Regional Strategic Industry (RSI) Promotion Projects and Their Impact on Regional Economic Growth

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Abstract

This study tries to measure the direct and indirect effects of the Regional Strategic Industry (RSI) promotion projects in Chungbuk Province in Korea. In specific, it critically examines whether there exists policy consistency and connectivity between the hardware-oriented Stage I and the software-centered Stage II RSI promotion projects. Major findings are as follows: Firstly, 'the continuous investment' is regarded as the most crucial policy leverage for the strategic industry promotion and regional economic growth. Secondly, without exceptions, the RSI promotion projects should switch their evaluation criteria to performance-oriented ones. This paper suggests a series of candidates including job creation, patent application, manpower training, and pilot production and sales, all of which would significantly contribute to budgetary efficiency. Thirdly, in selecting their subprojects, the RSI promotion projects should pay due attention to evaluating technology value and marketability. Fourthly, it should put policy priority in strengthening cluster networking and interconnectivity among projects, inevitably supporting a selective number of virtuous network systems. Fifthly, auxiliary projects such as marketing, technology aid, and knowledge-based services should not be overlooked.

Keywords: Regional Strategic Industry (RSI) Promotion Projects, Regional Economic Growth, Flow Diagram, Simulation, Chungbuk Province

Ⅰ. Introduction

In continuing efforts to boost national competitiveness through enhancing regional competitiveness, the discussion of how to innovatively build and apply the social and network capital for promoting regional industry becomes increasingly relevant. Specially, recent industrial economy strongly exhibits upward trends of being globalized, knowledge-based, service-oriented and converging. In order to build up regional industries to meet their trends--deviating from current flow--creative innovation for the regional strategic industry and initiatives aiming at cooperative systems is regarded as essential. To make regional strategic industry more competitive and sustainable, it seems imperative to strengthen

virtuous circles between the regional industry promotion policy and the regional economic growth effect.

This study primarily tries to elaborate the outcomes of the Regional Strategic Industry (RSI) promotion projects and their spillover effects. Specifically, this study critically examines whether there exists policy consistency and connectivity between the hardware-oriented Stage I and the software-centered Stage II RSI promotion projects in Korea. This study examines the Chungbuk Province′s strategic industry promotion projects and their effects, mostly covering from 2002 to 2012.

Derived from simulation works, this study presents causal loop diagrams revealing linkage structure and the direct and indirect effects of the Chungbuk RSI promotion project. The processes will be demonstrated through the flow diagrams adopted from the system dynamics approaches, all of which enables computer simulation works, visualizing modeling procedures and final outputs. This study also analyzes the popular patterns of major variables and evaluates the appropriateness of the proposed models with sensitivity tests. Lastly, it searches for couples of policy leverages to foster the RSI promotion projects in Chungbuk Province.

Ⅱ. Literature Review

1. Outline of Regional Strategic Industry Promotion Projects

In order to tackle the shrinking of regional industry, especially after the financial crisis raging in 1998, Korean central and local governments have actively implemented the RSI promotion projects since from 1999. Starting from four regional projects in 1999, all the non-capital areas have been under the influence of the RSI promotion projects since 2002. They have covered various targets such as infrastructure building (establishing test-bed and equipment centers), R&D centers dealing with Industry-University-Institute collaboration, and task force teams.

Whilst the Roh Moo-Hyun Administration (2003-2007) expanded the budget for supporting the regional strategic industry under the title of the balanced national development initiatives, the Lee Myung-Bak Administration (2008-2012) shifted its paradigm towards the mega-city region, expanding geographic coverage.

The RSI promotion projects hosted by Division of Regional Industry, the ex-Ministry of Knowledge Economy, focused on the establishing regional innovation systems, regional strategic industry development guidelines, and local science technology promotion roadmaps stressing regional specialization sectors. The target areas of these projects are the thirteen metropolitan city-provinces, except for the Capital Region. Adopting grant programs of regional governments, they are subsidized by the central and local government in the form of matching funds, covering 30 percent of the construction cost, 70~80 percent of the building equipment cost, and 60 percent of the enterprise support service cost.

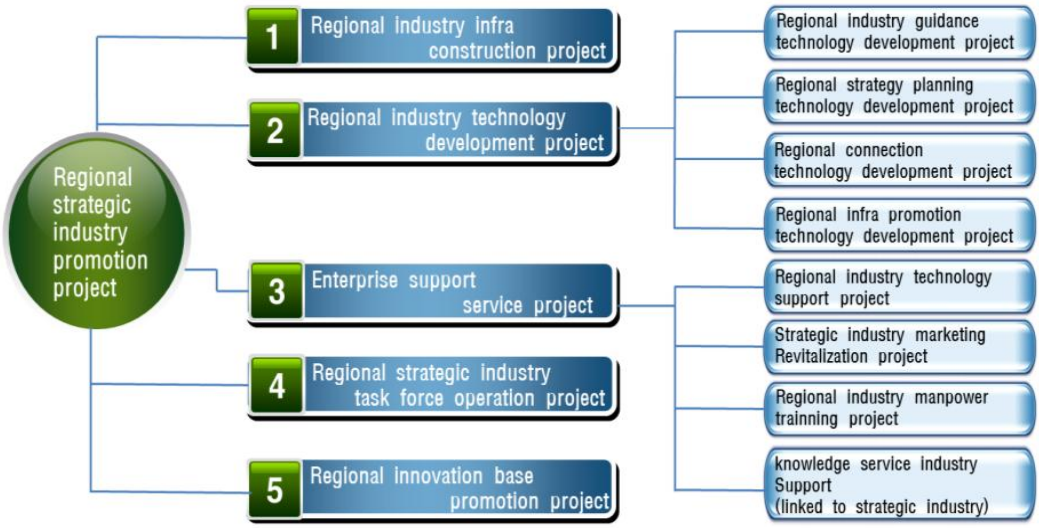
The RSI promotion projects are divided into 5 project units, that is, regional industry foundation projects, regional industry technology development projects, enterprise support service projects, regional innovation agency operating projects, and the regional base promotion projects. The composite system of these RSI promotion projects is as follows in the [Figure 1].

2. Implementation status of Chungbuk Strategic Industry Promotion Projects

The investment for the hardware and software sectors to promote the regional strategic

industry in Chungbuk was kicked off in 2002. According to <Table 1>, key projects were transformed from Stage I building-up hardware projects to Stage II software ones. In other words, Stage I projects were pushed toward technical development and infrastructure construction projects. In contrast, Stage II projects put emphasis on software-oriented programs such as manpower development, technical support, knowledge-based industry support, regional base promotion, regional innovation agency operation, and technical development projects.

[Figure 1] Block diagram of the RSI promotion projects



Concisely, State I (2002-2007) projects supported establishing sectorial specialization centers, in addition to infrastructure equipment and research funds solely for effective production activities. Chungbuk sponsored 181 billion Won of public funds: 161.15 billion Won for the government expense, 28.11 billion Won for the provincial government expense, and 36.85 billion Won for the private sector. In Stage II, the RSI promotion projects and regional base promotion projects were integrated, and their fund was expanded to 153.48 billion Won: 93.8 billion Won for the government expense, 49.3 billion Won for the provincial government expense, and 10.38 billion Won for the private sector.

