Three Essays on Inward Foreign Direct Investment and Region

By

Sunmin Yoon

Dissertation

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

DOCTOR OF PHILOSOPHY

IN DEVELOPMENT POLICY

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ABSTRACT

THREE ESSAYS ON INWARD FOREIGN DIRECT INVESTMENT AND REGION

By

Sunmin Yoon

The dissertation consists of three essays on FDI and regional economy. Although there are differences in structure and methodology for each essay, each essay is closely related to each other in the following two major directions.

First, the essays, focusing on FDI inflow, observe the unbalanced development between the capital area and non-capital area in Korea.

Second, the essays in this dissertation are closely linked together as each essay is focusing on each element of the production function below.

Y=A*(L, K), where Y refers to the final policy goals pursued by regional economic policies, such as the development of the local economy and the increase of the regional population; and A, L and K represent innovation capacity, human capital and capital investment respectively.

More specifically, Chapter 1 is a study on element K. This essay reviews Korea's balanced regional development policy to narrow the gap between the metropolitan and non-metropolitan areas, and reviews the Korean government's policy to revitalize FDI, and describes the current status of FDI attraction in non-metropolitan areas.

Chapter 2 is a study on element L. This essay observes how the proportion of highly educated workforces affects the inflow of FDI. In addition, this essay observes how the proportion of highly educated workforces (1) between the manufacturing and service industries, and (2) between the capital area and non-capital area affects differently on the inward FDI attraction performances.

Finally, Chapter 3 is a study on element A. This essay observes how the inflow of FDI affects the strengthening of regional innovation capabilities. In particular, this chapter analyzes the difference in the effect of FDI inflow on regional innovation capabilities using an interaction term between non-capital area dummy variables and regional FDI inflow performance.

Through series of essays on strengthening regional innovation capabilities through FDI inflow, the importance of human capital to increase FDI inflow and FDI-regional economy related-policies' improvement, this dissertation hopes to contribute to the balanced development among Korean regions.

Dedicated to Mi Jang,
My dearest wife

ACKNOWLEDGEMENTS

It has been 7 and half years since I started the Ph.D. program, and I finally finished the program. Throughout the time, there were doubts and uncertainty to myself whether I have enough strength to finish the program. Without the support from my supervisors and family members who gave me strength to carry on, this journey would not have been possible to finish.

Especially I would like to express my sincere gratitude to my supervisors; professor Siwook Lee and professor Changyong Choi. Throughout the program, they have shared wisdom and experiences for my academic growth. I also owe a lot to professor Changkeun Lee, professor Chungeun Yoon and Dr. Doohee Lee; their professional and valuable advices shaped and forged my dissertation in many ways.

I thanks to my father, the late Mr. Yoon, Young-hak. He always had genuine passion and talent for learning and academic experiences, but he had to spend his whole life to care his family. His attitude toward hardship and unconditional sacrifice for his family will be always remembered in my mind.

As father to my beloved son and daughters-Jiwon, Jisoo and Jiyin Yoon, and as son to my mother and parents-in-law, I should have spent much time with them, but I could not because my top priority was to finish the program. And this was one of the hardest things for me during last 7 and half years. I will spend as much time with them as I have in the past.

Lastly, without the sacrifice and encouragement from my loving wife, Mi Jang, this dissertation would not have been possible. Every moment of my life, she stands by my side and shares her everything for me to become a better man. I would like to express my sincere love and gratitude for my wife for everything that she has done to our journey as one team.

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1.1 Introduction

The purpose of this paper is to analyze imbalanced development status of the Korean regional economy and related policy measures, and to come up with policy implications and suggestions to support revitalizing regions by stimulating the inflow of FDI into regions. To do so, this paper attempts to review current regional economy policies and FDI attraction policies in Korea. In line with policy review, this paper also attempts to analyze various statistics related to regional economy and inward FDI performances in Korea.

Currently, the Korean economy is facing challenges in aspects due to the polarization between the capital and non-capital areas. In a situation where the overall capabilities of the country are concentrated in the capital area, the non-capital area is experiencing stagnation in growth due to the outflow of human resources and lack of corporate investment. Due to these imbalanced development among areas, most of non-capital areas are experiencing a crisis of "regional extinction" due to population decline, which will eventually not only deteriorate competitiveness of regions, but also threaten the existence of the country itself.

In order to resolve the imbalanced growth among regions, there may be various measures such as improving residential conditions and expanding transportation networks in the region, however from the view point of government agencies in charge of balanced regional development, including KIET (2020) and MOTIE (2020), they emphasize the importance of revitalizing regional investment. They argue that, in order for a region to achieve sustainable and endogenous growth, not relying on fiscal supports, it is crucial to develop the regional economy through sufficient capital investment. In the end, only when a regional economy can build competitive

industrial ecosystem by investments from competitive companies, talented human resources will come back and the region can have chance to flourish again.

Until now, Korean governments have recognized the importance of balanced regional development and implemented various policies such as innovation-led development, region-based specialized development, region-led cooperation etc. In line with the policies, Korean government has been deploying various measures, such as “local investment promotion subsidies” to promote investments to non-capital areas.

Unfortunately, investment performances into non-capital areas are not satisfying. As a result of analyzing statistics on the amount and proportion of facility investment by region in Korea, three regions that consists the capital area (Seoul, Incheon, Gyeonggi-do) account for about 50% of the nation’s facility investment. Also, according to MOTIE (2022), most of the non-capital area investments are also concentrated in the Chungcheong areas (Daejeon, Sejong, Chungbuk, Chungnam) - adjacent to the capital area; Of the 165 companies in the capital area that have moved to the non-capital area in the past decade, 89 companies have moved to the Chungcheong area, accounting for 53.9% of the total.

In a situation where regional investment is generally sluggish, the inflow of FDI is expected to play an important role in revitalizing the regional economy and balanced development. In general, not to mention increase in regional capital investment, as Grossman and Helpman (1995), Blomström and Sjoholm (1996) argued, FDI can have positive effect on host country’s companies, in terms of productivity improvement and technology spillover.

The Korean government operates legal systems such as protecting foreign investors and guaranteeing national support to attract FDI, and has various incentives such as tax reduction, cash grant, and location support.

However, the FDI inflow performances are also suffering from the polarization. The total amount of FDI attracted to 14 non-capital provinces has never exceeded the capital area; Of the total FDI attraction performance accumulated for last 60 years (1962~2020), the capital area accounted for $172.9 billion, accounting for 73% of overall performance.

Also, gap in FDI attraction between the capital and non-capital areas continues to get widen; The FDI gap between the two areas has been narrowed to $1.66 billion since the 2008 global financial crisis, however it has been widening again since 2012 and to $11.6 billion in 2018.

More concerning issue is the quality of regional investment. While the service industry accounts for 70% of the Korean economy's GDP and employment, the average annual service industry FDI flowing into the non-capital area between 2000 and 2020 is only $683 million; whereas the capital area reaches $5.15 billion. As for proportion, the service industry accounts for 28% of overall regional investment for the period between 2000 and 2020.

This paper argues that there are there are several policy challenges for promoting regional FDI. First, current central government-led FDI policies are hard to deal with various regional situations.

Second, even though general conditions in the non-capital areas are clearly inferior to the capital area, unified FDI policies and incentives make it difficult for local government to make customized FDI attraction strategy.

Third, local government has limited resources such as budget for cash grant; For cash grant offer, central government and local government are matching each other’s budget by predetermined ratio. Thus, if a local government suffers lack of budget, so does the total size of cash grant offer to potential foreign investors.

Fourth, local governments designate, without considering local resources and capabilities, overlapping "strategic new industries" which are indistinguishable among regions. This overlapping leads to unnecessary competition for attracting similar FDIs among regions.

Lastly, and the most importantly, lack of linkage and cooperation between regional economy policies and FDI attraction policies makes it hard to attract FDIs to regions effectively.

When planning country-wide FDI attraction strategy, it is highly desirable to consider regional industries' status; however, since it is not a mandatory, central government bodies for FDI attraction do not have motivations to reflect regional situation for the country-wide FDI plans. From a survey conveyed by a national investment promotion agency, only 23% of regional foreign invested companies match regional strategic industries.

Throughout this paper, author argues that, though Korean government tries to implement various policy measures, imbalanced development between the capital and the non-capital areas are getting worse; and also, one of the major reasons of the imbalanced development is insufficient regional investments. One solution to mitigate the risk of insufficient investment to non-capital area is promoting inward FDI; FDI can be helpful to ease the imbalanced regional development and has a meaningful effect on the regional economy by reinforcing capital inflows, increasing innovational capabilities.

However, lack of cooperation between regional economic policy and FDI policy makes it hard to attract FDI into non-capital area, and FDI performance itself shows clear difference between the two areas.

It is important to link the central government's FDI attraction policy with regional policies. To do so, this

paper proposes to define promotion measures only for non-capital regional investment in the Foreign Investment Promotion Act.

In addition to the central government-led legal framework, it needs to be considering strengthening the role of local governments; the local governments should also make vision and strategy to build competitive regional industrial ecosystems, and put efforts to interconnect the regional strategy with central and regional FDI attraction policies.

As for the contribution to previous studies, through comprehensive review of policies and statistics, this paper explains various evidences and problems of imbalanced development between the capital and the non-capital areas in Korea. Another contribution is that this paper presents the necessity and linkage plans between the regional industrial policy and the regional FDI attraction policy, which have been regarded as separate policies.

However, this study has the several limitations. First, due to the difficulty of acquiring relevant data, previous researches on differences in FDI attraction strategies by local governments are insufficient. Second, this study did not cover of role and performance of the investment promotion agency (IPA) in Korea. Thus, author suggests studying the role of local governments and IPA for regional FDI attraction for further studies.

1.2 Literature Review

1.2.1 Cause of regional imbalanced development

Studies on the causes of regional imbalanced development are distinguished by a theory that focuses on the composition of local industries and a theory that focuses on regional productivity gaps. According to (Rosenthal and Strange (2003), regional productivities differ from concentration of high value-added industries.

In this regard, the endogenous growth theory assumes increasing returns to scale and emphasizes "convergence pessimism" as technological variables are determined endogenously and human capital is integrated into the model. In other words, there is a possibility that the imbalance between regions will widen. Meanwhile, Kim and Lee (2010) point out that regional productivity plays an important role in the imbalance between regions. They empathize policy efforts to increase regional productivity are important to cure imbalance between regions.

1.2.2 Relationship between regional imbalanced development and growth

Traditional studies on regional imbalances have mainly been discussed in terms of whether regional imbalances decrease or increase with growth. In fact, theoretical research on whether regional imbalances increase or decrease according to the development stage of the country is a study with the perspective of regional imbalanced development as a result of internal factors rather than external factors such as trade and foreign investment.

Neoclassical economists such as Solow (1956) argued that the imbalance between regions basically decreases with growth because of the law of diminishing returns on capital and the movement of labor and capital in a competitive environment, resulting in regional convergence within a country. The neoclassical Solow model mentioned in the traditional approach emphasizes the "convergence optimism" that the income gap decreases because it presupposes a closed economy, exogenous savings rate, declining productivity of capital, and constant returns to scale.

Therefore, income level and growth rate have a negative relationship. This theory suggests the so-called β-convergence that β which represents the relationship between income level and growth rate, has a statistically

significant negative value. However, post-Keynesians such as Myrdal and Sitohang (1957) and Kaldor (1970) argue that growth is a spatially cumulative process and that regional imbalanced development tends to widen.

1.2.3 Definition of foreign direct investment

OECD defines foreign direct investment (FDI) as "a category of cross-border investment in which an investor resident in one economy establishes a lasting interest in and a significant degree of influence over an enterprise resident in another economy." OECD also mentioned that "Ownership of 10 percent or more of the voting power in an enterprise in one economy by an investor in another economy is evidence of such a relationship."

IMF (2004) version of definition is "Foreign direct investment enterprise is "defined as an incorporated or unincorporated enterprise in which a foreign investor owns 10 per cent or more of the ordinary shares or voting power of an incorporated enterprise or the equivalent of an unincorporated enterprise". Both organizations consider 10 per cent or more voting power as a key characteristic of FDI.

In Korea, foreign direct investment defined by the Foreign Investment Promotion Act includes (1) foreigners acquiring stocks or shares of domestic corporations or companies, (2) providing long-term loans to domestic corporations invested, and (3) contributing to non-profit corporations. Like the IMF and OECD, Korea recognizes FDI only when foreigners own the total number of voting stocks or more than 10/100 of the total investment amount (Article 2 (2) 1 of the Enforcement Decree of the Foreign Investment Promotion Act).

Table 1.1. Definition of FDI under the Foreign Investment Promotion Act

Target	① Foreigners own shares or shares of a domestic company for the purpose of establishing a continuous economic relationship with a domestic company, such as participation in the management activities of a domestic company

	② own more than 10% of the total number of shares with voting rights; or ③ own less than 10/100 of total number of shares with voting rights and; - conclusion of an executive dispatch contract - Long term product and parts contracts of at least one year - Technology introduction and joint R&D contracts are concluded ④ Refers to a long-term loan of more than 5 years that a foreign parent company, etc. lends to the relevant foreign-invested company (=subsidiary company)
Investment Type	acquisition of new shares acquisition of existing shares Acquisition of shares by Merger and Acquisition(M&A) Long-term loan

Source : Re-quote Rhee (2009, 8)

1.2.4 Economic effects of attracting FDI

Many previous studies argue that attracting foreign direct investment can play a major role in the country's economic growth (Caves 1974; Kokko 1994; Lipsey 2002) . In general, FDI is known to have a stable inflow of foreign capital into the host country, increased employment, increased gross national product and real income, an inflow of excellent overseas experience and management resources as well as industrial restructuring effect. (Kwon 2006)

Countries that attract FDI are said to have the effect of improving trade and international balance of payments and competition. (Caves 1982) In particular, a number of previous studies have confirmed the effectiveness of FDI through empirical analysis on the economic effects of FDI inflows from Asian countries such as China (Madariaga and Poncet 2007), and they have shown that FDI inflows have a significant impact on economic growth in developing countries (Borensztein, Gregorio, and Lee 1998).

In the case of Korea, FDI, which was mainly introduced after the Asian financial crisis in 1997, played an

important role in securing Korea's stable foreign exchange reserves at the time. In 1998, when the foreign exchange shortage was most severe, Korea's FDI attraction increased by $5.4 billion, contributing 17% of its foreign reserves increased by $31.6 billion, and foreign direct investment contributed to $9.3 billion, contributing 42% of its foreign reserves increased by $22 billion in 1999 Without stable foreign exchange security through foreign direct investment immediately after the financial crisis, Korea's overcoming of the financial crisis would have been delayed for a considerable period of time. (KOTRA 2007)

1.2.5 FDI and regional development imbalance

There are research results that FDI affects the imbalanced development among regions have also been addressed. Tondl and Vuksic (2003) argue that foreign direct investment (FDI) had a greater impact on the growth of central and eastern European countries than domestic investment. From their analysis, foreign investors played a role in the growth of Eastern European countries in the late 1990s. Foreign direct investment mainly promotes regional growth through technology transfer.

There are several previous studies which claims that increase in inward FDI effects positively to regional economy growth in Korea; Hyun and Kwon (2017) empirically analyze how the inflow of FDI affects the economic growth of 16 metropolitan local governments in Korea. They argue that the increase in FDI inflow had a positive effect on economic growth such as regional investment and employment. They also argue that the inflow of FDI has a positive effect on alleviating income inequality.

Kwak and Chae (2015) argue that the inflow of FDI resolves the growth imbalance among regions, and helps balanced growth. In particular, they argue that it is necessary to actively attract domestic and foreign investment in new industries in vulnerable areas for balanced regional development.

1.3 Overview of imbalanced development among regions in Korea

1.3.1 Current status of imbalanced between capital and non-capital areas

Korea, one of the poorest countries in the world since the Korean War, had no choice but to concentrate its limited resources on certain areas in order to achieve economic growth. As a result, overall national competencies such as population, economy, industry, finance, urban infrastructure, education, and finance were concentrated in capital area.

Thanks to the selection and concentration development strategy, in the second half of the 20th century, Korea achieved rapid economic growth and was called one of Asia's four dragons. On the other hand, as the imbalance and inequality between the capital and non-capital areas intensified, Korea has facing serious problems of regional inequality by the centralization of the capital area. Currently, the inequality between regions in Korea became a major obstacle to the further development of the country.

Table 1.2. Change of major economic indicators between the capital and the non-capital (%, KRW. Mil)

	Population (%)		GRDP (%)		Per capita GRDP		Per capita GRI	
	2010	2018	2010	2018	2010	2018	2010	2018
Capital	49.3	49.8	49.3	51.8	27	38	30	42
Non-capital	50.7	50.2	50.7	48.2	27	35	24	32

Source: KRIHS (2020)

Population

As for the population, the proportion of the population in the capital area continued to increase, and the population in the capital area exceeded 50% of the total population in 2019. From 2010 to 2020, the average annual population growth rate in the capital area was 0.6%, exceeding 0.4% of the total population growth rate

in Korea by 0.2%p. More seriously, the non-capital young population between the ages of 20 and 34 continues to move to the capital area. In 2014, the number of young populations who moved from the non-capital area to the capital area was 39,430, but in 2020, the number increased to 90,719.

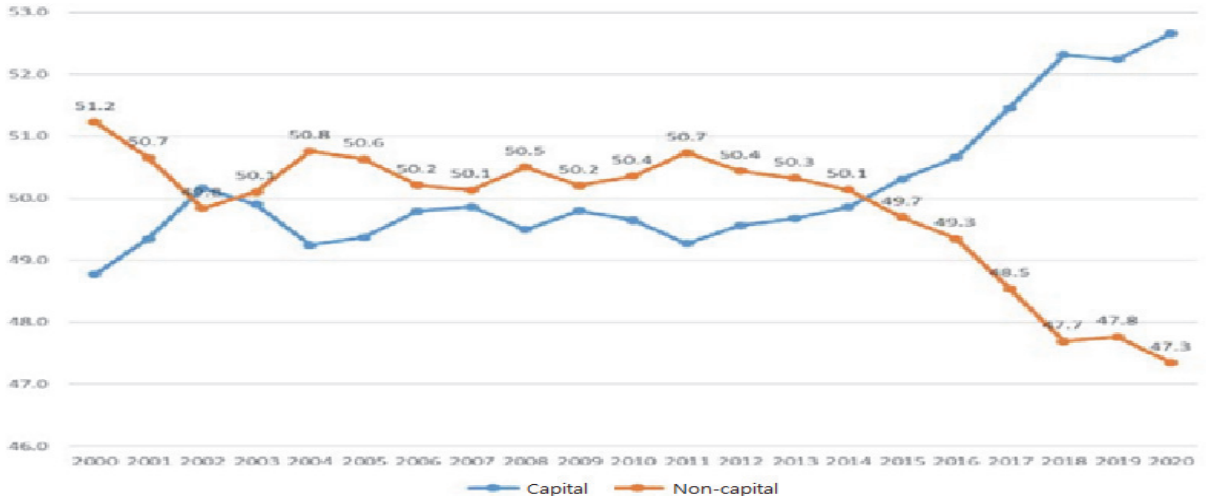
Production and income

In the case of production, the proportion of GRDP in the capital area accounted for more than 50% of Korea's gross product in 15 years, and the gap continues to widen. In the case of income, the income gap between the capital area and the non-capital area also tends to widen due to the transfer of corporate income from the non-capital area to the capital area.

Added value

In the case of total added value, according to regional income statistics from the Korea National Statistical Office, the capital area has increased to 52.7% in 2020 after accounting for 50.3% of the total added value nationwide since 2015. (See Figure 1.1)

Figure 1.1. Trend in the proportion of total value added between the capital and the non-capital area (%)

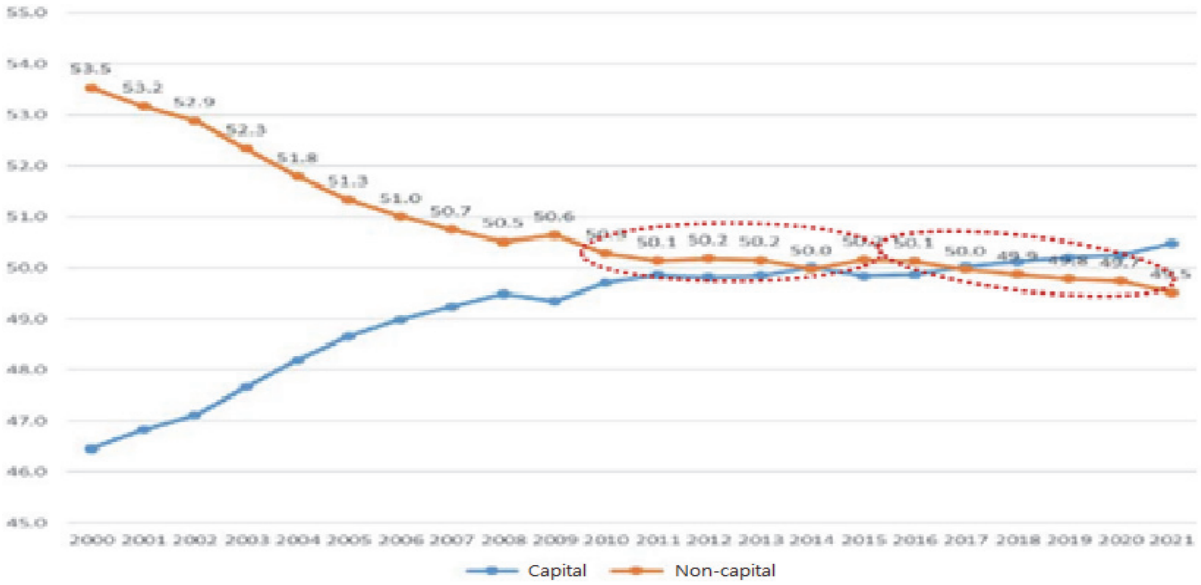


Source: Kim (2022)

Job markets

Similar trends can be seen in the case of jobs. The proportion of employed people in the capital area accounted for 49.7% of all employed people in Korea in 2010, but exceeded 50.0% in 2017 and reached 50.3% in 2021. In addition, the number of Korea's top 1,000 companies based in the Seoul capital area reached 729 as of 2020. Not only the inequality in quantity, but also the inequality in quality of jobs between the areas is significantly different. (See Figure 1.2)

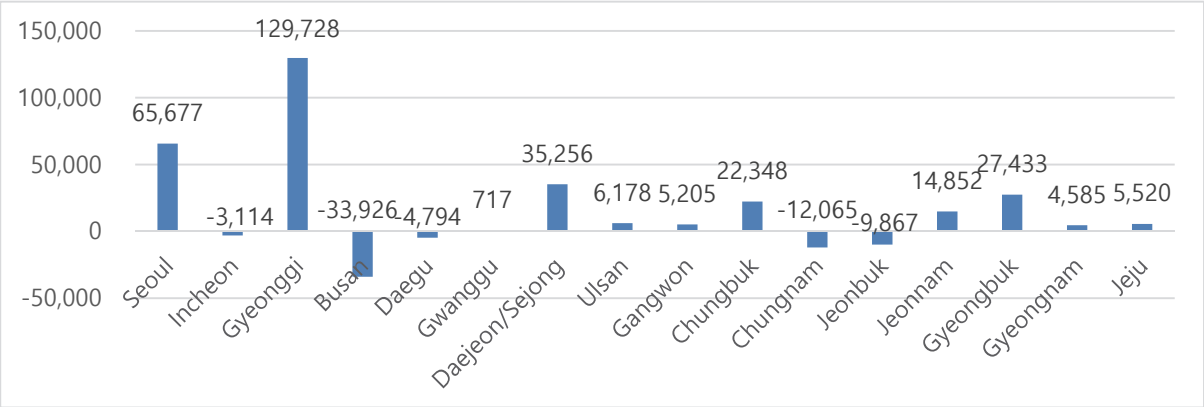
Figure 1.2 Trend in the proportion of the number of employed (%)



Source: Kim (2022)

According to data from the Korea National Statistical Office, the increase in managers, experts and related workers from 2015 to 2020 was concentrated in Seoul and Gyeonggi, and most of these jobs decreased in key non-capital areas such as Busan and Daegu. (See Figure 1.3)

Figure 1.3. Increase/decrease of managerial and professional jobs by Province (2015~2020)



Source: Kim (2022), National statistics office of Korea

Investments to non-capital areas

Imbalance in investment flowing into the region is also a major concern for balanced development. The proportion of investment in the capital area to overall investment in Korea was 47.6% in 2020. (See Table 1.3). In particular, new investments by large companies are concentrated in the capital area, and the number of companies moving from the capital area to the provinces is also decreasing.

According to statistics from the Ministry of Trade, Industry and Energy, there were 17 cases of companies in the capital area moving to non-capital areas in 2015 to 6 cases in 2019 and only 1 case in 2021. Considering that the area of the capital area is only 12% of Korea's total land area, it can be seen how much investment is concentrated in the capital area.

Table 1.3. Facility investment amount and proportion by region (2018~2020)

	2018		2019		2020		
	KRW Tril.	(%)	KRW Tril.	(%)	KRW Tril.	(%)	yoy(%)
Overall	581	100	585	100	609	100	4.1
Seoul	**82**	**14.1**	**86**	**14.6**	**88**	**14.5**	**2.3**
Incheon	**28**	**4.9**	**30**	**5.1**	**34**	**5.5**	**13.3**
Gyeonggi	**163**	**28.1**	**162**	**27.7**	**169**	**27.7**	**4.3**
Busan	27	4.7	29	4.9	29	4.7	0
Daegu	14	2.5	16	2.7	17	2.9	6.3
Gwangju	10	1.8	11	1.8	12	1.9	9.1
Daejeon	12	2.1	13	2.3	15	2.5	15.4
Ulsan	26	4.5	23	3.9	22	3.7	-4.3
Sejong	6	1.1	6	1.1	6	1	0
Gangwon	17	2.9	18	3	19	3.1	5.6
Chungbuk	27	4.7	26	4.4	24	3.9	-7.7
Chungnam	46	7.9	43	7.3	47	7.8	9.3
Jeonbuk	17	2.9	17	3	18	3	5.9
Jeonnam	27	4.6	30	5.2	34	5.5	13.3
Gyeongbuk	35	6	35	5.9	35	5.8	0
Gyeongnam	35	6	35	5.9	34	5.6	-2.9
Jeju	8	1.3	7	1.3	7	1.1	0

Source: National statistics database (KOSIS)

Another concern about regional investment is that majority of the non-capital area investment by companies in the capital area is concentrated in Chungcheong region (Chungnam province, Chungbuk province, Sejong City, and Daejeon City), which are geographically adjacent to the capital area.

According to the Ministry of Trade, Industry and Energy (2022), 89 out of 165 companies, which account for 53.9% of total, that moved to the non-capital area for last 10 years (2012~2021) and received financial subsidies from the government are invested in Chungcheong region. The numbers are even bigger when considering

another near-capital region-Gangwon-do province; Gangwon accounts for 22 companies (13.3%), then Chungchenong and Gangwon regions account for 67.2% of overall company investment to non-capital regions. (See Table 1.4)

Table 1.4. Status of the capital area companies moved to the non-capital area in Korea

Region	Busan	Daegu	Gwangju	Daejeon	Ulsan	Gangwon	Chungbuk
No. (%)	5 (3%)	4 (2.4%)	-	9 (5.5%)	-	22 (13.3%)	14 (8.5%)
Region	**Chungnam**	**Jeonbuk**	**Jeonnam**	**Gyeongbuk**	**Gyeongnam**	**Jeju**	**Sejong**
No. (%)	51 (30.9%)	8 (4.8%)	16 (9.7%)	9 (5.5%)	4 (2.4%)	8 (4.8%)	15 (9.1%)

Source: MOTIE (2022)

Investment for regional innovation capabilities

What matters worse is that the imbalance of investment for regional innovation, which may serve as the cornerstone for future economic development. For R&D investment, 69.2% of Korea's total R&D investment and 78.5% of private R&D investment are concentrated in the capital area. For investment funds, according to the electronic disclosure information of venture capital analysis (DIVA) in year 2021, the number of venture funds formed by non-capital accounts only holds for 4.2% of the total number of associations; holds for 2.4% of the total amount. (See Table. 1.5)

Table 1. 5. Current status of venture fund investment associations

	Total amount	No. of associations
All associations	KRW 26.152 trillion	988
Associations in the non-capital areas	KRW 0.7594 trillion	42

Source: author, original data from DIVA (http://diva.kvca.or.kr, as of Jan 2021)

1.3.2 Problems from the imbalanced development

Country level

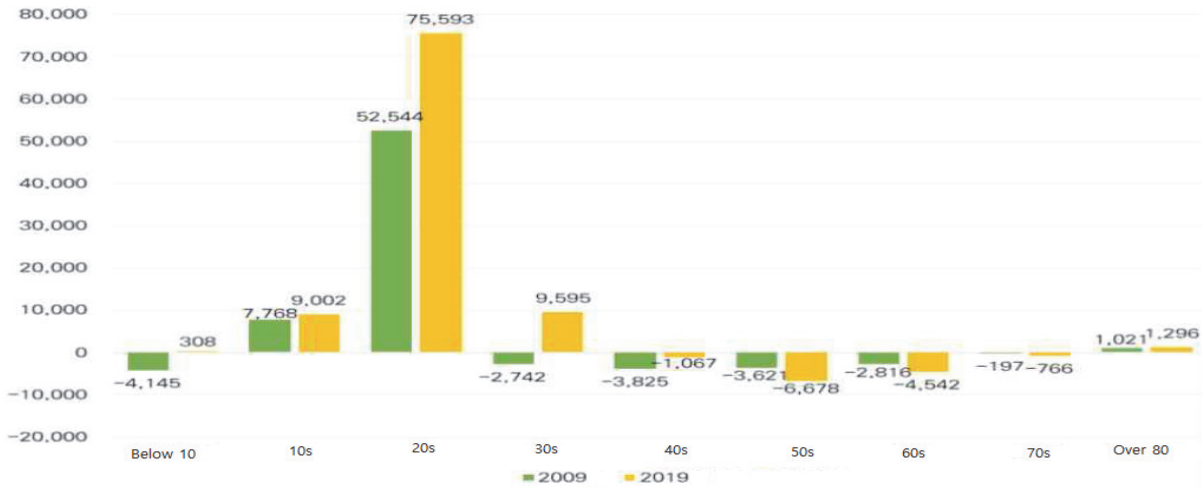
As pointed out in the previous section, imbalance between the capital and non-capital area inevitably raises the problem of resource allocation within country. Most of the investments are made around the capital area where the nation's capabilities are concentrated, and investment is always insufficient in non-capital areas. Lack of government and private investment in non-capital areas weakens regional industrial competitiveness, which eventually leads to a shortage of decent jobs in non-capital area, causing competitive human capital to leave the areas. This vicarious circle eventually weakens not only the competitiveness of non-capital areas, but also the entire country.

