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Chinese regional inequality and sectoral foreign direct investment

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Chinese Regional Inequality and Sectoral Foreign Direct Investment

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Chinese Regional Inequality and Sectoral Foreign Direct Investment

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Abstract

Following the 1978 economic reforms, China gradually became first amongst developing countries and the second in the world, after the USA, in terms of stock of inward Foreign Direct Investment (FDI). Sustained GDP growth, a high rate of capital return and brisk economic development made China one of the best destinations for foreign capital; however, the benefits of this spectacular growth have not been evenly distributed throughout the various Chinese regions. There are many low-income and poor economic performing provinces in China although poverty is mainly concentrated in the inland regions. Since the beginning of the 2000s, a series of policies have been designed and implemented by the Chinese government to encourage foreign company investment in central and western provinces to help decrease the regional inequality with limited successes.

This paper uses Panel Least Squares method to empirically analyze the impact of industrial sector FDI on Chinese regional inequality during 2003-2013. The resulting analysis shows the connection between FDI in industrial sectors and regional inequality in China. In particular, regional inequality affects FDI location choices. The findings show that economic and non-economic indicators such as human capital, infrastructure, per capita income, and government policies affect regional inequality and foreign firms' location choices. Despite government policies to support inland regional economic development, foreign firms still prefer to invest in coastal provinces further illustrating the effects of clusters in this region.

Keywords: FDI, China, Panel, regional inequality, MNCs
JEL codes: F68, F63, F21, F23, F16, C33

1. Introduction

After economic reforms in 1978, China has gradually become the country with the highest stock of inward FDI among developing countries and the second highest in the world, after the USA in 2016 (OECD, 2017). Sustained GDP growth, high rates of capital return, and brisk economic development made China one of the preferred destinations for foreign capital. Sound economic policies facilitated the absorption of large amounts of FDI, helping China to increase its industrial productivity, improve its competitive advantage, and generate millions of new jobs for its people and creating a dynamic economy now known as the "China miracle". As the majority of inward FDI goes to the manufacturing sector, this sector experienced the highest growth and improvement in technology use. In 2001, the manufacturing sector absorbed 66 per cent of total FDI while the share for the real estate sector was only 11 percent. In 2014, the share of the manufacturing sector, while decreasing to 44.3 per cent, still had the highest share of total inward FDI (NBS 2016).

While there are many empirical studies about the positive effects of FDI on China's economic development (Li and Zhong 2003; Zhang et al. 2010; Cheung and Ping 2004; UNCTAD 2006; Buckley et al. 2007), this spectacular overall performance camouflages unevenly distributed growth benefits. Large parts of China have not participated in the overall development of the country and there are many low-income and poorly-performing provinces in China trapped by low economic progress. The geographic and sectorial pattern of China's growth process has greatly attenuated its aggregate impact on poverty resulting in a concentration of poverty and distress in some inland provinces.

The phenomenon of regional imbalance in China's development has found official recognition; Deng Xiaoping, in 1992, announced "Let some get rich first" (Whiteley 2007). Deng believed that the poor would benefit from the economic boom as the economic growth in Eastern regions trickled down to all parts of the country. Due to continual increasing regional inequality in China, President Hu Jintao, in 2006, subsequently insisted on the necessity of combating regional inequalities and "building a harmonious society" as the first priority of China.[1] More recently, President Xi Jinping has reiterated the party slogan of "Don't worry about the amount, worry that all have the same amount."[2] As a result of this political recognition, since the beginning of the 2000s, there have been a series of policies (e.g., tax incentives, investment in infrastructure, and the establishment of new Special Economic Zones (SEZs)) designed and implemented to encourage foreign investment in the central and western provinces of China to decrease the regional inequality (Azarhoushang 2013). Nonetheless, regional inequalities and the widening gap between developed and underdeveloped provinces remain one of the most important concerns of the Chinese government.

[1] http://cpcchina.chinadaily.com.cn/2010-09/16/content_13918117.htm

[2] https://www.ft.com/content/3c521faa-baa6-11e5-a7cc-280dfe875e28

This paper explores the effects of industrial sector FDI on regional inequality in China from 2003 - 2013 and consists of five sections. Section 2 uses models of economic geography and spiders and snakes to determine the variables that affect foreign firms' location choices and regional inequality. It also provides a brief overview concerning the history of regional inequality in China. The econometrics model and data have been illustrated in section 3. The results of the model are provided in section 4 and conclusions are drawn in the last section.

2. FDI and regional inequality in China

The majority of literature and empirical studies look at the effects of FDI on host countries at the aggregate level and neglect their effects on regional inequality. Host countries (especially developing countries) must provide preconditions such as access to international markets, reliable financial sector, good human capital, and well developed infrastructure for communication and transportation to attract FDI. Host countries absorb FDI in certain regions which have the above mentioned factors and thus FDI can intensify regional inequality.

Since the 1980s, Multinational Enterprises (MNEs) have accelerated their investment. Due to the revolution in Information and Communication Technology (ICT) and the implementation of neoliberal policies in developed and developing countries, the volume of investment by foreign companies increased significantly. Globalisation allowed MNEs to build their own Global Value Chain (GVC) to focus on their core competencies while outsourcing other stages of production to lower production costs and to gain from specialisation. Low value-added stages of production were outsourced to developing countries in the form of vertical FDI or international subcontracting while higher value-added stages stayed in developed countries.

Theoretical and empirical studies about the location choices of foreign companies and its effects on regional development have developed since the mid-90s thanks to recognition of new economic geography and mathematical foundation of increasing return to scale under imperfect competition. Furthermore, the increase of GVCs concomitant with an increasing share of intermediate goods in global trade has increased the demand for a new international trade theory to explain these most recent trends in global economics. [3,4]

There are two main approaches to evaluating the effects of FDI on regional inequality. The first approach emphasises the role of agglomeration forces on the location choices of MNEs and their effects on the regional development of host countries. In this approach, foreign firms have

[3] Since the 1960s, trade between countries with similar factor endowments has grown very rapidly and was unexplained by traditional trade theories such as the Ricardian and Heckscher-Ohlin models. However, after World War II, the pattern of trade changed due to decreasing transportation costs, neoliberal policies, and improved communications technology. New international trade theory emphasizes imperfect competition and increasing returns to scale as explanatory factors for trade between similar countries (Krugman 2008).