<Table 1> Categories of Chungbuk strategic industry promotion projects

Type		Supporting Project	Agent
Regional Strategic Industry promotion project	Regional Specialization Center (H/W) (Stage I)	Semiconductor Equipment Component Test Center Electo Information Component Industry Support Center Conventional Medicine Development Support Center Health Care Industry Support Center Next Generation Semiconductor Embedded System Technical Support Center	Chungbuk TP (Techno- Polis)
	Regional Specialization Center (H/W) (Stage II)	Next Generation Semiconductor experiment Infra Electro Convergence Component Industry Test Infra Oriental Medicine Industry Cluster Health Care Industry Bio-venture Park System IC design support infra	

	Enterprise Support (S/W) (Stage II)	Health Care Industry Technology Enhancement Oriental Medicine Industry Technology Enhancement Electro Convergence Component Technology Enhancement Semiconductor Industry Technology Enhancement	
	Task Force (S/W)	Chungbuk Strategic industry Task Force Operation Projects	
	Regional Base Promotion	Chungbuk Regional Base Promotion	

Source : Chungbuk Technopolis

3. Research Trends

First of all, Kim and Kim (2007) analyzed the relatedness between the public R&D research institute, the budget of medium-sized businesses, and the research development outputs (technology) to find out the key reasons why the ratio of R&D investment was almost same over research period, even though the government R&D budget was expanded over years during the same period. They pointed out that the actual result was poor even though the government enacted independent ordinances encouraging technology development. Also they criticized the fact that most of public R&D research institutes did not set up technology licensing organization or similar organizations.

Kim and Ahn (2011) tried to simulate decision-making procedures of complicated R&D investment projects using System Dynamics approaches. Meanwhile, Lee (2010), applying a System Thinking methods, paid attention to why Daegu Millano project ended in failure. She pointed out the fact that the insufficient consensus building among the stakeholders was destined to fail.

In a similar context, Kim (2011) examined logistics industry cluster of the global corporations, all of which would locate in the Incheon Harbor complex. In long-term perspectives, he developed causal loop diagrams and simulation models which would facilitate the central and local government′s strategy development.

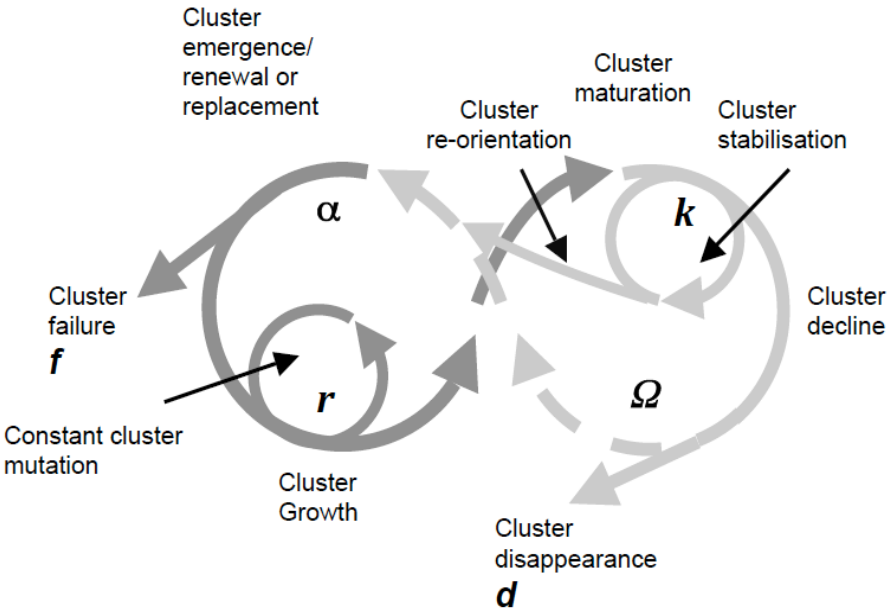
Related to the overseas precedent studies, Scheel et al (2005) constructed System Dynamics models integrating three main actors of region, industry, and corporation. This study suggested eight indicators to measure regional attractiveness: clustering and association, added value, differentiation value, added economic value, attractiveness leverage, global market coverage, innovation, and social capital. They developed couples of dynamic models for location of the start-ups, highlighting aerospace, automobile component, ergonomics, and software industry clustering examples.

Teekasap (2009) analyzed the effects of the government policy on cluster formations, using System Dynamics modeling. His conceptual cluster models focused on the correlation of resources, workers, jobs, unemployment, salary, market demand, and production capacity. This study reaffirmed that cluster was rapidly growing, especially after a training institute was established, but cluster size was be impeded by increasing land area.

Kuns (2007) paid attention to the cases of the medium-sized businesses, which are growing with clustering or with global value chains by being independent from regional networks. On the contrary, Ho and Wang (2009) figured out the interrelation between subsystem and indicators in regards to the sustainable development systems of the science city. Their study selected the indicators for sustainable development, using the Fuzzy Delphi method and simulated it with System Dynamics.

Meanwhile, as shown in the [Figure 2], the cluster evolution model suggested by Martin and Sunley (2011) implied stabilized and decayed patterns would co-exist and everlasting transformation would be the most important precondition for the continuous expansion of any

cluster. In other words, it seemed apparent that cluster stabilization might cause the break-down in the end. In order to keep cluster vitality, they insisted, due attention should be paid to cluster transformation.



[Figure 2] Cluster cycle model

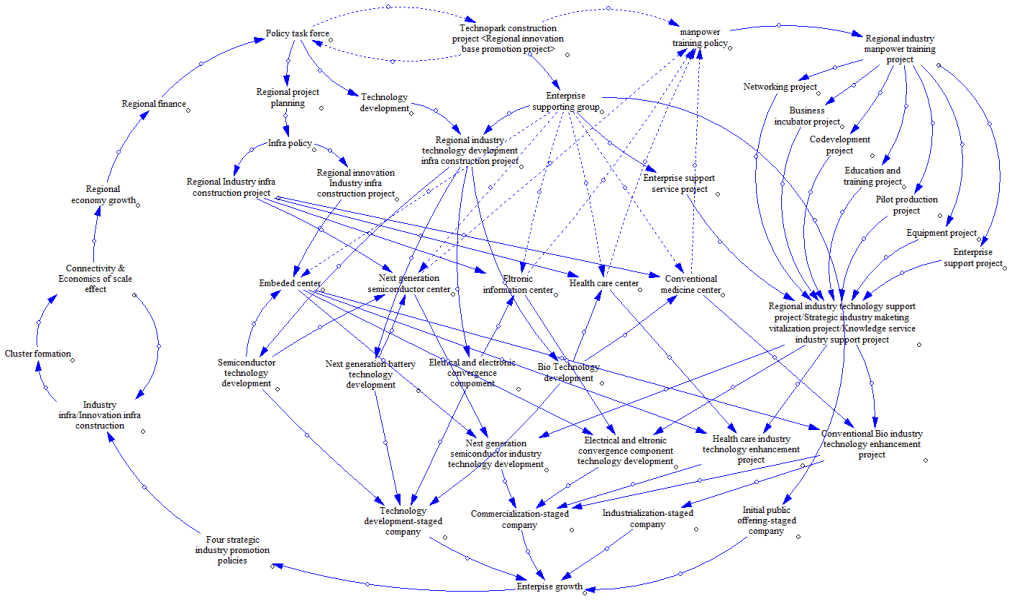
Source: Martin, R., and P. Sunley (2011), "Conceptualizing Cluster Evolution: Beyond the Life-Cycle Model?", Papers in Evolutionary Economic Geography (#11.12), Urban and Regional Research Center, Utrecht University, http://econ.geo.uu.nl/peeg/peeg.html.