Capital area

The capital area, where everything is concentrated, suffers from severe traffic congestion, long commuting hours, high housing costs and narrow living areas. Especially human capitals moving from non-capital area are mostly young workforces (See Figure 1.4); they move in search of good jobs, have to bear the high living costs of the capital area, which will inevitably lower their quality of life without solid foundation in the area.

According to KRIHS-Korea Research Institute for Human Settlements (2020), traffic congestion costs in Seoul account for 46% of the country and exceed 50% including Gyeonggi province. In addition, it takes more than an hour and a half to commute to and from the capital area, which is about 1.2 times longer than 76 minutes in the non-capital area. Thus, living in the capital area gives extra-burdens to the young workforces who voluntarily move to the capital area.

Figure 1.4. Net movement of population to the capital area by age group



Source: KRIHS (2020)

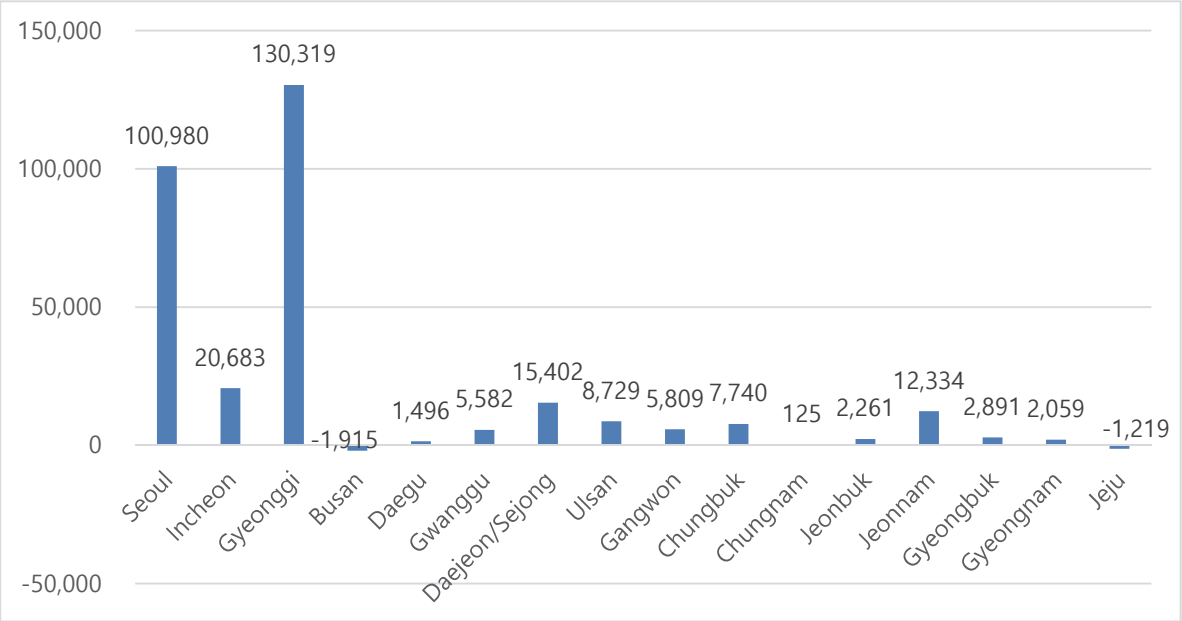
Non-capital areas

Quality jobs in non-capital area is running out, as decent jobs and competitive new industries are mostly concentrated in capital area. As knowledge-based service sector industries have become main forces of job creation; jobs in the high-growth knowledge service sector are concentrated in the capital area.

According to a survey conducted by the Kim (2022) and Korea Institute of Industrial Economics (KIET), the increase in the number of workers in the three high-growth industries (software, video broadcasting, and R&D specialized services) in the knowledge service industry from 2015 to 2020 is led by Seoul, Gyeonggi and Incheon.

This statistic implies that non-capital area cannot share the future direction of development of Korean industries. This eventually ignites ‘brain-drain’ from non-capital area to the capital area, and losing opportunities for further development and upgrading economy of the areas. (See Figure 1.5)

Figure 1.5. Increase/decrease by city and province of workers in the three high-growth industries (S/W, video broadcasting, and R&D specialized services) of the knowledge service industry (2015-2020)[1]



Source: Kim (2022)

1.4 Review of balanced regional development policies in Korea

1.4.1 Brief history

Early years (1960s~2002)

Korea's industrial policy has been gradually developed to support economic growth through industrialization since the 1960s. The need for regional development policies has already existed since the 1960s. As Korea became rapidly industrialized, the population of Seoul began to increase rapidly. In 1964, measures to prevent concentration of population in large cities were announced.

[1]. There are several exceptions such as Daejeon/Sejong and Jeonnam province; however, these performances are exceptional as there are R&D centers concentration (Daejeon) and recent relocation of central government (Sejong), and relocation of KEPCO (Korea Electronic Power Corporation) to Naju city in Jeonnam province.

However, industrial policies emphasizing "regions" did not emerge until the mid-1990s. This is because until then, Korea's industrial policy valued the growth of the entire national economy rather than regional balance and regional development. With the full-fledged implementation of the local autonomy system in 1995, region-focused industrial policies emerged. In 1995, the Ministry of Trade and Industry specified the promotion of region-centered industrial development strategies as one of the basic directions of industrial policy.

Due to the 1997 Asian financial crisis, Korea recognized her limitations in existing development strategies and began to pursue region-centered endogenous industrial development strategies that sought balanced regional development and revitalization of the regional economy.

To promote local industries and establish a regional innovation system, Kim Dae Jung administration started to shape "cluster approach" method, and it has become the center of regional development policy since then.

Roh, Moo Hyun Administration (2003~2008)

With the establishment of the Roh Moo Hyun government in 2003, the Korean government began to promote balanced national development policies as the top national task. While the Roh Moo Hyun government pursued national competitiveness and balanced regional development at the same time, capital area began to promote qualitative development, the administration tried to foster strategic industries, and create “Innovation Cities” to non-capital area. In addition, the relocation of public institutions to the non-capital provinces and administrative capital relocation were also promoted for balanced regional development.

Figure 1.6. Regional development Policies of Roh, Moo Hyun administration

Key Issue			Concentration of the Seoul Capital area and the Deepening of Regional Imbalances
Reginal Policy	Objective		Building advanced country with multi-polars
	Strategy		Innovation-led development, multi-polar, dispersed development, upgrading quality of life
	Measures	5-Key Policies	Innovation policies: Establishment of Regional Innovation System Balanced policy: Special Zone for Regional Specialized Development Industrial policy: regional strategic industry, innovation cluster Spatial policy: Sejong Administrative City, Innovation City and Enterprise City Quality of life: building good place to live
		Implementation	Special Act on Balanced National Development, Balanced National Committee, Five-Year Plan for Balanced National Development, Special Account for Balanced National Development
	Target	Spatial Unit	Metropolitan cities, counties, and districts

Source: Song (2021) modified by author

Lee, Myung Bak Administration (2008~2013)

In 2008, the Lee Myung Bak government reorganized the system of regional development policies to secure the global competitiveness of the regional economy and established the first five-year plan for regional development. The main contents were segmenting whole country into five major metropolitan economic zones and two medium-sized economic zones, promoting strengthening regional industrial competitiveness based on the capital area.

Figure 1.7. Regional development Policies of Lee, Myung Bak administration

Key Issue			Region's inferior global competitiveness
Reginal Policy	Objective		Competitive regional development with guaranteed job and quality of life
	Strategy		Inter-metropolitan development for globalization, Region based and led specialized development, Inter-regional cooperation
	Measures	5-Key Policies	Growth potential maximization of whole country: 5+2 metropolitan economic areas Discover new growth engine: nurturing inter-metropolitan economic area leading industries Authority transfers to regions: strengthening local consumption tax and comprehensive subsidy to regions Balanced development: win-win development fund Development and improvement of existing development policies
		Implemen-tation	Special Act on Balanced National Development, Balanced Regional Development Committee, Five-Year Plan for Balanced Regional Development, Special Account for Balanced Reginal Development
	Target	Spatial Unit	163 city-county-districts level areas, 5+2 metropolitan economic areas, 4+3 mega-city development areas

Source: Song (2021) modified by author

Park, Geun Hye Administration (2013~2017)

Unlike the Lee Myung Bak government, which emphasized strengthening regional competitiveness, in 2013, the Park Geun Hye government sought to improve the quality of life of local residents through revitalization of the local economy. The Park administration established "the right to live happily in region" and "economic cooperation group".

Figure 1.8. Regional development Policies of Park, Geun Hye administration

Key Issue			The Low Quality of Life and Happiness of Local Residents
Reginal Policy	Objective		Happiness for the people, hope for region (HOPE project)
	Strategy		Establishing a happy living area in the region, supporting customized policy packages, and strengthening regional-led cooperation
	Measures	6-Key Policies	Building foundation for happy living region: Strengthening regional-led cooperation Creating Jobs and Boosting Regional Economic Vitality: Establishing a Center for Creative Economy Innovation Improving educational conditions and fostering creative students: fostering local universities Advancement of the Regional Cultural Ecosystem: Enhancement of Cultural Accessibility, etc. community welfare, healthcare: Establishment of Emergency Medical System in Vulnerable Areas Continued implementation of balanced regional development policies
		Implemen-tation	Special Act on Balanced National Development, Balanced Regional Development Committee, Five-Year Plan for Balanced Regional Development, Special Account for Balanced Reginal Development
	Target	Spatial Unit	63 Regional happy living regions

Source: Song (2021) modified by author

Moon, Jae In Administration (2017~2022)

The Moon Jae In government, which shares the political values of the Roh Moo Hyun government, is implementing a policy to lay the foundation for regional-led independent growth under the slogan "a country with strong regions, a balanced Korea." The Moon administration has selected and promoted three strategies and nine core tasks of "people, space, and industry". In particular, in the industrial field, related policies have been promoted and are focusing on strengthening the innovation capabilities of regions where corporate investment and jobs are created.

Figure 1.9. Regional development Policies of Moon Jae In administration

Key Issue			Unsustainable national development by the widening gap between the capital area and the regions
Reginal Policy	Objective		Establishing a Regional-led Foundation for Independent Growth
	Strategy		Human-Space-Industry strategy
	Measures	3-themes and 9-policies	Human Policies: A virtuous cycle of education for local talent and jobs, Cultural Tourism based on locality, Establishment of a Health and Welfare System to Ensure Basic Quality of Life Space Policies: Revitalizing Agricultural and Fishery Villages, Urban Renewal New Deal and Small and Medium-Sized Cities revitalization, Support for population reduction areas Industry Policies: Innovation City Season 2, Regional Industry Innovation, Economic Assetization of Regional Idle Assets
		Implemen-tation	Special Act on Balanced National Development, Balanced National Development Committee/Council for Regional Innovation, Five-Year Plan for Balanced National Development, Special Account for Balanced National Development
	Target	Spatial Unit	Provincial Areas, City-county-districts

Source: Song (2021) modified by author

1.4.2 Major regional development policies (focusing on industrial development)

Various policy efforts across the country are needed for regional development. Among them, this paper aims to introduce regional industrial policies that play a key role in revitalizing the local economy through local job creation.

The regional industry development policy is closely related to four policies: (1) industrial location, (2) investment and start-up, (3) industry-academic cooperation, and (4) regional innovation.

These four policies have different policy goals, but the ultimate goal is to strengthen regional competitiveness. From this point of view, organic linkage between these four policies is the most important for successful regional development policies.

Regional industrial location policies

The policy objectives are largely twofold. First is the balanced development of the country through regional industrial clusters and regional development, and the other is the strengthening of the international competitiveness of the region through attracting FDI and promoting trade.

To achieve these policy goals, the Korean government provides incentives for tenant companies, such as improving infrastructure in the location, tax reduction, and deregulation.

Major projects include the creation of special economic zones such as regional industrial zones, industrial complexes, free trade zones, and free economic zones.

A representative achievement of the policy to foster regional industrial location is industrial complexes. In particular, 1,257 industrial complexes throughout the country play a key role in the development of the Korean economy, which is responsible for two-thirds of domestic manufacturing production and exports and half of employment.

However, in the case of free economic zones, where the main policy goal is to attract FDI, the degree of regional development is uneven due to sluggish investment attraction except for the Incheon Free Economic Zone which

located in the capital area. According to statistics from MOTIE in 2022, free economy zone holds up 6.8% (USD 20.5 bn) of total FDIs into Korea. Among the USD 20.5 bn, Incheon free economy zone holds USD 13bn and other 9 zones took the rest.

Regional investment promotion policies

There are two main policy goals for regional investment and start-up policies. The first is easing the imbalance between the capital area and the non-capital area, and the second is shared growth by resolving polarization between large and small businesses.

The main policy measures are subsidies, funds and establishment of start-up supporting agencies. In the case of subsidies, "local investment promotion subsidies" will be provided to companies in the capital area that move to non-capital area and foreign-invested companies that invest in new or additional locations in the non-capital area.

According to data from the Ministry of Trade, Industry and Energy, the "local investment promotion subsidy" provided subsidies amounting to 2 trillion won to 1,300 companies from 2004 to 2021, inducing more than 26 trillion won in private investment and creating 6.9 million local jobs.

In the case of funds, it is support for fostering local venture companies and revitalizing start-ups using policy funds such as venture funds of the Ministry of SMEs and Startups. For supporting agencies, as for start-up supporting agencies, government ministries, including the Ministry of SMEs and Startups, have established 17 creative economic innovation centers and regional start-up care centers of each provincial-level regions are promoting various venture and start-up-related financial projects.

Regional industry-academic cooperation and HR development Policies

There are two main policy objectives. The first is university education and cultivation of industrial manpower consistent with regional industrial trend and needs, and the second is community development through technology advancement.

The main policy measures are R&D support, technical advice, infrastructure construction for industry-academic cooperation, and manpower training. To this end, the Korean government is promoting "Industrial-Academic Cooperation Leading University," "Industrial-Academic Convergence Zone," and projects to train local innovative human resources. The biggest difficulty of the industry-academic cooperation policy is that the curriculum of local universities is rigid around suppliers, making it difficult to train industrial personnel in a timely manner reflecting the characteristics of local industries.

Regional innovation capacity enhancement policies

The goal of the policy is to develop technologies and strengthen innovation capabilities in local industries.

Major policy measures include technology development support, tax benefits and project cost support for "special R&D zones" companies, local R&D support budgets, R&D information system construction, and industry-academic-research cooperative technology development projects.

These projects are implemented in accordance with the comprehensive plan for the promotion of local science and technology (prepared in every five years), and are implemented on regional level through the R&D Special Zone and the Regional R&D Support Group, etc.

Special R&D zones are designated in five regions: Busan, Daegu, Gwangju, Daejeon, and Jeonbuk, and regional R&D support groups are established in 12 regions, including Busan.

Difficulties in promoting regional R&D support policies include difficulty in settling a self-sustaining venture ecosystem in artificially created special zones, and lack of organic cooperation with the central government-led special zones and local governments.

1.4.3 Implications

National efforts for balanced regional development have continued for decades, but as described in the previous chapter, the concentration of population, economic and social resources in the Seoul capital area have intensified over time. Of course, the concentration of the population in the capital area was eased for a certain period because of the construction of innovative cities and the relocation of public institutions to those regional cities. However, as the relocation of public institutions to the innovative cities was completed, the trend of concentration in the capital area intensified again.

There may be various causes such as industry, education, and settlement conditions for imbalanced regional development, but authorities-concerned such as the National Balanced Development Committee and MOTIE (2022) and KIET (2021), argue that the lack of investment and decent jobs in regional areas is the most crucial issue. Investment bankers and venture capitalists in Korea are mostly concentrated in Seoul, especially Gangnam and Yeouido area, and they prefer investment destinations near the capital area.

Under the circumstances, it is difficult for regional businesses to attract the investment needed to grow their businesses. In addition to the investment issue, the lack of decent jobs in the region causes the outflow of local young talent to the capital area. As a result, it is difficult for regional companies with potential to find

competitive human resources and investment opportunities, and they eventually move to the capital area. The relocation of those regional companies to the capital area leads to a decrease in decent regional jobs, which in turn creates a vicious cycle structure that leads to the outflow of local young talents to the capital area.

From this chapter, this paper would like to address that, in order to achieve balanced regional development and job creation, investment to the region must be actively carried out. As discussed earlier, the Korean government is supporting policy incentives for attracting general investments to regions, such as the relocation of companies in the capital area to regions. The next chapter examines the current status and policies for FDI attraction in Korea, which occupies an important position in overall investment in Korea.

1.5 Review of FDI attraction policies in Korea

1.5.1 Policy overview

According to MOTIE statistics, Korea's first inward FDI record begins in 1962, which was $3.57 million on report-basis, grew to $386.1 billion as of the first quarter of 2021. The increase in FDI attraction performance has led to changes in policy stance for FDI over a long period of time, resulting in various deregulation and improvement in support systems.

The Korean government has allowed FDI passively and limitedly after the Korean War, but in the wake of the 1997 Asian financial crisis, the country viewed FDI as a way to overcome the economic crisis and prepared an active investment attraction policy.

Accordingly, as of 1998, various policies and systems related to foreign investment were extensively reorganized. In particular, the Korean government enacted the Foreign Investment Promotion Act in November

1998 to simplify investment procedures, expand investment incentives, and create a foreign investment regional system, a type of special economic zone.

After the Asian financial crisis, the Korean government enacted the Foreign Investment Promotion Act (1998) and completely reorganized the FDI system. The enactment of the law is considered as the foundation for promoting foreign investment by simplifying investment procedures, expanding incentives, designating foreign investment areas, strengthening administrative support and easing registration requirements.

In addition to the establishment of the system, the Korean government expanded and reorganized the KISC, an existing organization dedicated to attracting foreign investment, to Invest Korea to strengthen its support capabilities for attracting investment.

1.5.2 Major stages of FDI attraction policies

Jang and Cheon (2000) and KOTRA (2020) classify the stages of change in the Korean FDI system into the following four stages after the enactment of the Foreign Capital Inclusion Promotion Act in 1960.

The first stage was the investment restriction stage (1962-1981), when free aid was reduced and the need to expand the introduction of paid-out foreign capital increased as it was converted to a loan type. At that time, it was a time of implementing policies to induce foreigners to invest in new capital, but it is evaluated as a stage of passively restricting (regulating) investment through strict examination by the government due to concerns over foreign capital's domination of the domestic industry.

For more than 20 years from 1962 to 1981, the average annual FDI arrival amount was only $73.3 million, but each approved FDI project contributed greatly to the development of Korea's economy and major industries.

About 70% of the FDI made during this period was invested in the manufacturing industry, especially the chemical industry (29.6%) and the electronics industry (14.4%), which is evaluated to have contributed to building the foundation for strengthening the competitiveness of Korea's manufacturing industry.

The second stage is the foundation creation stage (1984-1990), when FDI was converted from regulation to attraction in order to enhance the international competitiveness of the domestic industry. In particular, in 1984, the system was changed from a positive list system that announced FDI-allowed industries to a negative list system that announces restricted and prohibited industries.

During this stage, the average annual FDI arrival amount was $488.6 million, an increase of 6.7 times compared to the previous stage. In addition, the proportion of the manufacturing industry was 60.2%, down from 70% of the previous stage, and as FDI in the service sector gradually increased, foreign service-industry companies' entry into the Korean domestic market began to increase.

The third stage is the liberalization stage (1991-1997), when the FDI reporting system was introduced and the FDI opening plan was established and implemented in response to the opening policy of the Korean economy. The Korean government introduced the foreign investment reporting and acceptance system in 1991, simplifying the FDI process and expanding the foreign investment liberalization rate from 90.6% to 97.2%. In 1996, Korea joined the OECD and strongly promoted investment liberalization. In this process, M&A-type foreign investment was also allowed as a representative investment liberalization measure.

The FDI introduced at this stage on average was $1.187.6 billion annually, an increase of 1.43 times compared to the previous stage, the average FDI in the manufacturing sector was $685.3 million, and the service industry was $456.5 million annually. During this period, FDI not only pursued production efficiency, but also

invested heavily for the purpose of accessing the Korean market. In particular, in the service sector, FDI increased in the fields of distribution, tourism, and finance.

The fourth stage is the stage of FDI promotion and full liberalization (1998–present), based on the keynote of full liberalization and active investment attraction in the process of overcoming the 1998 financial crisis.

Immediately after the Asian financial crisis, the Korean government recognized that FDI could play an important role in the process of overcoming the crisis, including securing foreign exchange, financial and corporate restructuring, and established a strong support system to promote FDI. Hence, in the 2000s, foreign direct investment was completely liberalized by signing free trade agreements with major trading partner countries such as the United States.

Since 1998, right after the financial crisis, the inflow of FDI has increased significantly, and an annual average of $10.89 billion, which has increased more than nine times from the previous stage. During this period, the proportion of the manufacturing industry in FDI decreased significantly to 37.3%, while the proportion of the service industry increased significantly to 60.2%.

Table 1.6. Inward FDI attraction performance by period and industries in Korea
(Based on arrival performances, USD 1 Mil.)

	Stage 1		Stage 2		Stage 3		Stage 4	
	1962-1981		1982-1990		1991-1997		1998-2019	
	Amount	%	Amount	%	Amount	%	Amount	%
Manufacturing	50.6	69.0	294.3	60.2	685.3	57.7	4,060.0	37.3
Service	20.9	28.5	188.2	38.5	456.4	38.4	6,558.7	60.2
Agri-fisheries	0.3	0.4	0.7	0.7	37.2	3.1	10.2	0.1
Electric & gas construction	1.5	2.0	5.3	1.1	8.7	0.7	265.8	2.4
Total	73.3	100	488.6	100	1,187.6	100	10,894.7	100

Source: MOITE FDI statistics, KOTRA (2021)

1.5.3 3 sub-stages of FDI policy after year 1998

On the basis of 4 stages above, KOTRA (2021) divided the fourth stage (1998~current) into 3 sub-stages. The first sub-stage was foundation building stage for FDI promotion (1998-2003), when the Korean government enacted the Foreign Investment Promotion Act (1998) after the Asian financial crisis. The enactment of the law is believed to have laid the foundation for promoting foreign investment attraction, such as simplifying investment procedures, expanding incentives, designating foreign investment zones, strengthening administrative support and easing registration requirements. In addition to establishing a system base, the Korean government expanded and reorganized the existing KISC (Korea Investment Service Center), an organization dedicated to attracting foreign investment, into Invest Korea to strengthen support capabilities for attracting investment.

The second sub-stage was the stage of promoting attraction (2004-2014), which is a time when the investment environment in Korea was improved and various support systems were prepared by responding to competition to attract FDI between countries. The cash grant system and reward system were newly established (2004), and various support systems such as recognition of investment in non-profit corporations (2007) were prepared and improved.

The last stage is stabilization stage (2015~). As Korea's annual FDI attraction exceeds $20 billion on a reporting basis, it is a time when inward FDI is being upgraded both in quantitatively and qualitatively. The FDI attraction policy is being promoted to abolish the discriminatory tax reduction system for domestic and foreigners, expand cash support, and foster industries related to the 4th Industrial Revolution.

1.5.4 Policy aims

The aim of Korea's foreign direct investment policy is to actively attract foreign investment that plays a positive role in the development of the Korean economy. In particular, not only for the performance of foreign investment in terms of simple production, export and employment growth, the policy but also puts emphasis on attracting FDIs that can enhance the global competitiveness of Korean industry and promote regional development.

1.5.5 Policy directions and measures

In most industries, the Korean government provides investment protection that guarantees free domestic management activities of foreign investors, treats them the same as domestic investors, and guarantees external remittances. It also operates an active investment promotion system, such as providing various incentives for foreign investment that is helpful to the Korean economy.

Investment Liberalization and Investment Protection Policies

Korea's FDI policy is designed and operated in accordance with two internationally universal principles: investment liberalization and investment protection. These two principles are reflected in the Foreign Investment Promotion Act.

Investment Liberalization

Unless otherwise expressly provided for in Korean law, foreign investors can freely conduct management activities in Korea without any special restrictions. The Korean government freely allows foreign direct investment in the 1,100 industries under the Korean Standard Industry Classification, except for 60 industries, including legislation, diplomacy, defense and public administration.

Investment protection

The Korean government legally protects foreign investors from political risks. Investment protection can be divided into four categories: external remittance guarantee, national treatment, and foreign exchange transaction guarantee.

First, foreign remittance guarantee: profits from stocks acquired by foreign investors, the sale price of stocks, principal and fees paid under long-term loan agreements are guaranteed according to the foreign investor's report or permission at the time of remittance.

Second, treatment of Koreans: Foreign investors and foreign-invested enterprises are treated the same as Koreans or domestic corporations for their business, except as otherwise provided for in related Acts.

Third, exclusion of provisions for suspension of foreign exchange transactions: Unless otherwise provided for in the Foreign Investment Promotion Act, matters concerning foreign exchange and external transactions shall be governed by the Foreign Exchange Transactions Act. If it is deemed inevitable due to serious economic conditions at home and abroad, such as natural disasters and warfare, foreign exchange transactions may be temporarily suspended or restricted under the Foreign Exchange Transactions Act, except for the application of this provision to foreign investment.

Lastly, exclusion of discrimination, such as tax reduction and exemption: The provisions on the reduction or exemption of tax-related laws applied to Korean nationals or corporations shall apply equally to foreign investors and their enterprises, except as otherwise provided in the Act.

Investment Incentives

The Korean government provides various incentives such as tax cuts, cash grant, and location support for foreign investment with high value-added industries and high job creation effects

Table 1.7. Major incentive measures for FDI attraction in Korea

	Details
Tax cut	Tariffs and local taxes are reduced for foreign-invested companies operating new growth engine industrial technologies or moving into foreign investment zones
Cash grant	For foreign investors to new growth engine industry prescribed by the FDI Acts and subordinate statutes, or investment accompanying the creation of jobs or the establishment of R&D facilities in the new growth engine industry
Location support	Rent reduction, tax reduction, and location support are provided to foreign investors who invest in special economic zones such as foreign investment zones, free trade zones, and free economic zones
Other incentives	employment subsidies, education and training subsidies can be subsidized upon considering investment region and economic benefits

* Source: Invest Korea (2021), reorganized by author

1.5.6 Legal basis for promoting FDI attraction to region

According to Article 14 (2) 6 of the Foreign Investment Promotion Act, cash grant can be supported for investments that have a great effect on the domestic economy. Article 20-2 (5) 2 of the Enforcement Decree of the same Act stipulates that this cash grant can be provided to foreign investors who contribute to the development of the local economy by investing in regional specialized industries.

Table 1.8. Legal basis for promoting FDI attraction to region

FOREIGN INVESTMENT PROMOTION ACT

Article 14-2 (Cash Grants for Foreign Investments)

(1) Where a foreigner makes any of the following foreign investments at least at the foreign investment ratio prescribed by Presidential Decree, the State or the competent local government may provide the foreigner with cash grants required for the uses prescribed by Presidential Decree, including the creation or extension of factory facilities, and research and development, taking into account whether the relevant foreign investment accompanies high technology, the effect of technology transfer, the scale of job creation, whether the foreign investment overlaps any domestic investment, the propriety of the location in which the foreign investment is made, etc.:

6. Where it is an investment that has a large effect on the domestic economy for its amount, for which the Foreign Investment Committee deems it necessary to provide cash grants in accordance with the standards prescribed by Presidential Decree with respect to the requirements for foreign investors, etc.

ENFORCEMENT DECREE OF THE FOREIGN INVESTMENT PROMOTION ACT

Article 20-2 (Uses of Cash Grants for Foreign Investment)

(5) "Standards prescribed by Presidential Decree" in Article 14-2 (1) 5 of the Act mean that a foreign investor falls under either of the following cases:

2. Where the foreign investor engages in a region-specific industry as defined in subparagraph 4 of Article 2 of the Special Act on Balanced National Development or a cooperative inter-region industry as defined in subparagraph 5 of the same Article, and such industry is deemed to contribute to developing the regional economy.

Source: www.law.go.kr

1.6 Current status of regional FDI attraction performance in Korea[2]

1.6.1 Characteristics of FDI attractions performances by region

As a result of analyzing FDI statistical data by the Ministry of Trade, Industry and Energy, it can be confirmed that most of Korea's regional FDI performance is concentrated in the capital area (Seoul, Incheon, and Gyeonggi).