[4] In 2013, trade in intermediate goods had the largest share in world trade and reached USD 7 trillion, followed by primary goods with USD 4 trillion, consumer goods USD 3.8 trillion, and capital goods USD 2.7 trillion. Almost 50 percent of intermediate goods came from developing countries (UNCTAD 2014: 4).

a tendency to invest in a few special regions of the host countries (especially in developing countries) due to clustering benefits. The second approach, focusing on dispersion forces, is a more recent development. In this method, dispersion forces affect location choices and foreign firms choose to invest in several regions, dispersing geographically in order to be closer to potential customers (Baldwin 2012).

Agglomeration forces

Krugman (1991) deviates from the neo-classical trade models of zero transportation cost and argues that companies in the manufacturing sector choose their location according to economies of scale and scope, transportation costs, and the share of non-agricultural goods in total expenditure. As a result, companies invest in regions and locations with high demand and/or low production and low distribution costs in order to create scale economies. Consequently, locations near to these central regions may be the second choices of investing companies.

By increasing consumption of non-agricultural goods and achieving economies of scale, improved infrastructure become an important factor in attracting additional investment. Drawing further FDI into special regions increases regional disparity in host countries. Hence, openness to foreign trade and FDI may aggravate regional inequality by concentrating industries in special regions, particularly when a host country has an unbalanced geographic distribution of industry and fragmented factor markets.

Amid business scholars, the idea of clustering has received much attention and support. Porter (1990) has emphasised the role of clustering on firms' competitive advantages defining clusters as "(c)ritical masses- in one place- of unusual competitive success in particular fields". In a globalised era, the source of sustainable advantages highly depend on the regional characteristics such as knowledge, relationships, and motivations, and thus Porter (1990) argues that competitiveness exists both within and among countries, urging CEOs to rethink the impact of location on firm profitability.[5]

To explain the significant effects of clusters on competitiveness, Porter follows Marshallian ideas concerning business environments in industrial districts, believing that clusters encourage both competition and cooperation (Marshall 1920). Due to rival competition for market share increases through higher productivity, innovation, and proximity to supplier/customer, barriers to entry for new firms are decreased.[6] Cooperation in a cluster is the result of vertical integration that creates links between local institutions and companies in related industries

[5] Krugman et al. (2018) argue that knowledge spillover, the existence of specialized suppliers and the presence of a pool of talented candidates in industrial clusters, decreases per unit costs to all firms within a cluster and can also improve indirect cooperation among firms in that region. These result in external economies of scale in production.

[6] If the entry barrier is defined as lower cost of running business in one location, the above mentioned factors can reduce the costs of establishing of new firms within a cluster compared to other regions.

(suppliers). Hence, a cluster is another way of creating value chains as a result of firm and institutional proximity in one location. This proximity can also build additional trust and coordination. Krugman (1991) and Fujita et al. (1999) emphasise vertical and horizontal specialisation as important factors of agglomeration.[7] Wage gaps between unskilled and skilled workers facilitate the determination of vertical specialisation since MNCs outsource the labour intensive production stages to low wage countries and the skill intensive stages to high skilled, higher wages countries. Vertical specialisation is the main explanation of North-South outsourcing patterns while horizontal specialisation explains high value-added stages being outsourced to developed countries.

Porter recommends a series of policies to developing countries to promote clustering in designated regions. These are the improvement of the human capital and technology levels of local companies, trade promotion within regions and with neighbouring countries to improve domestic firms competitiveness, and being a member of GVCs.[8] Porter emphasises that upgrading infrastructure in all regions and improving access to industrial inputs (e.g., skilled workers and capital) are necessary conditions in preventing regional inequality (Porter 1998). Kanbur and Venables (2007) in their global project on spatial inequality used a new economic geography model and argued that public infrastructure, FDI, trade openness, and government expenditures (central and local) are the four main determinants of regional inequality in developing countries and further conclude that although FDI has positive effects on the development of industrial districts, it results in higher regional inequality.

Dispersion forces

The history of outsourcing goes back to the industrial revolution when, after the invention of the steam engine, it became economically feasible to produce goods far away from customers. The dispersion of production in the first unbundling (after the industrial revolution) was only limited to different industrial locations (districts) within the borders of countries or between neighbouring countries due to high transportation costs and poor communication technologies for long distance outsourcing. Hence, agglomeration forces in line with lower transportation costs played the main roles in firms' location choices.

The rise of MNCs and creation of GVCs gained momentum in the 1960s. Since the 1990s, the new wave of globalisation, also referred to as the second unbundling, started to develop due to the revolution in ICT following a reduction in transportation costs and tariffs in developed and developing countries following market based policies; and the opening up of international capital flows. These developments allowed MNCs to break down their production processes into different stages and outsource some of these stages to other regions in a manner not previously

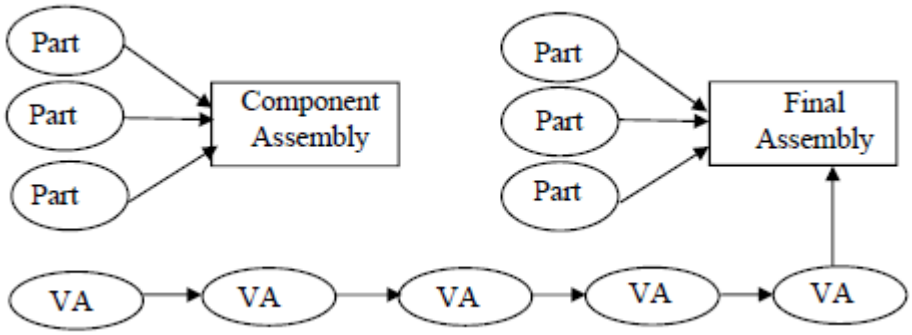
[7] Vertical specialization refers to imported goods used as inputs to produce final export goods while horizontal specialization is defined as goods produced from start to finish in one country (Hummels et al. 1998)

[8] Each region has a source of competitiveness due to its historical condition, geographical location and worker skill such as the wine industry in California and Silicon Valley in San Francisco (Porter 1998).

known. Thus, dispersion forces have become the main determinant of geographical unbundling (Baldwin 2012) and an important factor in location choice.

Baldwin and Venables (2013) divided GVCs into two extreme cases with one common factor, cost reduction, as the main motive for spatial unbundling. In the ***snakes*** chain, production stages follow an engineering order; each stage produces in one location and moves to next location where new parts are added. This chain continues until the final assembly and the final good is produced. In contrast with snakes, the ***spiders*** chain assembly does not follow a particular order; several intermediate goods from different locations reach the final point of assembly. In actuality, most GVCs are a combination of snakes and spiders.[9] Figure 1 diagrams an example GVC as a combination of snakes and spiders.

