proportion of enrollment to higher education, we should find a higher negative impact on the education level by FDI in the interior areas, since people could otherwise agglomerating to the coast for higher education since the coast has more educational resources. This is the case comparing the implied β for the coastal and interior areas. Moreover, as FDI brings more working opportunities to the coastal areas, the opportunity cost for higher education increases. As a result, more graduates from the secondary or primary school join the industry directly. Through the changes of opportunity cost for further education decisions, FDI significantly affects education level in the host country. Because the level of education plays a negative role in GDP growth national-wide, FDI improves the output growth in the short-run. However, in the long-run, the increase in FDI is harmful for human capital stock and intellectual asset accumulation,and thus slows the output growth. In the east and middle areas, the increase of FDI leads to a short-run growth of GDP, and in the west areas, even the short-run effect on GDP is negative. A proper explanation for the positive β value for the west areas maybe that FDI companies in the west is not enough to absorb all the people who graduated from secondary school,

so the choose to enroll in higher education in expecting that they would get better jobs later.

Channel 3: Industrial Structure Change

To test hypothesis 3, we apply equation (7) to examine the effects of FDI on the industrial structure change of the emerging economy.

$$\begin{aligned} ind_{i,t} &= c_0 + c_1 FDI_{i,t} + c_2 FDI_{i,t-1} + c_3 FDI_{i,t-2} + c_4 \ln GDP_{i,t} + c_5 \ln GDP_{i,t-1} \\ &+ c_6 inv_{i,t} + c_7 open_{i,t} + c_8 gov_{i,t} + c_9 edu_{i,t} + c_{10} netex_{i,t} + c_{11} ind_{i,t-1} + \xi_{i,t} \end{aligned} \tag{7}$$

Table 7 in the appendix reports the effects of FDI on the changes of China's industrial structure on the national level. There is no significant relationship between FDI and industrial structure change on the aggregate level. In the east area, one percent increase of FDI leads to 0.45 percent increase of the proportion of tertiary industry. In the other two areas, however, the effects are negative: 2.2 percent decrease in the west and 0.09 percent decrease in the middle. More FDI inflow stimulates the development of tertiary industry in the east, while impair its development in the middle and west.

FDI to the emerging economies such as China aims at labor intensive manufacturing industries rather than the tertiary industries especially in the interior areas. Its performance improves the prosperity of tertiary industry such as financial markets and producer service industry in the east. From the results in Table 4 in the appendix, we can conclude that FDI does not have a significant effect on output growth through the channel of industrial structure change on the national level, however, it will slower down the growth of the east and coastal areas.

Channel 4: Government Intervention

In order to attract more FDI, the Chinese government (also at local level) initiates various preferential policies such as lower income tax rate, tax reduction and exemption, free land usage. We test the effects of FDI on government revenue by applying equation (8).

$$\begin{aligned} gov_{i,t} &= d_0 + d_1 FDI_{i,t} + d_2 FDI_{i,t-1} + d_3 FDI_{i,t-2} + d_4 \ln GDP_{i,t} + d_5 \ln GDP_{i,t-1} \\ &+ d_6 inv_{i,t} + d_7 open_{i,t} + d_8 ind_{i,t} + d_9 edu_{i,t} + d_{10} netex_{i,t} + d_{11} gov_{i,t-1} + \kappa_{i,t} \end{aligned} \tag{8}$$

The results are reported in Table 8 in the appendix. The value of implied β shows that on the national level, FDI has a negative effect on the growth of local government revenue, and one percent increase of FDI leads to 0.26 percent decrease of the government revenue in proportion to GDP.

For the east areas, the effect is not significant. The negative effect of FDI on local government revenue is more significant in the middle than the west, interior than the coastal. One percentage increase of FDI to the west leads to 0.37 percent decrease of government revenue and for the middle area 0.44 percent, and interior areas 0.87 percent, coastal areas 0.12 percent. This is intuitive, in order to attract more FDI, governments in the middle, west and interior areas has to give more incentive policies for foreign investments otherwise, they will flow to the coastal and east areas. Although the preferential policies encourage more FDI inflows, the government revenue is also

reduced significantly. Since government revenue and thus intervention is helpful for the economic growth, incentive policies for FDI will hurt long-run growth.

Channel 5: Degree of Openness

On the one hand, FDI acts as an alternative of trade between the host country and the home country. On the other hand, Because foreign invested enterprises may take advantage of the low-cost unskilled labor and land in the recipient country, and import intermediate goods and export finished goods through forward and backward industrial linkages, FDI may also have either a "Crowd In" effect or a "Crowd Out" effect on international trade in the emerging economies.

Equation (9) specifies the effect of FDI on degree of openness.

$$\begin{aligned} open_{i,t} &= e_0 + e_1 FDI_{i,t} + e_2 FDI_{i,t-1} + e_3 FDI_{i,t-2} + e_4 \ln GDP_{i,t} + e_5 \ln GDP_{i,t-1} \\ &+ e_6 inv_{i,t} + e_7 gov_{i,t} + e_8 ind_{i,t} + e_9 edu_{i,t} + e_{10} netex_{i,t} + e_{11} open_{i,t-1} + \psi_{i,t} \end{aligned} \tag{9}$$

The appendix Table 9 shows the results. On the national level, one percent increase of FDI increases the proportion of international trade to GDP by 1.4 percent, which means that foreign invested enterprises have a positive effect on China's international trade in the global markets. The positive effect of FDI on trade is 1.29 percent for the east area, and only 0.78 percent in for the west. However, in the middle, one percent increase of FDI leads to a decrease of international trade by 1.2 percent, which means FDI is a substitute for foreign trade. Intuitively, participation in international trade facilitates in-depth specialization and the division of labor in the areas with comparative advantages, so the allocation of resources is more effective and the production frontier is shifted. For the interior areas, more FDI will facilitate the degree of openness while such effect is smaller for the coastal areas.