Of the total FDI attraction performance accumulated from 1962 to 2020, the capital area accounted for $172.9 billion, accounting for 73% of the total.

In detail, Seoul accounted for 53.5% of Korea's total cumulative FDI attraction from 1962 to 2020, Gyeonggi Province accounted for 12.3% and Incheon accounted for 7.2%. During the period, the three regions hold top 3 in Korea's 17 metropolitan cities' FDI attraction rankings respectively.

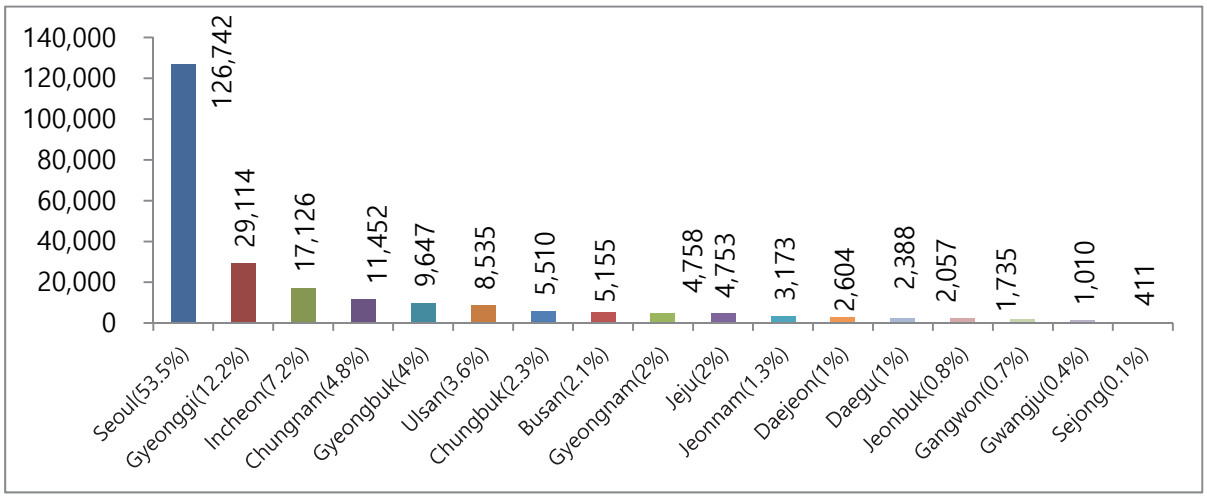
On the other hand, the non-capital area attracted $63.1 billion in FDI during the same period, accounting for 27% of the total FDI attraction performance. Among non-capital metropolitan governments, Chungcheongnam-do, adjacent to the capital area, had the largest FDI attraction of $11.4 billion, followed by Gyeongbuk province, Ulsan Metropolitan City, Chungbuk province, and Busan Metropolitan City. (See Figure 1.10)

However, these regions only account for 4.8 percent, 4.1 percent, 3.6 percent and 2.3 percent of Korea's total FDI attraction performance, respectively, accounting for a very low proportion compared to the Seoul capital area.

[2] In most Korean government reports regarding FDI, they usually use pledged FDI, which indicates the size of future FDI disbursements, however, all FDI performances in this paper are arrived FDIs as arrived FDIs actually indicate already realized disbursements.

Figure 1.10. Accumulated FDI Attraction performances by metropolitan-level (1962-2020)

(Unit: USD1 mil., % based on arrival)



Source: Author, using MOTIE FDI data

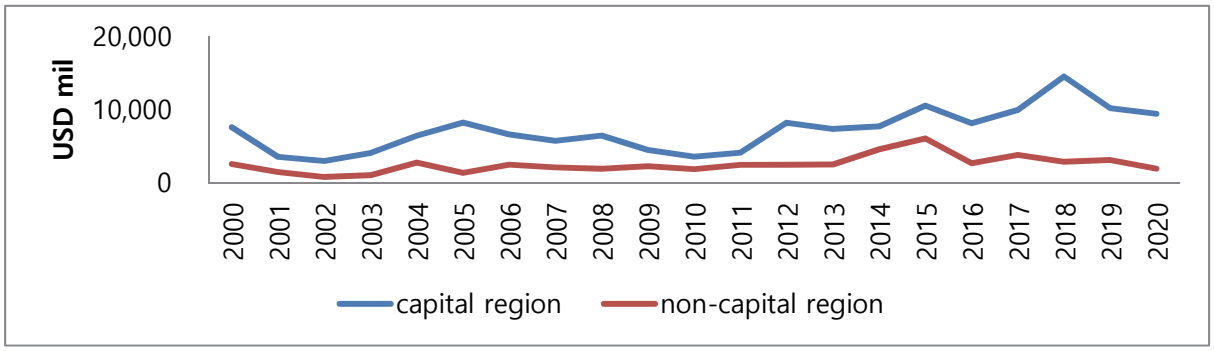
1.6.2 Imbalanced FDI attraction performance among regions in last 20 years

As Korea's FDI attraction became active in the 2000s, the discrepancy of FDI attraction performance between the capital and non-capital areas is showing a growing trend. In particular, in the early 2000s, the difference between the two continued to fluctuate, but after 2010, the difference in FDI attraction between regions has been widening than before.

Overall performance

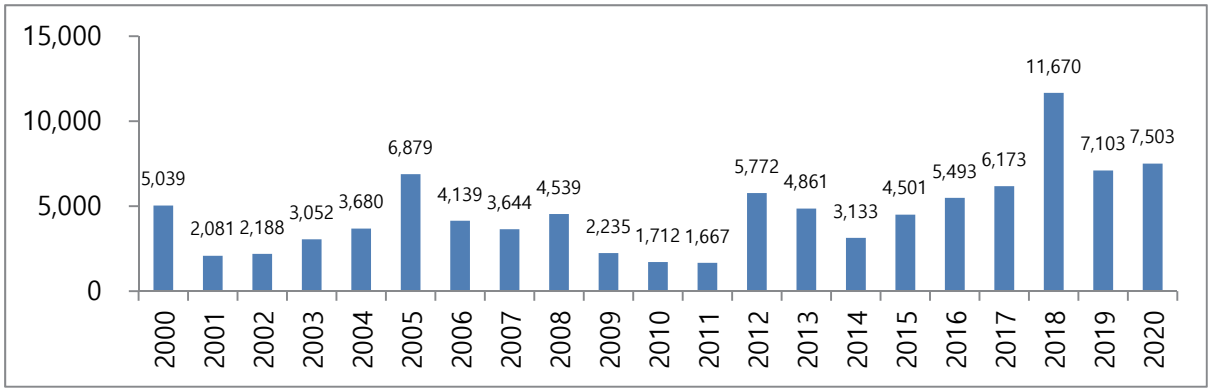
As a result of analyzing the overall performance of inward FDI over the past 20 years, the total amount of FDI attracted to 14 provinces in the non-capital area has never exceeded three provinces in metropolitan cities, and the difference in FDI attraction between the capital and non-capital areas continues to grow. In particular, the FDI gap between the two regions, which has narrowed to $1.66 billion since the 2008 global financial crisis, has been widening again since 2012, and has increased to $11.6 billion in 2018. (See Figure 1.11 and 1.12)

Figure 1.11. Inward FDI performance in the capital vs. the non-capital areas over last 20 years



Source: Author, using MOTIE FDI data

Figure 1.12. Inward FDI gap between the capital and the non-capital area (USD mil)



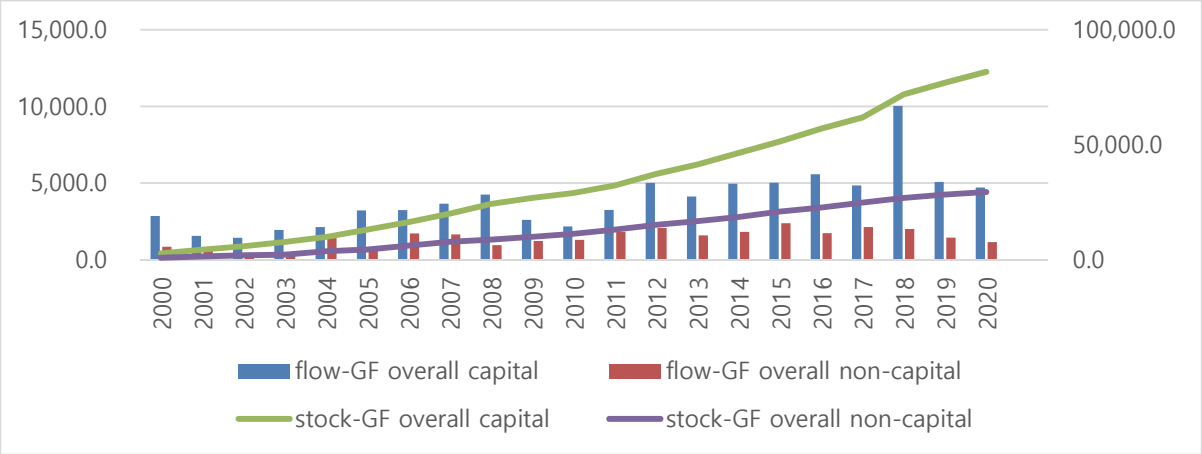
Source: Author, using MOTIE FDI data

By FDI type: Greenfield vs. M&A

In the analysis by type of FDI, the bias of FDI in the capital area is clear. In both Greenfield-type FDI and M&A-type FDI, the capital area showed better performance than the non-capital area. On flow basis,

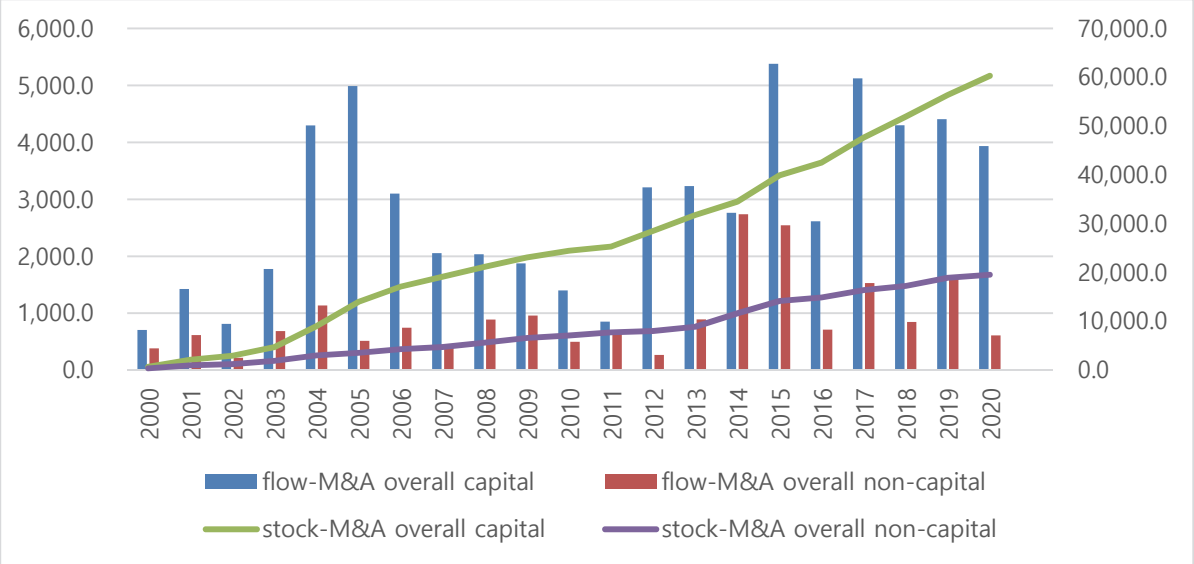
In the case of greenfield-type FDI, the proportion of non-capital investment to investment in the capital area is gradually increasing. The proportion of the non-capital area, which was about 30% in 2000, increased to 40% in 2015 and 36% in 2020. On the other hand, in the case of M&A type FDI, the proportion of non-capital area was 54% in 2000, 35% in 2015, and 32.4% in 2020. This is a result showing that the concentration of M&A type FDI in the capital area is higher than that of greenfield type FDI. (See Figure 1.13 and 1.14)

Figure 1.13. Flows and Stock of Greenfield type inward FDI



Source: Author, using MOTIE FDI data

Figure 1.14. Flows and stocks of M&A type inward FDI



Source: Author, using MOTIE FDI data

Table 1.9. The proportion of FDI stock of the non-capital area to the capital area

	2000	2005	2010	2015	2020
GF	29.98 %	33.72 %	33.82 %	40.8 %	36.0 %
M&A	54.4 2%	25.38 %	28.96 %	35.5 %	32.4 %

Source: Author, using MOTIE FDI data

By industry: Manufacturing industry

As a result of analyzing FDI by industry, in the case of the manufacturing industry, FDI stocks flowing into the capital and non-capital areas show almost similar performance. As a result of analyzing the manufacturing FDI by dividing it into greenfield FDI and M&A FDI, it can be confirmed that the performance of the capital area and the non-capital area is almost similar. Through statistics below, it can be inferred that in the manufacturing industry, inward FDI is relatively evenly flowing into both capital and non-capital areas. (See Figure 1.15, 1.16 and 1.17)

By industry: Service industry

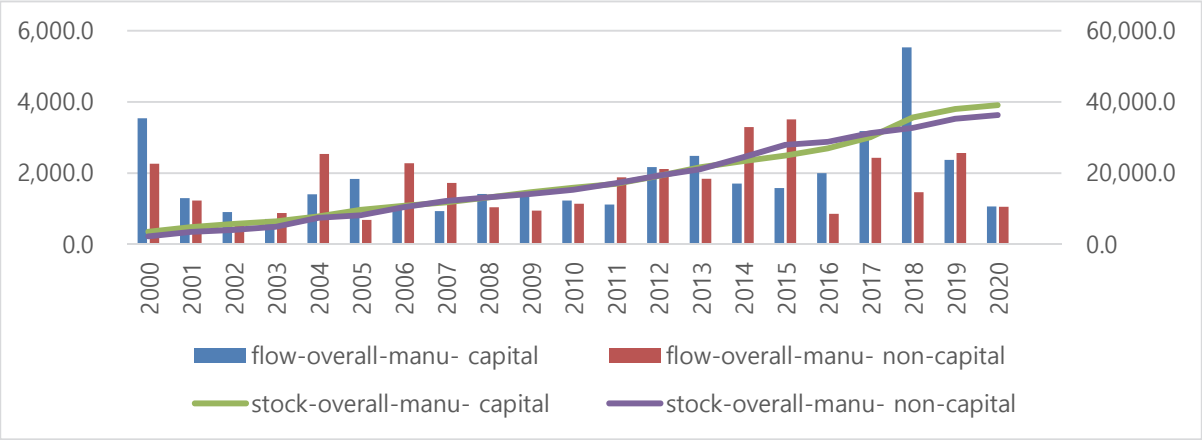
Unlike manufacturing industry's inward FDI trends, service industry's inward FDI shows very sharp contrast between the capital area and the non-capital area.

FDI in the service industry flowing into the capital area is generally increasing except for a few years after the 2008 global financial crisis. Inward FDI in the capital area increased from $3.88 billion in 2000 to $7.58 billion in 2020, and the average annual inflow during the same period was $5.15 billion.

However, the FDI of the service industry flowing into the non-capital area was significantly insufficient compared to the capital area. Inward FDI in the non-capital area recorded $706 million in 2020, starting with $298 million in 2000, and the average annual inflow during the same period was only $683 million.

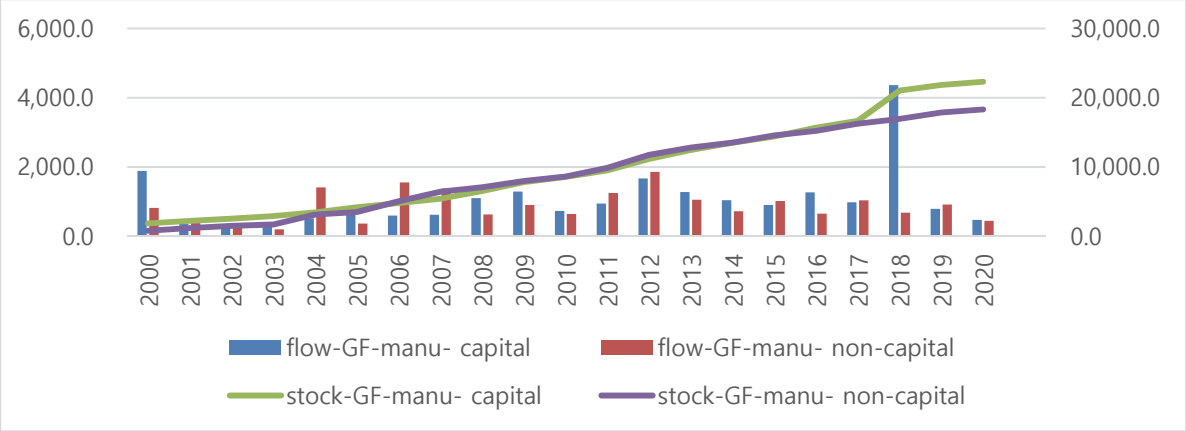
As a result of analysis by investment type, annual greenfield type inward FDI flows from 2000 to 2020 was $530 million, whereas annual inflow of M&A type FDI for the same period was $145 million. (See Figure 1.18, 1.19 and 1.20)

Figure 1.15. Flows and stocks of inward FDI on manufacturing industries (overall)



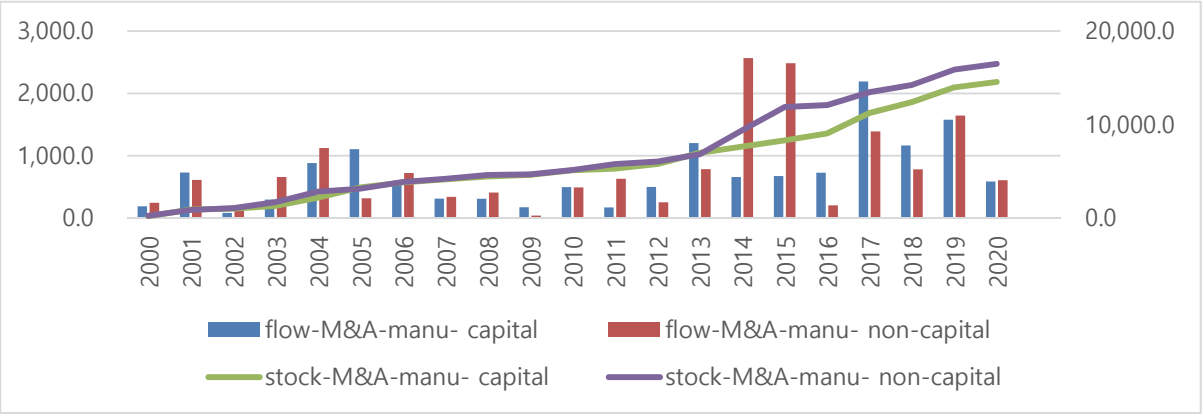
Source: Author, using MOTIE FDI data

Figure 1.16. Flows and stocks of inward FDI on manufacturing industries (greenfield type)



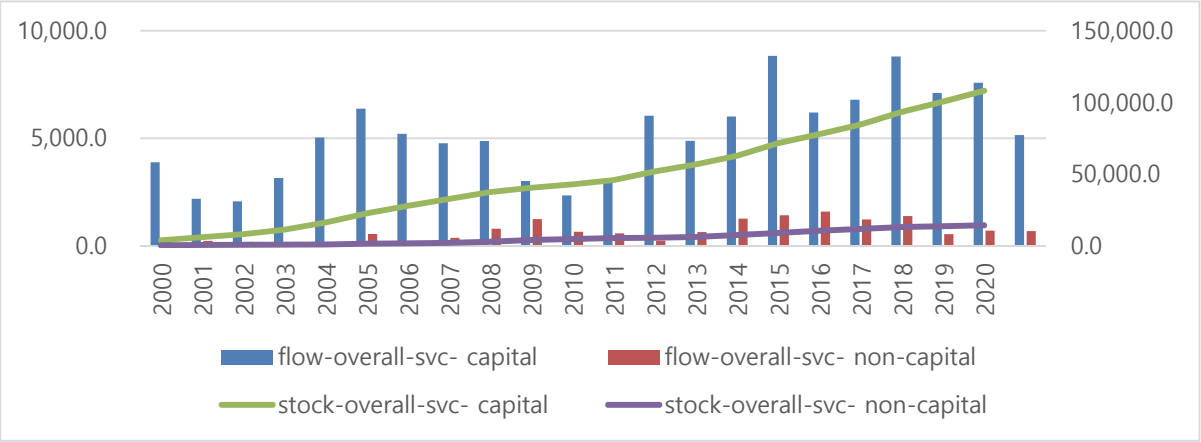
Source: Author, using MOTIE FDI data

Figure 1.17. Flows and stocks of inward FDI on manufacturing industries (M&A type)



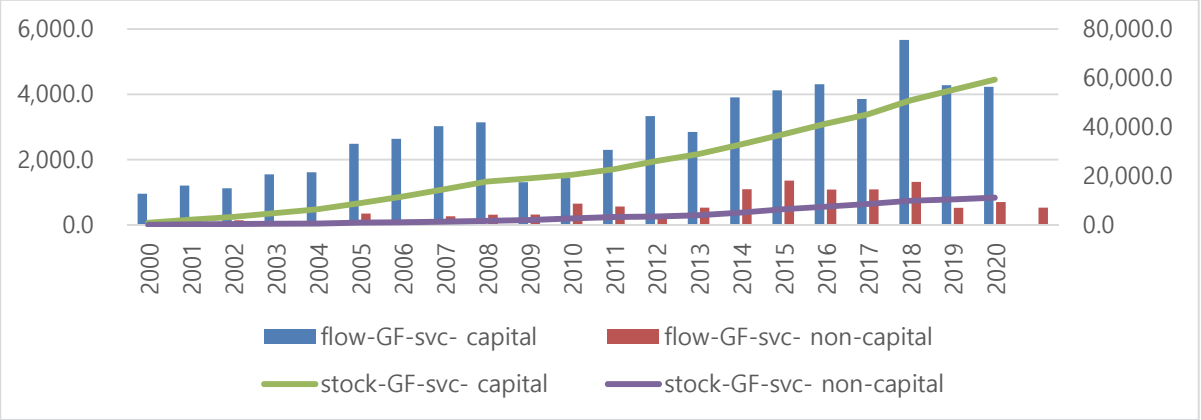
Source: Author, using MOTIE FDI data

Figure 1. 18. Flows and stocks of inward FDI on service industries (overall)



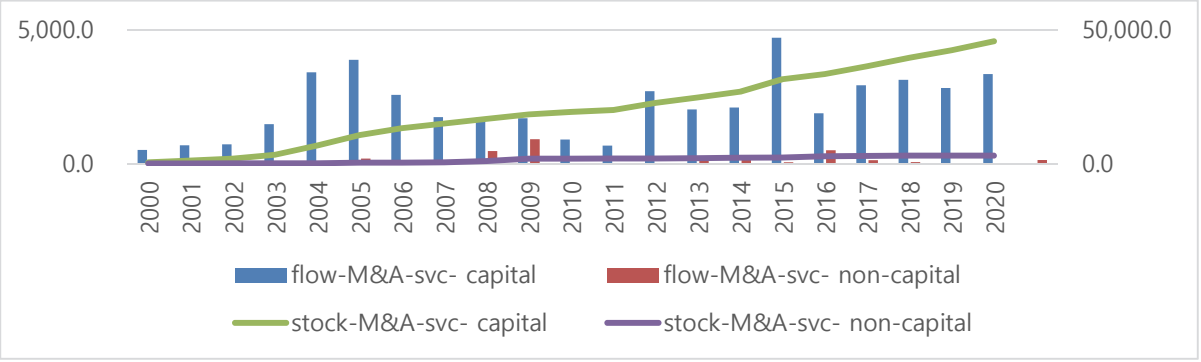
Source: Author, using MOTIE FDI data

Figure 1.19. Flows and stocks of inward FDI on service industries (greenfield type)



Source: Author, using MOTIE FDI data

Figure 1.20. Flows and stocks of inward FDI on service industries (M&A type)



Source: Author, using MOTIE FDI data

1.6.3 Implication

Through the inward FDI performance over the past 20 years, most of the FDI flowing into Korea is concentrated in the capital area. This is not surprising in that Korea's various infrastructures are well-established in the capital area.

Rather, a concern is the performance of FDI in the service industry. As Korea's economy develops, the industrial structure is also changing from traditional manufacturing to high value-added service industries; in 2022, the service industry accounts almost for 70% of the Korean economy's GDP and employment. However, the non-capital area still seems to be unable to deviate from the existing manufacturing-oriented industrial structure.

Therefore, the inflow of FDI from the non-capital area is also believed to be limited to the manufacturing sector. In order to revitalize the economy in the non-capital area, upgrade the industrial structure in the future, and increase the inflow of FDI into the service sector, the Korean government should nurture the high value-added service industry in the region.

1.7 Challenges of regional FDI attraction

1.7.1 Central-led FDI policy

Unlike Europe, where the decentralization system has been established for a long time, the history of the local autonomy system in Korea is short. Therefore, the FDI attraction policy to the region is also designed by the central government, and the region has no choice but to play a somewhat passive role. More specifically, the tax reduction system, and the designation of special economic zones are all decisions of the central government.

1.7.2 Indiscriminate FDI attraction incentives throughout the country

Local governments hope to receive more attractive FDI attraction incentives in non-capital areas in consideration of the imbalance in development between the capital and non-capital areas, but the central government, including tax authorities, maintains a unified FDI attraction support policy nationwide.

1.7.3 Limited resources of local government

Cash grant is an effective incentive for the government to use for attracting FDI, but by the foreign investment promotion Act, the central and local governments must jointly raise funds at a certain rate. In the case of the capital area, the ratio of financial sharing between local and central governments is 6:4, and in the non-capital area, it is 4:6. Even with the relatively favored financial sharing ratio comparing to the capital area, relatively poor financial conditions of local governments in regions are difficult to create a competitive cash grant, which means that from the perspective of foreign investors, investment conditions to region is less attractive than to the capital area.

1.7.4 Overlapping strategic industries among regions

If a specific industry is specialized in a specific region, national investment promotion agencies such as Invest Korea will be able to effectively support regional FDI attraction activities. However, in reality, every region eagerly hopes to nurture globally cutting-edged new industries, such as future mobility, hydrogen industries and artificial intelligence. In the end, all local governments are ended up with similar strategic industries to nurture. (See Table 1.10)

This eventually leads to unnecessary competition between regions, and it is highly likely that all regions will fail to foster strategic industries because they do not have a critical mass for establishing a new industrial

ecosystem. In the end, potential foreign investors and even national investment promotion agency such as Invest Korea are hard to make a plan to find a proper location to invest.

Table 1.10. Cases of overlapping strategic industries among regions

	ICT	BIO & Healthcare	Mobility & parts	Low Carbon and renewable energy
Busan	O		O	O
Ulsan		O	O	O
Gyeongnam		O	O	
Gwangju		O	O	
Jeonnam		O	O	O
Jeonbuk		O	O	
Daegu		O	O	O
Gyeongbuk	O	O	O	
Daejeon	O	O		
Sejong	O	O	O	
Chungnam		O	O	O
Chungbuk		O	O	O
Gangwon	O	O		
Jeju		O		O

Source: Author. Reorganizing overlapping regional strategic industries out of 56 Smart Specialization Industries (MOTIE), 14 National Innovation Clusters (MOTIE), 13 Industrial-Academic Convergence Zones (MOITE) and 48 Main Industries (MSS).

1.7.5 Lack of linkage between FDI policy and regional industrial policy

Under the Foreign Investment Promotion Act, the central government prepares a nationwide foreign investment promotion plan through the Foreign Investment Deliberation Committee by synthesizing the annual foreign investment promotion plan submitted by local governments.

This plan requires considering domestic industrial structure, but it is not mandatory, so there is a lack of link between foreign investment policy and industrial policy. In the same context, there is no support program for the

linkage between foreign-invested companies and local domestic companies.

As a result, a mismatch occurred between FDI and local strategic industries. According to a 2012 survey by Invest Korea, the matching ratio of foreign investment companies to the regional strategic industry was only 23% nationwide. (See Table 1.11)

Table 1.11. Matching ratio between inward FDI and regional industries

Region	No. of Foreign invested companies in regional strategic industries	Total no. of foreign invested company in the region	Matching ratio
Chungnam	124	336	37%
Busan	113	686	16%
Gyeongnam	113	471	24%
Gwangju	64	144	44%
Gyeongbuk	62	225	28%
Chungbuk	61	230	27%
Daegu	51	359	14%
Jeonbuk	48	134	36%
Daejeon	36	139	26%
Ulsan	31	106	29%
Jeonnam	28	216	13%
Gangwon	13	115	11%
Jeju	3	87	3%
Total	747	3,248	23%

Source: KOTRA (2021) based on Invest Korea survey (2012)

If foreign-invested companies in a certain region are closely linked to the region's strategic industry, the company's innovation capabilities help the development of the regional strategic industry, and the industrial cluster. However, if, as seen on the table above, only 20 to 30% of foreign-invested companies investing in non-capital areas are related to regional strategic industries, it is difficult to expect a synergy effect between regional industrial policies and FDI policies.

1.8 Conclusion

1.8.1 Overall conclusion

This paper was conducted through analyzing and reviewing (1) status of imbalanced development between the capital and the non-capital area, (2) Korea's policy efforts for balanced regional development, (3) the status of attracting FDI to the non-capital area, and (4) the status of FDI inflow into Korea. By this paper, the author observes that, although FDI can ease the imbalanced regional development and has an important effect on the local economy, there is a lack of connection between Korea's regional economic policy and FDI policy. Also, the author was able to understand the current status of Korea as below.