Figure 1 : An Example GVC with Snakes and Spiders



Note that abbreviations are used for Value-Added (VA) and each stage of production (Part)
Source: Baldwin and Venables, 2013

In a value chain like Figure 1, the location of any production stage depends on the location of other stages. To make a location decision for each stage of production, the model focuses on production and fragmentation cost which is the sum of production factors, coordination, management costs, and transportation costs. Based on the technological level of production stages and international cost differences (factor production plus transportation costs), companies tend to locate themselves near their customers and/or suppliers (agglomeration forces) or disperse different stages' production. In such a model, the production stage will be outsourced to regions with lower unit production costs which can cover fragmentation costs even if the final assembly line is located in other regions. High value production stages will generally stay in developed regions due to technological advantages and the specific core

[9] For example, in the textile industry, first cotton should be produced. It is converted into yarn, then fabric, and in the final stage to shirts, i.e., a snake type of value chain; however adding buttons to the same shirt in the same processing stage follows a spider pattern.

competencies of lead firms and thus fragmentation costs would not be a significant component in the location decision.[10]

Poor regions that are part of GVCs may face different risks of being locked into the low value-added stages of production which may result in poor regions participating only in the fabrication processes with limited GDP contribution. Since the main part of GVCs' value-added is generated by subsidiaries, if governments do not invest in education and the improvement of local firms' absorption capacity, the MNCs technology spill over is unlikely to occur, preventing improvements of higher value-added creation in these countries. The potentially unrestricted nature of GVC activities therefore increases the vulnerability of local firms to external shocks in less developed regions (UNCTAD 2013b).

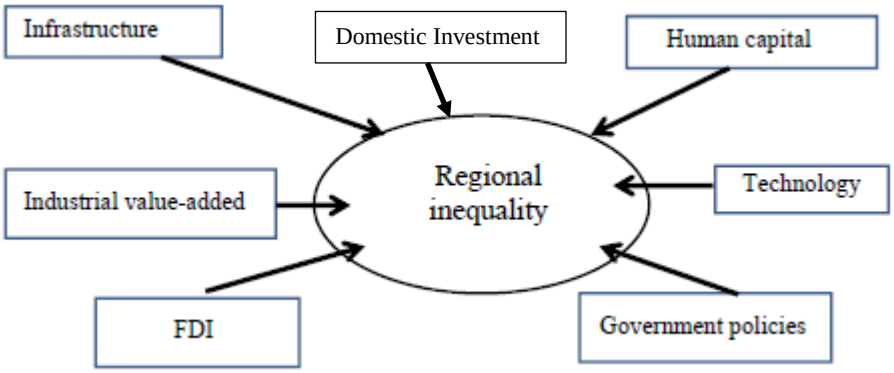
While agglomeration and dispersion forces equalise industry location, changes in trade costs have unexpected effects. A low level of international trade decreases the importance of location and distance. If the dispersion forces are weaker [stronger] than agglomeration forces then clustering is more [less] pronounced. When trade is very costly or a high level of protectionism exists in a region, it is unprofitable for firms to invest and agglomeration and industry clustering thus become impossible. Although lowering trade costs encourages clustering, and is a plausible explanation for industry clustering in the Global North during the first unbundling, further reduction in trade costs (transportation costs and tariffs) will eventually lead to dispersion, the main factor for the second unbundling, resulting in the North-South outsourcing practice (Baldwin 2012).

Literature review

Regional inequality has various economic and non-economic determinants. Economic indicators such as income per capita, employment growth, and Gini coefficients are typically considered important criteria for examining regional disparity. Since the 1980's and with studies by Sen (1983; 1985), scholars in the field of regional studies have emphasized that regional inequality is a multidimensional phenomenon. This paper also uses a multidimensional methodology to investigate the sectoral FDI effects on regional inequality in China. Moreover, in a unique approach in the regional studies literature, industrial value-added is used as the main indicator for regional inequality. In addition, firm location choices and institutional motives for investing in certain regions are often neglected in the existing literature and we additionally attempt to address these omissions in this paper. Important dimensions of regional inequality that are analysed in this paper are shown in Figure 2.

[10] In the snake, agglomeration forces play a more important role as each stage links to an upstream and a downstream stage (each production stage crosses the border at least twice) compared to the spider processes, where each stage only links to final assembly therefore crossing the border only once. Therefore fragmentation costs would be higher in a snake process.

Figure 2: Dimensions of regional inequality



Hu (2002) developed an economic geography model to analyse the linkages between foreign trade, FDI, industrial agglomeration, and regional inequality in China. He argued that coastal regions with better access to foreign markets and public infrastructures would become the principal locations for absorbing foreign companies and industrial capital. These regions are able to gain a leadership position in the absorption of FDI due to positive feedback mechanisms created by increasing returns to scale, dynamics of industrial structure, and the size of firms. Based on 2017 China National Bureau of Statistics (NBS) data, exports by foreign companies accounted for about 24 per cent of total Chinese exports of which more than 85 percent of these companies were located in coastal regions. In 2017, the average ratio of exports to GDP in coastal regions was 25 percent while for inland China this was only 4.8 percent (NBS 2018).

The majority of studies concerning FDI effects on China's regional disparity illustrate the negative impacts of FDI on regional inequality (Chen and Fleisher 1996; Bao et al. 2002; Zhang and Zhang 2003; Fleisher et al. 2010). A few studies have shown the positive effects of FDI in decreasing inequality for several regions in China. Ouyang and Fu (2012) showed that positive outcomes of FDI had spillover effects on inland regions through backward and forward linkages, depending on the level of their industrial development. Through panel data analysis, Lessmann (2013) showed that FDI had possibly negative effects on China's regional inequality during 1990s; in the 2000s this effect vanished or was reversed. He argued that due to factor mobility, i.e., the influx of immigrant workers to these regions, skills, expertise, and capital was transferred to less developed provinces, improving industrial development in these regions. We now examine the various development programs below.