Channel 6: Balance of Trade

Equation (10) is applied to examine the exact effect of FDI on net export as one channel between FDI and output growth.

$$\begin{aligned} netex_{i,t} &= e_0 + e_1 FDI_{i,t} + e_2 FDI_{i,t-1} + e_3 FDI_{i,t-2} + e_4 \ln GDP_{i,t} + e_5 \ln GDP_{i,t-1} \\ &+ e_6 inv_{i,t} + e_7 gov_{i,t} + e_8 ind_{i,t} + e_9 edu_{i,t} + e_{10} open_{i,t} + e_{11} netex_{i,t-1} + \vartheta_{i,t} \end{aligned} \tag{10}$$

Table 10 in the appendix shows the results. On the national level, one percent increase of FDI leads the proportion of trade surplus to GDP to increase by 0.9 percent. The effect in the east area is not significant, 0.68 percent in the west. For the middle, one percent increase of FDI leads to a trade deficit at 0.55 percent in proportion to GDP.Comparing the effect of FDI on balance of trade and its effect on the degree of openness, we can find that regions with a higher level of openness have a higher level of trade surplus. For the middle area, FDI not only causes a decrease in international trade, but also leads to a trade deficit. Combining the results in Table 10 and Table 4 in the appendix, FDI promotes Chinese national income and economic growth through a trade surplus effect for the west areas, and hence enhances the output growth in west areas in China, while such effect is not significant for the east areas, thus increase of FDI narrows the gap between east and west.

Channel 7: Technology Spillover Effect

Equation (11) examines the spillover effect of FDI on level of TFP change in the recipient country.

$$TFP_{i,t} = f_0 + f_1 FDI_{i,t} + f_2 FDI_{i,t-1} + f_3 FDI_{i,t-2} + f_4 \ln GDP_{i,t} + f_5 \ln GDP_{i,t-1} + f_6 inv_{i,t} + f_7 gov_{i,t} + f_8 ind_{i,t} + f_9 edu_{i,t} + f_{10} open_{i,t} + f_{11} netex_{i,t-1} + f_{12} TFP_{i,t-1} + \delta_{i,t} \quad (11)$$

The effects of FDI on TFP are reported in Table 11 in the appendix. In general, FDI is has negative effect on productivity growth on the national level. Yet its effect to the middle areas is not significant. For the east areas, such effect is positive, while for the west areas, one percent increase of FDI will lead to 9 percent decrease of TFP level. For the interior areas, the effect is also negative and coastal areas has effects positive. This implies that on the national level, increase of FDI will impede the technology innovations, and such negative effects especially larger for the interior areas, middle and west areas. For the coastal and east areas, increase of FDI has some positive effect on TFP level, yet the effect is very small. As TFP is a significant determinant of output growth and has positive effect both on the national level and by region, so FDI is expected to decrease China's output growth through the channel of TFP progress, especially for the west and the interior areas.

One explanation for this negative spillover effect is that FDI may impede technology progress through discouraging R&D activities in the domestic-invested enterprises and since most FDI companies are labor intensive, the core technology belongs to is original country rather than transferred to domestic firms. It leads to a lower level of innovations and inventions in the host country, and the slower technology progress shift the production frontier to a lower level. The effect for the west is similar to the national level. However, for the east and coastal areas, such spillover effects are positive, which implies there is positive technology spillover or technology transfer between FDI companies and domestic companies. We also test whether FDI could impede R&D activities and number of patents granted as expected by applying equations (12) and (13).

$$patent_{i,t} = g_0 + g_1 FDI_{i,t} + g_2 FDI_{i,t-1} + g_3 FDI_{i,t-2} + g_4 \ln GDP_{i,t} + g_5 \ln GDP_{i,t-1} + g_6 inv_{i,t} + g_7 gov_{i,t} + g_8 ind_{i,t} + g_9 edu_{i,t} + g_{10} open_{i,t} + g_{11} netex_{i,t-1} + g_{12} patent_{i,t-1} + \varphi_{i,t} \quad (12)$$

$$R\&D_{i,t} = h_0 + h_1 FDI_{i,t} + h_2 FDI_{i,t-1} + h_3 FDI_{i,t-2} + h_4 \ln GDP_{i,t} + h_5 \ln GDP_{i,t-1} + h_6 inv_{i,t} + h_7 gov_{i,t} + h_8 ind_{i,t} + h_9 edu_{i,t} + h_{10} open_{i,t} + h_{11} netex_{i,t-1} + h_{12} R\&D_{i,t-1} + \sigma_{i,t} \quad (13)$$

The results are shown in Table 12 in the appendix. We can see that FDI has a significant negative effect on the number of patents granted on a national level. The effects to the middle areas are also negative. Yet the effect for the east and west areas are positive. Table 13 in the appendix reports the estimated effects of FDI on expenditure in R&D activities. The results show that FDI has a negative effect on R&D investment on the national level. In general, FDI has negative externalities on technology growth and the level of TFP progress in China, which leads to slower down growth of GDP per worker.

5.4 FDI and China's Interregional Income Inequity

The impacts of FDI on regional output growth are different for different regions so that FDI is expected to influence interregional growth gap and income inequity in China. We summarize the effects from our empirical results in Table 2.

As FDI increase total level of investments in the east, middle areas while decrease the

total level of investments in the west areas, an increase of FDI is expected to widen the growth gap between the east and the west through the channel of physical capital accumulation. By examining hypothesis 2, we find that FDI enhances output growth in the west and interior,but no significant effects in the east and middle as well as coastal areas. So through the channel of education level or human capital accumulation, increased FDI will narrow the growth gap between east and west, as well as coastal and interior.

FDI narrows the growth gap between the west and other two areas through the channel of industrial structure change, and the gap between the east and interior through the channel of reduced government intervention. Although an increased level of FDI leads to growth in the west areas in China through promoting a higher level of international trade and gaining more trade surplus, the effects are not significant for other regions, so the growth gap between the east and the interior is narrowed.