Ⅲ. Construction and Analysis of Causal Loop Diagrams

1. Diagrams of Four Strategic industry promotion projects in Chungbuk

As mentioned earlier, four strategic industry promotion projects in Chungbuk were carried out with the Stage I and II projects. In the Stage I, the central and provincial governments formulated basic guidelines and appropriated the budget, depending on the priority of the strategic industry task force operating projects. In reality, the strategic industry task force team functioned as the main body in charge of R&D fund support tasks, which again funded the R&D related companies. Technopark construction projects, on the other hand, consisted of management support, marketing, education, training, and company supporting fund operation. Pilot production and research development support were transferred to the Stage II projects, and changed the title to regional innovation base projects. In the Stage II, the spotlight was given to company support service projects for technology development and regional industry manpower training projects.

With this backdrop, this paper tries to present basic structure of the four strategic promotion projects in Chunkbuk Province and reconstructs their system using VENSIM 5.9 software. The [Figure 3] shows diagrams on the linkage structure of the Chungbuk RSI promotion projects.



[Figure 3] Diagrams presenting the basic linkage structure of the Chungbuk RSI promotion projects (Stage I and II)

2. Project-Based Analyses

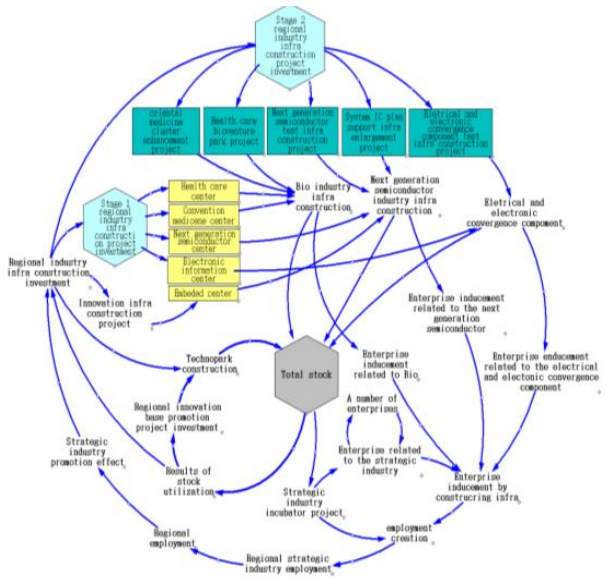
1) Infrastructure Construction Projects

The [Figure 4] points out the results of the center construction projects on the regional industry infrastructure construction project′s investment. As shown in the [Figure 4], the Stage planned regional projects such as Technopark construction as part of an infrastructure construction to promote Chungbuk′s strategic industry. In the Stage II, test beds in health care, oriental medicine industry, next generation semiconductors, system IC plan support, electrical and electronic converged to component built up. The central construction support projects were started from 2002 and ended in 2010. The feedback loops whose structure would enhance the regional competitiveness appears congruent with the enterprise inducement projects.

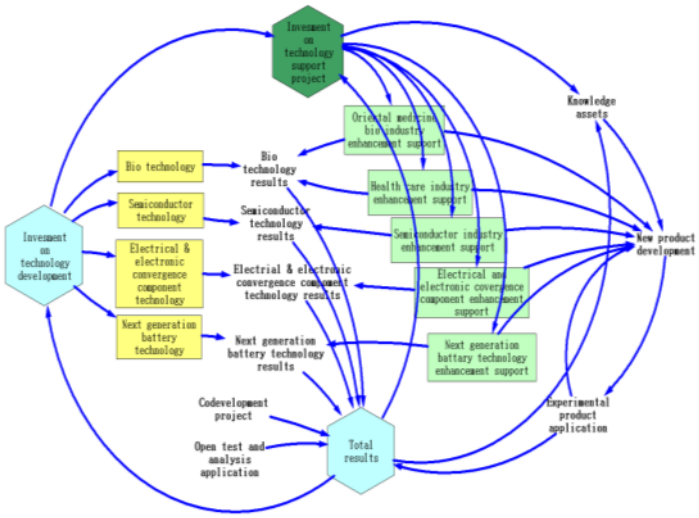
2) Strategic Industry Technology Development Projects

In the Stage II projects from 2008 to 2009, the system for developing focal technology to lead strategic industry was built up on the basis of the structure in response to demand of technology development of innovation-oriented enterprises. Thereafter, the technology development project was pushed forward up to 2012 to achieve creative research output within the limits of regional strategic industry.

Suggested in the [Figure 5], Chungbuk strategic industry technology development projects, which imply a continuous investment on the regional strategic industry have been increasing knowledge assets in connection with enterprise support service. Enterprises were allocated to technology development, analysis, production, patent certification, and information management. In consequence of the support, enterprises developed new products, increased knowledge assets, and funded continuous investment for its outputs.



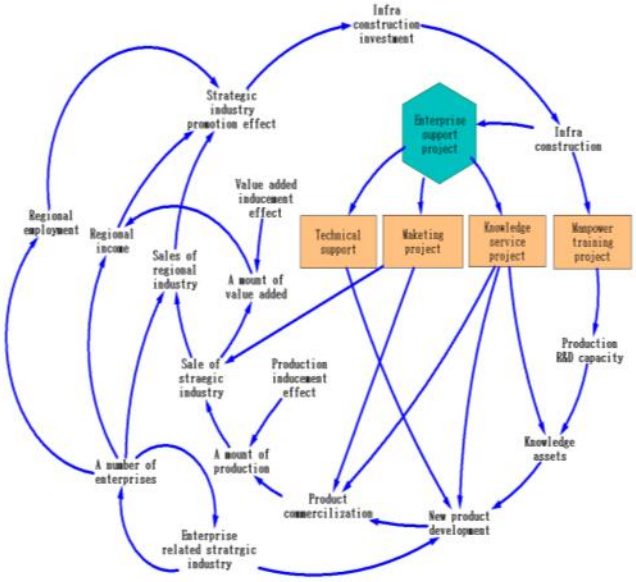
[Figure 4] The causal loops of infrastructure construction projects