First, this paper recognized that Korea's economic, social, and cultural concentration in the capital area and the resulting decrease in the regional population are getting worse.

Second, the Korean government has been promoting various balanced development policies for decades to solve the problem of imbalanced development between regions. In particular, the Korean government recognized the importance of corporate investment and good jobs in the region for balanced development, and provided policy incentives such as regional investment subsidies to promote the non-capital companies,

however investment inflows into the non-capital areas are still insufficient.

Third, most of the FDI flowing into Korea is concentrated in the capital area, and in particular, FDI, a service industry where high value-added new industries are concentrated, is concentrated in the capital area. This is worrisome in that it could continue to have a negative impact on the growth of the regional economy in the future.

Finally, there are relatively insufficient customized policies to attract FDI for the non-capital area. FDI may lessen the problem of lack of domestic capital investment and can be a channel for global companies' innovation capabilities and management know-how to spread to regional economies.

However, despite the poor investment environment in the non-capital area compared to the capital area, policy incentives for attracting FDI are almost the same throughout the country, and, due not enough incentives, foreign investors are less motivated to invest in the non-capital area.

In addition, due to the lack of linkage between FDI policies and regional strategic industries development plans, it is difficult for foreign-invested companies to incorporate into the regional industrial ecosystem, and opportunities for endogenous growth of the regional economy through FDI are not fully utilized.

1.8.2 Policy suggestions

In order to expand the attraction of FDI to the non-capital areas in the future, it is important to link the central government's FDI attraction policy with regional policies, and strengthen the role of local governments.

The role of the central government

First, in order to support the establishment of regional-specific FDI attraction strategies, the central

government needs to strengthen the linkage between regional development policies and FDI attraction policies.

The central government, by boosting FDI attraction to the regional strategic industry, should strengthen ties between the FDI attraction policy and the regional industrial policy. On October 14, 2021, the Korean government announced the establishment of an inter-regional cooperation plan.

According to the plan, the non-capital area can decide to build a regional area group with a concept of megacity beyond the cities and provincial boundaries, and foster new industries in the megacity units.

This plan was established based on the lessons of previous regional development policies that fostering new industry ecosystems at the provincial level have failed to create a critical mass. When local governments in the megacities cooperate to discover new strategic industries, it is necessary to attract FDI to the region according to new industries by megacity boundaries.

To this end, it is important to establish an organic cooperation system between the regional economy policy authorities and FDI attraction authorities, not to mention establish a plan to attract FDI in the future from the stage of selecting new industries to nurture.

Second, the central government should improve current FDI incentive system so that the incentives can be flexibly adjusted to meet regional conditions. Innovative incentives for non-capital area are urgently needed so that foreign investors can decide to invest in non-capital areas, where lack human resources, capital, and industrial ecosystems compared to the capital areas. However, if the incentives exclusively for foreign investors do not meet the global standard for prohibiting discrimination between domestic and foreigners, related authorities should also consider renovating the incentives for non-capital investments.

Third, it is necessary to establish a strategic FDI attraction policy in connection with regional special economic zones such as industrial complexes and free economic zones that play a central role in the regional economy. Through the policy, FDI in the new megacity region industries can be organically linked to the regional industrial ecosystem, and foreign-invested companies' innovation capabilities and management know-how need to create synergy effect in the regional economy.

The role of the local government

In addition, authority and responsibility, such as central-led regional policy and FDI attraction policy, should be boldly transferred to local governments, which are parties to the regional economy.

First of all, as most of the authority to select and support regional strategic industries is concentrated in the central government, it is necessary to improve the current situation in which it is difficult for the local government to take the lead in regional economic development. In addition, in order to attract regional FDI effectively, local governments need to establish an FDI attraction strategy considering regional industrial characteristics, and to prepare a customized incentive system.

To strengthening the authority of local governments to revitalize regional investment and increasing responsibility, it is necessary to consider revising the Foreign Investment Promotion Act and the Restriction of Special Taxation Act. In particular, this paper proposes to defining support measures for the non-capital regional investment in the Foreign Investment Promotion Act more elaborately, which is currently defined as the degree of declarative meaning.

In addition, local governments should establish vision and strategy for strengthening regional competitiveness by building strong regional industrial ecosystems and then put efforts to improve the FDI attraction system and implement the vision and the strategy step by step. It is desirable to consider building local government-led regional innovation networks. Also, policies for regional economic revitalization should be established and coordinated so that various policy measures to revitalize the local economy; such as fostering local talent, fostering regional industries, strengthening regional innovation capabilities, and investing in the non-capital areas.

1.8.3 Limitation and suggestion for further study

This study has the following limitations. First, due to the difficulty of acquiring relevant data, this study was not able to work on differences in FDI attraction strategies by local governments. Hence, this paper suggests, for further studies, a follow-up study on the central-local government cooperation on FDI attraction. Second, this study did not cover of role and performance of the investment promotion agency (IPA) in Korea. Thus, it is also worth to review the role of the investment promotion agency (IPA) in Korea that supports attracting regional FDIs up to date, and propose policy suggestions for the direction of local government-led future IPA governance reform.

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Chapter 2. Human capital, as a determinant of FDI

- Comparison among regions and industries in Korea -

2.1 Introduction

The purpose of this study is to understand how human capital, as a determinant of inward FDI, affects differently capital area and non-capital area in Korea.

Over the past decades, numerous scholars have conducted extensive research on the determinants of FDI inflow targeting various factors in various fields of economy, and society. Among them, the determinants commonly considered important in many studies are market size, openness, infrastructure environment, wages, human capital, investment profit, exchange rate, political risk, government's FDI attraction policy, and firm integration.

In particular, with regard to human capital, a number of previous studies, including Dellis, Sondermann, and Vansteenkiste (2017), have a common perception that the importance of human resources plays an important role in the inflow of FDI. In addition, it was studied that the inflow of FDI into developed countries for market-seeing was linked to the competitive human resources of host country. .(Antonakakis and Tondl 2012)

However, not all of these determinants are always meaningful regardless of time and place, and the importance between determinants can also change depending on the situation.

Previous studies related to FDI determinants have mainly shown two patterns. First, many researchers studied the determinants of FDI inflow, focusing on developing countries. This is not a surprising fact, given that the influx of FDI has been concentrated in Asian and other developing countries before and after China's accession

to the WTO. However, as a result, the analysis of the determinants of FDI in developed countries is somewhat insufficient compared to developing countries. As the situation of developed and developing countries are different, it may be difficult to apply the same determinants for developing countries in developed countries, so research on the determinants of FDI inflow from developed countries need more attention

Second, an absolute number of previous researches studied the determinants of FDI inflow at the country level through cross country analysis. Of course, it is important to analyze the determinants of country level through comparative analysis between countries, and considering the ease of securing data, it can be understood that cross-country analysis accounts for the majority of previous studies. However, considering that not all regions in the investment target country have the same conditions, investors will determine the investment target region according to regional differences and types of investment target industries within a country.

The inflow of FDI into Korea is clearly changing in amount, target region, and target industry along with Korea's economic growth. Most of the FDI that flowed into Korea after the Korean War was centered on efficiency-seeking, such as Korea's low wages and manufacturing side using abundant labor. But in the 2000s, as the proportion of horizontal FDI for market-seeking increases, such as the service industry, it was observed that the trend of FDI inflow is more focusing on high quality human capital and local market size and potential.

Externally, Korea began to strengthen cooperation with advanced economies through joining the OECD in 1996, and is recognized as an advanced country in the international community through changes in national status to UNCTAD group 1 in 2021. However, as the overall economic and social capabilities are concentrated in the capital area, polarization between the Capital area and the non-capital area is serious, and the gaps in economic development among regions are also widening as time goes by. Therefore, it is meaningful to observe

the different effect of the determinants of the inward FDI among regions in Korea.

This study used data from 228 cities, counties, and districts in Korea to classify them into capital, and non-capital area groups. Compare to 17 provincial regions, these 228 regions contribute to this study in terms of moderate sample size for better estimation result. This study would like to empirically show that human capital acts as an important determinant for the inflow of FDI into developed countries. Thus, this study empirically analyzes how the determinant of the inflow of human resources affects each regional group and different industries in Korea.

As a proxy for human resources, the proportion of the population with educational background above junior college graduation in 2010 and 2015 was used. As an analysis method, a GLS regression using pooled cross-sectional regression and a fixed effect method using two years of panel data were attempted.

As a result of GLS regression using cross sectional data, we observed human capital is a statistically significant determinant of FDI inflow at the 1 percent level in all regional groups and industry groups. Along with human capital, per capita GRDP and trade openness also shows statistically significant positive effect to inward FDI in Korean regions and industries.

Specifically, in all industries in Korea, when human capital increased by 1%p, FDI increased by 4.74%, which is a statistically significant result at the 1% level. In manufacturing industry when human capital increased by 1%p, FDI increased by 3.55%, which is a statistically significant result at the 1% level. In service industry, when human capital increased by 1%p, FDI increased by 5.42%, which is a statistically significant result at the 1% level. Even though simple comparison among different estimations is not intuitive, effect of human capital is bigger in the service industry than manufacturing industry.

For panel data, this study adopted the fixed effect and random effect method. As a result of Hausman's test, FE was adopted in all occasions. Unlike the result of GLS analysis-where human capital had significant results in all analyses, the fixed effect analysis results were more conservative. In a nationwide analysis, human capital showed a valid positive effect on the inflow of manufacturing FDI, but not in the case of the service industry.

When looking at regional analysis, human capital was significant in the inflow of FDI throughout the capital area, and human capital showed a very strong positive correlation, especially in the inflow of FDI into the service industry. This finding is consistent with Blomström and Kokko (2003) that human capital development is more important than the manufacturing industry in the service industry FDI. On the other hand, there was no significance in the manufacturing industry. This finding is consistent with the findings from Jones and Wren (2016) that service industry FDI has different location choice process from manufacturing industry.

From the estimation, we observe that the effect of human capital on FDI inflow was generally significant in the capital area, but not in the non-capital area. In particular, this study witnessed that human capital showed a very significant positive relationship with the inflow of FDI into the service industry in the capital area. In service industry of capital areas, when human capital increased by 1%p, FDI increased by 4.26% by fixed effect model, which is a statistically significant result at the 1% level.

Through this empirical study, we may speculate that the FDI flowing into the capital area is likely to be a high value-added FDI that requires high-quality human capital, while the FDI flowing into the non-capital area are not. In other words, it may be inferred that Korea has different growth stages among regions, and accordingly, there is a difference in the effects of the determinants of FDI inflow; In order to alleviate the concentration phenomenon in the capital area and balanced development of non-capital area, it is necessary to establish customized FDI attraction strategies in consideration of regional characteristics.

2.2 Literature Review

2.2.1 Determinant of inward FDI

The inward FDI is determined by a variety of factors, from objective indicators such as host country's degree of economic development and infrastructure to host country's political situation and institution.

Choi (2015), Asongu, Akpan, and Isihak (2018) synthesized previous studies and cited market size, trade openness, infrastructure, factor cost, R&D expenditure, educational background level, transportation cost, and national risk as major determinants for inward FDI.

Considering that most of the preceding studies were cross-county comparative studies, factors such as trade openness and national risk are generally not expected to have a significant impact in regional analysis within a country. However, those determinant mentioned above are used even in within-county regional level analysis (Cheung and Lin 2004).

Table 2.1. List of FDI determinants and relationship to inward FDI

Determinant	Proxy for	Relationship to FDI
Market Size	Economic development stage of host country	(+)
Trade Openness	Dependence on Int'l Economy	(+) on vertical FDI (-) on horizontal FDI
Infrastructure	Major infrastructure for economic activities	(+)
Factor Cost	Production cost including labor cost	(+) on vertical FDI Mixed on horizontal FDI
R&D Expenditure	Science & technology ability of host country	(+)
School Enrollment Year	Quality of human capital in host country	(+)
Transportation Cost	Distance between home country and host country	(-) on vertical FDI (+) on horizontal FDI
Country Risk	Political institution and social stability of host country	(-)

* source: Choi (2015) re-citation.

2.2.2 Difference between developed / developing economies

Antonakakis and Tondl (2012) argued that market size and potential are important determinants of the inflow of FDI to developed countries. Saini and Singhania (2018), by analyzing 20 developed and developing countries, also argued that even though GDP is an important factor in attracting FDI in developed countries, trade openness and capital formation are also important determinants for inward FDI to developed countries.

According to UNCTAD statistics, as of 2018, the world's FDI balance to GDP was 38%, and 42% in developed countries. However, during the same period, Korea's FDI balance to GDP was 14.3%, which is considered difficult to consider inward FDI as a key element of Korea's economic development. Rather, it is thought that the expansion of the Korean economy through a wide global FTA network is acting as a positive factor in attracting FDI to Korea.

2.2.3 Human capital as a vital determinant

A number of previous studies on the determinants of inward FDI have a common perception that the importance of human capital plays an important role in inward FDI attraction.

Blomström and Kokko (2003) analyzed the relationship between MNC and host countries invested in East Asia and Latin America, and argued that the inward FDI varies depending on the quality of human capital in host country. They also argued that a host country with high level of human capital can further upgrade her human capital by attracting large amounts of FDI from technology-intensive MNCs; whereas countries with low levels of human capital are likely to receive "low quality" FDI that does not significantly affect the national economy and technological innovation.

Noorbakhsh and Paloni (2001) empirically analyzed 36 developing countries in Africa, Asia, and South America from 1980 to 1994 using (1) high school admission rate, (2) years of high school enrollment and (3) secondary and tertiary education of working age population as proxy of human capital. As a result of the study, it was analyzed that human capital was a significant determinant of the inward FDI; also, human capital was the most important among determinants, and became more important over time.

In particular, regarding the inflow of FDI into developed countries, Antonakis and Tondl (2012) analyzed the investment determinants of OECD countries using labor productivity as a proxy for human capital, and argued that the market-seeking FDI outflow of OECD countries is linked to the existence of competitive human capitals in host countries.

2.2.4 Regional determinants within an economy

As discussed in Table 2.1, factors that determine FDI between countries include trade costs such as tariffs and distance from home countries, and differences in market size and factor nonexistence of home and host countries. However, the location selection of foreign-invested companies within one investment destination country will be mainly determined by the factors of regional level rather than these factors at the national level. (J. Kim 2015)

Most of the existing studies between FDI and economic growth have been conducted as empirical studies at country level. This is thought to be due to the difficulty of securing regional statistics for regional comparative analysis within-country, although cross-country analysis also has significant meaning.

Nevertheless, there are several studies focusing on determinants of inward FDI at regional level. Coughlin, Terza, and Arromdee (1991) argued that per capita income and manufacturing density have a positive impact on FDI in the U.S. Casi and Resmini (2014), by using a result of cross-sectional spatial lag model from 2005~2007

European regional data, found that infrastructure, market accessibility, labor force quality, governance, and agglomeration exert a positive impact on attracting FDI. In case of the U.K., Jones and Wren (2016) found out that service industries have different patterns of location determination process from manufacturing industries; they also empathized that agglomeration effect is important factor for service FDI placement as a region with agglomeration economies are to do with the larger consumer markets of these areas, or the availability of higher skilled human capital.

Many empirical studies at the regional level of within country are often focusing on China, where it is relatively easy to secure statistical data at the regional level.

Most of the preceding studies that empirically analyzed China, such as Zhang and Felmingham (2002), Xu et al. (2019), were analyzed by dividing the region of China into the eastern coastal region, the central region, and the western region. Most of the research results have shown that China's FDI attraction was centered on the eastern coastal region. In addition, Fujita and Hu (2001) attempted an empirical analysis of SEZs in China, Hong (2014) at prefecture-level cities in China, and Wang (2013) at SEZs in China.

Most of these empirical studies on China's region derived the results that FDI contributed to China's economic growth. However, some say that these results are focused only on the role of FDI in economic growth due to the rapid growth of the Chinese economy after China's reform and opening up. Berthélemy and Démurger (2000) criticized that since China advocated reform and opening up in 1979, many studies on China have mainly focused on the impact of FDI on economic growth as those studies regarded inward FDI as one of the important drivers of national economic growth.

Qin et al. (2006) questioned the validity of investment-driven growth development strategy in China. Their empirical investigation of post-1990 data analyses and macro-econometric model simulations show that market

demand has become a regular force in driving investment since reforms.

In addition, it can be concluded that the inward FDI has a positive effect on the local economy on the premise that foreign-invested companies have a better level of technology than local companies, but relatively few studies show that the inward FDI into developed countries helps the country's economic growth.

2.2.5 Determinants of FDI inflows to Korea

Country level

Prior to the 1997 Asian financial crisis, Korea took a passive stance in attracting FDI, and most of the introduced FDI appears to be international aids or manufacturing sector FDI for efficiency-seeking vertical FDI. Therefore, most studies on the determinants of FDI flowing into Korea began to be analyzed after the financial crisis. Choi and Lee (2004), Ko (2006), Yeo and Lee (2009), Kim and Kang (2012).

S.R. Lee (2015) analyzed the determinants by dividing foreign investments in Korea into 50 industries from 1995 to 2013 into greenfield type FDI and M&A type FDI using statistical data of inward FDI by industry provided by the Ministry of Trade, Industry and Energy. For the empirical analysis, sales, labor costs, R&D investment, industrial concentration, as well as the number of labor disputes were used. As a result, Lee argued that green field-type FDI increases as industries that can utilize high-skilled workers or include large companies with high market share or industries with favorable investment environments or lower FDI barriers.

Jeon and Rhee (2008) examined the link between Korea's FDI inflows from the U.S. using firm-level data of FDI transactions from 1980 to 2001. Korea's FDI inflows from the U.S. are found to have significant associations with real exchange rates, relative wealth, relative wage costs, expected exchange rate changes, and interest rate differentials.

Region level

There are not many studies that empirically analyzed inward FDI from a regional perspective in Korea. Yoon (2012) argued that the larger the market size of local governments seeking to attract FDI through empirical analysis of metropolitan cities in Korea, the more positive they are in attracting investment from foreign-invested companies. Yi and Choi (2001) emphasized the establishment of a strategy to attract FDI in consideration of regional characteristics by analyzing the comparative advantage of attracting FDI in Busan, Korea.

Ahn and Kim (2009) conducted an empirical study on the impact of local governments' foreign direct investment policies on corporate performance, focusing on the Jinsa industrial complex in Gyeongsangnam-do. As a result of the study, it was found that local governments' related policies had a major influence on attracting FDI, and the impact of government policies between the manufacturing and service industries also showed significant differences within the same industrial complex.

Because it was difficult to obtain a sufficient number of samples necessary for empirical analysis, province-level areas or specific local governments, not city-county-district level, empirical studies were mainly conducted previously. As a result, there was a limit to grasping the effect of differences among regions and industries on attracting FDI.

2.3 Model and data

The purpose of this empirical study is to determine whether human capital has a significant effect on attracting FDI in the region, and by industry in the region. In particular, this study aims to support shaping better FDI attraction policies by reflecting regional heterogeneity. For this purpose, this study breaks 16 provinces of Korea into 2 groups; they are capital area and non-capital area for comparison purposes.

2.3.1 Model

To identify the effect of human capital to inward FDI attraction by region, this study attempts, GLS regression model by using pooled cross-sectional data, and fixed effect model by using panel data. All independent variables were given a 1-year time lag.

Model 1: GLS (Generalized Least Square) Regression

It is estimated that there will be heteroscedasticity among panel entities composed of regional inward FDI performance. The existence of heteroscedasticity between panel entities means that a certain relationship between sectors not explained in the model and explanatory variables can be established. Therefore, a problem with the missing variable may occur, and in this case, the simple OLS estimator cannot be a consistency. Therefore, this study uses the generalized least squares (GLS) by assuming heteroscedasticity between panel objects.

This empirical analysis is based on the following regression equation (Eq1~Eq3).

$$\log(FDI)_{it} = \alpha + \beta HK_{it-1} + \gamma \log(CV)_{it-1} + \delta d_{t-1} + \varepsilon_{it-1} \text{ (Eq1)}$$

$$\log(FDI)_{it}^{Manu} = \alpha + \beta HK_{it-1} + \gamma \log(CV)_{it-1} + \delta d_{t-1} + \varepsilon_{it-1} \text{ (Eq2)}$$

$$\log(FDI)_{it}^{Svc} = \alpha + \beta HK_{it-1} + \gamma \log(CV)_{it-1} + \delta d_{t-1} + \varepsilon_{it-1} \text{ (Eq3)}$$

Where the dependent variable (FDI) is aggregated FDI inflows in logarithm form; α is constant; HK is a measure of human capital; CV is a vector of control variables, i.e., a set of FDI determinants other than the human capital variable; *d* is time dummy for year 2011 and 2016 and epsilon is error term. Each equation will be estimated separately by region groups (all area, capital area, non-capital area).

Model 2: panel data fixed effect[3]

In the analysis of determinants of FDI by region, panel analysis is based on the premise that there is no relationship between explanatory variables and panel entities' characteristics.

Under panel data, the results are analyzed by simultaneously estimating the fixed effect model and the random effect model. This empirical analysis is based on the following regression equation (Eq4~Eq6).

$$\log(FDI)_{it} = \beta_0 + \beta_1 HK_{it-1} + \beta \log(CV)_{it-1} + \alpha_i + u_{it-1} \quad \text{(Eq4)}$$

$$\log(FDI)_{it}^{Manu} = \beta_0 + \beta_1 HK_{it-1} + \beta \log(CV)_{it-1} + \alpha_i + u_{it-1} \quad \text{(Eq5)}$$

$$\log(FDI)_{it}^{Svc} = \beta_0 + \beta_1 HK_{it-1} + \beta \log(CV)_{it-1} + \alpha_i + u_{it-1} \quad \text{(Eq6)}$$

Where dependent variable (FDI) is aggregated FDI inflows in logarithm form; HK is a measure of human capital; CV is a vector of control variables, i.e., a set of FDI determinants except the human capital variable; α_i represents all unit-specific, time-constant factors; finally, u_{it-1} represents an unobserved factor that changes over time (time-varying factor). Each equation will be estimated separately by region groups (all area, the capital area, the non-capital area).

2.3.2 Data and Variables

In this study, pooled cross-sectional data and panel data were constructed using data from two years in 2011 and 2016.

[3] After analyzing the model with a fixed-effect model and a random-effect model using panel data, the Hausman test rejected the null hypothesis that independent variables and regional characteristics were mutually independent at the 1% significance level, indicating that it was appropriate to analyze the fixed-effect model.

Unit of administrative district subject to statistical analysis

This study used statistical data from city-county-district units for empirical analysis of the determinants of FDI inflow in each region.

According to the Ministry of Public Administration and Security (2021), Korea's administrative districts currently consist of 17 metropolitan cities and provinces, 226 cities and counties, and 3501 towns and villages.

Until now, there have been several reorganizations of small administrative districts such as integration and division of cities, counties, and districts, including the launch of integrated Changwon City, which combines Masan, Changwon, and Jinhae, but most administrative districts have not changed much over the decades. This study organized panel data for 228 cities, counties, and districts according to the administrative district organization around 2010. (See Table A 2.3)

Most of the preceding studies related to attracting FDI by Korean regions, such as K.-D. Lee and G. J. Hwang (2010) conducted empirical analysis using panel data at 17 provinces due to difficulties in data collection, and Kwak (2013) conducted qualitative research in specific regions such as Gumi city.

In addition, Kang (2019), Hwang and Kang (2020) conducted empirical studies on special economic zones such as free economic zones and Jeju International Free Cities in a limited range. As far as the researcher knows, this study is meaningful as the first attempt to empirically analyze the effect of human capital on attracting inward FDI using panel data at the city, county, and district levels across the country. Through empirical analysis at the city, county, and district levels, this study was able to identify differences in inward FDI attraction effects between the capital area, non-capital area, and local metropolitan areas and small and medium-sized cities with the effective sample size required for empirical analysis.

Period of the data

Due to the problem of securing some key city-county-district data, the dependent variable was constructed using data for 2011 and 2016, and the independent variable for two years in 2010 and 2015. In particular, the human capital variable, a key independent variable of this study, is the proportion (%) of the highly educated population with college graduates or higher in cities, counties, and districts, and data collected by (S.-H. Lee 2019) were reprocessed based on the 2010 and 2015 census sample data released every five years.

2.3.2.2 Variables

Dependent Variable: FDI

In this study, inward FDI stock of city-county-district based on the arrival amount was used as a dependent variable, and the source of statistical data is the Ministry of Trade, Industry and Energy. The inward FDI stock of each city, county, and district began to calculate from year 2000. Around year 2000, inward FDI attraction began to get attention as Korean government valued the importance of inward FDI. The inward FDI stock value was processed in natural logarithm form.

Unlike variables such as GDP and population that closely correlate previous year's performance with that of the year, inward FDI attraction performance is fluctuating every year. Therefore, in order to identify and analyze FDI trends over a certain period of time, it is considered reasonable to use stock-based statistics as in Pegkas (2015)'s study rather than flow-based statistics.[4]

In the case of Korea, when FDI attraction statistics are published, the amount of reported tends to be

[4] By definition, FDI flows are transactions recorded during the reference period (typically year or quarter), whereas FDI stocks are the accumulated value held at the end of the reference period (typically year or quarter). (OECD n.d.)

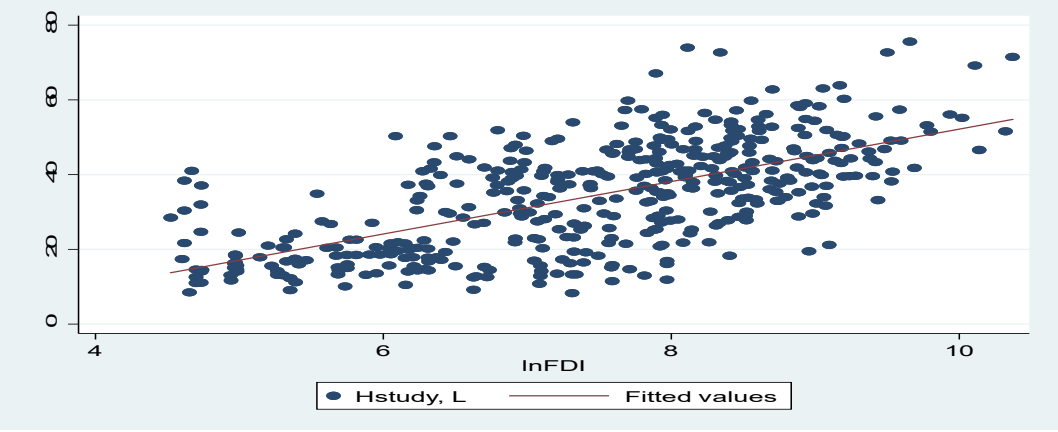
prioritized. Although policy authorities announce both report-based and arrival-based performance when releasing various FDI statistics, it is thought that policy authorities mainly refer to the reported amount because the reported amount performance is generally bigger than the arrival amount. However, since what really affects the real economy is the performance of FDI arrived. Thus, all FDI-related variables used in this study are arrival-based FDI values.

Independent variable (1): Human capital (the proportion of highly educated people of a city-county-district level)

The proportion of highly educated people is the key independent variable of this study, which represents the ratio of those with vocational college graduates or higher to the total population of cities, counties, and districts.

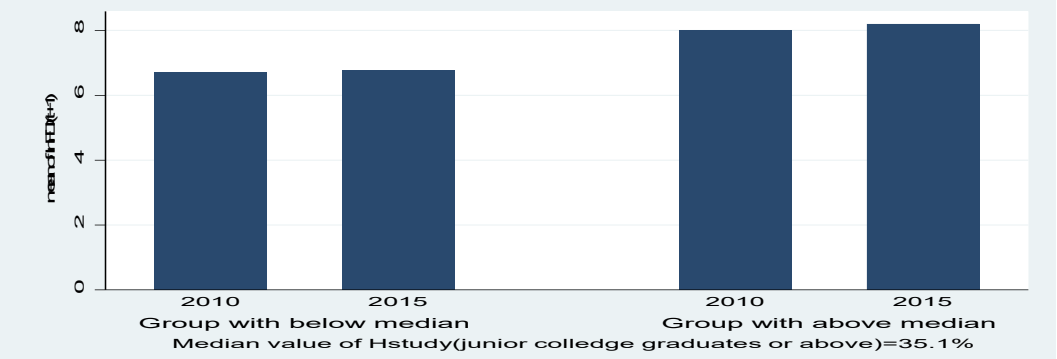
Lee (2019) created a regional job quality index to analyze employment trends in cities, counties, and districts in Korea, and the analysis estimated the ratio of highly educated people (junior university or higher) at the city, county, and district level in 2010 and 2015. In this study, the proportion of highly educated people was partially modified to reflect regional administrative district reorganization, and then used for empirical analysis.

Figure 2.1. Scatterplot of Bilateral Relationship between Human Capital and Inward FDI



Source: author

Figure 2.2. Group comparison by median value of Hstudy variable



Source: Author

Figure 2.2 shows comparison between groups by median value of Hstudy variable (percentage of highly educated residents in city-county-district level regions) in year 2010 and year 2015; one can observe the performance of low Hstudy group is inferior to high Hstudy group; also, year 2015 has better performance than year 2010 in both groups.

Control variables included regional economic growth and openness to the local economy. Key independent variable is a human resource, but it was considered that regional economic growth and trade openness are important determinants in previous studies.

Independent variable (2): Economic Growth

Gross Regional Domestic Product (GRDP) is one of the main control variables in this study. As previously analyzed in the literature review section, host country's market size and market potential act as important determinants in the inflow of FDI into developed countries, and GDP was used as a proxy for market size in most cross-country analysis.