The negativeeffect of FDI to TFP is significant for the west areas, while for the east areas, such effects is positive. In this perspective, FDI widens the gap between the west and east through shifting its production possibility frontier, that impede technology innovations for the west yet has positive spillover effects for the east. Generally speaking, through the channel of technology spillover and innovation effect, FDI widens the gap between the east and the interior areas.

Table 2: Channels between FDI and Economic Growth in China

Hypothesis	Channel	National	East	West	Middle	Coastal	Interior
H1	*FDI➔inv*	+	+	+	+	+	+
	K➔GDP	+	+	+	+	+	+
Widen	Total Effect	+	+	+	+	+	+
H2	*FDI➔edu*	-	-	+	no	-	-
	edu➔GDP	-	no	-	no	+	-
Widen	Total Effect	+	no	-	no	-	+
H3	*FDI➔ind*	no	+	no	-	+	no
	ind➔GDP	+	-	+	+	+	+
Narrow	Total Effect	no	-	no	-	+	no
H4	*FDI➔gov*	-	no	-	-	-	-
	gov➔GDP	+	+	-	-	+	no
Narrow	Total Effect	-	no	+	+	-	no
H5	*FDI➔open*	+	no	+	-	no	+
	open➔GDP	no	+	+	no	no	no
Narrow	Total Effect	no	no	+	no	no	no
H6	*FDI➔netex*	+	no	+	-	no	+
	netex➔GDP	no	+	+	-	no	+
Narrow	Total Effect	no	no	+	+	no	+
H7	*FDI➔TFP*	-	+	-	no	+	-
	TFP➔GDP	+	+	+	+	+	+
	Total Effect	-	+	-	no	+	-
	FDI➔patent	-	+	+	no	no	+
Widen	*FDI➔R&D*	-	no	no	+	-	no

6. Conclusion

This paper examines the exact channels between FDI and China's economic growth,

and its effect on regional inequality. We show that higher level of FDI facilitates China's output growth on the national level through the channel of inspiring more physical capital accumulation, reducing the proportion students pursuing higher education. The channel through enhancing dependence of trade and trade surplus, as well as the industrial structure is not significant on a national level. On the other hand,FDI slows down economic growth in China through reducing government income as well as discouraging technology progress. We also find that through the channels of physical capital accumulation and TFP, FDI widens the income gap between the coastal east and the interior area, and through the channels of industrial structure change, government intervention and human capital accumulation, degree of openness and balance of trade, FDI narrows the interregional growth gap during the past 34 years.

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Appendix

Table 1: Location of Mainland Provinces

Mainland Province	Location	Location	Mainland Province	Location	Location
Beijing	East	Interior	Henan	Middle	Interior
Tianjin	East	Coastal	Hubei	Middle	Interior
Hebei	East	Coastal	Hunan	Middle	Interior
Shanxi	Middle	Interior	Guangdong	East	Coastal
Inner Mongolia	West	Interior	Guangxi	West	Interior
Liaoning	East	Coastal	Hainan	East	Coastal
Jilin	Middle	Interior	Sichuan	West	Interior
Heilongjiang	Middle	Interior	Guizhou	West	Interior
Shanghai	East	Coastal	Yunnan	West	Interior
Jiangsu	East	Coastal	Tibet	West	Interior
Zhejiang	East	Coastal	Shannxi	West	Interior
Anhui	Middle	Interior	Gansu	West	Interior
Fujian	East	Coastal	Qinghai	West	Interior
Jiangxi	Middle	Interior	Ningxia	West	Interior
Shandong	East	Coastal	Xinjiang	West	Interior

Table 2: Effects of FDI on Output Growth Level

	(1) Total lnGDP	(2) East lnGDP	(3) West lnGDP	(4) Middle lnGDP	(5) Coastal lnGDP	(6) Interior lnGDP
FDI	0.152	0.470***	5.164***	1.441**	0.425***	3.670***
	(0.448)	(0.151)	(1.479)	(0.628)	(0.158)	(0.925)
FDI_1	3.491***	0.0122	9.905***	0.212	0.0434	7.533***
	(0.636)	(0.230)	(1.595)	(0.884)	(0.244)	(1.053)
FDI_2	-3.257***	-0.116	-11.67***	-0.517	-0.126	-8.949***
	(0.473)	(0.161)	(1.578)	(0.657)	(0.168)	(0.967)
lnGDP_1	0.985***	0.995***	0.944***	1.004***	0.996***	0.967***
	(0.00855)	(0.00365)	(0.0235)	(0.00577)	(0.00369)	(0.0140)
_cons	0.189***	0.115***	0.481***	0.0357	0.107***	0.305***
	(0.0668)	(0.0297)	(0.175)	(0.0423)	(0.0299)	(0.105)
N	920	341	331	248	310	610
adj. R^2	0.949	0.997	0.877	0.997	0.997	0.926
F_stat	4304.4206	25646.7310	594.3122	19357.1183	25001.6657	1917.9397
p_value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Standard errors in parentheses, $^{*}p< 0.10$, $^{**}p< 0.05$, $^{***}p< 0.01$

Table 3: Effects of FDI on Output Growth Rate

	(1) Total dlnGDP	(2) East dlnGDP	(3) West dlnGDP	(4) Middle dlnGDP	(5) Coastal dlnGDP	(6) Interior dlnGDP
FDI	0.0809	0.438***	4.938***	1.506**	0.397**	3.452***
	(0.443)	(0.151)	(1.465)	(0.623)	(0.157)	(0.916)
FDI_1	3.621***	-0.0218	10.23***	-0.170	0.00989	7.773***
	(0.629)	(0.229)	(1.581)	(0.891)	(0.243)	(1.043)
FDI_2	-3.302***	-0.0991	-11.50***	-0.345	-0.110	-8.896***
	(0.468)	(0.161)	(1.562)	(0.655)	(0.168)	(0.955)
lnGDP_1	-0.0115	-0.00501	-0.0506**	0.00139	-0.00384	-0.0283**
	(0.00848)	(0.00363)	(0.0233)	(0.00581)	(0.00367)	(0.0139)
dlnGDP_1	-0.0877***	0.120**	-0.0798***	0.148**	0.120**	-0.0838***
	(0.0190)	(0.0538)	(0.0282)	(0.0628)	(0.0563)	(0.0216)
_cons	0.169**	0.107***	0.441**	0.0445	0.100***	0.276***
	(0.0662)	(0.0298)	(0.173)	(0.0420)	(0.0299)	(0.104)
N	920	341	331	248	310	610
adj. R^2	0.061	0.067	0.246	0.090	0.064	0.185
F_stat	18.6602	7.9212	24.5892	7.2637	7.0408	32.3613
p_value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Standard errors in parentheses, $^{*}p<0.10$, $^{**}p<0.05$, $^{***}p<0.01$