Policies to Reduce Uneven Development

Until the end of the 1970s, the Chinese economy was one of the most closed economies in the world. An urgent need for technological upgrading and the inability of previous economic regimes to increase living standards, helped force the Chinese government to open the doors to the global economy. The first step in the reform process was the opening of new trade channels in coastal provinces such as Guangdong and Fujian, close to Hong Kong and Taiwan, through the establishment of Special Economic Zones (SEZ). The SEZ were designated "to experiment with an outward-looking, market-oriented economic system and to serve the country as a 'window' to the Western world" (Ge 1999, p 49). The establishment of SEZ illustrated the tendency of the government toward an uneven development path at the beginning of the reform programs. The 'growth consensus' actually divided China into three economic development regions (coastal, central, and western). The development strategy consensus was that first growth should start in the coastal region, move gradually to the central region, and finally attain the western provinces. The Chinese government believed that to achieve high and sustainable economic growth, some regions should become rich faster than others (Wang and Hu 1999).

The economic logic behind this strategy had much to do with the geographic location of coastal provinces in their access to international markets, historical backgrounds, the cultural proximity to Chinese diaspora in Hong Kong, Singapore, Taiwan, and Macao as well as a high concentration of large cities in coastal provinces.[11] The cultural proximity of the Chinese diaspora with the residents of coastal provinces was a contributing factor to the fast development of the coastal region. The first groups to invest under the open door policies did so in coastal provinces, such as Guangdong, and were overseas Chinese, part of the diaspora. Up until the end of the 1990s, nearly half of all FDI in China originated from the Chinese diaspora (Yao 2009).

The concentration of large cities in the coastal province was another factor contributing to high economic growth in the eastern region. The existence of large cities such as Beijing, Shanghai, Tianjin, and Guangzhou in the coastal region with close proximity to international markets, was one of the main reasons for the Chinese preferential policies aimed at strengthening agglomeration forces that, à la Krugman (1991), created economies of scale in these cities and accelerated economic growth.

Since the end of the 1990s, the increase in regional inequality due to the preferential policies toward coastal provinces came to the attention of the central government. In an attempt to combat increasing regional inequality, Chinese leaders passed and implemented a series of preferential policies in favour of the inland region: the ***Western Development Strategy***,

[11] Increasing trade with western powers during the 19th century and the close proximity of southern and eastern coastal provinces to international markets developed the coastal region as an important Chinese trade center. In the 19th century, the most developed Chinese city was Shanghai, which became the most dynamic city in East Asia and the main engine of Chinese economic growth at the beginning of 20th century (Banerjee et al. 2005).

Reviving the Northeast, and the ***Central Raising Program***. These policies were marginally successful and we examine each in turn.

The main strategies of the 1999 ***Western Development Strategy*** were improving the infrastructure and environmental protection with the amount of total investment reaching one trillion Yuan. In addition, investment in human capital and preferential policies for FDI and domestic investment were included. The program was able to attain a majority of its goals in infrastructure upgrading and environmental projects, however; the program was not very successful (2001 - 2014) in reaching its main goal of attracting domestic and foreign investment to reduce regional inequality (Azarhoushang 2017).

The main economic activities of the northeast region are heavy industries and extracting natural resources, principally by State Owned Enterprises (SOEs). After reforms and the introduction of market mechanisms, the support of the central government for SOEs was gradually reduced; the latter led to the decline in productivity and the rate of return in these firms. In the 1980s and until the reforms of the early 1990s, the economic performance of the northeast regional SOEs was better than coastal provinces' SOEs, however; increasing foreign and domestic investment in the coastal region meant that the SOEs in the north-eastern region lagged behind the private companies in the coastal areas. A series of layoffs in SOEs in the northeast region started to increase productivity in these enterprises. While the unemployed workers were partially absorbed into the coastal provinces, those who remained in the northeast subsequently suffered from increasing poverty. The industrial structure of northeast SOEs was relatively old and there was an urgent need for heavy investment to improve R&D centres and technology levels. The northeast region had a high level of human capital, relative to other regions (Lin and Yao 2001).

The central government therefore decided to heavily invest in the northeast region to better utilise the skilled workforce, to combat high unemployment, and to reduce the gap between northeast and coastal provinces. As part of the 2003 ***Reviving the Northeast*** program, close to 150 billion Yuan was invested into the northeast region (Yao 2009). The results of this program, similar to the ***Western Development Strategy,*** were not successful enough to attain the main goal of overcoming regional inequality (Azarhoushang 2017).

Huge investments in the western and northeast regions encouraged local governments in the central region to ask for more funds and support for their provinces. A new program was then passed in 2006 to address the need for upgrading industrial structure, improvement of infrastructure, establishment and promotion of industrial districts for the central region (Yao 2009). Similar to previous programs, the 2006 ***Central Rising Program*** was successful in reaching some of its goals, i.e., infrastructure improvement and the establishment of new economic and development zones, however; the program was unable to significantly reduce regional inequality. These programs show that the Chinese government has attempted to reduce the regional inequality through various preferential policies and other initiatives. Despite

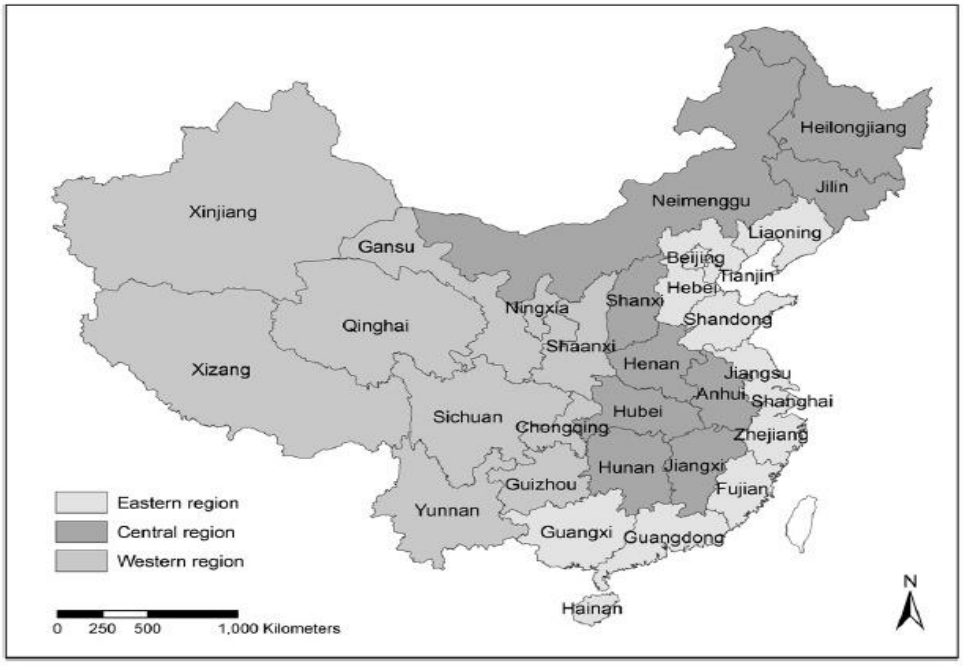
economic successes in some inland region provinces, the Chinese government was unable to fully capitalize on these programs to reduce regional inequality and in some cases, regional inequality actually increased further.