Hong (2014) empirically analyzed the relationship between FDI and regional GDP using panel data from 254 China's pre-level cities from 1994 to 2010.

Accordingly, in this study, regional GDP, or Gross Regional Domestic Product (GRDP), was used as a proxy for economic growth in empirical analysis of regions in Korea. This study used annual GRDP data published by the National Statistical Office.[5]

Independent variable (3): Trade Openness

The trade openness degree is expressed as the log-processed value of each region's international trade ratio to GRDP. In most cross-border comparative studies, trade openness has been included as an important indicator. In this study, we will investigate whether trade openness also affects comparison at regional level.

Independent variable (4): Other Control Variables

As capital area holds a dominant position in Korean economy, this paper adds a variable which is a distance between Seoul metropolitan city and city-county-district level regions. The degree of integration of existing firms in the region can also affect the decision to attract FDI. In this study, the number of firms per 1,000 people was converted into log values and used as a proxy for the existing corporate integration. In addition to firm integration, this study also added a control variable for living condition; that is a number of hospital beds per 1,000 people.

[5] The Korea National Statistical Office provides GRDP statistics obtained from city, county, district governments, but data from all local governments at the city, county, and district levels were available from 2009.

Table 2.2. List of Variables

Variable name	Proxy for	Detail	Source
lnFDI (Dep. Var.)	FDI inflows	FDI stock since 2000 in arrival based (Logarithm form)	MOTIE
lnManu (Dep. Var.)	Manufacturing FDI inflows	Manufacturing FDI stock since 2000 in arrival based (Logarithm form)	MOTIE
lnSvc (Dep. Var.)	Service FDI inflows	Service FDI stock since 2000 in arrival based (Logarithm form)	MOTIE
Hstudy (Indep. Var.)	Human Capital	Percentage of residents over junior college degree in city-county-district level regions	Lee(2019), modified
lnperGRDP (Indep. Var.)	Market size	Per capita GRDP (Logarithm form)	KOSIS
Open (Indep. Var.)	Trade openness	Export+Import/GRDP (Percentage)	KITA, KOSIS
lnDistance (Indep. Var.)	Distance from Seoul	Distance between Seoul and a city-county-district level region	www.hanbat.ac.kr
lnFirm (Control Var.)	Agglomeration effect	Number of firms per 1,000 people (Logarithm form)	KOSIS
lnHospital (Indep. Var.)	Living condition	Number of hospital beds per 1,000 people (Logarithm form)	KOSIS

Source: Author

2.4 **Empirical Findings**

2.4.1 **Descriptive Statistics and Correlations**

Table 2.3. Descriptive statistics for pooled cross-sectional data

Variable	Obs	Mean	Std. Dev.	Min	Max
lnFDI: overall FDI	437	7.391	1.371	0.301	10.328
lnManu: Manufacturing FDI	380	7.096	1.325	4.430	9.680
lnSvc: Service FDI	381	6.917	1.358	0.301	10.270
Hstudy: Human Capital	458	33.81	14.394	8.3	75.6
lnperGRDP: Per capita GRDP	457	1.395	0.253	0.790	2.580
Open: Trade Openness	457	0.564	1.177	0.002	12.283
lnDistance: Distance from Seoul	458	4.675	1.852	0	6.398
lnfirms: Firm agglomeration	446	1.866	0.127	1.602	2.721
lnhospital: No. hospital beds	457	1.022	0.339	-1.250	1.8155

Table 2.4. Descriptive statistics for panel data

VARIABLE	MEAN	STD.DEV.	MIN	MAX	OBS
LOG OVERALL FDI					
OVERALL	7.391	1.371	0.301	10.328	N=437
BETWEEN		1.393	0.301	10.203	n=221
WITHIN		0.247	6.178	8.605	T-bar=1.977
LOG MANU. FDI					
OVERALL	7.096	1.325	4.430	9.680	N=380
BETWEEN		1.319	4.430	9.528	n=194
WITHIN		0.220	6.135	8.057	T-bar=1.958
LOG SVC FDI					
OVERALL	6.917	1.358	0.303	10.270	N=381
BETWEEN		1.385	0.303	10.157	n=197
WITHIN		0.266	5.580	8.803	T-bar= 1.934
L.HUMAN CAPITAL					
OVERALL	33.810	14.394	8.300	75.600	N=458
BETWEEN		14.254	10.700	74.150	n=229
WITHIN		2.114	27.610	40.010	T-bar=2
L.LOG PER GRDP					
OVERALL	1.386	0.253	0.790	2.580	N=457
BETWEEN		0.247	0.833	2.551	n=229
WITHIN		0.055	1.267	1.505	T-bar=1.995
L.OPENNESS					
OVERALL	0.564	1.177	0.002	12.283	N=457
BETWEEN		1.155	0.003	10.625	n=229
WITHIN		0.226	-1.163	2.293	T-bar=1.995
L.LOG FIRMS					
OVERALL	1.866	0.127	1.600	2.721	N=446
BETWEEN		0.123	1.622	2.680	n=223
WITHIN		0.033	1.778	1.954	T-bar=2
L.LOG HOSPITAL					
OVERALL	1.012	0.339	-1.250	1.815	N=457
BETWEEN		0.328	-0.664	1.814	n=229
WITHIN		0.086	0.381	1.642	T-bar=1.995

Source: author

Table 2.5. Matrix of correlations

Variables	(1) Overall FDI	(2) Manu FDI	(3) SVC FDI	(4) Human Capital	(5) Per GRDP	(6) Trade Openness	(7) Firm Agglo	(8) No. Hospital	(9) Dist-ance
(1) Overall FDI	1.000								
(2) Manufacturing FDI	0.737	1.000							
(3) Service FDI	0.763	0.531	1.000						
(4) Human Capital(-1yr)	**0.558**	**0.341**	**0.693**	**1.000**					
(5) per capita GRDP(-1yr)	0.389	0.421	0.221	-0.031	1.000				
(6) Trade Openness(-1yr)	0.173	0.273	0.091	0.039	0.159	1.000			
(7) Firm Agglomeration(-1yr)	0.086	-0.002	0.144	-0.070	0.546	-0.012	1.000		
(8) No. of Hospital beds(-1yr)	-0.104	-0.167	-0.184	-0.194	0.062	-0.004	0.295	1.000	
(9) Distance from Seoul	-0.355	-0.187	-0.515	-0.499	0.097	0.089	0.049	0.352	1.000

Source: author

2.4.2 **Effect of highly educated human capital on inward FDI determination**

Metropolitan-level analysis by Industry

Table 2.6 shows the GLS results of country-level analysis from pooled cross sectional data estimation, as well as fixed effect and random effect results from panel data estimation. Also, results from panel data of both manufacturing industry and service industry are displayed. This study attempted three different estimations by industry group: all industry, manufacturing industry and service industry.

As shown in the table, the effects of human capital on inward FDI are statistically significant and positive in all the cases in GLS regression results. 1%p increase in human capital proxy can lead to 4.74% increase in the inward FDI of all industries, 1%p increase in human capital proxy can lead to 3.55% increase in the inward FDI of manufacturing industry, and 1%p increase in human capital proxy can lead to 5.42% increase in the inward FDI of service industry.

As for panel data, the effect of human capital by fixed effect estimation is statistically significant at 10% level for manufacturing industry; 1%p increase in human capital leads to 1.68% increase in inward FDI on manufacturing industry. However, the effect was insignificant for service industry inward FDI, though its magnitude is positive. As for random effects, the effect of human capital for all three types of industry categories. Though results from random effects are statistically significant and positive in all the cases, the Hausman test results suggest that the null hypothesis that the random effect is correct specification cannot be rejected at the 1% level. Thus, this study used fixed effect results for interpretation.

Combining results from GLS and fixed effect estimation, it can be inferred that there may be unobservable factors that effect through time; after eliminating time effect, the effect of human capital to inward FDI at country level was not as strong as GLS estimation.

As for other determinants, trade openness does not show any significant impact on inward FDI. This is not consistent with previous studies using cross-country data. Unlike cross-country comparative analysis, it can be inferred that there is no clear difference in trade openness condition among regions within a country, or that trade openness may not be important in selecting the location of foreign-invested companies within Korea.

Interestingly, as for a distance variable, the closer it is to Seoul, the better the inward FDI attraction performance; 1% increase in distance variable leads to 0.1% decrease in FDI performance. This trend it shown more clearly in service industry; 1% increase in distance variable leads to 0.17% decrease in FDI performance, whereas 0.03% decrease in manufacturing industry.

Capital area Analysis

This section shows estimation results from capital area; they are Seoul Metropolitan city, Incheon Metropolitan city and Gyeonggi province. Like country-level analysis, the GLS regression results show statistically significant positive effects in all industries in the metropolitan area. From Table 2.7, when human capital increases by 1%p, the inward FDI increase effect in the capital area increased 4.4% in the entire industry, 3.15% in the manufacturing industry, and 4.06% in the service industry.

In the case of panel data analysis, unlike the fact that there was no significant effect in the country-level analysis, human capital shows a statistically significant positive effect on the inflow of FDI in the entire industry at 1% level. When human capital increased by 1%p, the FDI inflow increased by 3.03% based on the fixed effect result and 3.83% based on random effect.

In the case of the service industry in the capital area, when the human capital increased by 1%p, the FDI inflow increased by 4.26% based on the fixed effect result and 4.8% based on the random effect. On the other hand, in the case of the manufacturing industry in the capital area, although magnitude has a positive value, it is not statistically significant.

This finding is consistent with Blomström and Kokko (2003) that human capital development is more important than the manufacturing industry in the service industry FDI. Through this, it can be inferred that the service industry FDI in the capital area prefers places where the highly educated population is concentrated. Considering that the service industry FDI in the capital area accounts for more than 80% of Korea's total inward FDI, human capital can be a valid investment determinant for the service industry FDI invested in Korea.

As per other variables, firm agglomeration plays a key determinant for inward FDI for both manufacture and service industries; their magnitudes are the biggest among all control variables.

Table 2.6. Estimation results for country-level analysis

	ALL AREAS								
	All Industry FDI			Manufacturing Industry FDI			Service Industry FDI		
	GLS	FE	RE	GLS	FE	RE	GLS	FE	RE
HUMAN CAPITAL	**0.0474*** **	**0.013**	**0.0358*** **	**0.0355*** **	**0.0168***	**0.0310*** **	**0.0542*** **	**0.010**	**0.0393*** **
(1 YR LAGGED)	(0.001)	(0.010)	(0.005)	(0.001)	(0.009)	(0.005)	(0.001)	(0.010)	(0.005)
PER CAPITA GRDP	1.8516***	0.8089*	1.3565***	2.3112***	0.591	1.5565***	0.8466***	0.9856**	0.7094***
(1 YR LAGGED)	(0.037)	(0.449)	(0.269)	(0.063)	(0.413)	(0.266)	(0.045)	(0.479)	(0.266)
TRADE OPENNESS	0.0942***	-0.002	0.0618	0.1844***	0.001	0.0795*	0.1144***	0.019	0.0997*
(1 YR LAGGED)	(0.014)	(0.063)	(0.045)	(0.017)	(0.058)	(0.043)	(0.012)	(0.077)	(0.053)
DISTANCE	-0.1044***	-	-0.1496***	-0.0306***	-	-0.0527	-0.1660***	-	-0.2257***
(1YR LAGGED)	(0.006)	-	(0.045)	(0.008)	-	(0.046)	(0.006)	-	(0.043)
FIRM AGGLOMERATION	-0.6843***	2.0657***	0.1000	-2.1973***	1.8886***	-0.3964	1.2130***	1.8609**	1.1499**
(1 YR LAGGED)	(0.057)	(0.779)	(0.507)	(0.160)	(0.720)	(0.503)	(0.049)	(0.810)	(0.511)
HOSPITAL BEDS	0.2751***	-0.032	0.1620	-0.3081***	-0.163	-0.1630	-0.0442	-0.130	-0.1082*
(1 YR LAGGED)	(0.035)	(0.204)	(0.151)	(0.079)	(0.225)	(0.173)	(0.048)	(0.207)	(0.153)
YEAR=2016	-0.0989***			0.0414			-0.1409***		
	(0.018)			(0.034)			(0.014)		
CONSTANT	4.7088***	2.0328*	4.5999***	7.0520***	2.3527**	4.9170***	2.3156***	1.8598*	3.3880***
(1 YR LAGGED)	(0.096)	(1.036)	(0.763)	(0.264)	(0.958)	(0.749)	(0.089)	(1.098)	(0.781)
N	427	427	427	373	373	373	373	373	373
R2		0.2699	0.4349		0.2718	0.3532		0.2385	0.5026
HAUSMAN TEST									
CHI2		20.61			26.82			15.78	
PROB > CHI2		0.0010			0.0001			0.0075	

Standard errors in parentheses / * p<0.10, ** p<0.05, *** p<0.01 / data source: MOTIE

Non-capital area analysis[6]

GLS estimation for non-capital area in Table 2.8 has similar trend with those of country-level and the capital area. However, the fixed effect estimation results of the non-capital areas show different trends; Human capital is not statistically significant across all industries in the area. Even in service industry, although not statistically significant, human capital has a negative estimator.

Instead, from the panel data regressions, firm agglomeration and per capita GRDP were the most important determinant for all industries in non-capital area. Thus, it can be inferred that human capital may affect differently in different spatial and industrial contexts. Also, it is also possible to infer that foreign investment into the non-capital area are less sensitive to local human capital environment as other factors such as low wage, less administrative restrictions and competitive land price, etc.

For distance variable, regardless of industry type, the close it is to Seoul, the poorer the FDI attraction performance is. Again, the result shows that foreign invested companies prefer to stay near the capital area.

[6] At the appendix section, this study provides additional estimation results from metropolitan cities in non-capital area; and county-city in non-capital area as well. The reason author puts those two results at the appendix is their results are similar to the whole non-capital area result, moreover, the sample size is smaller than the whole non-capital area.

Table 2.7. Estimation results for the capital area analysis

	CAPITAL AREAS								
	All Industry FDI			Manufacturing Industry FDI			Service Industry FDI		
	GLS	FE	RE	GLS	FE	RE	GLS	FE	RE
HUMAN CAPITAL	0.0440***	0.0303***	0.0356***	0.0315***	0.023	0.0346***	0.0406***	0.0426***	0.0393***
(1 YR LAGGED)	(0.004)	(0.010)	(0.007)	(0.005)	(0.016)	(0.009)	(0.003)	(0.010)	(0.006)
PER CAPITA GRDP	1.9223***	0.149	1.0958***	3.0489***	0.592	1.4078***	2.1510***	-0.341	0.9894***
(1 YR LAGGED)	(0.242)	(0.483)	(0.389)	(0.217)	(0.705)	(0.512)	(0.175)	(0.452)	(0.357)
TRADE OPENNESS	0.2798***	0.095	0.1547*	0.2404***	0.085	0.1456	0.1525***	0.014	0.1182
(1 YR LAGGED)	(0.054)	(0.097)	(0.084)	(0.084)	(0.165)	(0.121)	(0.037)	(0.091)	(0.078)
DISTANCE	-0.421**	-	-0.0536	0.1275***	-	-0.1571**	-0.2144***	-	-0.1649***
(1YR LAGGED)	(0.021)	-	(0.063)	(0.027)	-	(0.077)	(0.018)	-	(0.055)
FIRM AGGLOMERATION	-1.2231***	1.4982*	-0.0871	-1.7697**	2.3214*	-0.3542	-1.6107***	1.5593*	0.1228
(1 YR LAGGED)	(0.418)	(0.877)	(0.715)	(0.693)	(1.316)	(0.953)	(0.318)	(0.822)	(0.659)
HOSPITAL BEDS	0.3807**	0.070	0.1474	0.3198*	-0.270	0.0749	0.6564**	-0.032	0.0701
(1 YR LAGGED)	(0.158)	(0.280)	(0.232)	(0.183)	(0.421)	(0.307)	(0.130)	(0.263)	(0.212)
YEAR=2015	-0.1479***			-0.0062			-1.1129***		
	(0.036)			(0.048)			(0.035)		
CONSTANT	5.5949***	3.7708***	5.1766***	5.9438***	1.770	4.3337***	5.8995***	3.5140***	4.7010***
(1 YR LAGGED)	(0.561)	(1.150)	(0.976)	(1.008)	(1.709)	(1.301)	(0.441)	(1.077)	(0.904)
N	128	128	128	123	123	123	128	128	128
R2		0.5573	0.5943		0.4224	0.4360		0.6022	0.7101
HAUSMAN TEST									
CHI2		16.95			9.85			21.92	
PROB > CHI2		0.0046			0.0796			0.0005	

Standard errors in parentheses / * p<0.10, ** p<0.05, *** p<0.01 / data source: MOTIE

Table 2.8. Estimation results for the non-capital areas analysis

	NON-CAPITAL AREAS								
	All Industry FDI			Manufacturing Industry FDI			Service Industry FDI		
	GLS	FE	RE	GLS	FE	RE	GLS	FE	RE
HUMAN CAPITAL	0.0491***	0.005	0.0343***	0.0391***	0.009	0.0298***	0.0534***	-0.008	0.0379***
(1 YR LAGGED)	(0.002)	(0.014)	(0.006)	(0.002)	(0.012)	(0.007)	(0.001)	(0.015)	(0.007)
PER CAPITA GRDP	2.0938***	1.0623*	1.4020***	2.3994***	0.629	1.4825***	0.7639***	1.5451**	0.6414*
(1 YR LAGGED)	(0.081)	(0.599)	(0.346)	(0.109)	(0.521)	(0.327)	(0.126)	(0.675)	(0.357)
TRADE OPENNESS	0.0618***	-0.031	0.0537	0.8615***	-0.027	0.0776	0.0862**	-0.025	0.0939
(1 YR LAGGED)	(0.017)	(0.080)	(0.053)	(0.024)	(0.067)	(0.049)	(0.036)	(0.105)	(0.067)
DISTANCE	0.0022	-	0.0050	-0.123*	-	-0.3258	-0.0603	-	0.0479
(1YR LAGGED)	(0.056)	-	(0.223)	(0.064)	-	(0.230)	(0.039)	-	(0.235)
FIRM AGGLOMERATION	-0.2145***	2.1265**	0.4598	-1.7702***	1.7469**	-0.1485	2.0292***	1.831	1.7001**
(1 YR LAGGED)	(0.251)	(1.017)	(0.659)	(0.268)	(0.881)	(0.622)	(0.228)	(1.104)	(0.701)
HOSPITAL BEDS	0.2184***	-0.066	0.1466	-0.4571***	-0.113	-0.2096	-0.1097***	-0.178	-0.1643
(1 YR LAGGED)	(0.063)	(0.254)	(0.186)	(0.057)	(0.273)	(0.212)	(0.030)	(0.268)	(0.199)
YEAR=2015	-0.1476***			0.0131			-0.1743***		
	(0.042)			(0.042)			(0.033)		
CONSTANT	2.9032***	1.561	3.0018*	6.6789***	2.5642**	6.1026***	0.3517	1.325	0.9582
(1 YR LAGGED)	(0.607)	(1.361)	(1.564)	(0.626)	(1.186)	(1.558)	(0.562)	(1.523)	(1.707)
N	299	299	299	250	250	250	245	245	245
R2		0.2372	0.3002		0.2165	0.3067		0.2004	0.2870
HAUSMAN TEST									
CHI2		12.81			18.00			12.79	
PROB > CHI2		0.0252			0.0029			0.0254	

Standard errors in parentheses / * p<0.10, ** p<0.05, *** p<0.01 / data source: MOTIE

2.5 Conclusion

2.5.1 Overall conclusion

The results of this study show that there are spatial differences in inward FDI determination; also, there exists different pattern of FDI determination between industries. Under these findings, this study came to an end that, in general, human capital is one of the statistically significant determinants for inward FDI; but the effects differently across regions and industries in Korea.

From GLS estimation and Random effect estimation, human capital has statistically significant positive effect regardless of spatial and industry differences. In the country-level fixed effect results, the effect of human capital was not statistically significant, whereas a significant positive effect of human capital was found in capital area. Contrary to the result of capital area, this study did not find any significant effect of human capital for inward FDI in non-capital area; rather, market size and agglomeration economies are found to be significant determinants in non-capital area.

From the fixed effect results of spatial difference in manufacturing and service industries, this found that the impact of human capital in capital area is statistically significant positive on service industries' inward FDI, whereas the effect was unclear to manufacturing industries' inward FDI. This finding is consistent with the findings from Jones and Wren (2016) that service industry FDI has different location choice process from manufacturing industry. Considering that most of service industries FDI are concentrated in capital area, the patterns of service industries FDI in capital area may reflect general interest of service sector foreign investors to Korea.

2.5.2 Policy Implication

Up to now, the major pillar of industrial policy of Korea has been manufacturing industry; and the industry's rapid growth was regarded as a key to success of Korean economy. Thus, back in 20th century, majority of inward FDI to Korea was consistent of manufacture industry FDI. However, from the beginning of 21th century, the proportion of FDI in the service industry has a tendency to exceed that of the manufacturing industry, and the pattern of FDI inflow is also changing.

This study reckons that industrial structure of Korea is changing from cost-effective manufacturing industry to high-technology based industry where high-value service industry is flouring on the basis of manufacturing competitiveness of the past.

In this context, “servitization” of industries based on existing major manufacturing industries, which Korea had strengths in, will have an important impact on the development of the Korean economy in the future. Policy makers need to establish industrial policies and supportive measures that aligned with the concept of servitization. It is thought that it will be very important to establish a trade strategy that considers the servitization of not only Korea but also the global industry.

The FDI attraction department of the central and local governments should establish a customized FDI attraction strategy tailored to the local situation in consideration of the industrial characteristics of each region. To this end, so-called ‘top-down’ style FDI attraction policy from central government as of now, need to transform more like ‘bottom-up’ style policy established by each region.

In addition, instead of the current uniform incentive system, a comprehensive incentive plan reflecting the characteristics of the region should be prepared to support strengthening the autonomy of attracting investment in the region.

Through this empirical study, we may speculate that the FDI flowing into the capital area is likely to be a high value-added FDI that requires high-quality human capital, while the FDI flowing into the non-capital area are not.

Thus, from the point of the non-capital authorities’ view, it may be important to prepare incentive systems such as various tax cuts to attract FDI, but efforts should be made to strengthen the fundamental competitiveness of the region by strengthening human capital such as fostering highly educated personnel and skilled labor forces.

Lastly, both central and local governments need to consider developing ‘another Seoul’ in the non-capital area for having critical mass for regional economic development. So called megacity-region which is a combined entity of provincial level regions may have enough innovational foundations and resources to nurture a globally competitive new industry for Korean regions.

2.5.3 **Limitation and Further Research Suggestions**

This study was conducted using city, county, and district-level data. Should other researchers try to conduct research in this field in the future, they need to understand the types of data available at the city, county, or district level are relatively limited compared to national or metropolitan level, and the data accuracy and availability vary by year and region.

One of the important variables of this study, the data on the proportion of human capital (highly educated populations) by city-county-district, or district level, was partially modified from Lee (2019); and this data was surveyed on residents of city-county-district, and is not surveyed on workers actually working in the relevant cities, counties and district. It is expected that more accurate results will be obtained if follow-up research is conducted based on incumbent workforce data of the city-county-district level.

Also, if additional data using the 2020 National Statistical Office demographic register and census sample data can be included, it will be more helpful to analyze the effect of human capital to inward FDI into regions Korea more accurately as the study can gain 1 more year's data.

2.6 References

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Appendix

Table A 2.1. Estimation results for metropolitan cities in the non-capital area

	METROPOLITAN CITIES IN NON-CAPITAL AREA								
	All Industry FDI			Manufacturing Industry FDI			Service Industry FDI		
	GLS	FE	RE	GLS	FE	RE	GLS	FE	RE
HUMAN CAPITAL	**0.0157*** **	**0.008**	**0.0148**	**0.0211*** **	**0.013**	**0.0171**	**-0.0047***	**0.008**	**0.0077**
(1 YR LAGGED)	(0.004)	(0.018)	(1.011)	(0.006)	(0.013)	(0.011)	(0.003)	(0.019)	(0.011)
PER CAPITA GRDP	1.4627***	1.049	1.3352***	1.8593***	-0.319	1.3038***	1.3246***	1.7879*	1.0586**
(1 YR LAGGED)	(0.180)	(0.857)	(0.432)	(0.292)	(0.597)	(0.491)	(0.153)	(0.886)	(0.430)
TRADE OPENNESS	-0.0076	-0.184	-0.1499	0.3112**	-0.2062**	-0.1318	-0.2054***	0.075	-0.0047
(1 YR LAGGED)	(0.099)	(0.130)	(0.116)	(0.129)	(0.091)	(0.101)	(0.053)	(0.135)	(0.118)
DISTANCE	-0.3509***	-	-0.1951		-	0.4074	-0.7180***	-	-0.6629
(1YR LAGGED)	(0.066)	-	(0.426)		-	(0.633)	(0.081)	-	(0.419)
FIRM AGGLOMERATION	-1.8232***	0.899	-1.0041	-1.2425**	1.428	-0.4417	-0.1916	0.593	0.7233
(1 YR LAGGED)	(0.223)	(1.687)	(0.808)	(0.492)	(1.176)	(0.934)	(0.236)	(1.743)	(0.804)
HOSPITAL BEDS	1.0373***	0.158	0.4289	-1.9575***	0.5799*	-0.0433	0.7411***	0.015	0.3611
(1 YR LAGGED)	(0.172)	(0.481)	(0.353)	(0.240)	(0.335)	(0.335)	(0.166)	(0.497)	(0.356)
YEAR=2015	-0.0680**			0.2442***			0.012		
	(0.030)			(0.057)			(0.041)		
CONSTANT	9.3236***	4.122	7.8537***	7.6296***	3.4558*	2.9369	9.4127***	3.240	7.4842***
(1 YR LAGGED)	(0.439)	(2.625)	(2.758)	(1.211)	(1.830)	(3.848)	(0.510)	(2.713)	(2.723)
N	74	74	74	74	74	74	74	74	74
R2		0.3668	0.1926		0.5175	0.2442		0.3572	0.2265
HAUSMAN TEST									
CHI2			3.86		20.77				2.12
PROB > CHI2			0.5704		0.0009				0.8318

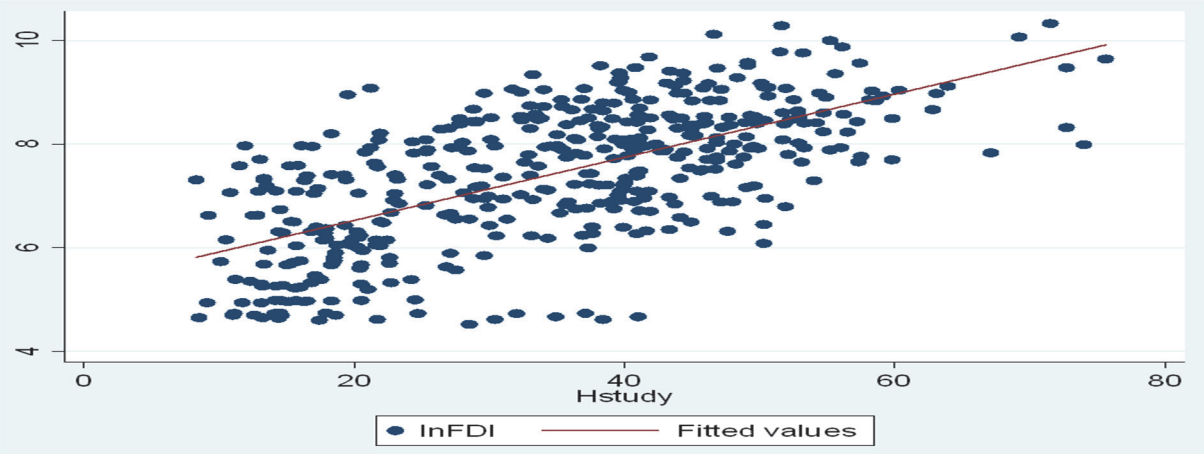
Standard errors in parentheses / * p<0.10, ** p<0.05, *** p<0.01 / data source: MOTIE

Table A 2.2. Estimation results for cities and counties in the non-capital area

	NON-METROPOLITAN CITIES IN IN NON-CAPITAL AREA								
	All Industry FDI			Manufacturing Industry FDI			Service Industry FDI		
	GLS	FE	RE	GLS	FE	RE	GLS	FE	RE
HUMAN CAPITAL	**0.0496*** **	**0.005**	**0.0304*** **	**0.0589*** **	**0.007**	**0.0439*** **	**0.0537*** **	**-0.019**	**0.0311*** **
(1 YR LAGGED)	(0.003)	(0.019)	(0.009)	(0.003)	(0.018)	(0.009)	(0.002)	(0.022)	(0.010)
PER CAPITA GRDP	2.9955***	0.963	1.7607***	1.9638***	0.808	1.1006**	1.1508***	1.249	0.9069*
(1 YR LAGGED)	(0.158)	(0.774)	(0.472)	(0.215)	(0.710)	(0.437)	(0.203)	(0.939)	(0.511)
TRADE OPENNESS	0.0974***	-0.001	0.0842	0.1042***	0.004	0.0960*	0.1505***	-0.085	0.1134
(1 YR LAGGED)	(0.026)	(0.096)	(0.060)	(0.028)	(0.084)	(0.054)	(0.032)	(0.141)	(0.081)
DISTANCE	0.1134	-	-0.0350	-0.3185***	-	-0.3609	-0.1546***	-	-0.0647
(1YR LAGGED)	(0.073)	-	(0.265)	(0.104)	-	(0.261)	(0.060)	-	(0.293)
FIRM AGGLOMERATION	3.5352***	2.4006*	0.8743	0.0448	1.753	0.2168	3.3873***	2.445	1.9698**
(1 YR LAGGED)	(0.664)	(1.288)	(0.872)	(0.826)	(1.180)	(0.811)	(0.667)	(1.474)	(0.984)
HOSPITAL BEDS	0.1888**	-0.104	0.0937	-0.1420	-0.282	-0.0848	-0.1765**	-0.234	-0.2507
(1 YR LAGGED)	(0.088)	(0.304)	(0.215)	(0.138)	(0.361)	(0.251)	(0.069)	(0.331)	(0.236)
YEAR=2015	-0.4980***			-0.1644*			-0.2833***		
	(0.083)			(0.098)			(0.076)		
CONSTANT	-5.8746***	1.033	2.0171	4.3560**	2.5698*	5.7014***	-2.2372	0.644	0.8222
(1 YR LAGGED)	(1.413)	(1.641)	(1.932)	(1.717)	(1.493)	(1.858)	(1.480)	(1.903)	(2.282)
N	225	225	225	176	176	176	171	171	171
R2		0.2254	0.3074		0.1938	0.3631		0.1849	0.2160
HAUSMAN TEST									
CHI2		16.81			9.49				8.67
PROB > CHI2		0.0049			0.0910				0.1232