Table 4: Results of Growth Decomposition

	(1) Total lnGDP	(2) East lnGDP	(3) West lnGDP	(4) Middle lnGDP	(5) Coastal lnGDP	(6) Interior lnGDP
lnk	0.840***	0.845***	0.827***	0.750***	0.801***	0.849***
	(0.0118)	(0.0181)	(0.0182)	(0.0266)	(0.0161)	(0.0153)
edu	-0.0448***	-0.00900	-0.117***	0.0441	0.0581***	-0.0944***
	(0.0161)	(0.0206)	(0.0361)	(0.0306)	(0.0187)	(0.0229)
ind	0.561***	-0.402*	1.302***	0.841***	0.501**	0.830***
	(0.123)	(0.214)	(0.182)	(0.198)	(0.213)	(0.145)
gov	0.391***	0.354**	-0.826***	-0.914***	0.439***	0.0406
	(0.111)	(0.145)	(0.232)	(0.255)	(0.124)	(0.178)
open	0.00609	0.0613**	0.561***	-0.0223	0.0226	-0.0360
	(0.0254)	(0.0283)	(0.145)	(0.228)	(0.0231)	(0.0858)
netex	0.0253	0.0718**	0.460***	-0.818**	0.0160	0.469***
	(0.0288)	(0.0312)	(0.175)	(0.342)	(0.0253)	(0.144)
_cons	0.603***	0.964***	0.277**	1.531***	1.063***	0.411***
	(0.0825)	(0.124)	(0.135)	(0.189)	(0.0982)	(0.112)
N	859	319	308	232	290	569
adj. R^2	0.964	0.973	0.961	0.980	0.985	0.957
F_stat	3862.9899	1921.7078	1271.6382	1880.1179	3161.3733	2090.7207
p_value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
corr(lnGDP,TFP)	0.1495	0.0007	0.4092	0.2569	0.0989	0.1922

Standard errors in parentheses, $^{*}p<0.10$, $^{**}p<0.05$, $^{***}p<0.01$

Table 5: Crowd In or Crowd Out Effects of FDI on Domestic Investment

	(1) Total inv	(2) East inv	(3) West inv	(4) Middle inv	(5) Coastal inv	(6) Interior inv
FDI	0.640***	0.642***	-0.148	2.584***	0.591***	0.647***
	(0.110)	(0.126)	(0.258)	(0.594)	(0.133)	(0.209)
FDI_1	-0.461***	-0.473**	0.305	-3.182***	-0.423**	-0.474*
	(0.160)	(0.188)	(0.360)	(0.839)	(0.200)	(0.269)
FDI_2	-0.165	-0.0780	-0.464	1.878***	-0.0696	-0.0262
	(0.121)	(0.139)	(0.305)	(0.650)	(0.144)	(0.235)
lnGDP	0.0127	0.181***	0.0155	0.0817	0.166***	0.0135
	(0.00832)	(0.0474)	(0.00989)	(0.0613)	(0.0499)	(0.00937)
lnGDP_1	0.0108	-0.165***	0.0226**	-0.0637	-0.154***	0.0181*
	(0.00868)	(0.0472)	(0.0108)	(0.0635)	(0.0498)	(0.00979)
edu	0.0168***	0.0187***	0.0564***	0.0459***	0.0245***	0.0226***
	(0.00484)	(0.00620)	(0.0131)	(0.0122)	(0.00727)	(0.00699)
ind	-0.00632	-0.116**	0.146**	0.0246	-0.0454	-0.0107
	(0.0351)	(0.0513)	(0.0601)	(0.0829)	(0.0773)	(0.0422)
gov	0.0759*	0.00497	0.0643	0.436***	0.0412	0.105
	(0.0416)	(0.0505)	(0.0924)	(0.144)	(0.0548)	(0.0703)
open	-0.0388***	-0.0189**	-0.131***	-0.153	-0.0272***	-0.00993
	(0.00814)	(0.00823)	(0.0491)	(0.0967)	(0.00873)	(0.0257)
netex	-0.0364***	-0.0174*	-0.120**	-0.0237	-0.0262***	0.0437
	(0.00901)	(0.00901)	(0.0522)	(0.134)	(0.00946)	(0.0392)
inv_1	1.037***	1.040***	0.824***	1.071***	1.040***	0.991***
	(0.0359)	(0.0553)	(0.0593)	(0.0764)	(0.0588)	(0.0452)
inv_2	-0.200***	-0.252***	-0.130**	-0.357***	-0.262***	-0.187***
	(0.0380)	(0.0579)	(0.0605)	(0.0804)	(0.0610)	(0.0482)
_cons	-0.126***	-0.0403	-0.221***	-0.117	-0.0263	-0.183***
	(0.0316)	(0.0462)	(0.0557)	(0.100)	(0.0500)	(0.0439)
N	910	340	325	245	309	601
adj. R^2	0.912	0.879	0.926	0.946	0.886	0.923
F_stat	786.3183	206.8788	339.7441	357.0227	200.9884	602.5590
p_value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
impliedβ	0.0859	0.4292	-1.003	4.4755	0.4432	0.7490
Effects	Crowd out	Crowd out	Crowd out	Crowd In	Crowd out	Crowd out