[Figure 5] The causal loops of technology development projects

3) Strategic Industry Enterprise Support Projects

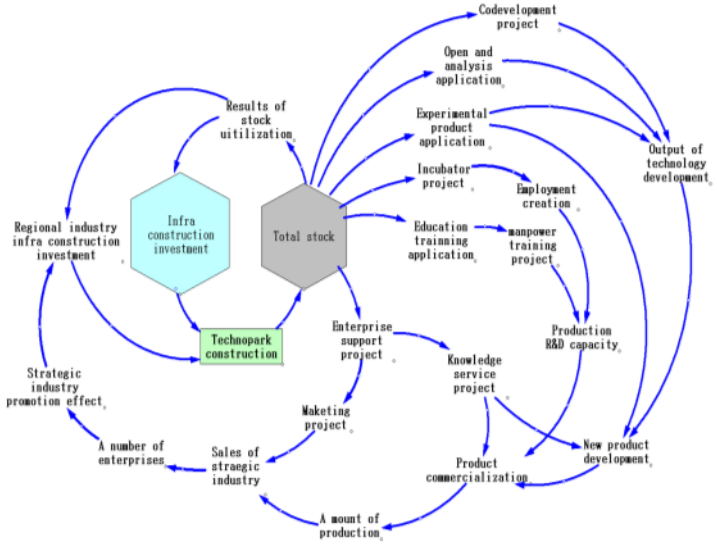
The Chungbuk Strategic Industry Enterprise Support Projects in the [Figure 6] are funded continuously, connecting regional industry infrastructure construction projects. The following is shown: the structure yielding domestic and foreign marketing, the cultivation of the markets, business start-up, and training employees. Enterprise support projects imply that the systems connecting the increase of new products and the amount of production of the value added should be maintained.



[Figure 6] The causal loops of enterprise support projects

4) Regional Innovation Base Promotion Projects

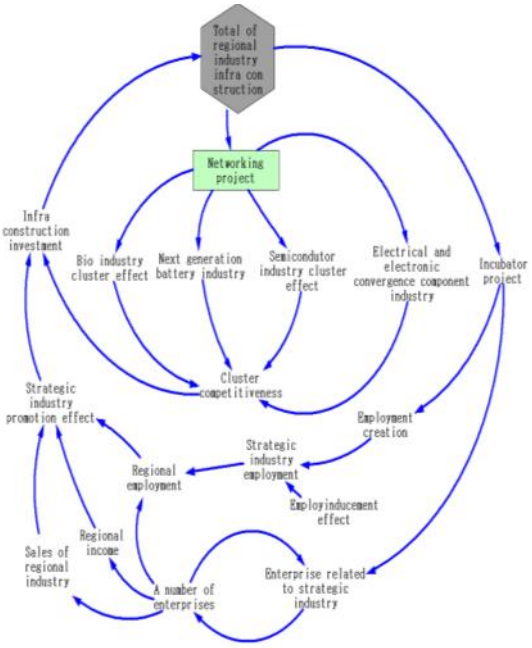
Based on the Stage I Infrastructure Construction Projects, regional innovation based promotion projects carried forward resources for survey and analysis, monitoring group built-up and management, industry-university-institute council operation to strengthen the technopark functions as a regional innovation base. In the Stage II to support the enterprises concentrating on the software, integrated service is created in order to support the technology enterprise promotion projects such as training, management and technology infra utilization projects. As seen from the [Figure 7], the projects are made of virtuous circulation that the technopark performs such as incubator projects, education and training, enterprises support for strengthening the R&D capacity, creating employment and promoting strategic industry in regions.



[Figure 7] The causal loops of regional innovation base promotion projects

5) Strategic Industry Growth and Regional Economic Performance

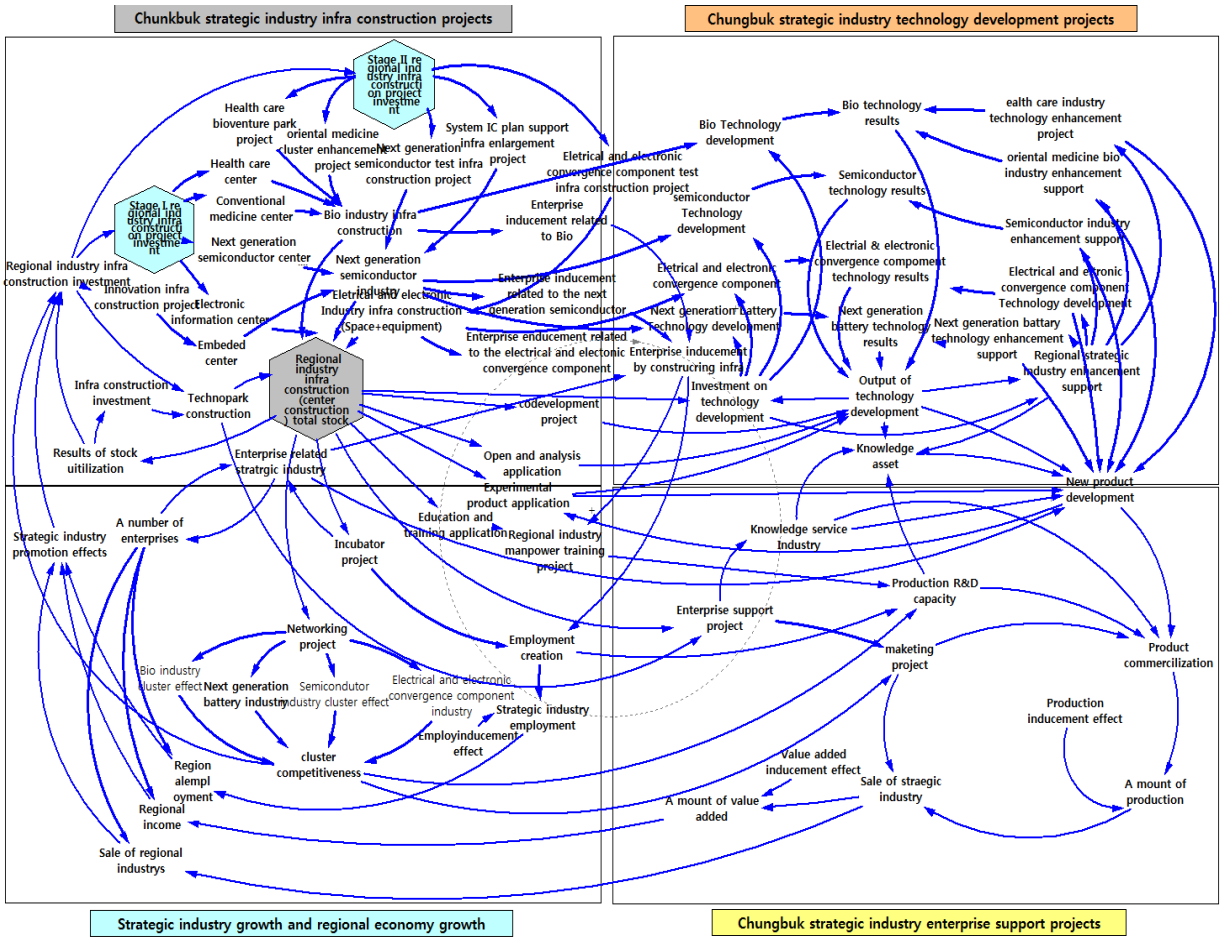
From the [Figure 8], this project affects the cluster effects of the bio industry, next generation battery industry, semiconductor industry, and electrical and electronic convergence component industry, while also increasing the cluster competitiveness. Increasing the cluster competitiveness is also related to the regional industry infrastructure construction investment, which also enlarged the front back industry across the board while the regional industry growth promotes the incubator projects, which increase employment and the number of companies in different regions. This structure formed the virtuous cycle of input of capital, strengthening of the technical capacity, employee training, business start-up, enterprise inducement, knowledge-sharing, cooperation reinforcement. Thus, as a result, it is implied that productivity increase and innovation improvement are comprised for the front back correlation in these regions.