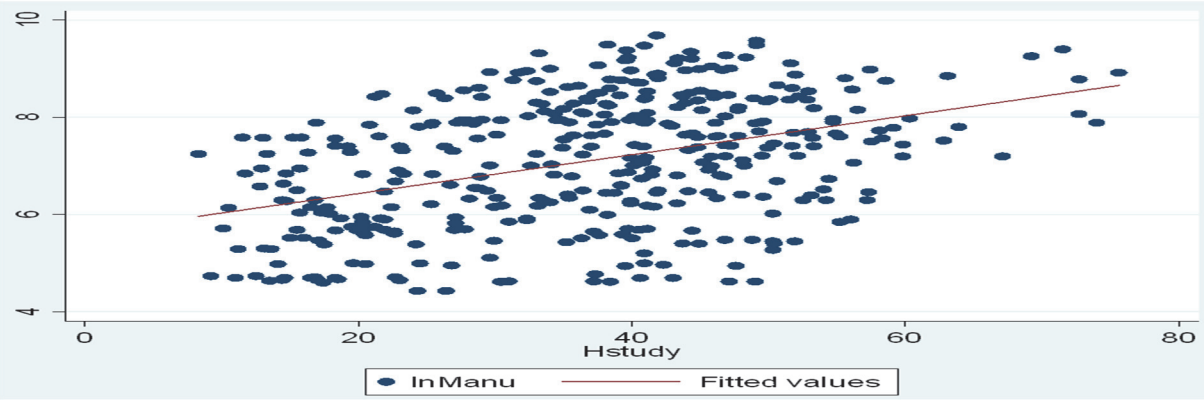
Standard errors in parentheses / * p<0.10, ** p<0.05, *** p<0.01 / data source: MOTIE

Figure A 2.1. Scatterplot: human capital (-1 yr) and inward FDI for all industry types



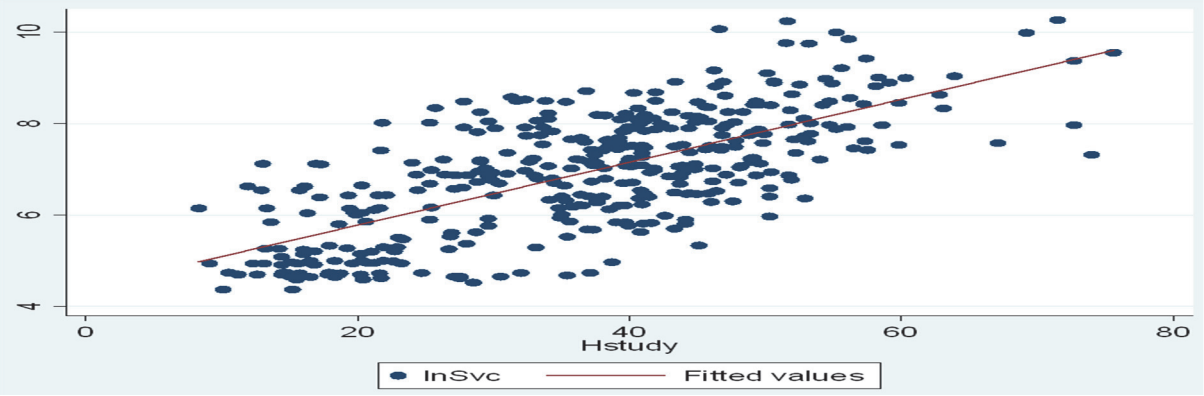
Source: Author

Figure A 2.2. Scatterplot: human capital (-1 yr) and inward FDI for manufacturing Industry



Source: Author

Figure A 2.3. Scatterplot: human capital (-1 yr) and inward FDI for service industry



Source: Author

Table A 2.3. 228 City-county-district lists of Korea used in this study

no.	prvcode	prv	ctycode	cty	no.	prvcode	Prv	ctycode	cty
1	11	서울시	11110	종로구	**26**	26	부산시	26110	중구
2	11	서울시	11140	중구	**27**	26	부산시	26140	서구
3	11	서울시	11170	용산구	**28**	26	부산시	26170	동구
4	11	서울시	11200	성동구	**29**	26	부산시	26200	영도구
5	11	서울시	11215	광진구	**30**	26	부산시	26230	부산진구
6	11	서울시	11230	동대문구	**31**	26	부산시	26260	동래구
7	11	서울시	11260	중랑구	**32**	26	부산시	26290	남구
8	11	서울시	11290	성북구	**33**	26	부산시	26320	북구
9	11	서울시	11305	강북구	**34**	26	부산시	26350	해운대구
10	11	서울시	11320	도봉구	**35**	26	부산시	26380	사하구
11	11	서울시	11350	노원구	**36**	26	부산시	26410	금정구
12	11	서울시	11380	은평구	**37**	26	부산시	26440	강서구
13	11	서울시	11410	서대문구	**38**	26	부산시	26470	연제구
14	11	서울시	11440	마포구	**39**	26	부산시	26500	수영구
15	11	서울시	11470	양천구	**40**	26	부산시	26530	사상구
16	11	서울시	11500	강서구	**41**	26	부산시	26710	기장군
17	11	서울시	11530	구로구	**42**	27	대구시	27110	중구
18	11	서울시	11545	금천구	**43**	27	대구시	27140	동구
19	11	서울시	11560	영등포구	**44**	27	대구시	27170	서구
20	11	서울시	11590	동작구	**45**	27	대구시	27200	남구
21	11	서울시	11620	관악구	**46**	27	대구시	27230	북구
22	11	서울시	11650	서초구	**47**	27	대구시	27260	수성구
23	11	서울시	11680	강남구	**48**	27	대구시	27290	달서구
24	11	서울시	11710	송파구	**49**	27	대구시	27710	달성군
25	11	서울시	11740	강동구	**50**	28	인천시	28110	중구

no.	prvcode	prv	ctycode	cty	no.	prvcode	Prv	ctycode	cty
51	28	인천시	28140	동구	**81**	41	경기도	41210	광명시
52	28	인천시	28170	미추홀구	**82**	41	경기도	41220	평택시
53	28	인천시	28185	연수구	**83**	41	경기도	41250	동두천시
54	28	인천시	28200	남동구	**84**	41	경기도	41270	안산시
55	28	인천시	28237	부평구	**85**	41	경기도	41280	고양시
56	28	인천시	28245	계양구	**86**	41	경기도	41290	과천시
57	28	인천시	28260	서구	**87**	41	경기도	41310	구리시
58	28	인천시	28710	강화군	**88**	41	경기도	41360	남양주시
59	28	인천시	28720	옹진군	**89**	41	경기도	41370	오산시
60	29	광주시	29110	동구	**90**	41	경기도	41390	시흥시
61	29	광주시	29140	서구	**91**	41	경기도	41410	군포시
62	29	광주시	29155	남구	**92**	41	경기도	41430	의왕시
63	29	광주시	29170	북구	**93**	41	경기도	41450	하남시
64	29	광주시	29200	광산구	**94**	41	경기도	41460	용인시
65	30	대전시	30110	동구	**95**	41	경기도	41480	파주시
66	30	대전시	30140	중구	**96**	41	경기도	41500	이천시
67	30	대전시	30170	서구	**97**	41	경기도	41550	안성시
68	30	대전시	30200	유성구	**98**	41	경기도	41570	김포시
69	30	대전시	30230	대덕구	**99**	41	경기도	41590	화성시
70	31	울산시	31110	중구	**100**	41	경기도	41610	광주시
71	31	울산시	31140	남구	**101**	41	경기도	41630	양주시
72	31	울산시	31170	동구	**102**	41	경기도	41650	포천시
73	31	울산시	31200	북구	**103**	41	경기도	41731	여주시
74	31	울산시	31710	울주군	**104**	41	경기도	41800	연천군
75	32	세종시	32000	세종시	**105**	41	경기도	41820	가평군
76	41	경기도	41110	수원시	**106**	41	경기도	41830	양평군
77	41	경기도	41130	성남시	**107**	42	강원도	42110	춘천시
78	41	경기도	41150	의정부시	**108**	42	강원도	42130	원주시
79	41	경기도	41170	안양시	**109**	42	강원도	42150	강릉시
80	41	경기도	41190	부천시	**110**	42	강원도	42170	동해시

no.	prvcode	prv	ctycode	cty	no.	prvcode	prv	ctycode	cty
111	42	강원도	42190	태백시	**141**	44	충남도	44230	논산시
112	42	강원도	42210	속초시	**142**	44	충남도	44260	당진시
113	42	강원도	42230	삼척시	**143**	44	충남도	44710	금산군
114	42	강원도	42720	홍천군	**144**	44	충남도	44760	부여군
115	42	강원도	42730	횡성군	**145**	44	충남도	44770	서천군
116	42	강원도	42750	영월군	**146**	44	충남도	44790	청양군
117	42	강원도	42760	평창군	**147**	44	충남도	44800	홍성군
118	42	강원도	42770	정선군	**148**	44	충남도	44810	예산군
119	42	강원도	42780	철원군	**149**	44	충남도	44825	태안군
120	42	강원도	42790	화천군	**150**	45	전북도	45110	전주시
121	42	강원도	42800	양구군	**151**	45	전북도	45130	군산시
122	42	강원도	42810	인제군	**152**	45	전북도	45140	익산시
123	42	강원도	42820	고성군	**153**	45	전북도	45180	정읍시
124	42	강원도	42830	양양군	**154**	45	전북도	45190	남원시
125	43	충북도	43110	청주시	**155**	45	전북도	45210	김제시
126	43	충북도	43130	충주시	**156**	45	전북도	45710	완주군
127	43	충북도	43150	제천시	**157**	45	전북도	45720	진안군
128	43	충북도	43720	보은군	**158**	45	전북도	45730	무주군
129	43	충북도	43730	옥천군	**159**	45	전북도	45740	장수군
130	43	충북도	43740	영동군	**160**	45	전북도	45750	임실군
131	43	충북도	43745	증평군	**161**	45	전북도	45770	순창군
132	43	충북도	43750	진천군	**162**	45	전북도	45790	고창군
133	43	충북도	43760	괴산군	**163**	45	전북도	45800	부안군
134	43	충북도	43770	음성군	**164**	46	전남도	46110	목포시
135	43	충북도	43800	단양군	**165**	46	전남도	46130	여수시
136	44	충남도	44130	천안시	**166**	46	전남도	46150	순천시
137	44	충남도	44150	공주시	**167**	46	전남도	46170	나주시
138	44	충남도	44180	보령시	**168**	46	전남도	46230	광양시
139	44	충남도	44200	아산시	**169**	46	전남도	46710	담양군
140	44	충남도	44210	서산시	**170**	46	전남도	46720	곡성군

no.	prvcode	prv	ctycode	cty	no.	prvcode	prv	ctycode	cty
171	46	전남도	46730	구례군	**201**	47	경북도	47820	청도군
172	46	전남도	46770	고흥군	**202**	47	경북도	47830	고령군
173	46	전남도	46780	보성군	**203**	47	경북도	47840	성주군
174	46	전남도	46790	화순군	**204**	47	경북도	47850	칠곡군
175	46	전남도	46800	장흥군	**205**	47	경북도	47900	예천군
176	46	전남도	46810	강진군	**206**	47	경북도	47920	봉화군
177	46	전남도	46820	해남군	**207**	47	경북도	47930	울진군
178	46	전남도	46830	영암군	**208**	47	경북도	47940	울릉군
179	46	전남도	46840	무안군	**209**	48	경남도	48170	진주시
180	46	전남도	46860	함평군	**210**	48	경남도	48220	통영시
181	46	전남도	46870	영광군	**211**	48	경남도	48240	사천시
182	46	전남도	46880	장성군	**212**	48	경남도	48250	김해시
183	46	전남도	46890	완도군	**213**	48	경남도	48270	밀양시
184	46	전남도	46900	진도군	**214**	48	경남도	48310	거제시
185	46	전남도	46910	신안군	**215**	48	경남도	48330	양산시
186	47	경북도	47110	포항시	**216**	48	경남도	48340	창원시
187	47	경북도	47130	경주시	**217**	48	경남도	48720	의령군
188	47	경북도	47150	김천시	**218**	48	경남도	48730	함안군
189	47	경북도	47170	안동시	**219**	48	경남도	48740	창녕군
190	47	경북도	47190	구미시	**220**	48	경남도	48820	고성군
191	47	경북도	47210	영주시	**221**	48	경남도	48840	남해군
192	47	경북도	47230	영천시	**222**	48	경남도	48850	하동군
193	47	경북도	47250	상주시	**223**	48	경남도	48860	산청군
194	47	경북도	47280	문경시	**224**	48	경남도	48870	함양군
195	47	경북도	47290	경산시	**225**	48	경남도	48880	거창군
196	47	경북도	47720	군위군	**226**	48	경남도	48890	합천군
197	47	경북도	47730	의성군	**227**	50	제주도	50110	제주시
198	47	경북도	47750	청송군	**228**	50	제주도	50130	서귀포시
199	47	경북도	47760	영양군					
200	47	경북도	47770	영덕군					

Chapter 3. Effect of inward FDI on innovation in Korean regions

- Focusing on spatial and industrial difference -

3.1 Introduction

This study aims to find how inward FDI affect differently in innovation activities among Korean regions and industries as well as different FDI types (greenfield vs M&A). Since easing concentration of the capital area and balanced development of the non-capital area have become national agenda of Korea, this study attempts to find different regional effect of FDI.

Researchers have been interested in host country's innovation effect through inward FDI. Grossman and Helpman (1995) argued that inward FDI has a positive effect on host country's productivity improvement. Blomström and Sjoholm (1996) argued that foreign-invested companies had a positive effect on host country's companies, such as improving work force productivity through technology transfer.

However, the effects appear in various ways under different contexts such as FDI type, regional differences. By types of FDI, Greenfield type and M&A type FDI, previous studies argue that Greenfield type FDI has positive relation to innovation of host countries, whereas M&A type FDI has no significant contribution (Liu and Zou (2008), García, Jin, and Salomon (2013)). Regarding within-country regional differences, previous studies argued that spatial differences among regions affect differently on the effect of inward FDI. Cheung and Lin (2004), using province level data from China, analyzed that spillover effect of FDI toward western China was more effective than that of coastal region-where most developed and over 80% of inward FDI is concentrated.

Inspired by empirical approach of Cheung and Lin (2004), this study, using Korean patent data from KIPO (Korean Intellectual Property Office), also attempts panel data analysis to observe different effects of FDI by region, by FDI type and by industry type.

In this study, we use various industrial intellectual property rights (IPR) as proxies for innovation activities. Among IPRs, this study adopts patent application, design application and trademark application as dependent variables. To capture effect of FDI, this study, using FDI statistics from Ministry of Trade, Industry and Energy

(MOTIE), adopts FDI flow as main independent variable. Further this study divides FDI into subgroups for comparison: manufacturing industry FDI and service industry FDI; greenfield FDI and M&A FDI.

Also, this study groups 16 Korean province-level regions under two roofs for comparison reason. First group is the capital area group which consists of Seoul metropolitan city, Incheon metropolitan city and Gyeonggi province. Second group is the non-capital area group which consists of remaining 13 province-level regions. Finally, for empirical analysis this study adopts panel fixed effect estimation method.

Estimation results indicate several findings. Firstly, overall, inward FDI has positive and statistically significant impact to local innovation activities across various IPR types, industries and regional groups; In detail, 1% increase in last year's FDI leads to 0.027% increase in all-types of patents applications.

Secondly, FDI contributes more on design innovation and trademarks than on patent application. This result is consistent with Cheung and Lin (2004) that 'the spillover effect is the most effective for minor innovation such as design application, emphasizing demonstration effect of FDI.

Thirdly, FDI has statistically significant and positive impact on patent application of manufacturing industry, whereas such effect is insignificant in the service industry; 1% increase in last year's FDI leads to 0.01% increase in patent applications of manufacturing industry. This result is in line with Taques et al. (2021), that patent registrations tend to be lower at service industry than in the manufacturing industry, as trademark registration being a 'golden' method of IPR registration in the services.

Fourthly, from spatial comparison between the capital area and the non-capital area using interaction between region dummy and FDI, FDI contributes more to the non-capital area, where generally regarded as less-developed and inferior to the capital area.

Lastly, greenfield type FDI consistently has positive impact on local innovation activities, whereas M&A type FDI has not.

For conclusion, this study argues that positive effects of FDI exists but varies upon spatial, industry differences. Thus, policy makers need to consider customized FDI attraction policies for each region and industry to be invested.

As estimation results indicates that innovation of the non-capital area is better-off by attracting FDIs than the capital area, authorities-concerned need more effort to upgrade FDI related policies for the non-capital area. If the non-capital area can attract more FDI, this can help to boost innovation in the area. Since regional economic downturn and lack of good jobs due to weak regional competitiveness hinders development of the non-capital area and balanced national development, strengthened innovation from more FDI can be of great help to the non-capital area. To do this, it is desirable to hand-over more administration power and discretion to regional governments who knows the regions more than central government.

For further researches on this subject, this study proposes others researches to study the relationship between regional FDI and innovation based on firm-level data. Even though this study is first of its kind capturing regional differences and relationship between FDI and innovation in Korea, using regional level data is challenging as choice of data has to have certain limitation. By using rich firm-level data, future studies may find more meaningful results.

3.2 Effect on Inward FDI on Innovation of Host Designation

Various effects of inward FDI to host countries have been a famous subject among researchers. Among the effects, this paper focuses on the effect of inward FDI on innovation activities in Korean regions.

In previous literatures, innovation in host countries is generally described as transfer of know-hows and knowledges of home countries those often came together with FDI; and these effects are often proxied by number of patent application when it comes to empirical studies.

3.2.1 Effect of inward FDI on innovation of host country

There have been many preceding studies on how MNC's FDI affects host country innovation. Scholars such as Caves (1974) have long been interested in the external effects of inward FDI (positive technology spillover effects). Scholars believe that the growing pressure on competition in the host country market following the entry into the FDI will motivate existing local companies to innovate. As a result, scholars view that local companies that are inferior in comparison learn the know-how of foreign-invested companies in competition to strengthen their productivity and reduce costs.

Grossman and Helpman (1995) argued that inward FDI has a positive effect on host country's productivity improvement. They also argued that the cause of this positive effect is not just the influx of FDI, but also the spread of innovation towards host country, such as the influx of various human capital and advanced technologies.

Blomström and Sjoholm (1996) analyzed the effect of differences in ownership structure of MNC on the transfer and spread of technology through empirical studies using cross-sectional data from Indonesia. They argued that foreign-invested companies had a positive effect on domestic companies, such as improving labor productivity through technology diffusion.

Fu (2008), by reviewing previous literatures, classified the effects of FDI on regional innovation into four categories. Firstly, FDI directly performs various innovation activities, including R&D activities, for corporate activities in host country. Secondly, foreign-invested companies can indirectly influence innovation activities in their region. Thirdly, FDI can affect regional innovation capabilities through competitive effects. Finally, the efficiency of host country innovation can be maximized through various experiences related to innovation that home country's parent company has.

3.2.2 Greenfield FDI vs. M&A FDI

Previous studies on FDI innovation have also paid much attention to the differences between greenfield FDI and M&A FDI. Most previous studies argue that greenfield FDI has a significant positive relationship with host country innovation. On the other hand, in the case of M&A FDI, it is argued that there is no significant or significant negative relationship.

Liu and Zou (2008) found that Greenfield FDI had a positive effect on the innovation of local Chinese companies. On the other hand, they observed that M&A FDI does not play a significant role in strengthening the innovation capabilities of local companies.

García, Jin, and Salomon (2013) empirically analyzed the relationship between inward FDI and host country companies' innovation performance at industry-level and firm-level using data from 1799 Spanish manufacturing companies during the period 1990 to 2002. As a result, they found that the inward FDI to Spain was negatively related to the innovation of local companies. Based on these findings, Similar to Liu and Zou (2008), they argued that the M&A type FDI of home country's parent company aims to increase host country's

market dominance in the same industry rather than R&D activities, and as a result, it does not affect host country's industrial innovation.

3.2.3 Relationship between inward FDI and innovation in regional context

In the case of within-country studies, there are many preceding studies targeting China, where it is relatively easy to secure inward FDI and regional-related data. (Cheung and Lin (2004); Qi and Li (2008); Y. Chen and Chen (2009); Yang and Lin (2012); Z. Chen and Zhang (2019))

Among them, Cheung and Lin (2004) empirically analyzed China's 26 provinces patent data for six years from 1995 to 2000; they attempted to find empirical evidence of positive effects of FDI in China. From their empirical research, they found evidence of positive spillover effects of FDI on the number of domestic patent applications; as the inward FDI increased in a region so did number of applications in the region. They argued that the effect of FDI was the strongest on minor innovations such as design patent applications. Also, they argued that there are regional differences of inward FDI effect;

In Korean context, Choi and Seo (2010) assumed that FDI would have a positive effect on the management and innovation performance of a company, and conducted an empirical analysis through the PSM method. As a result of the analysis, foreign direct investment had a positive effect on both management performance and innovation before matching.

Although it appeared statistically significant, all of them lost statistical significance after matching, indicating that the positive effect of foreign direct investment on companies was weaker than expected.

Kim, Nam, and Jeong (2016) empirically analyzed the effect of the FDI ratio on corporate innovation for 388 Korean companies. As a result, it was found that the higher the ratio of FDI, the more positive the effect was on corporate product innovation. However, no significant effect could be found between the ratio of FDI and its effect on process innovation.

Yim et al. (2018) conducted an empirical analysis of the impact of inward FDI on innovation in Korea from 1998 to 2015 by dividing it into green field type FDI and M&A type FDI. As a result, it was confirmed that inward FDI had a significant positive effect on the number of patent applications, which is a proxy for innovation. In addition, it was found that the greenfield type FDI had a significant night effect on the number of patent applications, while the M&A type did not have a significant night effect on the number of patent applications.

3.3 Brief introduction of Industrial Property Right (IPR) System of Korea

3.3.1 Types of Industrial Property Right

The Korean Patent Act was first enacted in 1946. The Korean government established the current industrial property protection system by separating the patent law into the four industrial property laws in 1961. In current Korean industrial property right system, there are 4 kinds of major rights; they are patent, utility model, design and trademark. And each IP is under legal protection; they are the Patent Act, Utility Model Act, Design Act and Trade Mark Act respectively.

Patent

The Korean patent system is operated in accordance with the Patent Act. Article 1 of the Patent Act defines that the purpose of the patent system is to promote the development of the national industry by protecting and encouraging inventions. In order to achieve the purpose of the patent system of national industrial development through technology disclosure, the Korean government (Korean Intellectual Property Office) grants exclusive patent rights to inventors in exchange for technology disclosure.

Patent rights take effect through establishment registration, and the duration is 20 years from the date of application, and only valid within the country in which the right has been acquired.

There are two different kinds of rules for patent grant. cording to KIPO, the first-to-file rule and the first-to-invent rule are two different principles for determining which applicant is to be granted the rights when two or more patent applications are filed for the same invention. The first-to-file rule[7] applies in Korea.

Utility Model

Inventions related to the shape, structure, or combination of objects may be protected as registered utility models. According to the Utility Act, the protection period for utility models is 10 years from the date of reporting. Under the utility model system in the past, utility models were registered without practical examination, which was to reduce the burden of testing and encourage the development of small inventions.

[7] First-to-file is a method of granting a right to the invention first applied to the Korean Intellectual Property Office regardless of the time when the invention was made. On the other hand, first-to-invent is a method of granting rights to the applicant who first invented it regardless of the order of application.

However, as the average waiting period for the actual examination of patent applications was reduced to less than one year, the advantage of exemption of examination for registration of utility models was less attractive In October 2006. Considering repeatedly reported misuse and abuse of registered rights without examination and reduced efficiency of examination work, the KIPO converted the utility model grant system from pre-examination grant to the after-examination grant registration system.[8]

Design

According to the Design Protection Act, design refers to the shape, shape, color, or combination of objects, which causes aesthetics through sight. The design right arises from the date of establishment registration and lasts until 20 years after the date of application for design registration.

Cheung and Lin (2004) assumed that design patents are technically less sophisticated and that the demonstration effect of FDI is perhaps more applicable to such innovation, relative to invention and utility model patents

Trade Mark

Trade mark is also a widely used proxy for innovation in previous literatures (Zheng et al. 2020, Li et al. 2021). According to the Trade Mark Act, a trademark refers to a ‘mark’ used to identify one's own product and another's product; And a ‘mark’ refers to "any indication used to indicate the source of a product, regardless of its composition or expression, as symbols, letters, figures, sounds, smells, three-dimensional shapes, holograms, actions, or colors".

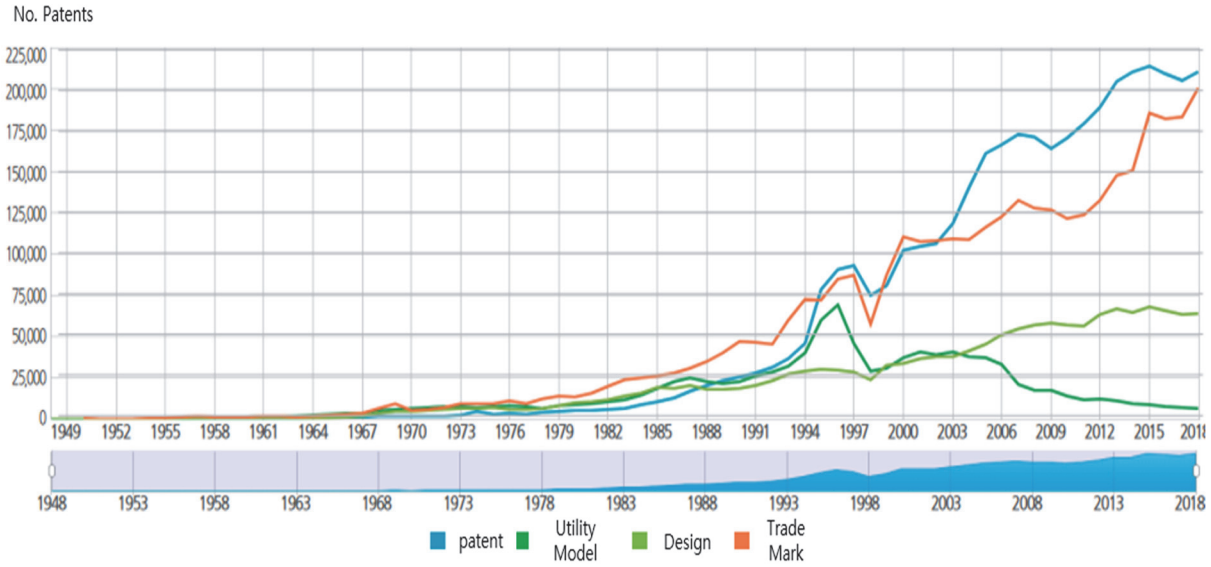
[8] Since the change in the utility model application policy in 2006, the skepticism about utility model patents has been raised. The registration requirements for both patents and utility models are identical, whereas the legal protection period is 20 years for patents and 10 years for utility models. Therefore, applicants prefer patent applications with longer legal protection periods. From the statistics from KIPO, the number of applications for utility models in Korea decreased from 1,3661 to 5,447 in 2019, and there is steadily decreasing trend. Also, due to the policy change, yearly utility model statistics before and after 2006 shows substantial difference in terms of trend and numbers of registration. In this empirical study, author did not include utility model statistics in the empirical analysis in forthcoming chapters of this study.

3.3.2 Current Status of Industrial Property Rights

Overall Status

From Figure 3.1, Korea's industrial property right applications have been on the rise since the mid-1970s. In particular, since the late 1990s, the number of applications for patents and trade mark has increased rapidly. Trade mark has shown faster growth since 2012. Compared to patent and trademark applications, design applications are showing a relatively modest increase. On the other hand, after experiencing a stagnation period in the 2000s, numbers of utility model applications are continued to decline after the introduction of the post-registration system in 2006.