Standard errors in parentheses, * $p< 0.10$, ** $p< 0.05$, *** $p< 0.01$

Table 6: Effects of FDI on Education Level

	(1) Total edu	(2) East edu	(3) West edu	(4) Middle edu	(5) Coastal edu	(6) Interior edu
FDI	2.103***	0.347	2.835***	-3.062	0.385	2.659***
	(0.465)	(0.752)	(0.656)	(2.083)	(0.667)	(0.783)
FDI_1	-5.978***	-2.258**	-12.59***	3.752	-1.851*	-10.74***
	(0.659)	(1.086)	(0.862)	(2.839)	(0.980)	(0.973)
FDI_2	3.256***	0.615	9.887***	-1.838	0.448	7.029***
	(0.504)	(0.792)	(0.824)	(2.150)	(0.699)	(0.872)
lnGDP	-0.0826**	0.455	-0.0256	0.106	0.168	-0.0156
	(0.0353)	(0.280)	(0.0259)	(0.211)	(0.248)	(0.0352)
lnGDP_1	0.223***	-0.256	0.0713**	0.128	0.0499	0.143***
	(0.0359)	(0.278)	(0.0279)	(0.218)	(0.247)	(0.0362)
inv	0.330***	0.283	0.519***	0.0643	0.324**	0.357***
	(0.0711)	(0.175)	(0.0956)	(0.133)	(0.156)	(0.0850)
ind	-0.325**	-0.394	-0.255	-0.393	-1.130***	-0.199
	(0.147)	(0.306)	(0.155)	(0.284)	(0.373)	(0.157)
gov	0.114	0.287	0.0518	0.981*	-0.0754	0.102
	(0.174)	(0.292)	(0.238)	(0.503)	(0.269)	(0.260)
open	0.150***	0.168***	0.0804	0.368	0.184***	0.0527
	(0.0343)	(0.0475)	(0.128)	(0.335)	(0.0425)	(0.0956)
netex	0.148***	0.162***	0.106	-0.540	0.190***	-0.160
	(0.0379)	(0.0521)	(0.136)	(0.463)	(0.0460)	(0.146)
edu_1	0.788***	0.756***	0.810***	0.778***	0.754***	0.782***
	(0.0201)	(0.0365)	(0.0336)	(0.0444)	(0.0351)	(0.0259)
_cons	-1.006***	-1.517***	-0.379***	-1.671***	-1.419***	-0.913***
	(0.129)	(0.260)	(0.143)	(0.332)	(0.235)	(0.158)
N	919	341	330	248	310	609
adj. R^2	0.905	0.889	0.934	0.951	0.915	0.909
F_stat	802.5075	249.2974	427.6058	441.3267	305.7187	556.5279
p_value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
impliedβ	-2.9198	-5.3114	0.6947	-5.1712	-4.1382	-4.8257

Standard errors in parentheses, * $p< 0.10$, ** $p< 0.05$, *** $p< 0.01$

Table 7: Effects of FDI on Industrial Structure

	(1) Total ind	(2) East ind	(3) West ind	(4) Middle ind	(5) Coastal ind	(6) Interior ind
FDI	0.0833	0.163**	-0.159	0.348	0.185***	-0.134
	(0.0597)	(0.0787)	(0.144)	(0.286)	(0.0662)	(0.119)
FDI_1	-0.129	-0.235**	0.0386	-1.329***	-0.275***	-0.150
	(0.0857)	(0.115)	(0.199)	(0.383)	(0.0983)	(0.150)
FDI_2	0.0484	0.146*	-0.271	0.962***	0.122*	-0.0426
	(0.0641)	(0.0823)	(0.169)	(0.293)	(0.0697)	(0.130)
lnGDP	0.0112**	0.0496*	0.00922*	-0.0513*	0.00756	0.0134**
	(0.00448)	(0.0292)	(0.00547)	(0.0287)	(0.0249)	(0.00523)
lnGDP_1	-0.00619	-0.0511*	0.00106	0.0752**	0.00216	-0.00486
	(0.00473)	(0.0289)	(0.00607)	(0.0293)	(0.0247)	(0.00557)
inv	-0.0115	-0.0273	0.0220	-0.0122	-0.00563	-0.0207
	(0.00924)	(0.0184)	(0.0214)	(0.0178)	(0.0159)	(0.0129)
edu	0.00260	0.0133***	-0.0111	-0.0180***	-0.00200	0.00394
	(0.00261)	(0.00381)	(0.00716)	(0.00580)	(0.00369)	(0.00390)
gov	-0.0457**	-0.0597*	0.0260	-0.0126	-0.0768***	-0.0352
	(0.0222)	(0.0306)	(0.0506)	(0.0690)	(0.0269)	(0.0388)
open	0.00656	0.00306	-0.0140	0.0411	0.00540	0.0358**
	(0.00444)	(0.00508)	(0.0277)	(0.0460)	(0.00438)	(0.0143)
netex	0.00510	0.00182	0.00717	0.0882	0.00561	0.0154
	(0.00490)	(0.00554)	(0.0293)	(0.0630)	(0.00473)	(0.0219)
ind_1	0.846***	0.839***	0.823***	0.808***	0.780***	0.836***
	(0.0191)	(0.0321)	(0.0338)	(0.0388)	(0.0387)	(0.0238)
_cons	0.0209	0.0733**	-0.0187	-0.111**	0.00571	-0.000977
	(0.0171)	(0.0289)	(0.0307)	(0.0467)	(0.0255)	(0.0245)
N	919	341	330	248	310	609
adj. R^2	0.880	0.905	0.819	0.914	0.920	0.862
F_stat	618.2746	295.3792	137.5973	241.3745	323.1519	348.5131
p_value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
impliedβ	0.0175	0.4596	-2.2112	-0.0990	0.1455	-1.9915