We now turn to the empirical investigation of the effects of industrial sector FDI on regional inequality.

3. Data and Methodology

To explore the effects of FDI on regional inequality, we examine data from 2003-2013 for the 27 provinces and 4 municipalities of mainland China. In the majority of empirical studies on Chinese regional inequality, mainland China is divided into three regions: the Coastal (Eastern) Region which includes 9 provinces and 3 municipalities (Beijing, Shanghai and Tianjin); the Central Region consists of 9 provinces; and the Western Region with 8 provinces and one municipality (Chongqing). Figure 3 shows the map distinguishing Chinese regions.

Figure 3: Chinese Regions



Source: Bin, 2015

Data

The majority of empirical studies have used a multidimensional approach for measuring regional inequality in different countries and regions and this paper does the same. Economic variables, infrastructure, government policies, and education levels are the main dimensions of the model. So, data for this study includes the growth rate of Foreign Direct Investment (FDI), the growth rate of government investment (GINV), the growth rate of private domestic investment (PINV), the growth rate of per capita gross regional product (GRPPC), human capital (HC), infrastructure (INFRA), and the coefficient of variation industrial value-added (IVACV).

We use annual province-level panel data for 2003 - 2013. All the data in this study are taken from the China Statistical Yearbook. Taking the natural logarithms of a series of values against time has the property that periods with constant rates of change (growth or decline) plot as straight lines. Hence, we choose to use log transformations of all variables to attain linear forms.

The log of the rate of growth of manufacturing sector FDI is our indicator of inward FDI and is considered to be the total FDI absorbed by each Chinese province. This includes monetary, physical, intangible assets, and other forms of investment, and is equal to direct investment into the manufacturing sector by foreign enterprises. We expect increases in FDI to positively affect the industrial value-added in a given region.

Government investment (GINV) is our indicator of government policies. A high public budget for remote areas can accelerate their development, via the attraction of domestic and foreign capital, and decrease the income gap between rich and poor regions in China. Therefore, public expenditure has positive effects on economic development and reduction of regional inequality. The local governments' expenditure includes expenditures for public services, national defence, public security, education, science and technology, culture, sport and media, social safety net, employment policies, health care, environmental protection, urban and rural community affairs, agriculture, forestry and water conservancy, transportation and other expenditures (NBS 2016).

Domestic private investment (PINV) has positive effects for regional development. Keynes (1936) established a precise relationship between aggregate employment and income and the rate of investment. Keynes argued if firms do not invest enough in the economy due to a lack of demand or negative expectations, then the government should increase its expenditure, including its social investments, to stimulate the economy and sustain development (Sheehan 2009). Different schools of economic thought are of the opinion that insufficient investment is one of the major factors contributing to underdevelopment; therefore, regions with a higher domestic investment benefiting from higher gross output are expected to be more developed. We expect both government investment and private investment to have positive effects on the industrial value-added in a given region.

A higher per capita gross regional product (GRPPC) encourages firms to invest in that region due to higher effective demand. Furthermore, by increasing the income level the share of non-

agricultural goods in people's expenditure is expected to increase leading to an improvement of industrial value-added in a region (Krugman 1990).

As a measure of infrastructure, we use the sum of kilometer length of highways and railways per square kilometer of provincial area. This type of infrastructure is not included into government investment calculations. A higher infrastructure ratio attracts more investment and accelerates the regional development process. The number of ports and waterways has not been taken into account as Chinese inland provinces are landlocked. This decision has precedence in the literature since most empirical work using infrastructure as a Chinese regional inequality determinant does not take into account sea access or the number of airports (Bin 2015; Cheong and Wu 2013; K. Wei, Yao, and Liu 2009).

The log of students enrolled in higher education to provincial population is chosen as the indicator of human capital (HC). A higher number of students would indicate the availability of high-skilled workers in provinces for absorbing high-tech industries and thus negatively affect variation in income inequality.

We also include fragmentation costs of foreign firms in China (FRCOST).[12] Although using input-output tables is the most common methodology for measuring fragmentation costs, due to our limited access to China Custom Data, we choose to use the regional total value of imports and exports of foreign-funded enterprises as the indicator of foreign companies' fragmentation costs in China.[13] The total value of foreign companies' trade in each region allows us to track the location choices of foreign firms. Higher volumes of regional trade help to explain the willingness of firms to invest in those regions.

As a measure of the growth rate of foreign firm production costs in Chinese provinces, we use total profit (PRCOST). Although the total profit of firms fluctuates with business cycles, due to data availability, it is arguably the best indicator for production costs. We expect higher total profit to translate to lower production costs and therefore improve dispersion forces.

It is possible to argue that higher profit is due to charging higher prices rather than cost reduction. While this could be the case for firms in developed countries (especially those with differentiation strategies and increasing returns to scale in production), firms in China are participating in various manufacturing stages and, as previously indicated, face fierce competition due to their low levels of technology and hence are not in the position to increase

[12] Fragmentation cost is the sum of cooperation costs and transportation costs. Although the ICT revolution and "Washington Consensus" policies enabled firms to outsource their production stages to various far off locations, assuming costless cooperation and transportation is unrealistic (Baldwin and Venables 2013). Per-unit shipment cost and all trade barriers, such as tariffs, are an important part of fragmentation costs while the next most important consideration includes cooperation and management costs.

[13] This paper examines the manufacturing sector data at the provincial level so using input-output tables was not possible. "Total imports and exports of goods" refers to the real value of commodities imported and exported across the border of China, i.e., between China and other countries (NBS 2016).

their prices. Furthermore, by implicitly assuming external economics of scale as the source of gains for agglomerated Chinese firms, prices should actually decrease due to these gains and thus profits would stay the same even while costs reduce.

As a main contribution to the literature, we choose to use industrial value-added (IVACV) as the main indicator of regional inequality as measured by the log coefficient of variation (CV) from the mean. CV is a popular measure of statistical dispersion, defined as the ratio of the standard deviation to the mean. Although there are other measures such as Gini coefficient and Theil index for measuring inequality, we chose CV over the latter two measures due to the high sensitivity of Theil index to low incomes and the significant effects of high incomes on the Gini coefficient. We do not want to measure income inequality using this measure; rather it is explicitly used as a measure of regional inequality not income level differences.