[Figure 8] The causal loops of strategic industry growth and regional economic performance

6) Synthesis

Regional strategic industry promotion project is aiming to activate the industry cluster formation. As suggested in the [Figure 9], these projects promote infrastructure construction, technology development, enterprise support, and regional innovation base promotion to improve the competitiveness and to enhance the regional innovation system. Consequently, enterprises develop technology aggressively, receive tangible and intangible aids, and create values that add to the commercialization of products. The infra construction project is building up the industry infrastructure to foster regional strategic industry, and support hardware and software to enterprises. These systems raise the possibility to induce enterprise and locate them in desired regions. Furthermore, enterprises improve production capability and contribute to profits for the regional economy. The scale of regional employment, thus, is being expanded, industry economy is revived, and the possibility to improve local competitiveness is on the rise.



[Figure 9] Integrated diagram of four strategic industry promotion project in Chungbuk

Ⅳ. Simulation Modeling and Analysis on Chungbuk Strategic Industry Promotion

1. Overview of Simulation

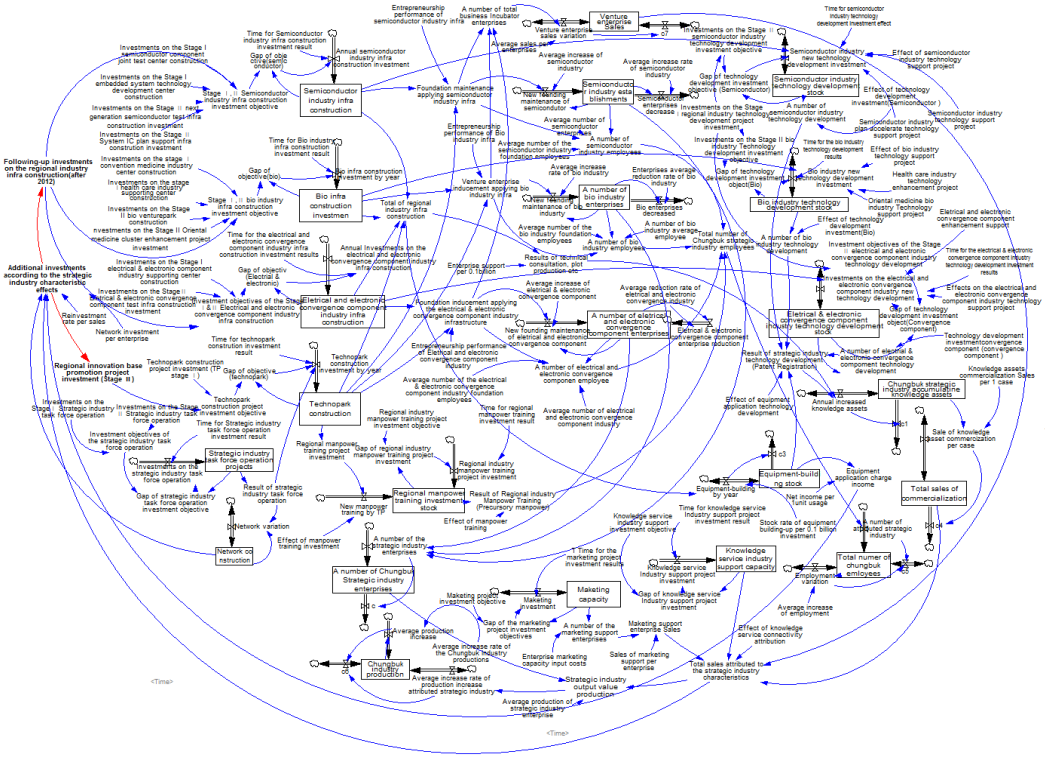
The analysis by the simulation model of the System Dynamic methodology is a useful tool to recognize the causal-cycled feedback structure of how to be mutually connected to Stage I and II projects, how to attribute to strategic industry promotion and local economy growth, and how to appear in a long-term pattern. The objects of this study are the five sectors, eighteen projects in four strategic industry promotion projects divided into Stage I and II from 2002 to 2012. This study aims at analyzing how its outcomes are shown in terms of infrastructure building, technology development, foundation, manpower training, marketing, networking, commercialization and sales. Also, a simulation model is built up to discriminate how Chungbuk strategic industries grow and face limits of growth in the 2022 after completing State II of the strategic industry promotion projects in 2002.

The [Figure 10] presents the relationship between the Chungbuk strategic industry promotion projects and sub-projects, implementation results of these projects, and interregional linkage effect in Chungbuk. The variable level changed by the affection of rate variable is the most important variable to indicate the status of the analysis object system. Major level variables are listed in the <Table 2>: characteristics of presenting the regional industry infrastructure construction project, regional innovation base promotion project, technology development

project, enterprise support service project, result of strategic industry promotion, and attribution of regional economy growth.

<Table 2> Key level variables

Category	Fields of strategic industry promotion project	The name of variable
level variable	Regional industry infra construction project	Semiconductor/ Bio/ Electrical and electronics convergence component industry infra construction
	Regional innovation base promotion project	Technopark construction
	Technology development project	Semiconductor/ Bio/ Electrical and electronics convergence component industry technology development stock
	Enterprise support service project	Strategic industry manpower training stock, marketing capacity, knowledge service industry support capacity, strategic industry task force operation, network building-up
	The results of Strategic industry promotion	accumulated sales of venture company, a number of semiconductor/ bio/ Electrical and electronics convergence component industry enterprises, a number of enterprises of Chungbuk strategic industry, accumulated knowledge assets of Chungbuk strategic industry, accumulated sales of commercialization, equipment building-up stock
	Attribution of regional economy growth	the total number of the employed, outputs of Chungbuk industry



[Figure 10] Simulation models of Chungbuk strategic industry results and interregional economic linkage structure

2. Simulation works

1) Simulation scenarios

This study sets up three scenarios like <Table 3> to predict how the result in 2022 of the Chungbuk strategic industry promotion project proceeded from 2002 to 2012. An reinvestment model is assumed that the Chungbuk strategic industry not only grows as a result of the strategic industry promotion projects of Stage I and II, but also continuously reinvests a certain percentage of sales with the consequence of growth in it. The Stage III investment model sets up the scenarios additionally investing fifty percentage of Stage II project.