Standard errors in parentheses, * $p< 0.10$, ** $p< 0.05$, *** $p< 0.01$

Table 8: Effects of FDI on Government Revenue

	(1) Total gov	(2) East gov	(3) West gov	(4) Middle gov	(5) Coastal gov	(6) Interior gov
FDI	0.0873	0.0469	0.0967	1.160***	0.118	-0.0519
	(0.0539)	(0.0693)	(0.134)	(0.224)	(0.0739)	(0.0965)
FDI_1	-0.305***	-0.161	-0.537***	-1.762***	-0.259**	-0.402***
	(0.0773)	(0.100)	(0.183)	(0.299)	(0.109)	(0.121)
FDI_2	0.155***	0.0905	0.267*	0.428*	0.121	0.123
	(0.0582)	(0.0725)	(0.160)	(0.227)	(0.0773)	(0.106)
lnGDP	-0.0189***	-0.0463*	-0.0153***	-0.0708***	-0.0504*	-0.0168***
	(0.00402)	(0.0255)	(0.00511)	(0.0213)	(0.0273)	(0.00424)
lnGDP_1	0.00804*	0.0397	-0.00458	0.0579***	0.0445	0.00143
	(0.00422)	(0.0253)	(0.00565)	(0.0223)	(0.0271)	(0.00449)
inv	0.0211**	0.00726	0.0420**	0.0367***	0.00345	0.0419***
	(0.00829)	(0.0162)	(0.0200)	(0.0134)	(0.0175)	(0.0104)
edu	0.00955***	0.00772**	0.0141**	0.0103**	0.00754*	0.00939***
	(0.00233)	(0.00335)	(0.00670)	(0.00446)	(0.00405)	(0.00314)
ind	0.0261	0.0429	0.0377	-0.0167	0.0418	0.0280
	(0.0173)	(0.0287)	(0.0314)	(0.0293)	(0.0440)	(0.0193)
open	0.00287	0.00171	0.0643**	-0.0296	0.00167	0.00260
	(0.00400)	(0.00446)	(0.0255)	(0.0352)	(0.00485)	(0.0117)
netex	0.00255	0.00177	0.0231	0.0790*	0.00158	-0.000505
	(0.00442)	(0.00487)	(0.0274)	(0.0474)	(0.00524)	(0.0179)
gov_1	0.761***	0.837***	0.536***	0.611***	0.838***	0.621***
	(0.0189)	(0.0256)	(0.0454)	(0.0514)	(0.0289)	(0.0299)
_cons	0.0878***	0.0507**	0.153***	0.127***	0.0474*	0.127***
	(0.0149)	(0.0248)	(0.0274)	(0.0375)	(0.0273)	(0.0191)
N	919	341	330	248	310	609
adj. R^2	0.750	0.860	0.402	0.773	0.857	0.590
F_stat	254.4786	191.5433	22.0054	77.9456	170.0495	82.2950
p_value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
impliedβ	-0.2623	-0.1448	-0.3735	-0.4473	-0.1235	-0.8731

Standard errors in parentheses, $^{*}p< 0.10$, $^{**}p< 0.05$, $^{***}p< 0.01$

Table 9: Effects of FDI on Degree of Openness

	(1) Total open	(2) East open	(3) West open	(4) Middle open	(5) Coastal open	(6) Interior open
FDI	0.294	1.137	-0.656**	0.0776	0.673	1.107***
	(0.432)	(0.834)	(0.276)	(0.246)	(0.865)	(0.313)
FDI_1	1.858***	0.567	3.561***	0.866***	0.913	3.067***
	(0.617)	(1.211)	(0.337)	(0.331)	(1.272)	(0.379)
FDI_2	-0.917**	-0.554	-2.315***	-1.258***	-0.379	-2.396***
	(0.465)	(0.874)	(0.323)	(0.244)	(0.900)	(0.353)
lnGDP	0.0297	-0.0863	0.00686	0.00348	-0.0832	-0.0191
	(0.0324)	(0.309)	(0.0107)	(0.0248)	(0.320)	(0.0140)
lnGDP_1	0.0305	0.193	0.0372***	0.00751	0.0990	0.0284*
	(0.0338)	(0.306)	(0.0116)	(0.0256)	(0.318)	(0.0146)
inv	-0.538***	-0.673***	-0.184***	-0.0128	-0.910***	-0.00177
	(0.0643)	(0.191)	(0.0401)	(0.0152)	(0.196)	(0.0345)
edu	0.113***	0.122***	0.0186	0.00523	0.214***	-0.0107
	(0.0185)	(0.0402)	(0.0139)	(0.00506)	(0.0456)	(0.0104)
ind	0.315**	0.280	0.131**	0.0300	1.413***	0.130**
	(0.135)	(0.335)	(0.0645)	(0.0334)	(0.482)	(0.0631)
gov	-0.155	-0.439	0.347***	0.0985*	0.0901	0.1000
	(0.160)	(0.323)	(0.0961)	(0.0590)	(0.347)	(0.103)
netex	-1.002***	-1.004***	-0.683***	0.230***	-1.004***	-1.069***
	(0.0151)	(0.0237)	(0.0412)	(0.0525)	(0.0235)	(0.0377)
open_1	0.131***	0.114***	0.250***	0.744***	0.105***	0.253***
	(0.0137)	(0.0216)	(0.0382)	(0.0366)	(0.0216)	(0.0248)
_cons	-0.235*	-0.371	-0.270***	-0.0818**	-0.00147	-0.0422
	(0.122)	(0.300)	(0.0575)	(0.0402)	(0.320)	(0.0647)
N	919	341	330	248	310	609
adj. R^2	0.853	0.868	0.652	0.824	0.875	0.855
F_stat	489.3713	204.3293	57.8374	106.8879	198.4013	328.3302
p_value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
impliedβ	1.4212	1.2980	0.7867	-1.2281	1.3486	2.3802