In the second set of regressions, the industrial value-added per capita (VADD) is used as an independent variable to explain the growth of regional FDI. IVACV in contrast relates the distribution of VADD across provinces in China.

All data have been taken as natural logs due to the non-linearity of the model variables.[14] In this paper, we attempted to find and use the most reliable and precise available data for all 31 Chinese provinces. China Statistics Yearbook is used as the main data source; however, it does not provide the required data prior to 2003 hence this is the starting year of our investigation. In addition, due to changes in statistical methods and/or the addition of new variables for each category by China National Bureau of Statistics (NBS), the beginning year of some of the included variables begins after 2003.

In addition to the data described above, we incorporate two dummy variables in order to separate the effects of each region. The Central region is chosen as the base region while Dummy 1 isolates the effects for the Eastern region and Dummy2 isolates the effects for the Western region. By multiplying these dummies with each of the independent variables, we are able to infer their effects on the dependent variable in the different regions. Table 1 illustrates the variables used in our quantitative model estimations and their predicted impacts.

[14] Unit root tests on the panel showed stationarity in the natural logs.

Table 1: Variables and Predicted Impacts

Variable	Variable description	Predicted Impact
FDI	Growth rate of Foreign Direct Investment	Regions with higher inward FDI have higher development levels.
FRCOST	Fragmentation costs	Higher fragmentation costs reduce dispersion forces and encourage firm investment in industrial districts.
GINV	Growth rate of government investment	Higher government investment improves regional development.
GRPPC	Growth rate of gross regional product per capita	Higher gross regional product indicates higher effective demand and hence improves agglomeration forces in a region.
HC	Human Capital	Increased student enrolments mean higher human capital levels which help to improve technological advancement in regions and economic development.
INFRA	Growth rate of infrastructure	This growth rate of railroads and highways are not included in the government investment statistics. Better and more highways and railroads encourage companies to invest in regions and indirectly have positive effects on regional development.
IVACV	Coefficient of variation industrial value added (distribution of value-added across regions)	Higher industrial value-added illustrates the technological advantages of a region as well as its economic growth. The distribution of VADD across provinces in China.
PINV	Growth rate of private investment	Higher private investment has positive effects on regional development.
PRCOST	Production costs	Higher production costs increase the likelihood of regional agglomeration forces.
VADD	Industrial value-added per capita	Higher returns to value added per capita enhance the effects of FDI and domestic investment in a region.

Industrial value-added (Model 1)

The manufacturing sector has been shown to play a key role in countries development paths. The industrial sector is the middle development stage where countries move from an input-driven to a knowledge-based economy. In this stage, the share of the manufacturing sector, in both GDP and the supply of labour, reaches its highest level resulting in it becoming the

dominant sector. Consequently, industrial value-added is an important indicator for measuring the increase in the income levels in developing countries (Felipe et al. 2012). As a result, the coefficient of variation of industrial value-added (IVACV) has been chosen as the main indicator of regional inequality in this research, making this paper unique in its investigation of regional inequality. In addition, because we use statistical dispersion, the Central Region is considered the base region and we include dummy variables for the Eastern and Western Regions.

To establish the effects of the indicated variables on industrial value-added, where ***i*** is the province and ***t*** is the year, we write the following model:

$$IVACV_{it} = \alpha_i + \beta_1 FDI_{it} + \beta_2 D_1 FDI_{it} + \beta_3 D_2 FDI_{it} + \beta_4 GINV_{it} + \beta_5 D_1 GINV_{it} + \beta_6 D_2 GINV_{it} + \beta_7 HC_{it} + \beta_8 D_1 HC_{it} + \beta_9 D_2 HC_{it} + \beta_{10} INFRA_{it} + \beta_{11} D_1 INFRA_{it} + \beta_{12} D_2 INFRA_{it} + \beta_{13} GRPPC_{it} + \beta_{14} D_1 GRPPC_{it} + \beta_{15} D_2 GRPPC_{it} + \varepsilon_{it} \quad (1)$$

Results from the empirical estimation of this model are given in Table 1 in the Appendix. There are endogeneity concerns in the above model. It could, of course, be argued that growth of FDI will also have effects on the dependent variable and affect the dispersion of industrial value-added. Since we determine below the absence of common unit roots, in order to examine the direction of causation and control for endogeneity concerns, a second model is developed where FDI is the dependent variable.

Model 2

In model 1, we investigate the effects of FDI and other variables on the industrial value-added, chosen as the main indicator of regional inequality. We also choose to explore the effects of industrial sector FDI on interregional inequality in China in a second model. As firm location choice determines regional FDI concentration, we analyse the effects of agglomeration and dispersion forces on firm investment decisions. It is essential to determine if higher regional development levels lead to the concentration of foreign firms or if the lower production and fragmentation costs of less developed regions improve the dispersion forces and prepare the balanced growth path. Moreover, we are interested in determining whether the existence of regional inequality leads to higher FDI absorption in well-developed regions (agglomeration forces) intensifying regional inequality or rather if firm location choices based on fragmentation and production costs (dispersion forces) lead to regional inequality. Consequently, the direction of causation is questionable.

Since it is possible that FDI is an indicator of firm location choices, we additionally choose to run this second model where FDI is the dependent variable. The growth rates of fragmentation costs and production costs, industrial value-added, human capital, infrastructure, per capita gross regional product, government investment, and private investment are now considered as

independent variables. Where ***i*** is the province and ***t*** is the year, we write the following model for FDI:

$$\mathrm{FDI}_{it} = \theta_i + \gamma_1 \mathrm{VADD}_{it} + \gamma_2 D_1 \mathrm{VADD}_{it} + \gamma_3 D_2 \mathrm{VADD}_{it} + \gamma_4 \mathrm{FRCOST}_{it} + \gamma_5 D_1 \mathrm{FRCOST}_{it} + \gamma_6 D_2 \mathrm{FRCOST}_{it} + \gamma_7 \mathrm{PRCOST}_{it} + \gamma_8 D_1 \mathrm{PRCOST}_{it} + \gamma_9 D_2 \mathrm{PRCOST}_{it} + \gamma_{10} \mathrm{GINV}_{it} + \gamma_{11} D_1 \mathrm{GINV}_{it} + \gamma_{12} D_2 \mathrm{GINV}_{it} + \gamma_{13} \mathrm{PINV}_{it} + \gamma_{14} D_1 \mathrm{PINV}_{it} + \gamma_{15} D_2 \mathrm{PINV}_{it} + \gamma_{16} \mathrm{INFRA}_{it} + \gamma_{17} D_1 \mathrm{INFRA}_{it} + \gamma_{18} D_2 \mathrm{INFRA}_{it} + \gamma_{19} \mathrm{HC}_{it} + \gamma_{20} D_1 \mathrm{HC}_{it} + \gamma_{21} D_2 \mathrm{HC}_{it} + + \gamma_{22} \mathrm{GRPPC}_{it} + \gamma_{23} D_1 \mathrm{GRPPC}_{it} + + \gamma_{24} D_2 \mathrm{GRPPC}_{it} + \varepsilon_{it} \quad (2)$$