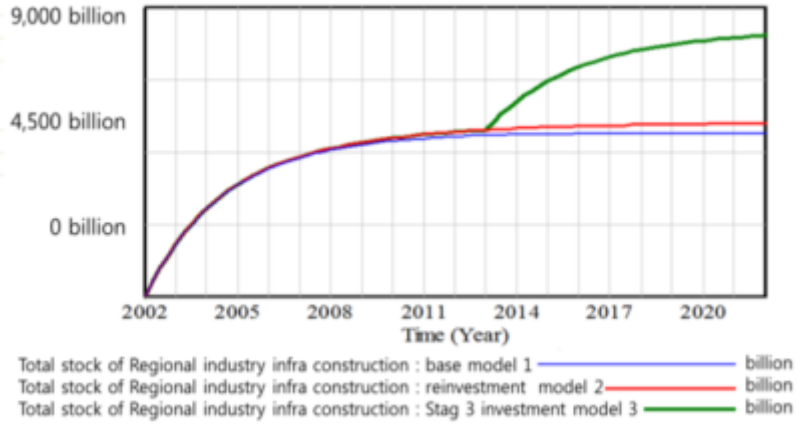
<Table 3> Three scenarios of simulation

Scenario Type	Scenario composition/ premise
Basic Model	- A model of investment and result analysis of Stage I, II strategic industry promotion project - None of any type of investment are made
Reinvestment Model	- Based on the basic model - A model of certain percentage of sales created by investment effect of strategic industry reinvest continuously and predict the result - Assumption that 20% of result of strategic industry promotion is reinvested
Stage III Investment Model	- A model that Additional investment is made for promoting Stage III strategic industry promotion based on the Reinvestment Model and predicts the result - Assumption that newly reinvest 50% of Stage II project investment

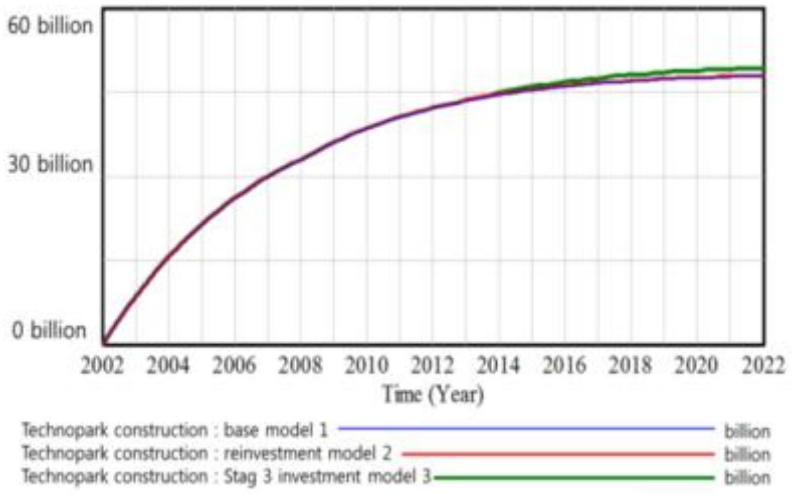
2) A Comparison with Simulation Outcomes of Basic Models, Reinvestment Models, and Stage III Investment Models

(1) A Comparison of Regional Industry Infra Construction Results

The {Figure 11} and {Figure 12} show the investment results of infra construction project to promote Chungbuk strategic industry, and show how investment results come from each project. Change of infra construction stock according to the three scenarios is that the result of Reinvestment scenario is much better than the result of Basic model which is funded by strategic industry promotion project without reinvestment, and the result of Stage III investment scenario is shown to be relatively high.



[Figure 11] A comparison with simulation outcomes of the infrastructure construction stock scenarios

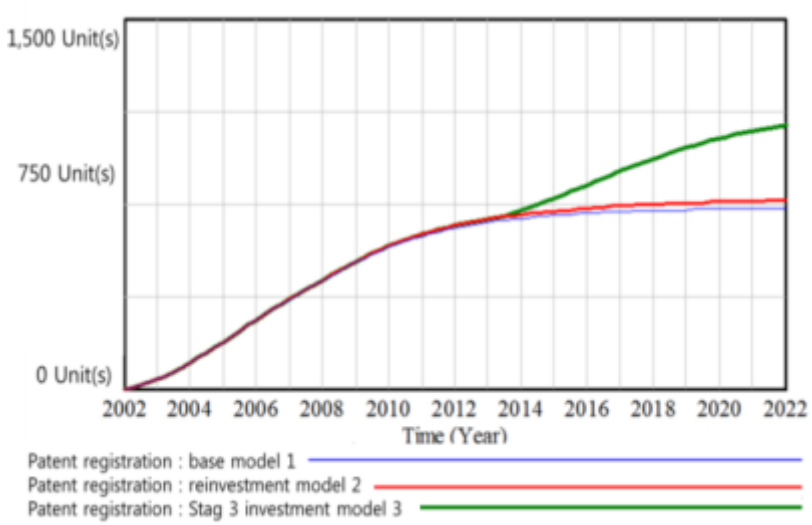


[Figure 12] A comparison with simulation outcomes of technopark construction scenarios

In [Figure 12] scenarios comparison about technopark construction investment, the outcomes of three scenarios are not significantly different but the effect of Stage III investment model is comparatively larger than Reinvestment model.

(2) A Comparison of Technology Development Results

In results of strategic industry technology development like [Figure 13], the results of the Stage III investment scenario(1,068 cases) is much bigger than the Reinvestment scenario(760 cases). It means that a massive investment of Stage III is necessary to obtain continuous results, however, reinvestment itself is not enough to achieve the technology development effect.

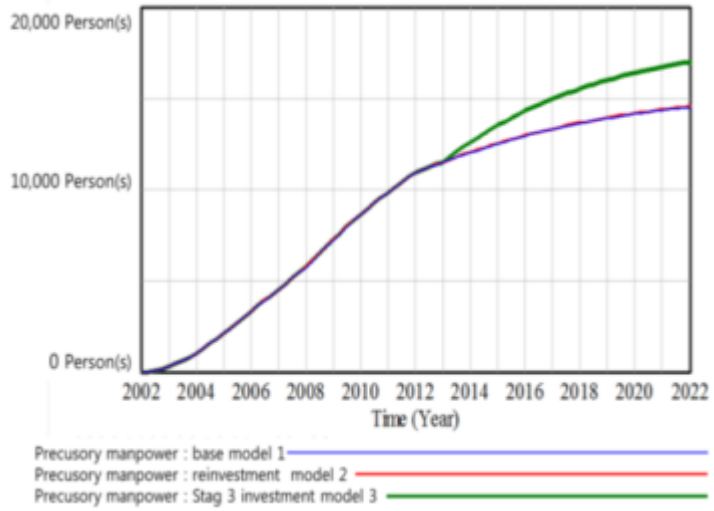


[Figure 13] A comparison with simulation outcomes of technology development scenarios