Standard errors in parentheses, * $p< 0.10$, ** $p< 0.05$, *** $p< 0.01$

Table 10: Effects of FDI on Balance of Payments

	(1) Total netex	(2) East netex	(3) West netex	(4) Middle netex	(5) Coastal netex	(6) Interior netex
FDI	0.286	0.992	-0.479*	-0.573***	0.631	-0.0143
	(0.411)	(0.797)	(0.258)	(0.218)	(0.832)	(0.207)
FDI_1	1.455**	0.405	2.259***	1.053***	0.714	1.530***
	(0.588)	(1.156)	(0.336)	(0.298)	(1.224)	(0.255)
FDI_2	-0.754*	-0.553	-1.283***	-0.645***	-0.421	-0.610***
	(0.442)	(0.834)	(0.299)	(0.226)	(0.866)	(0.225)
lnGDP	0.0279	-0.0294	0.00567	-0.0418*	-0.0477	-0.0000186
	(0.0309)	(0.295)	(0.00996)	(0.0221)	(0.308)	(0.00911)
lnGDP_1	0.0379	0.147	0.0299***	0.0372	0.0700	0.0125
	(0.0322)	(0.292)	(0.0108)	(0.0228)	(0.306)	(0.00958)
inv	-0.504***	-0.618***	-0.127***	-0.0100	-0.845***	0.0217
	(0.0612)	(0.183)	(0.0383)	(0.0136)	(0.189)	(0.0225)
edu	0.100***	0.103***	0.0120	0.00383	0.199***	-0.0203***
	(0.0176)	(0.0385)	(0.0131)	(0.00455)	(0.0440)	(0.00677)
ind	0.266**	0.219	0.108*	-0.0000606	1.382***	0.0451
	(0.129)	(0.319)	(0.0610)	(0.0299)	(0.463)	(0.0410)
gov	-0.100	-0.329	0.139	-0.00786	0.155	0.113*
	(0.153)	(0.309)	(0.0919)	(0.0534)	(0.334)	(0.0672)
open	-0.820***	-0.837***	-0.649***	0.0404	-0.855***	-0.469***
	(0.0131)	(0.0207)	(0.0353)	(0.0359)	(0.0209)	(0.0156)
netex_1	-0.0124	-0.0140	0.272***	0.704***	-0.0199	0.258***
	(0.0144)	(0.0226)	(0.0388)	(0.0503)	(0.0225)	(0.0239)
_cons	-0.282**	-0.481*	-0.208***	0.0462	-0.0799	-0.0722*
	(0.116)	(0.286)	(0.0544)	(0.0361)	(0.308)	(0.0422)
N	919	341	330	248	310	609
adj. R^2	0.817	0.834	0.563	0.586	0.849	0.834
F_stat	375.3274	157.0020	40.5110	33.4064	159.4221	280.2136
p_value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
impliedβ	0.9749	0.8323	0.6826	-0.5574	0.9060	1.2206

Standard errors in parentheses, * $p< 0.10$, ** $p< 0.05$, *** $p< 0.01$

Table 11: Effects of FDI on TFP

	(1) Total TFP	(2) East TFP	(3) West TFP	(4) Middle TFP	(5) Coastal TFP	(6) Interior TFP
FDI	0.352***	0.355***	0.0901	-0.196	0.300***	0.293
	(0.112)	(0.104)	(0.321)	(0.481)	(0.103)	(0.231)
FDI_1	0.0313	-0.159	-0.195	0.528	-0.0855	0.0385
	(0.161)	(0.149)	(0.440)	(0.653)	(0.150)	(0.294)
FDI_2	-0.389***	-0.170	-1.065***	-0.531	-0.168	-0.731***
	(0.120)	(0.107)	(0.381)	(0.493)	(0.106)	(0.253)
lnGDP	0.153***	0.387***	0.151***	0.582***	0.415***	0.152***
	(0.00843)	(0.0388)	(0.0122)	(0.0487)	(0.0381)	(0.0103)
lnGDP_1	-0.128***	-0.370***	-0.0882***	-0.604***	-0.410***	-0.109***
	(0.00893)	(0.0379)	(0.0136)	(0.0501)	(0.0377)	(0.0110)
inv	-0.112***	-0.129***	-0.220***	-0.0494	-0.127***	-0.128***
	(0.0174)	(0.0251)	(0.0476)	(0.0303)	(0.0256)	(0.0253)
edu	0.00195	0.00891*	-0.0127	0.0284***	0.0220***	-0.00859
	(0.00499)	(0.00502)	(0.0163)	(0.0102)	(0.00571)	(0.00796)
ind	-0.212***	-0.195***	-0.255***	0.00816	-0.109*	-0.270***
	(0.0361)	(0.0501)	(0.0745)	(0.0653)	(0.0613)	(0.0460)
gov	-0.0753*	-0.0589	-0.0454	0.180	-0.0459	0.0232
	(0.0418)	(0.0401)	(0.113)	(0.116)	(0.0410)	(0.0758)
open	0.00927	0.00839	0.0548	0.132*	0.00563	0.0154
	(0.00836)	(0.00663)	(0.0614)	(0.0775)	(0.00674)	(0.0282)
netex	-0.0132	-0.0126*	-0.104	-0.0512	-0.0162**	-0.0477
	(0.00921)	(0.00722)	(0.0648)	(0.106)	(0.00726)	(0.0428)
TFP_1	0.920***	0.920***	0.881***	0.975***	0.912***	0.918***
	(0.0114)	(0.0160)	(0.0226)	(0.0197)	(0.0190)	(0.0150)
_cons	-0.0933***	-0.0777**	-0.296***	0.111	-0.00699	-0.200***
	(0.0333)	(0.0383)	(0.0705)	(0.0798)	(0.0382)	(0.0495)
N	919	341	330	248	310	609
adj. R^2	0.897	0.947	0.873	0.928	0.928	0.894
F_stat	672.0976	503.2140	189.7076	265.4822	331.2541	431.1918
p_value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
impliedβ	-0.0713	0.3250	-9.8310	-7.960	0.5284	-4.8719