As the majority of variables which affect industrial value-added also affect FDI, we expect similar correlations and results in the results from Model 2, i.e., infrastructure, government and private investment, and additional human capital would all positively enhance the effects of regional FDI. The industrial value-added, infrastructure, and per capita gross regional product are also positively enhance the effects of regional FDI. Since FDI is also regional in nature, we again consider the existence of three regions, Central, Western, and Eastern, through the inclusion of dummy variables. In this model, we include two additional variables, explained above, as measures of fragmentation and production cost, and these are also taken as logged values.

In order to determine the size and impacts of independent variables on our models and based on our observations, we estimate our regressions using panel data. The results are shown in Tables 1 and 2 in the Appendix. In order to investigate the proposed models, we first apply simple panel least squares method. In a first step, the Levin-Lin-Chu (2002) test has been used to rule out common unit roots in the panel data. All variables are found to be consistent and there is no common unit root.

Following econometrics methodology for panel data, a Chow test and a Haussmann test have been used to determine which methods best fit to our data. The null hypothesis for the Chow test is that pooling works better than a fixed effects methodology and based on the F-Limer test, a fixed effects methodology is considered preferable to pooling. The results of these tests confirm that panel data is appropriate to use in the regression analysis.

We include the results from the fixed effects regression analysis in the reported results however; based on the Haussmann test, the random effects is preferred for Model 1. The regional dispersion is not fixed across time and there exist regional institutional differences or other variations certainly impacting the dispersion of value added. These considerations confirm the use of a random effects model from both a theoretical and a practical perspective. We then

apply a Haussmann test to choose between fixed and random effects methods.[15] According to the p-values in the Table 1, random effects model is confirmed as a better fit for Model 1. Performing the same tests for Model 2, the fixed effects regression method is preferred to random effects. All variations are reported in the tables in the Appendix.

4. Results and findings

Results from Model 1 are reported in Table 1 shown in the Appendix. The results using the random effects estimation of Model 1 indicate that FDI has a positive effect on the distribution of value added in the central region, our benchmark region. Using the dummy variables for the other two regions in interaction with FDI provides us with a reasonable method to assess the other two regions. The Eastern region is insignificant and we conclude that the effect of FDI on the Eastern region's industrial inequality is not as great as in the Central region. Whether this is due to a saturation effect of FDI having arrived first in the Eastern region would need to be studied. The Western region is also positive and significant when examining the interaction of the Western region dummy and FDI. This would seem to indicate that for the Central and Western regions, FDI has a positive effect on the distribution of value added.

Government investment is positive and highly significant for both the Central region and the Western region. This shows that the distribution of value added is positively affected by government investment in these two regions; however it has a negative and significant effect on the Eastern region.

Private investment, in contrast to that of government, has a negative and significant effect on dispersion of value-added in the Eastern region and positive effects in both the Central and the Western regions. This would seem to indicate that while private investment is desirable, and to be encouraged, the resulting effects on inequality are to be carefully considered in further policies concerning public-private partnerships. Even with government policies to encourage domestic companies to invest inland, firms still prefer to invest in the eastern region due to the strong presence of agglomeration forces. Therefore, the government should design and implement policies to improve the industrial base of inland regions through improving the effectiveness of institutions and industrial productivity via strategic collaboration and cooperation between government and the private sector which corresponds to our preferred definition of a public-private partnership (Rodrik 2009).

The presence of increased growth rates in human capital, i.e., school enrollment in higher education, has a negative effect on the dispersion of industrial value-added meaning that this

[15] In this test the null hypothesis determines the efficiency of random effects over fixed effects. A Haussmann test has a Chi-square distribution function and its degree of freedoms is equal to the number of variables in each of our models.

helps to lower income inequality by our measure. Interestingly this is significant only for the Western and Central Regions seemingly indicative again of a saturation effect for the Eastern regions. This is quite plausible given the large amounts spent to increase skill levels for the Eastern region early on in the policy initiatives.

Infrastructure is not significant for either the Central or the Western region; however it has a negative effect on the Eastern region. This is left as a puzzle to be solved in future work. One possible explanation is the lack of proper local and/or intra region roads that could connect companies to main highways and railroads within the inland regions. The Chinese government is heavily investing in several infrastructure projects domestically as well as to connect inland regions to other countries through the Belt and Road Initiative" (KPMG 2009). Due to the lag between investment and construction phases with the operational phase, many of these projects are not included in the data used in this paper.

Increases in gross regional product per capita also have a significant negative effect on the regional industrial inequality with very high (99%) significance. This is true for all regions and is in line with our theoretical reasoning in this paper. A higher per capita gross regional product helps to encourage regional firm investments as this provides final demand and positive market access effects. As shares of non-agricultural goods in people's expenditure increases due to higher income shares and this further lends an improvement of regional industrial value-added.

The results for Model 2 present similar findings which are shown in Table 2 of the Appendix. In contrast to the first model, the preferred estimation method is fixed effects. A fixed effects model is preferred to the panel least square pooling data methodology and this is confirmed with the F-Limer test. Based on the Haussmann test, the fixed effects model is more appropriate than the random effects model. This is conceptually understandable as with FDI there are more stable time variant effects and, once investment decisions are made, they are generally longer term follow through effects.

The industrial value added is positive and significant for both the Eastern regions however; there is no effect for the Central and Western region. This would indicate that foreign firms have a preference for investing in coastal regions due to agglomeration effects and increases in inland regions industrial value-added did not affect their location decisions.

The effect of government investment is insignificant for all regions. This is difficult to interpret however the totally insignificant effects would lead one to conclude that past non-trivial infrastructure investment in the Eastern region led to sufficient regional development precluding any additional effects on inward FDI during the 10-years of analysis. Furthermore, inland regional investment has not attained a level ensuring reliable infrastructure of the magnitude required to convince foreign firms to invest in those regions. We speculate that government investment and FDI policies are even more important for these regions.