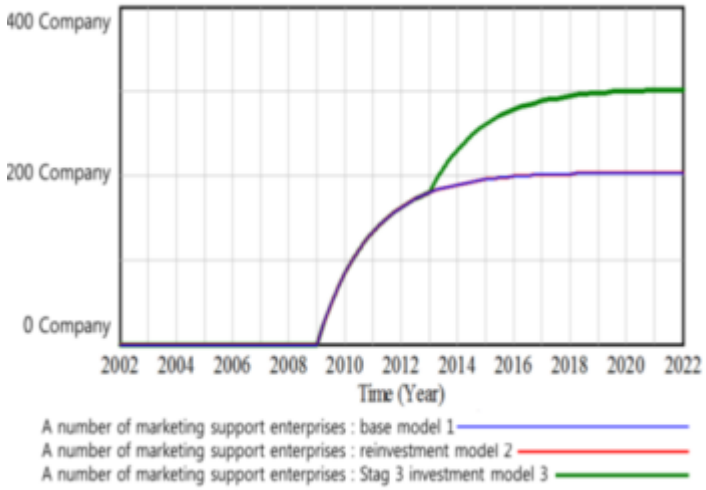
(3) A comparison of enterprise support service project results

As suggested in the [Figure 14], the three scenarios comparison with regional strategic

industry manpower training results is shown that reinvestment is insufficient, and that the investment result of Stage III strategic industry promotion projects comes relatively.
The result of a number of enterprises received marketing aid by enterprise support service projects according to the three scenarios is predicted so that the result of an intensive investment model of Stage III is nearly two times bigger than an Reinvestment model as seen in the [Figure 15]



[Figure 14] A comparison with simulation outcomes of regional industry manpower training scenarios



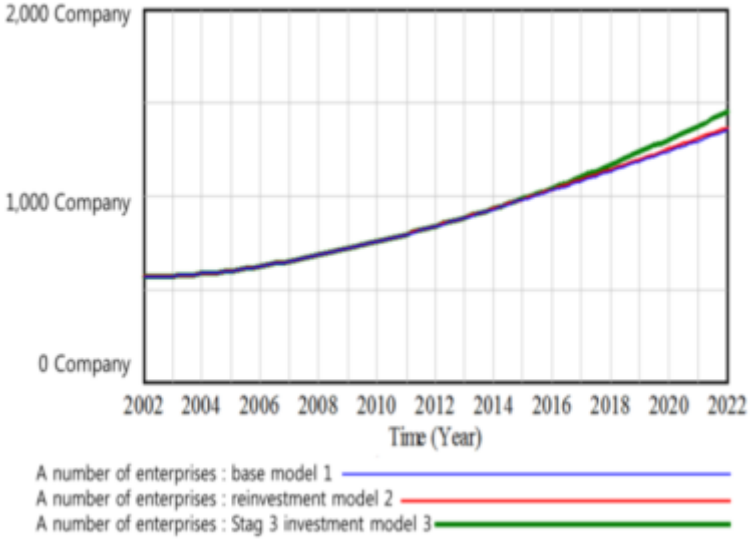
[Figure 15] A comparison with simulation outcomes of marketing support enterprises scenario

(4) A comparison with strategic industry promotion results

① A number of enterprises and the employed in strategic industry

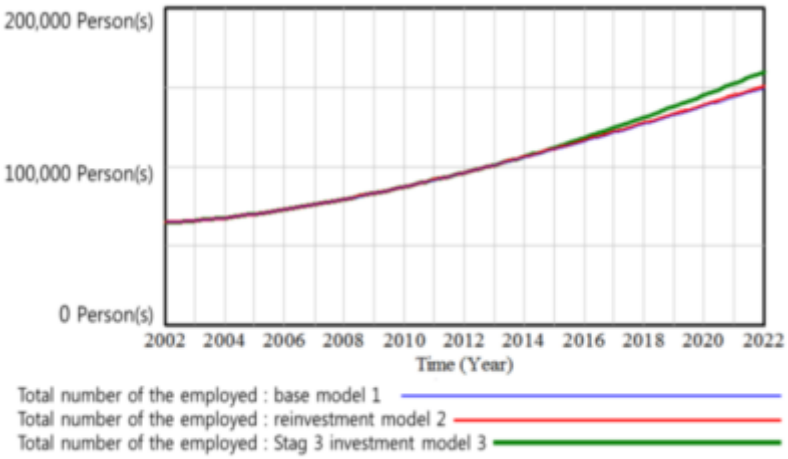
A number of enterprises and the employed in the four Chungbuk strategic industries as variables effected by the results of strategic industry, are the acid test. As presented in the

[Figure 16], a number of enterprises in four Chungbuk strategic industry is expected to increase 1,447 in 2022 from the Stage III model, but the results of Basic model and Reinvestment model are below the results of the Stage III model.



[Figure 16] A comparison with simulation outcomes of a number of Chungbuk strategic industry enterprises

The difference of increasing total employees between these two scenarios comes from the implicit dominant positioning of investment. According to the simulation result of the Stage III investment model from the [Figure 17], the number of employees in Chungbuk strategic industry is expected to run into 159.2 thousand people in 2022. The result of the Stage III investment model is higher in comparison with the difference of the strategic industry promotion results by two scenarios.

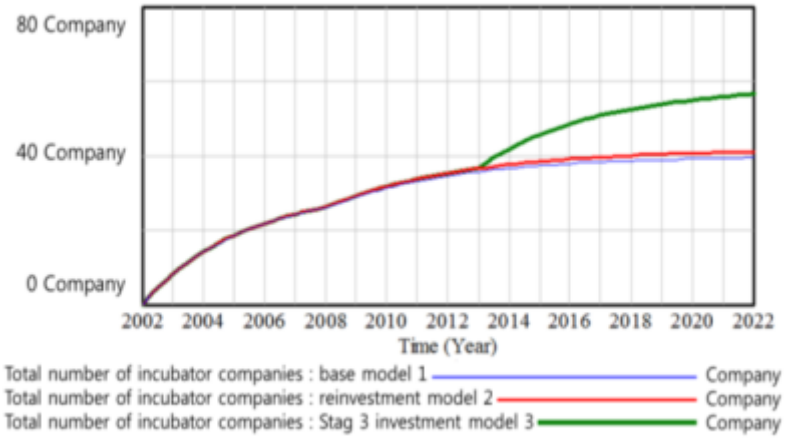


[Figure 17] A comparison with simulation outcomes of the total employees scenario

② Incubator, total sales, amount of production

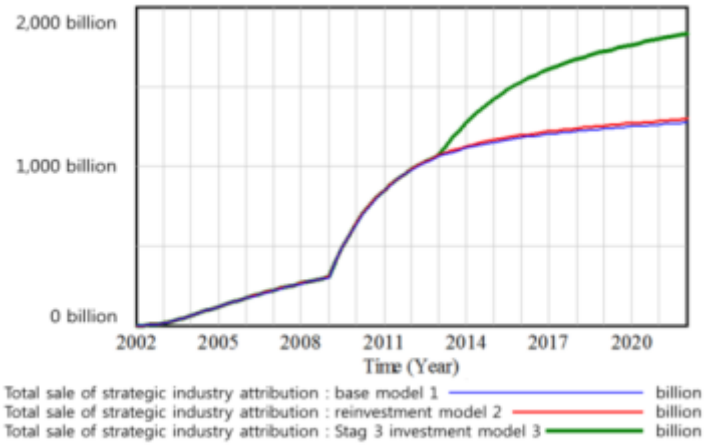
In the same vein, a number of annual incubator enterprises, which are the fruit of the strategic

industry promotion have a huge difference depending on the scenarios in the [Figure 18].