Standard errors in parentheses, $^{*}p<0.10$, $^{**}p<0.05$, $^{***}p<0.01$

Table 12: Effects of FDI on Number of Patents Granted

	(1) Total patent	(2) East patent	(3) West patent	(4) Middle patent	(5) Coastal patent	(6) Interior patent
FDI	-3.922***	-1.344	-5.136**	-6.756	-2.160	-6.062***
	(1.246)	(1.331)	(2.572)	(8.315)	(1.401)	(2.257)
FDI_1	2.865*	0.543	11.34***	2.206	1.530	7.142**
	(1.649)	(1.845)	(4.175)	(9.466)	(1.945)	(3.003)
FDI_2	1.026	2.274*	1.098	1.174	1.655	1.049
	(1.242)	(1.330)	(2.941)	(7.763)	(1.389)	(2.328)
lnGDP	0.118	-0.731	0.0255	0.227	-0.815	0.108
	(0.0783)	(0.517)	(0.0945)	(1.023)	(0.556)	(0.0893)
lnGDP_1	0.0102	1.152**	-0.127	-0.110	1.126**	-0.0706
	(0.0815)	(0.504)	(0.102)	(1.050)	(0.557)	(0.0944)
inv	0.549**	0.234	1.372***	1.055*	0.371	0.964***
	(0.213)	(0.340)	(0.515)	(0.615)	(0.369)	(0.289)
edu	0.372***	0.151**	0.648***	0.497**	0.233**	0.452***
	(0.0594)	(0.0706)	(0.153)	(0.203)	(0.101)	(0.0829)
ind	0.975**	1.485**	0.240	-0.738	2.971***	0.464
	(0.466)	(0.605)	(0.866)	(1.334)	(1.014)	(0.586)
gov	2.884***	1.544	2.506	2.250	1.474	3.302***
	(0.943)	(1.216)	(1.579)	(2.727)	(1.267)	(1.257)
open	-0.0430	-0.0340	-0.590	-1.980	-0.0421	-0.571
	(0.103)	(0.0891)	(0.788)	(1.983)	(0.101)	(0.443)
netex	0.0404	0.0485	0.896	1.068	0.0364	-0.463
	(0.107)	(0.0919)	(0.835)	(2.234)	(0.104)	(0.496)
patent_1	0.467***	0.597***	0.257***	0.294***	0.555***	0.349***
	(0.0400)	(0.0625)	(0.0696)	(0.0964)	(0.0670)	(0.0517)
_cons	1.867***	-1.285	4.286***	3.969	-0.545	3.181***
	(0.550)	(1.230)	(0.813)	(2.764)	(1.389)	(0.652)
N	480	176	176	128	160	320
adj. R^2	0.785	0.880	0.743	0.739	0.881	0.743
F_stat	149.4528	108.9678	44.0959	31.5188	99.7277	79.2771
p_value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
impliedβ	-0.0582	3.6551	9.8277	-4.7818	2.3034	3.2704

Standard errors in parentheses, $^{*}p<0.10$, $^{**}p<0.05$, $^{***}p<0.01$

Table 13: Effects of FDI on Expenditure in R&D Activities

	(1) Total R&D	(2) East R&D	(3) West R&D	(4) Middle R&D	(5) Coastal R&D	(6) Interior R&D
FDI	-0.00717*	-0.00611	-0.00997	0.0433	-0.00912*	-0.00957
	(0.00418)	(0.00625)	(0.00644)	(0.0269)	(0.00503)	(0.00766)
FDI_1	0.00295	-0.00185	0.00191	-0.0535*	0.00251	-0.00155
	(0.00554)	(0.00841)	(0.0131)	(0.0278)	(0.00647)	(0.0108)
FDI_2	-0.00260	0.00315	-0.0106	0.0900***	0.00111	-0.000876
	(0.00506)	(0.00758)	(0.00793)	(0.0229)	(0.00586)	(0.00853)
lnGDP	0.000327	0.00157	0.0000191	0.00187	-0.00330	0.000299
	(0.000243)	(0.00265)	(0.000239)	(0.00503)	(0.00212)	(0.000285)
lnGDP_1	-0.000223	-0.000886	-0.000174	0.000751	0.00382*	-0.000356
	(0.000264)	(0.00262)	(0.000255)	(0.00508)	(0.00220)	(0.000312)
inv	-0.000333	-0.00157	0.00427***	-0.00271	0.00000442	0.00143
	(0.000823)	(0.00190)	(0.00146)	(0.00211)	(0.00158)	(0.00117)
edu	0.000858***	0.00136***	-0.000535	-0.000703	0.000999***	0.000478
	(0.000204)	(0.000351)	(0.000402)	(0.000594)	(0.000338)	(0.000296)
ind	0.00974***	0.0122***	0.00404	0.00367	0.0182***	0.00648***
	(0.00172)	(0.00252)	(0.00260)	(0.00523)	(0.00330)	(0.00232)
gov	-0.00155	-0.000531	-0.00300	0.00300	-0.00163	-0.00124
	(0.00298)	(0.00509)	(0.00395)	(0.00813)	(0.00394)	(0.00405)
open	-0.000176	-0.000688	-0.00269	-0.00396	0.000368	0.000990
	(0.000542)	(0.000654)	(0.00287)	(0.00648)	(0.000657)	(0.00165)
netex	-0.00129	-0.00133	0.00646*	0.0112	-0.00260*	-0.00277
	(0.00108)	(0.00124)	(0.00325)	(0.00673)	(0.00144)	(0.00207)
R&D_1	0.765***	0.717***	0.653***	0.744***	0.742***	0.658***
	(0.0323)	(0.0614)	(0.0640)	(0.0989)	(0.0614)	(0.0503)
_cons	-0.00234	-0.00725	0.000890	-0.0209*	-0.00916	0.000375
	(0.00197)	(0.00945)	(0.00222)	(0.0107)	(0.00811)	(0.00236)
N	330	121	121	88	110	220
adj. R^2	0.782	0.872	0.561	0.757	0.925	0.597
F_stat	101.6300	70.0940	14.5888	24.1083	113.2142	29.5845
p_value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
impliedβ	-0.0290	-0.0170	-0.0537	0.3117	-0.0213	-0.0351

Standard errors in parentheses, $^{*}p<0.10$, $^{**}p<0.05$, $^{***}p<0.01$