Figure 3.1. Country-level Intellectual Property Right Application Status by year



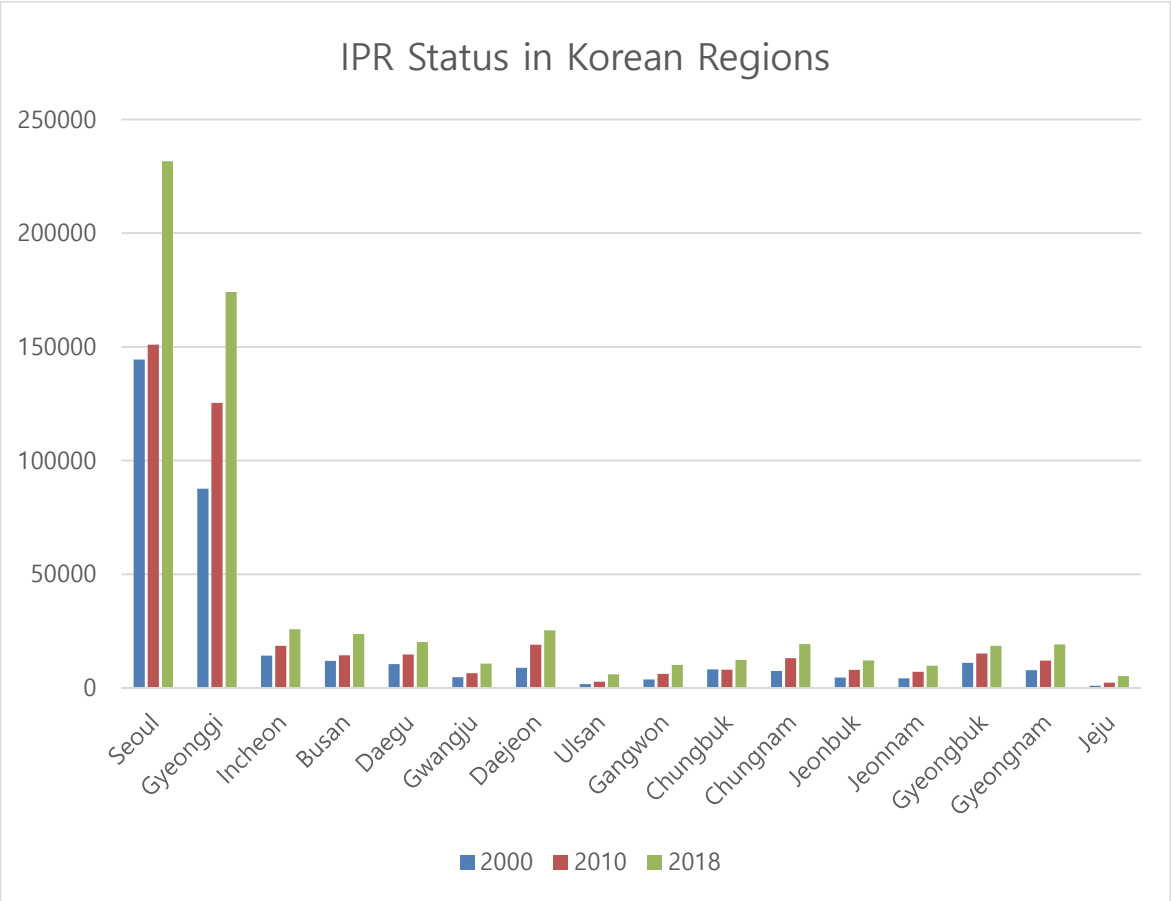
* Source : KIPO (2019)

Regional Industrial Property Rights Status

Figure 3.2 shows spatial distribution of IPS application of year 2000, 2010 and 2018. Among 16 province-level administration areas, except newly founded Sejong-city, in Korea, Seoul and Gyeonggi province account for overwhelming application performance in all three years shown in Figure. According to data provided by the Korean Intellectual Property Office, the number of IPR applications in Seoul increased from 14,449 in 2000 to 150,978 in 2010 and 231606 in 2018. During the same period, Gyeonggi province increased to 87,639 and 12,537 to 174,134.

In areas other than Seoul and Gyeonggi province also, the number of patent applications continued to increase. Daejeon increased from 8,868 in 2000 to 18,994 in 2010 and 25,364 in 2018. Ulsan increased from 1,662 to 2,755 and 5,955 during the same period.

Figure 3. 2. Spatial distribution of IPR applications from 2000 to 2018

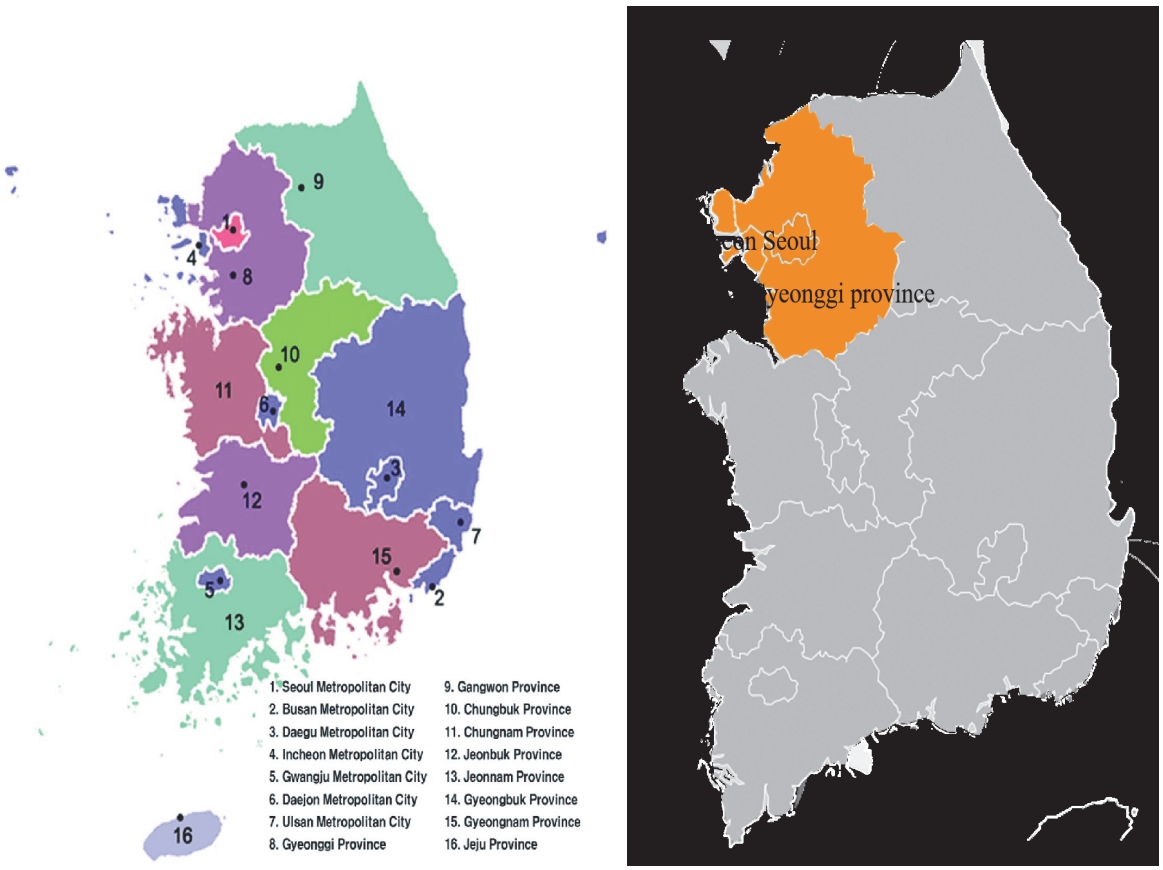


* Source: Reorganized original data from KIPO (ipstats.kipo.go.kr) by author. Sejong-city is not included

Regional discrepancy between the capital area and the non-capital area

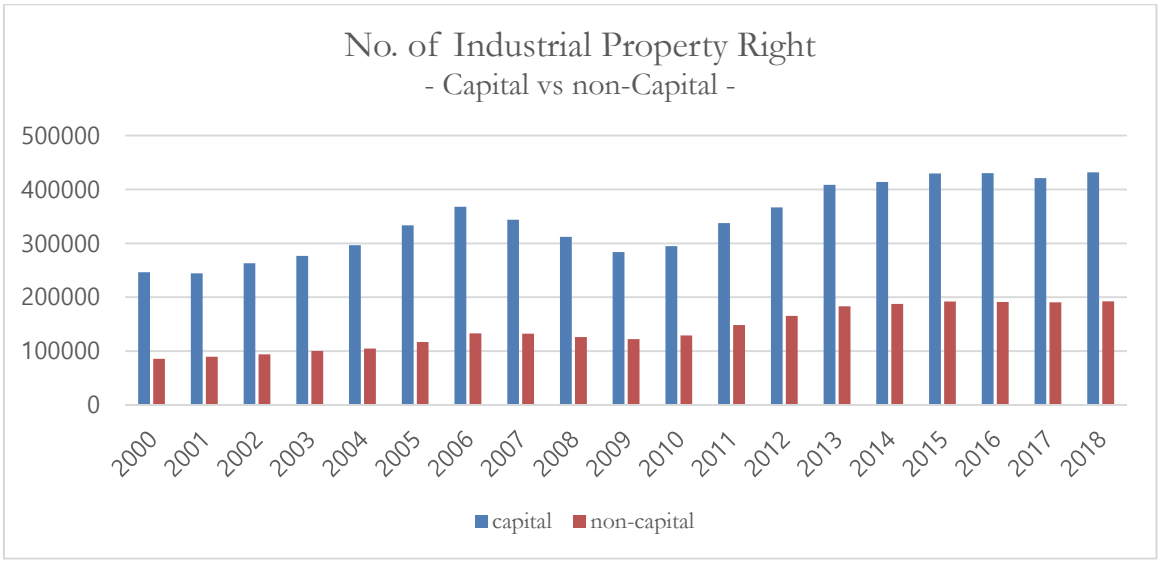
As seen in Figure 3.2, there is a wide gap in the amount of IPS applications between the capital area and the non-capital area. Figure 3 shows the locations of the provinces used in this study and the locations of the capital area including Seoul Metropolitan city, Gyeonggi province, and Incheon Metropolitan city.

Figure 3.3. Map of Korea by province and by capital/non-capital area



* Source: Park et al. (2017), Kang and Kim (2019)

Figure 3.4. Spatial distribution of IPS application between Capital and non-Capital area



* Source: Author by reorganizing original data from KIPO (ipstats.kipo.go.kr). Sejong-city is not included.

Figure 3.4 compares the amount of IPS applications between the capital area and the non-capital area groups over the past 19 years. It can be seen that both groups show similar trends of annual changes. Although the proportion of IPR applications in non-capital areas has increased compared to the past, but the gap between groups has not changed significantly.

Table 3.1 shows spatial distribution of IPR applications in Korea. In 2000, the capital area accounted for 75.8% of the nation's IPR applications, 64.58% of utility models, 75% of designs, and 79% of trademarks. On the other hand, in the case of the non-capital areas, most individual provinces and metropolitan cities showed less than 5% of the market share in all application areas.

Although this stance did not change significantly in 2010 and 2018, it can be observed that the overall proportion of the non-capital areas is slightly increasing. In terms of patent applications, the proportion of the capital area decreased by around 13%p from 75% in 2000 to 62% in 2018.

In the case of design applications, the proportion of the metropolitan area is gradually decreasing from 75% in 2000 to 72% in 2010 and 70% in 2018.

In the case of trademarks, the proportion of the metropolitan area has decreased from 79% in 2000 to 75% in 2018, showing a similar trend to design applications.

However, in the case of utility models, the proportion of the metropolitan area slightly increased from 64% in 2000 to 66% in 2018, but it is necessary to consider a decrease in the overall number of applications for utility models.

Table 3.1. Spatial distribution of IPR applications in Korea (%)

Province	2000				2010				2018			
	Patent	Utility	Design	TM	Patent	Utility	Design	TM	Patent	Utility	Design	TM
Capital												
Seoul	41.50%	30.63%	38.15%	56.99%	28.22%	23.44%	32.68%	48.59%	28.75%	24.24%	32.02%	47.41%
Gyeonggi	31.18%	27.66%	30.88%	19.23%	32.40%	33.04%	33.75%	22.88%	29.42%	36.24%	32.29%	24.50%
Incheon	3.00%	6.29%	6.68%	2.87%	4.29%	6.19%	6.16%	3.16%	3.88%	6.21%	5.77%	3.70%
Sub-total	**75.68%**	**64.58%**	**75.70%**	**79.09%**	**64.91%**	**62.68%**	**72.59%**	**74.62%**	**62.05%**	**66.69%**	**70.08%**	**75.61%**
Non-capital												
Busan	1.75%	5.48%	4.23%	3.52%	2.87%	6.31%	3.74%	3.48%	3.80%	4.74%	4.40%	3.55%
Daegu	1.75%	4.97%	4.78%	2.38%	2.55%	5.04%	6.44%	2.65%	2.87%	3.30%	6.14%	2.46%
Gwangju	1.79%	1.96%	1.04%	0.86%	1.85%	1.55%	1.39%	1.17%	2.05%	1.67%	1.88%	1.33%
Daejeon	4.07%	2.58%	1.49%	2.05%	7.74%	3.82%	1.49%	2.11%	6.65%	3.43%	2.33%	2.31%
Ulsan	0.48%	0.79%	0.36%	0.38%	0.77%	0.87%	0.52%	0.55%	1.27%	1.35%	0.90%	0.66%
Gangwon	0.61%	1.30%	0.95%	1.52%	1.35%	1.37%	1.25%	1.76%	1.65%	1.74%	1.34%	1.70%
Chungbuk	3.16%	2.97%	1.80%	1.78%	1.97%	2.08%	1.97%	1.74%	2.20%	2.20%	1.74%	1.85%
Chungnam	1.58%	2.70%	2.73%	2.28%	3.43%	3.16%	2.85%	2.77%	4.13%	2.27%	2.74%	2.27%
Jeonbuk	1.12%	1.80%	1.32%	1.33%	2.00%	2.10%	1.89%	1.66%	2.41%	2.10%	1.55%	1.64%
Jeonnam	0.97%	1.94%	1.15%	1.13%	1.82%	1.88%	1.10%	1.84%	1.95%	2.40%	1.19%	1.31%
Gyeongbuk	4.87%	5.03%	1.81%	1.48%	4.90%	3.19%	2.20%	2.71%	4.34%	2.63%	2.24%	1.96%
Gyeongnam	1.96%	3.54%	2.39%	1.81%	3.47%	5.77%	2.30%	1.97%	4.13%	5.12%	2.86%	2.08%
Jeju	0.20%	0.36%	0.25%	0.38%	0.38%	0.17%	0.28%	0.98%	0.50%	0.37%	0.61%	1.27%
Sub-total	**24.32%**	**35.42%**	**24.30%**	**20.91%**	**35.09%**	**37.32%**	**27.41%**	**25.38%**	**37.95%**	**33.31%**	**29.92%**	**24.39%**

* Source: Reorganized original data from KIPO (ipstats.kipo.go.kr) by author. Sejong-city is not included.

3.4 Empirical Model and Data Description

3.4.1 Empirical Model

To estimate the effect of inward FDI on innovation in Korea, this study adopts following econometric models based on the model of Cheung and Lin (2004).

$$lnAllpatent_{it} = \beta_0 + \beta_1 lnFDI_{it-1} + \beta_2 Region * lnFDI_{it-1} + \beta_3 lnRDper_{it} + \beta_4 Open_{it} + \beta_5 lnPGRDP_{it} + \varepsilon_{it} \text{ (Eq.1)}$$

$$lnPatent_{it} = \beta_0 + \beta_1 lnFDI_{it-1} + \beta_2 Region * lnFDI_{it-1} + \beta_3 lnRDper_{it} + \beta_4 Open_{it} + \beta_5 lnPGRDP_{it} + \varepsilon_{it} \quad \text{(Eq. 3)}$$

$$lnDesign_{it} = \beta_0 + \beta_1 lnFDI_{it-1} + \beta_2 Region * lnFDI_{it-1} + \beta_3 lnRDper_{it} + \beta_4 Open_{it} + \beta_5 lnPGRDP_{it} + \varepsilon_{it} \quad \text{(Eq. 4)}$$

$$lnTrademark_{it} = \beta_0 + \beta_1 lnFDI_{it-1} + \beta_2 Region * lnFDI_{it-1} + \beta_3 lnRDper_{it} + \beta_4 Open_{it} + \beta_5 lnPGRDP_{it} + \varepsilon_{it} \quad \text{(Eq. 5)}$$

where subscripts *i* and *t* denote province and time period, respectively. Region[9] is a dummy variable; 0 for capital and 1 for non-capital area. This study adopts four items as measures of innovation outcome of inward FDI; they are the number of patent/design/trademark and overall patent applications.

To capture heterogeneity of target industries and different characteristics of inward FDI, this study also sets econometrics models as follows:

$$lnAllpatent_{it} = \beta_0 + \beta_1 lnFDI^{GF}_{it-1} + \beta_2 Region * lnFDI_{it-1} + \beta_3 lnRDper_{it} + \beta_4 Open_{it} + \beta_5 lnPGRDP_{it} + \varepsilon_{it} \quad \text{(Eq. 6)}$$

$$lnAllpatent_{it} = \beta_0 + \beta_1 lnFDI^{MA}_{it-1} + \beta_2 Region * lnFDI_{it-1} + \beta_3 lnRDper_{it} + \beta_4 Open_{it} + \beta_5 lnPGRDP_{it} + \varepsilon_{it} \quad \text{(Eq. 7)}$$

$$lnAllpatent_{it} = \beta_0 + \beta_1 lnFDI^{Manu-GF}_{it-1} + \beta_2 Region * lnFDI_{it-1} + \beta_3 lnRDper_{it} + \beta_4 Open_{it} + \beta_5 lnPGRDP_{it} + \varepsilon_{it} \quad \text{(Eq. 8)}$$

$$lnAllpatent_{it} = \beta_0 + \beta_1 lnFDI^{Manu-MA}_{it-1} + \beta_2 Region * lnFDI_{it-1} + \beta_3 lnRDper_{it} + \beta_4 Open_{it} + \beta_5 lnPGRDP_{it} + \varepsilon_{it} \quad \text{(Eq. 9)}$$

$$lnAllpatent_{it} = \beta_0 + \beta_1 lnFDI^{Svc-GF}_{it-1} + \beta_2 Region * lnFDI_{it-1} + \beta_3 lnRDper_{it} + \beta_4 Open_{it} + \beta_5 lnPGRDP_{it} + \varepsilon_{it} \quad \text{(Eq. 10)}$$

$$lnAllpatent_{it} = \beta_0 + \beta_1 lnFDI^{Svc-MA}_{it-1} + \beta_2 Region * lnFDI_{it-1} + \beta_3 lnRDper_{it} + \beta_4 Open_{it} + \beta_5 lnPGRDP_{it} + \varepsilon_{it} \quad \text{(Eq. 11)}$$

[9] Since this paper adopts fixed effect model with panel data of T=19, author did not put 'region' as an independent variable; unlike cross-sectional data, the 'region' variable will be omitted due to multicollinearity. Eliminating time-invariant unobservable using fixed effect model may give us chance to observe regional characteristics of FDI inflows to regions more effectively.

3.4.2 Data

The analysis of this paper is based on province-level panel data in Korea. There are 17 provincial level administrative areas in Korea. Due to data availability, this paper uses 16 provinces except newly designated Sejong Special Autonomous City. Data used in this study is from 2000 to 2018.

Dependent Variable[10]

For dependent variables, as measures of R&D output, this study uses the number of (1) all-types of patents (patent application + design application), (2) patent application, (3) design applications and (4) trade mark application respectively. All these outputs are in form of natural logarithm, and are originated from Korea Intellectual Patents Office (KIPO).

Key Independent Variable

lnFDIit-1 refers to the logarithmic form of realized value of FDI in province *i* in year *t-1*. Also, this value is one year lagged value of inward FDI flow. Following Cheung and Lin (2004), one year lagged FDI values are used to estimate the effect of FDI. Given that most of the patent applications filed in Korea are for minor innovations (utility model or external designs).

Provincial level data of realized inward FDI is from Ministry of Trade, Industry and Energy (MOTIE). This paper believes that it is reasonable to assume that inward FDI to host country (Korea) affects domestic innovations within a short period of time. Therefore, the coefficient β_1 measures magnitude of the effect of lagged FDI value.

R&D Activity Related Variables

To capture the effect of inward FDI separately from that of other R&D inputs, this study includes numbers of R&D related personnel[11].

[10] This study dropped utility model application variable from empirical analysis. Until 2006, in order to quickly establish rights, a pre-registration system-examining only several formal requirements-for utility model applications were implemented. However, due to problems such as misuse and abuse of immature utility models registered without examination, the Korean Intellectual Property Office strengthened the utility model examination system from October 2006. As a result, the number of applications for utility models since October 2006 has decreased significantly compared to previous years.

[11] Cheung and Lin(2004) observed high correlation between R&D personnel and R&D expenditure variables. Thus, they used

lnRDperit refers to the logarithmic form of numbers of R&D related personnel in Korean provinces. Korean Statistics Office provides three different types of R&D personnel and expenditure: (1) university side data, (2) firm side data and (3) public side data. This paper adopts aggregated value of the three sides data.

Other Control Variables

This study includes several control variables such as trade openness (openit), per capita GRDP (lnPGRDPit) of each province.

Trade openness is ratio of international trade amount over GRDP of each region. Trade openness, to some extent, reflects whether inward FDI invested is driven by cheap labor forces of abundant natural resources of host country. Garcia et al. (2013) argued that M&A type investment negatively affects innovation in host countries by taking a market stealing strategy rather than doing R&D activities in order to increase market dominance in the same industry. In this study, variable open$_{it}$ is in the form of percentage.

Per capita GRDP is included to figure out different stages of economic development of each province, as different economic may result in different innovation capabilities of each province.

3.4.3 Estimation Strategy

This study performs panel data analysis to capture regional heterogeneity among different regional groups. For panel data estimation strategy, Eq. 1~4 is used for estimation of different types of patents (invention, design, trademark and aggregation of the 3 types of patents) applications respectively.

Regional Group Heterogeneity

To capture regional heterogeneity, this study groups 16 provinces into 5 different groups[12]. First, in order to analyze the impact of FDI on innovation across the provinces, a country-level group was established that includes all 16 provinces.

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only one of the two variables at a time. Their overall estimation results were similar in terms of quality. Thus, this study adapts R&D personnel variable only.

[12] In this study, rather than comparing and analyzing each of the individual provinces, provinces with similar characteristics were grouped and analyzed. This study aims to understand how FDI affects regional innovation differently between capital regions and the non-capital regions, and what differences exist depending on the degree of development even among the non-capital regions.

Next, in order to compare the differences between the capital are and the on-capital area, capital group and non-capital group are formed. The capital area group consists of Seoul city, Incheon city, and Gyeonggi-do; and the non-capital area group consists of the remaining 14 non-capital provinces.

Finally, within the non-capital area group, a metropolitan city group and a non-metropolitan city group were established to capture the difference between metropolitan cities and municipalities even within the non-capital region.

For efficiency and accuracy[13] reasons, this study will display estimation results of country-level, the capital area and the non-capital area. Results of metropolitan-city group and non-metropolitan city group are shown at the appendix chapter.

Sectorial Heterogeneity

Inward FDI may have different impact on different target industries. To observe sectorial heterogeneity, this study breaks FDI data into three groups: all industry group, manufacturing industry group and service industry group.

Greenfield FDI vs. M&A FDI

Different characteristics (greenfield FDI/M&A FDI) of FDI may have different intentions and expectations to host regions. To observe heterogeneity of characteristics of FDI, this study sets two sub-groups (greenfield FDI and M&A FDI) for each manufacturing and service industries.

3.5 Empirical Findings

3.5.1 Descriptive Statistics

This section analyzes the descriptive statistics of variables used in the empirical analysis.

[13] Capital group only has three provinces-Seoul, Incheon and Gyeonggi. Thus 19 years' panel data of capital group can only have 57 samples at best. Thus, due to limitation of insufficient sample size, this study decided to show related results at appendix section.

Table 3.2. Descriptive statistics shows descriptive statistics of data used in this study. The average annual number of patent applications from 2000 to 2018 was 27,908. In detail, there are 11,987 invention applications, 5,353 design applications and 10,567 trademark applications on average. The average annual R&D-related personnel are 28,753.

During the same period, the overall FDI average was $587 million, in detail, the greenfield FDI average was $329 million, and the M&A FDI average was $234 million. Among the Greenfield FDI, investment in the manufacturing industry was $124 million and investment in the service industry was $199 million. Among M&A FDI, investment in the manufacturing industry was estimated at $87 million and investment in the service industry was estimated at $139 million.

In this study, for analysis purpose, natural logarithms are taken on the variables presented in the table except for percentage type variables such as openness variable.

Table 3.4 shows result of Granger causality test for observing direction of the relationship among various types of patents and FDI inflow. By panel vector auto-regression Granger causality test, this paper observed FDI inflow causes innovation activity-patents. In all cases, the Wald test results are statistically significant at the 1% significance level, thus this paper rejects the null hypothesis of "FDI inflow does not Granger-cause innovation activities (patent)".

For all types of patents, the test result shows that FDI inflow Granger-causes the patents with Wald test result of 0.001; which means that FDI inflow contributes to regional innovation activities. Same patterns can be found in other Granger causality test results of individual types of patents such as patent, design and trademark. However, the test results were failed to reject the null hypothesis for relationships from patents to FDI inflow performances as this paper observes no statistically significant.

Table 3.2. Descriptive statistics

	VARIABLE	MEAN	STD.DEV.	MIN	MAX	OBS
ALL-TYPES	overall	27908.82	49066.35	731	229616	N=304
(NO.)	between		48573.28	2733.105	171263	n=16
	within		13722.37	-35032.5	86261.82	T=19
PATENT	overall	11987.81	19566.72	180	81284	N=304
(NO.)	between		19301.82	654.684	61943.26	n=16
	within		5694.612	-20085.45	31328.55	T=19
DESIGN	overall	5353.658	9187.869	127	36874	N=304
(NO.)	between		9169.556	306.632	28643.16	n=16
	within		2308.914	-7767.816	13584.5	T=19
TRADEMARK	overall	10567.35	21737.91	370	124984	N=304
(NO.)	between		21218.45	923.947	82813.53	n=16
	within		7004.29	-16970.18	52737.82	T=19
FDI	overall	587050.5	1287995	0	8338686	N=304
(1,000 USD)	between		1181212	31154.5	4855203	n=16
	within		588690.4	-2306876	4615552	T=19
R&D STAFFS	overall	28753.88	42526.78	681	225982	N=304
(PERSON)	between		40539.03	2133.474	138883.9	n=16
	within		16209.34	-63077	115852	T=19
OPENNESS	overall	62.506	52.631	1.829	309.426	N=304
(%)	between		50.274	2.915	209.178	n=16
	within		19.817	-19.969	162.753	T=19
PER GRDP	overall	24.87751	11.12285	9.211688	65.01415	N=304
(MIL KRW)	between		8.576134	15.85769	49.58014	n=16
	within		7.384916	4.682532	43.143	T=19

* Data source: FDI data from MOTIE, patents data from KIPO, all others from KOSIS

Table 3.3. Matrix of correlations

Variables	(1) lnAll	(2) lnPatent	(3) lnDesign	(4) lnTM	(5) lnFDI	(6) lnRDper	(7) Open	(8) lnperGRDP
(1) lnAllpatent	1.000							
(2) lnPatent	0.991	1.000						
(3) lnDesign	0.952	0.905	1.000					
(4) lnTrademark	0.921	0.893	0.934	1.000				
(5) lnFDI	0.608	0.600	0.604	0.634	1.000			
(6) lnRDper	0.952	0.954	0.881	0.873	0.602	1.000		
(7) openness	-0.042	-0.012	-0.075	-0.171	0.217	0.003	1.000	
(8) lnPerGRDP	0.211	0.270	0.106	0.180	0.373	0.251	0.644	1.000

* Source: author

Table 3.4. Results of Granger causality test (base on panel vector autoregression model)

	Wald test result (Prob > chi2)
All types of patents	
All types of patent Granger-causes FDI inflow	0.986
FDI inflow Granger-causes all types of patents	**0.001**
Patent	
Patent Granger-causes FDI inflow	0.116
FDI inflow Granger-causes patent	**0.021**
Design patent	
Design patent Granger-causes FDI inflow	0.520
FDI inflow Granger-causes design patent	**0.000**
Trademark patent	
TM Patent Granger-causes FDI inflow	0.434
FDI inflow Granger-causes TM patent	**0.000**

* Source: author

3.5.2 Effect of FDI on innovation activities on provincial Level

This section analyzes the effect of FDI on innovation according to Equation (2) ~ (7). The analysis is based on provincial level (all 16 provinces) panel data.

This study conducted estimations using both fixed effect and random effect models for all patent application types. By the Hausman test results[14], this study shows results of fixed effect models for the efficiency of the estimation results display.

Overall effect of inward FDI on all types of Industries

Table 3.5 shows overall effect of FDI on innovation in Korea. Inward FDI has statistically significant and positive effect for various types of innovation proxy but patent; Specifically, for all types of patents-which is sum of patent, design and trademark applications, 1% increase in last year's FDI leads to 0.027% increase in all-types of patents applications. Same applies to design and trademark application; 1% increase in last year's FDI leads to 0.02% increase in design patents applications, and 1% increase in last year's FDI leads to 0.034% increase in trademark applications. These findings are consistent with Cheung and Lin (2004); as mentioned in previous chapter, they assumed that design patents are technically less sophisticated and that the demonstration effect of FDI is perhaps more applicable to such innovation, relative to invention and utility model patents.

Other than FDI, per capita GRPD has consistent and significant positive impact on innovation. For R&D related personnel, this variable shows significant positive impact on patent application, whereas FDI did not have significance. This is reasonable, for patent application, since high-level of technology and human resource are the most important factors.