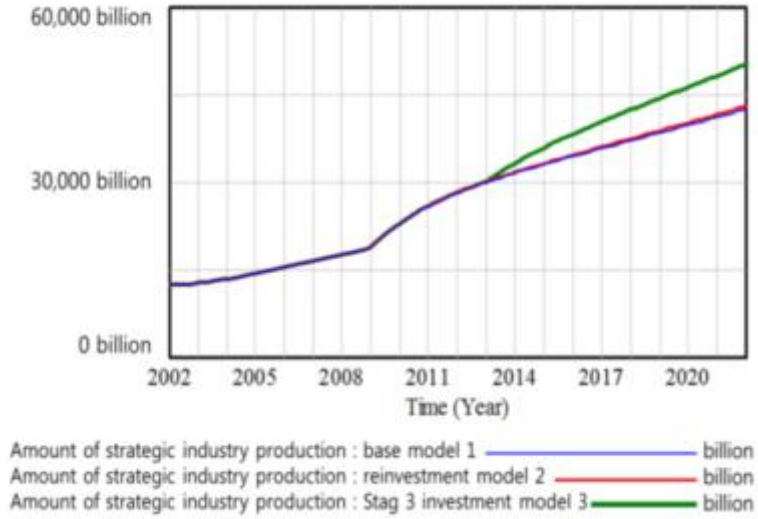
[Figure 18] A comparison with simulation outcomes of incubator enterprises scenarios

From the Stage III reinvestment model, it is predicted that 60 enterprises will be annually founded by 2022, that is at a high in comparison to the Basic model or Reinvestment Model. Also, the difference of total sales of enterprises is well shown to that newly additional investment on Stage III projects bringing more fruitful results(see Figure 19).The total sales of enterprises contributed to the Chungbuk strategic industry promotion is expected to reach 1.82 trillion.



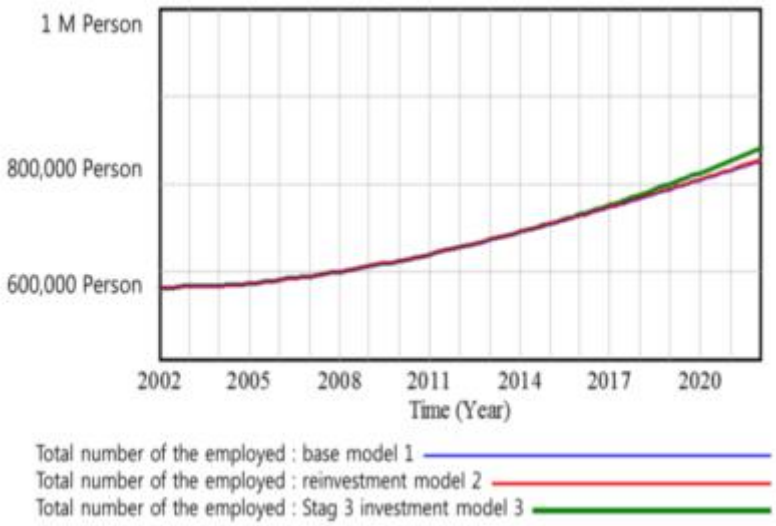
[Figure 19] A comparison with simulation outcomes of total sales scenarios

In the same context, the [Figure 20] indicates the difference of increasing production by promoting the Chungbuk strategic industry. Following the Stage III investment Model, total production of the Chungbuk strategic industry will reach to up 50 trillion, which is largely increased by the amount of money in comparison with the 42 trillion of the Basic model's expectation.



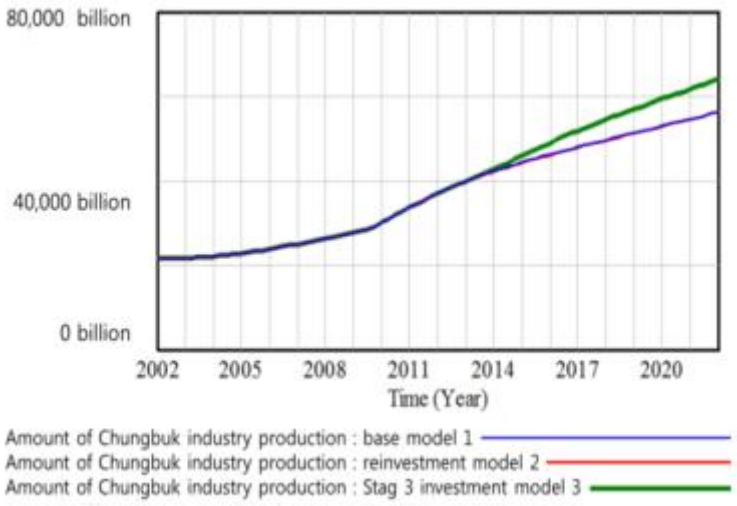
[Figure 20] A comparison with simulation outcomes of total production scenarios

The increasing total number of employees and production in Chungbuk is affected positively by the Chungbuk strategic industry promotion policy and also shows that the Stage III investment causes better achievement (see [Figure 20] and [Figure 21]). The positive effect creating 20 thousand employments will be caused by funding on Stage III investment, following the investment on State II strategic industry promotion project ended in 2012.



[Figure 21] A comparison with simulation outcomes of total employees scenarios

In the case of continuing investment on the Stage III strategic industry promotion project, the total amount of the Chungbuk industry production reaches up to 63.9 trillion Won, which is owed to the rapid increase of strategic industry production.



[Figure 22] A comparison with simulation outcomes of total Chungbuk industry production scenarios

Ⅴ. Conclusion: Searching for Policy Leverages

Even though various RSI (Regional Strategic Industry) promotion projects geared towards regional industry development have been actively implemented throughout the Stage I, and II, wide margins have existed among their performance. In other words, some projects have significantly exerted positive impact on the regional industry promotion, but others haven′t. Therefore, it seems inevitable to adopt selective options to intensively invest on couples of projects which would yield higher scores in the efficient category.

In this context, the Chungbuk RSI (Regional Strategic Industry) promotion projects in the future should take notice of couples of policy leverages. Firstly, ‘the continuous investment' is regarded as the most crucial policy leverage for the strategic industry promotion and regional economic growth. Secondly, without exceptions, the RSI promotion projects should switch their evaluation criteria to performance-oriented ones. This paper suggests a series of candidates including job creation, patent application, manpower training, and pilot production and sales, all of which would significantly contribute to budgetary efficiency. Thirdly, in selecting their subprojects, the RSI promotion projects should pay due attention to evaluating technology value and marketability. Fourthly, it should put policy priority in strengthening cluster networking and interconnectivity among projects, inevitably supporting a selective number of virtuous network systems. Fifthly, auxiliary projects such as marketing, technology aid, and knowledge-based services should not be overlooked.

Among these policy leverages, the policy priority should be given to strengthening infrastructure of the strategic industry. The same is also true for the continuous investment and capacity expansion, covering a series of activities from technology development and patent registration to prototype production and sales. Lastly, it seems crucial to set up RSI task force team(s) which would carry out performance-based evaluation works of the RSI promotion projects.

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