In contrast to government investment, private investment is positive and significant, although only for the Central region. As the arrival of private investment is possibly as a result of government policies, this increases the FDI investment in the region as well. The effect of private investment for both the Western and Eastern regions does not differ in any respect from that of the Central region.

Neither fragmentation costs nor production costs have significant effects on FDI absorption. For fragmentation costs, the total value of trade for foreign companies, there is a positive but insignificant effect on FDI absorption. The production cost of the manufacturing sector companies does not have a significant effect on FDI absorption nor does the presence of human capital growth, as measured by school enrolment in higher education. This is also true for gross regional product per capita effect on the FDI absorption for the regions. Thus it would seem that FDI decisions are dependent more on industrial value added and private investment, at least for the time period studied. Further investigation in this direction is required.

5. Conclusion

China has experienced high incoming FDI since the 1980s and while the benefits of this growth have been well established they have been unevenly distributed to Chinese regions resulting in low-income and poor economic growth in those provinces concentrated in inland China. A series of policies designed and implemented since the early 2000s have had the goal of encouraging foreign company investment in central and western provinces to help reduce regional inequality. These have had limited successes to date.

This paper uses a Panel Least Squares method to empirically evaluate the impact of industrial sector FDI on Chinese regional inequality during 2003-2013. The resulting analysis shows the connection between industrial sector FDI and regional inequality in China and that regional inequality does indeed effect FDI location. The empirical results demonstrate that economic and non-economic indicators such as human capital, infrastructure, per capita income, and government policies do affect regional inequality and foreign firms' location choices. Despite government policies to support inland regional economic development, foreign firms still prefer to invest in coastal provinces providing further evidence of regional clustering and its benefits.

The empirical findings in this paper also suggest that, to a limited extent, Chinese policies have been correctly targeted toward enhancing the effects of FDI for regional dispersion. It is imperative that to combat further inequities, the government should begin to assess more carefully the role of combining government investments and private investments in some more formal public-private partnership, as private investments do seem to play an important role in the enhancement of industrial value added. Further research concerning these adjustment mechanisms is clearly needed.

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Appendix

Table 1: Results of Model 1

Dependent variable is the growth rate of the coefficient of variation industrial value-added

Variables	**Random Effect**	Fixed Effect
FDI	0.66** (0.262)	0.61** (0.273)
D1*FDI	-0.57 (0.481)	-0.97 (0.615)
D2*FDI	-0.72** (0.295)	-0.67** (0.308)
Government Investment (GINV)	2.31*** (0.509)	2.49*** (0.752)
D1*GINV	-2.62*** (0.615)	-3.80*** (0.946)
D2*GINV	-2.12*** (0.606)	-2.05** (0.885)
Private Investment (PINV)	-1.94*** (0.390)	-1.94*** (0.425)
D1*PINV	1.75*** (0.560)	1.06 (0.649)
D2*PINV	1.62*** (0.469)	2.11*** (0.603)
Human Capital	-1.39** (0.74)	-2.11** (0.864)
D1*HC	1.05 (0.849)	1.99** (0.992)
D2*HC	1.54* (0.921)	2.49** (1.094)
Infrastructure	0.22 (0.279)	0.64* (0.372)
D1*INFRA	-0.64** (0.37)	-1.18** (0.487)
D2*INFRA	-0.03 (0.345)	-0.22 (0.507)
Gross Regional Product Per Capita	-1.92*** (0.536)	-2.15*** (0.941)
D1*GRPPC	2.85*** (0.671)	5.54*** (1.386)
D2*GRPPC	1.89*** (0.598)	1.07* (1.209)
Redundant Fixed Effects Tests	F Statistic	35.4
	Prob.	0.000
Haussmann Test	x^2Statistic	23.1
	Prob.	0.186

Note:
Standard errors are in parentheses. All variables are in natural logs. The dependent variable is IVACV. D1 is a dummy variable for the Eastern Region and D2 is a dummy variable for the Western Region. *, ** and *** refer to significance level at 10%, 5% and 1% respectively.

Variable	Random Effect	**Fixed Effect**
Industrial Value Added (VADD)	-0.45* (0.250)	-0.60 (0.454)
D1*VADD	0.60** (0.294)	0.87* (0.487)
D2*VADD	0.95*** (0.317)	-0.11 (0.564)
Fragmentation Costs (FRCOST)	-0.06 (0.061)	-0.014 (0.044)
D1*FRCOST	0.34*** (0.092)	-0.036 (0.062)
D2*FRCOST	0.21*** (0.067)	0.062 (0.052)
Production Cost (PCOST)	-0.09 (0.098)	0.015 (0.098)
D1*PRCOST	0.17 (0.134)	0.042 (0.106)
D2*PRCOST	-0.002 (0.114)	-0.0007 (0.136)
Government Investment (GINV)	0.22 (0.299)	0.38 (0.283)
D1*GINV	-0.66* (0.342)	-0.36 (0.299)
D2*GINV	-0.04 (0.339)	0.018 (0.330)
Private Investment (PINV)	0.94*** (0.160)	0.59*** (0.157)
D1*PINV	-0.20 (0.220)	-0.28 (0.178)
D2*PINV	-0.89*** (0.234)	-0.29 (0.234)
Infrastructure (INFRA)	0.19 (0.138)	0.19 (0.281)
D1* INFRA	-0.35* (0.194)	-0.37 (0.335)
D2* INFRA	0.14 (0.156)	0.06 (0.386)
Human Capital (HC)	0.18 (0.341)	0.02 (0.395)
D1*HC	-0.41 (0.396)	0.17 (0.406)
D2*HC	-0.43 (0.427)	-0.61 (0.582)
Gross Regional Product Per Capita	0.22 (0.292)	0.27 (0.594)
D1*GRPPC	0.08 (0.362)	-0.14 (0.637)
D2*GRPPC	-0.29 (0.320)	0.42 (0.718)
Redundant Fixed Effects Tests	F Statistic	34.2
	Prob.	0.000
Haussmann Test	X^2 Statistic	53.7
	Prob.	0.000

Table 2: Results of Model 2
Dependent variable is the Foreign Direct Investment

Note:

Standard errors are in parentheses. All variables are in natural logs. The dependent variable is Foreign Direct Investment. D1 is a dummy variable for the Eastern Region and D2 is a dummy variable for the Western Region. *, ** and *** refer to significance level at 10%, 5% and 1% respectively.

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