Unlike cross-country comparison, trade openness does not have significant impact except trademark. Since this study focused on within-country analysis, and policies and infrastructures that affect international trade are generally even and stable, this result makes sense.

[14] The Hausman test results(probabilities>0) are shown at the end of each column of estimation results tables.

Table 3.5. Metropolitan-level all-industry estimation result[15]

DEP. VAR	ALL-TYPES	PATENT	DESIGN	TRADEMARK
L.FDI	0.027***	0.012	0.020**	0.034***
	(0.007)	(0.011)	(0.008)	(0.007)
R&D STAFFS	0.053	0.235**	0.085	-0.082
	(0.067)	(0.102)	(0.076)	(0.063)
OPENNESS	0.000	0.001	0.000	-0.001***
	0.000	0.000	0.000	0.000
PER GRDP	1.245***	1.303***	0.892***	1.336***
	(0.082)	(0.125)	(0.092)	(0.077)
CONSTANT	-5.531***	-7.002***	-3.771***	-6.093***
	(0.371)	(0.567)	(0.419)	(0.352)
YEAR EFFECT	YES	YES	YES	YES
N	288	288	288	288
R2_W	0.851	0.777	0.727	0.849
HAUSMAN (PROB>0)	0.000	0.000	0.000	0.000

Standard errors in parentheses / * p<0.10, ** p<0.05, *** p<0.01 / data source: MOTIE, KIPO

1.2.1. Effect of inward FDI on the non-capital area

shows the effect of FDI in the non-capital area, by using region*FDI interaction terms. It is observed that the effect of FDI is stronger in the non-capital area than the capital area. 1% increase in the region interaction term leads to 0.071% increase in all-types of application, and 1% increase in the region interaction term leads to 0.111% increase in all-types of application, which is quite large.

As for different contributions of greenfield type FDI and M&A type FDI, this study finds that greenfield type FDI has statistically significant and positive effect on Korean industries, 1% increase in the region interaction term leads to 0.07% increase in all-types of application. Contrary to greenfield type FDI, M&A type FDI, not to mention it has negative (-0.001) direction, has no statistical significance. As we assume, Greenfield FDI has positive effect on innovation activities, while M&A FDI has not. Greenfield FDI has positive effect on innovation activities at 5% significance level.

[15] All the estimation results are based on 1-year time lagged FDI variable. See appendix Table A 3.10 for the estimation results based on various time lags (L=1~5).

This is consistent with Stiebale and Reize (2011) and Yim et al.(2018), which argued that host country companies do not benefit from technology transfer in the case of M&A FDI. Of course, there will be a positive effect of transferring the technology held by the foreign parent company to the investment target company of host country. However, if a foreign parent company uses a marketing strategy to increase market dominance within a short period of time rather than investing in R&D through M&A investment, it will be able to offset the positive effects of technology transfer.

Other control variables such as R&D related personnel, openness and per capita GRDP show similar estimation results with or without non-capital interaction term. Like table0, the impact of per capita GRDP has strongest impact among other variables in each estimation; 1% increase in per capita GRDP leads to 0.8~1.3% increase throughout all dependent variables.

Table 3.6. Metropolitan-level all-industry estimation result with a region interaction term

DEP. VAR	ALL-TYPES	PATENT	DESIGN	TRADEMARK	ALL-GF FDI	ALL-M&A FDI
L.FDI	-0.041	-0.064	-0.088**	0.036	-0.039	0.008
	(0.033)	(0.050)	(0.037)	(0.031)	(0.027)	(0.005)
REGION*FDI	**0.071****	0.079	**0.111*****	-0.003	**0.070****	-0.001
	(0.033)	(0.051)	(0.037)	(0.032)	(0.027)	(0.006)
R&D STAFFS	0.068	0.252**	0.109	-0.082	0.064	0.082
	(0.067)	(0.102)	(0.075)	(0.064)	(0.067)	(0.067)
OPENNESS	0.000	0.001	0.000*	-0.001***	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
PER GRDP	1.238***	1.295***	0.880***	1.336***	1.218***	1.243***
	(0.081)	(0.124)	(0.091)	(0.078)	(0.080)	(0.083)
CONSTANT	-5.439***	-6.901***	-3.627***	-6.096***	-5.290***	-5.469***
	(0.371)	(0.569)	(0.416)	(0.355)	(0.366)	(0.382)
YEAR EFFECT	YES	YES	YES	YES	YES	YES
N	288	288	288	288	288	288
HAUSMAN	FE	FE	FE	FE	FE	FE
WITHIN R2	0.853	0.779	0.736	0.849	0.857	0.848

Standard errors in parentheses / * p<0.10, ** p<0.05, *** p<0.01 / data source: MOTIE, KIPO

Overall Effect of inward FDI on manufacturing Industry

Table 3.7 shows overall effect of inward FDI on manufacturing Industry. The effect to all types is statistically significant and positive at the 1% significance level. For patent applications, the result is different from that of county-level analysis; 1% increase in manufacturing FDI leads to 0.009% increase in patent application following year. Also, its standard error is as low as 0.003. For design application, this study finds no significance. When it comes to trademark applications, there is positive relationship between FDI and applications.

Table 3.7. Metropolitan-level manufacturing industry estimation result

DEP. VAR	ALL-TYPES	PATENT	DESIGN	TRADEMARK
L.FDI-MANU	0.008***	0.009***	0.004	0.006***
	(0.002)	(0.003)	(0.003)	(0.002)
R&D STAFFS	0.134**	0.298***	0.135*	0.001
	(0.067)	(0.101)	(0.076)	(0.065)
OPENNESS	0.000	0.001	0.000	-0.001***
	0.000	0.000	0.000	0.000
PER GRDP	1.163***	1.209***	0.851***	1.271***
	(0.085)	(0.128)	(0.097)	(0.083)
CONSTANT	-5.178***	-6.632***	-3.588***	-5.794***
	(0.383)	(0.576)	(0.434)	(0.373)
YEAR EFFECT	YES	YES	YES	YES
N	288	288	288	288
HAUSMAN	FE	FE	FE	FE
WITHIN R2	0.850	0.782	0.723	0.840

Standard errors in parentheses / * p<0.10, ** p<0.05, *** p<0.01 / data source: MOTIE, KIPO

When the non-capital area interaction terms are added in Table 3.8, this study finds that most of positive effectiveness of FDI moves from the manufacturing industry FDI variable to the interaction terms. That implies that the effect from inward FDI on manufacturing industry is more effective to the non-capital area than the capital area. The capital area is thought to have sufficient resources for innovative growth, as various high-tech companies and high-quality research personnel are concentrated; thus, the effect from FDI may be less important than other innovation channel. On the other hand, the non-capital area seems to have a relatively greater importance of FDI due to relatively limited innovative resources compared to the capital area.

Table 3.8. Metropolitan-level manufacturing industry estimation result with region interaction term

DEP. VAR	ALL-TYPES	PATENT	DESIGN	TRADEMARK	ALL-GF FDI	ALL-M&A FDI
L.FDI(MANU)	-0.018*	-0.023	-0.030***	-0.001	-0.035	-0.016
	(0.010)	(0.015)	(0.011)	(0.010)	(0.025)	(0.015)
REGION*FDI	**0.027*** **	**0.033** **	**0.036*** **	0.008	**0.047***	0.021
	(0.010)	(0.016)	(0.012)	(0.010)	(0.025)	(0.015)
R&D STAFFS	0.162**	0.332***	0.172**	0.008	0.134**	0.109
	(0.067)	(0.102)	(0.076)	(0.066)	(0.068)	(0.068)
OPENNESS	0.000	0.001*	0.000*	-0.001***	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
PER GRDP	1.142***	1.184***	0.824***	1.265***	1.183***	1.220***
	(0.085)	(0.128)	(0.096)	(0.084)	(0.085)	(0.085)
CONSTANT	-5.067***	-6.498***	-3.443***	-5.763***	-5.205***	-5.355***
	(0.381)	(0.576)	(0.430)	(0.376)	(0.386)	(0.385)
YEAR EFFECT	YES	YES	YES	YES	YES	YES
N	288	288	288	288	288	288
HAUSMAN	FE	FE	FE	FE	FE	FE
WITHIN R2	0.853	0.785	0.732	0.840	0.848	0.846

Standard errors in parentheses / * p<0.10, ** p<0.05, *** p<0.01 / data source: MOTIE, KIPO

Overall Effect of inward FDI on Service Industry

Table 3.9 shows estimation results for overall effect of inward FDI on service industry. Previous year's FDI inflows to service industry has positive statistical significances in all patent category except patent applications, which is opposite from manufacturing industry in Table 3.7.

The difference context of innovation in both manufacturing industry and service industry has been an interesting topic for researchers (Tether (2003); Arvanitis (2008); Pires, Sarkar, and Carvalho (2008)). The finding in Table 3.9 is consistent with Hipp et al. (2003); Hipp and Grupp (2005); Taques et al. (2021); They argued that patent registrations tend to be lower at service companies than in the manufacturing sector, trademark registration being a 'golden' method of IPS registration in service industry.

For patent applications, R&D related personnel, as expected, has positive significance; 1% increase in R&D related personnel contributes 0.235% increase in patent applications, and this is relatively big magnitude. Among independent variables, consistent with other estimation results, per capita GRDP has strongest impact on the innovation of the industry.

Table 3.9. Metropolitan-level service industry estimation result

DEP. VAR	ALL-TYPES	PATENT	DESIGN	TRADEMARK
L.FDI-SVC	0.027***	0.012	0.020**	0.034***
	(0.007)	(0.011)	(0.008)	(0.007)
R&D STAFFS	0.053	0.235**	0.085	-0.082
	(0.067)	(0.102)	(0.076)	(0.063)
OPENNESS	0.000	0.001	0.000	-0.001***
	0.000	0.000	0.000	0.000
PER GRDP	1.245***	1.303***	0.892***	1.336***
	(0.082)	(0.125)	(0.092)	(0.077)
CONSTANT	-5.531***	-7.002***	-3.771***	-6.093***
	(0.371)	(0.567)	(0.419)	(0.352)
YEAR EFFECT	YES	YES	YES	YES
N	288	288	288	288
HAUSMAN	FE	FE	FE	FE
WITHIN R2	0.851	0.777	0.727	0.849

Standard errors in parentheses / * p<0.10, ** p<0.05, *** p<0.01 / data source: MOTIE, KIPO

As per the impact of interaction terms seen on Table 3.10, inward FDI helps innovation of the non-capital area more effective than that of capital region. For 1% increase in previous year's FDI, the non-capital area is better-off 0.019% at all-types, 0.03% at design application respectively.

For the comparison between greenfield type FDI and M&A type FDI, Table 3.10 indicates consistent result that greenfield type FDI has statistically significant and positive effect on the non-capital area, whereas M&A type FDI shows no statistical significance.

Table 3.10. Metropolitan-level service industry estimation result with a region interaction term

DEP. VAR	ALL-TYPES	PATENT	DESIGN	TRADEMARK	ALL-GF FDI	ALL-M&A FDI
L.FDI(SVC)	-0.016	-0.024	-0.027**	0.008	-0.049*	-0.002
	(0.010)	(0.016)	(0.011)	(0.010)	(0.025)	(0.005)
REGION*FDI	**0.019***	0.024	**0.030*****	-0.004	**0.058****	0.004
	(0.010)	(0.015)	(0.011)	(0.010)	(0.025)	(0.006)
R&D STAFFS	0.112	0.289***	0.147*	-0.051	0.116*	0.096
	(0.069)	(0.103)	(0.076)	(0.067)	(0.069)	(0.068)
OPENNESS	0.000	0.001*	0.000	-0.001***	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
PER GRDP	1.229***	1.290***	0.867***	1.331***	1.222***	1.237***
	(0.084)	(0.125)	(0.092)	(0.081)	(0.083)	(0.084)
CONSTANT	-5.410***	-6.942***	-3.629***	-5.991***	-5.376***	-5.429***
	(0.381)	(0.569)	(0.421)	(0.368)	(0.379)	(0.384)
YEAR EFFECT	YES	YES	YES	YES	YES	YES
N	288	288	288	288	288	288
HAUSMAN	FE	FE	FE	FE	FE	FE
WITHIN R2	0.845	0.778	0.729	0.838	0.847	0.844

Standard errors in parentheses / * p<0.10, ** p<0.05, *** p<0.01 / data source: MOTIE, KIPO

3.6 Conclusion

3.6.1 Overall conclusion

This study aims to find how effects of inward FDI affect differently in innovation activities among Korean regions and industries as well as different FDI types (greenfield vs M&A). For observing spatial differences between the capital area and the non-capital area, this study grouped 16 province level regions into 2 groups; Seoul, Incheon and Gyeonggi as the capital area group, and rest of 16 regions into non-capita areal group. Finally, using 19 years' panel data of 16 province level regions, this study adopts panel fixed effect estimation for empirical analysis.

The empirical analysis of the panel data indicates that, in general, FDI has positive and statistically significant impact to local innovation activities across various IPR types, industries and regional groups.

Firstly, from the comparison among IPR types, this study finds out that FDI contributes more on design innovation and trademarks than on patent application. This finding is in line with the finding of Cheung and Lin (2004) that 'the spillover effect is the strongest for minor innovation such as design application, emphasizing demonstration effect of FDI'.

Secondly, from the industry sector comparison, this study finds out that FDI has statistically significant and positive impact on patent application of manufacturing industry, whereas such effect is insignificant in the service industry. This finding is consistent with previous research of Taques et al. (2021), that they argue patent registrations tend to be lower at service industry than in the manufacturing industry trademark registration being a 'golden' method of IPR registration in service industry.

Thirdly, from regional group comparison between the capital area and the non-capital area, this study observes FDI contributes more to the non-capital area, where generally regarded as inferior to the capital area in many aspects including economy, culture, infrastructure and absorptive capacities.

Lastly, from the comparison between FDI types, the estimation result indicates that greenfield type FDI consistently shows statistically significant and positive impact on local innovation activities, whereas M&A type FDI shows no significance regardless of the directions of coefficients.

As for other independent variables, this study finds out that per capita GRDP-which is proxy for market

potential has the biggest impact on regional innovation, and the finding is in line with previous literatures. R&D related personnel is observed positive effect on patent applications which makes sense that patent often needs heavy technological supports from R&D personnel. When it comes to trade openness, this study finds no evidence of its general contribution to local innovation. This finding may imply that trade openness may not be a crucial concern in the context of within-country analysis for relatively moderate-sized countries like Korea.

3.6.2 Policy implication

This study observes that contribution of FDI for local innovation varies from regional groups and industry groups. Thus, authorities-concerned needs to consider more tailored FDI attraction policies reflecting spatial characteristics and regional industrial development strategies.

Especially, as this study observed the effectiveness of FDI on the non-capital area, policy makers need more efforts to improve FDI attraction policies for the non-capital area. The concentration of the capital area in Korea has already become the biggest obstacle to balanced national development. Behind these problems, there exists the regional economic downturn and lack of good jobs due to weak regional competitiveness. Revitalization of the regional economy through strengthening innovation capabilities plays an important role in balanced national development by increasing quality jobs in the region and strengthening regional competitiveness.

As this study confirmed that FDI flowing into the non-capital area has a greater effect on regional innovation capabilities than FDI flowing into the capital area, the central government may consider two-track FDI attraction policy system for the capital area and the non-capital area respectively; in other words, to promote FDI investment into the non-capital area, the government-concerned should consider more favorable and customized investment attraction incentive scheme to the area.

For the capital area, the area already has reasonably competitive industrial infrastructures in comparison with the non-capital area and so called “anchor companies” of industrial ecosystems such as Samsung electronics of semiconductor; thus, the aim of FDI policy needs to focus on strengthening global competitiveness of knowledge-concentrated and tech-concentrated industries in the area.

For the non-capital area, the link between regional industrial policies and FDI policies must be further strengthened. Unlike the capital area, where there are already various industrial ecosystems, the non-capital

areas often do not have diverse or advanced industrial ecosystems. In this case, it is difficult to attract foreign investment unless there are special circumstances. Therefore, it is necessary to develop regional industry development plan and to have relevant incentives in advance to attract large-scale investment by domestic core companies into the region, and then try to attract related foreign-invested companies from current global industrial ecosystems of the core domestic companies.

To do so, Local governments should establish customized industrial development plans necessary for regional development according to the circumstances of the local economy, and prepare various support measures necessary for them. Thus, the central government should consider transferring more authorities and freedoms related to attracting FDI to local governments; also, the central government needs to reflect local government opinions in timely manner when shaping country-wide FDI-related policies.

In addition, as long as it has been observed that green field-type FDI helps strengthen regional innovation capabilities compared to M&A-type FDI, efforts should be strengthened to attract green field FDI into the non-capital area.

3.6.3 Limitations and suggestions for further studies

One of the challenges may be adjustment in data. According to KIPO, in the case of regional data, regional statistics are calculated based on the current residence address of the patentee at the time of data extraction. If a certain patent is under possession of a firm, the patent data may be stable as the address of the firm is not likely changed frequently. However, if a patentee is an individual person, there may be more frequent change of the personal address as the person may move to other regions. If so, regional data extracted at certain point will differ from previous data; eventually this issue may lead to questioning the accuracy of the data. This is a major challenge of the patent statistics data from KIPO.

Second challenges may be limitation of useful control variables under the region-based empirical analysis. Firm level empirical analysis may use rich firm-level data such as firm's income and expenditures, company size, more segmentation based on service provided, market share and so on. However, this study is meaningful because this is first of its kind that conducted empirical study by dividing the relationship between inward FDI and innovation into Korea by region, industry, and type.

For further studies, this study recommends two suggestions. First, as for data analysis, this study recommends count data analysis techniques such as negative binominal model (NBM), generalized NBM, inflated NBM or Poisson model for patents as dependent variables, as well as spatial regression models at city-county-district level regions and at industry level, or industry by industry. Second, this study suggests, to observe firm-level effects, researchers may consider analyzing the relationship between regional FDI and innovation based on firm-level data. As firm level inward FDI performances are regards as private and sensitive business information, this study finds it hard to have relevant data.

Finally, this study recommends data analysis using the production function model, mentioned earlier in the preamble section, between regional growth as a dependent variable and inward FDI as an independent variable at industry level

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3.8 Appendix

Figure A 3.4. Scatterplot matrix among all-type patent and FDI variables

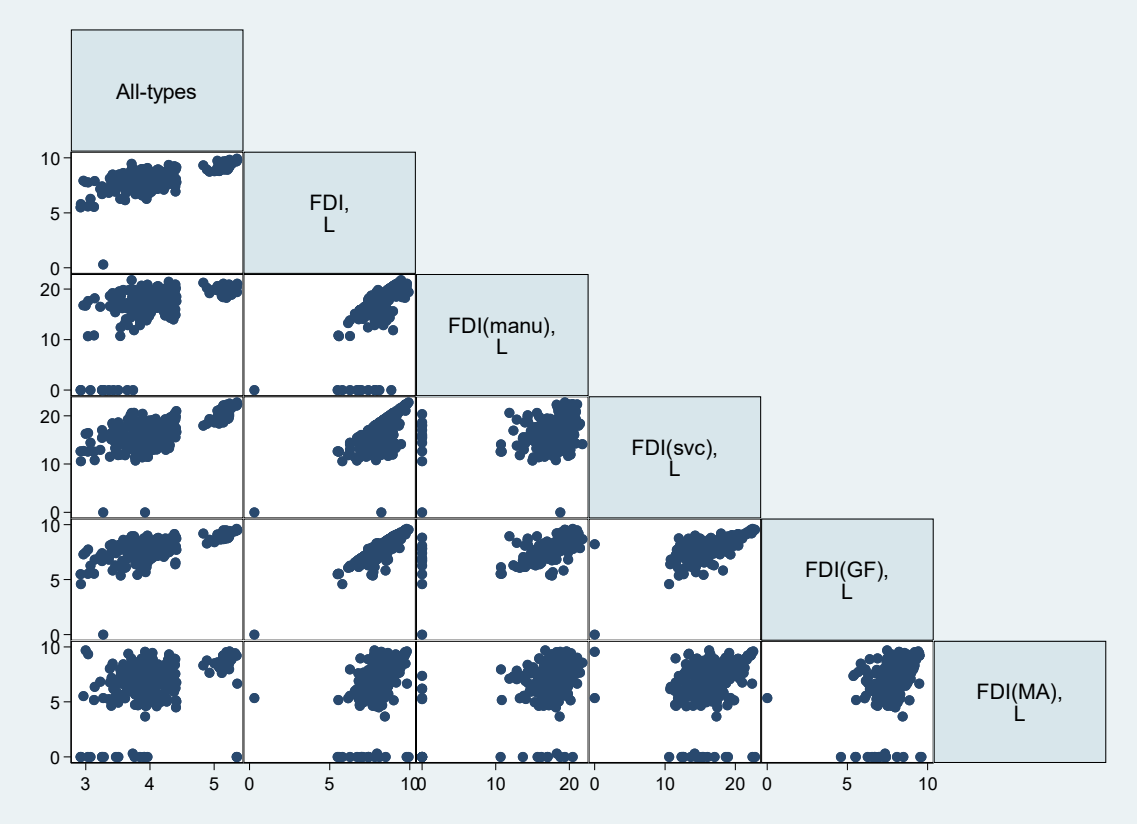

Table A 3.4. The capital area estimation result-all types of industries

DEP. VAR	ALL-TYPES	PATENT	DESIGN	TRADEMARK
L.FDI	0.013	0.032	-0.044*	0.054**
	(0.025)	(0.042)	(0.022)	(0.026)
R&D STAFFS	0.503**	1.129***	0.587***	-0.079
	(0.197)	(0.335)	(0.179)	(0.206)
OPENNESS	0.001	0.002*	0.000	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
PER GRDP	0.249	-0.690*	0.024	1.236***
	(0.228)	(0.387)	(0.206)	(0.238)
CONSTANT	0.442	3.670**	1.612**	-4.763***
	(0.872)	(1.482)	(0.789)	(0.911)
YEAR EFFECT	YES	YES	YES	YES
N	54	54	54	54
HAUSMAN	FE	FE	FE	FE
WITHIN R2	0.866	0.753	0.817	0.888

Standard errors in parentheses / * p<0.10, ** p<0.05, *** p<0.01 / data source: MOTIE

Table A 3.5. The non-capital area estimation result-all types of industries

DEP. VAR	ALL-TYPES	PATENT	DESIGN	TRADEMARK
L.FDI	0.026***	0.008	0.021**	0.032***
	(0.007)	(0.010)	(0.008)	(0.007)
R&D STAFFS	0.071	0.241**	0.113	-0.071
	(0.071)	(0.103)	(0.083)	(0.071)
OPENNESS	0.000	0.000	0.000*	-0.001***
	0.000	0.000	0.000	0.000
PER GRDP	1.308***	1.445***	0.929***	1.341***
	(0.085)	(0.123)	(0.100)	(0.085)
CONSTANT	-6.212***	-8.160***	-4.348***	-6.344***
	(0.392)	(0.572)	(0.461)	(0.394)
YEAR EFFECT	YES	YES	YES	YES
N	234	234	234	234
HAUSMAN	FE	FE	FE	FE
WITHIN R2	0.868	0.821	0.743	0.844

Standard errors in parentheses / * p<0.10, ** p<0.05, *** p<0.01 / data source: MOTIE

Table A 3.6. The capital area manufacturing industry estimation result

DEP. VAR	ALL-TYPES	PATENT	DESIGN	TRADEMARK
L.FDI-MANU	0.000	0.007	-0.013*	0.005
	(0.008)	(0.013)	(0.007)	(0.009)
R&D STAFFS	0.519**	1.161***	0.546***	-0.018
	(0.196)	(0.333)	(0.177)	(0.212)
OPENNESS	0.001	0.002*	0.000	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
PER GRDP	0.242	-0.713*	0.061	1.207***
	(0.229)	(0.388)	(0.207)	(0.248)
CONSTANT	0.528	3.842**	1.389*	-4.436***
	(0.861)	(1.462)	(0.778)	(0.933)
YEAR EFFECT	YES	YES	YES	YES
N	54	54	54	54
HAUSMAN	FE	FE	FE	FE
WITHIN R2	0.866	0.753	0.817	0.888
HAUSMAN (PROB>0)	0.000	0.002	0.021	0.000

Standard errors in parentheses / * p<0.10, ** p<0.05, *** p<0.01 / data source: MOTIE

Table A 3.7. The non-capital area manufacturing industry estimation result

DEP. VAR	ALL-TYPES	PATENT	DESIGN	TRADEMARK
L.FDI-MANU	0.008***	0.008**	0.005*	0.007***
	(0.002)	(0.003)	(0.003)	(0.002)
R&D STAFFS	0.158**	0.300***	0.172**	0.019
	(0.071)	(0.102)	(0.084)	(0.073)
OPENNESS	0.000	0.000	0.000*	-0.001***
	0.000	0.000	0.000	0.000
PER GRDP	1.218***	1.352***	0.878***	1.269***
	(0.089)	(0.128)	(0.105)	(0.092)
CONSTANT	-5.840***	-7.797***	-4.130***	-6.030***
	(0.406)	(0.584)	(0.480)	(0.418)
YEAR EFFECT	YES	YES	YES	YES
N	234	234	234	234
HAUSMAN	FE	FE	FE	FE
WITHIN R2	0.868	0.825	0.739	0.835

Standard errors in parentheses / * p<0.10, ** p<0.05, *** p<0.01 / data source: MOTIE

Table A 3.8. The capital area service industry estimation result

DEP. VAR	ALL-TYPES	PATENT	DESIGN	TRADEMARK
L.FDI-SVC	0.027***	0.048***	0.001	0.032***
	(0.010)	(0.009)	(0.010)	(0.010)
R&D STAFFS	0.326	1.088***	0.523**	(0.250)
	(0.195)	(0.037)	(0.197)	(0.207)
OPENNESS	0.000	0.012*	0.000	(0.001)
	(0.001)	(0.000)	(0.001)	(0.001)
PER GRDP	0.339	-0.796	0.049	1.330***
	(0.215)	(0.148)	(0.217)	(0.229)
CONSTANT	0.240	4.069***	1.312	-4.769***
	(0.805)	(0.877)	(0.813)	(0.857)
YEAR EFFECT	YES	YES	YES	YES
N	54.000	54.000	54.000	54.000
HAUSMAN	FE	RE[16]	FE	FE
WITHIN R2	0.884	1.000	0.802	0.900

Standard errors in parentheses / * p<0.10, ** p<0.05, *** p<0.01 / data source: MOTIE

Table A 3.9. The non-capital area service industry estimation result

DEP. VAR	ALL-TYPES	PATENT	DESIGN	TRADEMARK
L.FDI-SVC	0.002	(0.001)	0.003	0.004**
	(0.002)	(0.003)	(0.002)	(0.002)
R&D STAFFS	0.086	0.257**	0.106	(0.046)
	(0.068)	(0.102)	(0.076)	(0.065)
OPENNESS	0.000	0.000	0.000	-0.001***
	0.000	0.000	0.000	0.000
PER GRDP	1.242***	1.306***	0.887***	1.329***
	(0.084)	(0.125)	(0.093)	(0.080)
CONSTANT	-5.455***	-6.999***	-3.701***	-5.981***
	(0.382)	(0.570)	(0.424)	(0.367)
YEAR EFFECT	YES	YES	YES	YES
N	288.000	288.000	288.000	288.000
HAUSMAN	FE	FE	FE	FE
WITHIN R2	0.851	0.777	0.727	0.849

Standard errors in parentheses / * p<0.10, ** p<0.05, *** p<0.01 / data source: MOTIE

[16] Hausman test result for patent application suggests RE results. From FE results, L.FDI-svc is 0.046***(0.016), R&D is 0.8351.088**(0.331), openness is 0.002*(0.001), per GRDP is 0.539(0.365), constant is 3.378**(1.370) and within R2 is 0.785. S.D. Standard errors in parentheses Since both FE and RE results for L.FDI-svc are similar, this study shows FE results instead of RE result for consistency for readers.

Table A 3.10. Estimation results among various patent variables and FDI inflows in different time lags (L=1~5)

	LOG(ALL_PATENT)			LOG(PATENT)			LOG(DESIGN)			LOG(TRADEMARK)		
	Coef.	Std. Err.	P>|t|	Coef.	Std. Err.	P>|t|	Coef.	Std. Err.	P>|t|	Coef.	Std. Err.	P>|t|
LOG(FDI)												
L1.	**0.019*** **	0.006	0.002	0.009	0.009	0.324	**0.014** **	0.007	0.046	**0.021*** **	0.007	0.002
L2.	**0.025*** **	0.006	0.000	**0.017***	0.009	0.067	**0.037*** **	0.007	0.000	**0.026*** **	0.007	0.000
L3.	**0.016*** **	0.006	0.010	0.010	0.009	0.282	**0.021*** **	0.007	0.002	**0.014** **	0.007	0.043
L4.	0.010	0.006	0.127	-0.001	0.010	0.948	**0.016** **	0.007	0.022	**0.013** **	0.007	0.063
L5.	0.009	0.006	0.145	-0.003	0.009	0.759	**0.014** **	0.007	0.035	**0.010*** **	0.006	0.114
LOG(RDPER)	0.084	0.060	0.158	0.215*	0.092	0.020	0.156**	0.066	0.020	-0.033*	0.064	0.607
OPENNESS	-0.001***	0.000	0.000	-0.001*	0.000	0.051	0.000	0.000	0.332	-0.001***	0.000	0.000
LOG(PERGRDP)	0.901**	0.080	0.000	0.866***	0.124	0.000	0.483***	0.090	0.000	1.201*	0.087	0.000
_CONS	-3.473***	0.388	0.000	-3.752***	0.597	0.000	-1.657***	0.433	0.000	-5.676	0.420	0.000