TRANSFORMATION OF AGRICULTURE AND RURAL VILLAGES IN KOREA IN THE 1970S: EMPIRICAL INVESTIGATION USING ADMINISTRATIVE DATA

By

Sunjin Kim

THESIS

Submitted to

KDI School of Public Policy and Management

in partial fulfillment of the requirements

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Chapter 1
Social Capital and Agricultural Productivity

1.1 Introduction

There are two kinds of capital to be considered as main sources of economic growth: physical and human capital. Physical capital embodied in equipment and machines facilitates production whereas human capital embodied in human beings makes their capabilities and skills work in producing output. Solow (1956) argued in his classic, however, the long-run growth is not determined by the accumulation of production factors due to their attribute of diminishing marginal returns. Thus, I want to focus on the third source of growth, social capital. Just as physical and human capitals are productive so is social capital. The social capital inheres in the structure of relationships among people, that is, a person must be related to others (Portes, 1998).

Korea has experienced the remarkable growth of output per capita averaging 9 percent per annum for three decades since the economic take-off in the 1960s. Accordingly, most of conventional researches have shown that Korea could achieve the extraordinary economic development by accumulating factors of production (Krugman, 1994; Young, 1995; and Pyo and Kwon, 1991). Krugman (1994) claimed that “Once one had taken the effects of these more or less measurable inputs into account, there was nothing left to explain”.

It is true that production factors were main determinants on growth of output per capita, particularly, in urban areas where the industry-based development is the key driving

force. As the differences in per capita income are matched by differences in production technology, urban parts of Korea had been richer than the rural in the earlier stage of industrialization. Then, is it applicable to agriculture-based rural communities where community norms and trust among village people are relatively more important value than those in urban areas? Is there other factor than production factors to affect the agricultural productivity considering the fact that trust, cooperation, and information sharing among neighbors in the rural villages are necessary in doing farm activities? Do we observe the faster growth of per capita yield in rural communities where village people are more likely to participate and cooperate in community-level projects? Then, can we say that not only factors accumulation but also productivity growth employed by social capital is one of sources of Korea's rural development program?

The gap in per capita income between urban and rural regions during the late 1960s and early 1970s started to decrease after the initiative of *Saemaul Undong*, which is rural infrastructure development program aimed at reducing the urban and rural disparities. In fact, in the mid-1970s per capita income in rural areas exceeded that of urban. Given the stylized fact that rural people are poor due to low agricultural productivity, agricultural productivity significantly increased during this period mainly because of constructions of rural infrastructure. How did Korea's poor rural regions rapidly increase agricultural productivity in the 1970s in the face of nation-wide rural community development?

People in rural communities are tied by trust based on personal relation throughout trans-generation within the shared and limited space. Korea's rural communities and village are, in general, tied by blood, geographical separation and rice cultivation activities. These communities have complemented the state and market in providing local public goods by inducing community people to voluntary participation and cooperation based on trust and

personal interaction.

Accordingly, convergence among Korea's rural regions in terms of the growth of rice yield in the 1970s had been facilitated where the community-level development projects are successfully implemented and the village members are more actively involved in common village development projects. My hypothesis is that rice farming-based rural Korea was able to show faster growth of yield by virtue of greater social capital. Social capital accumulated by cooperation and participatory mechanism through community-level development projects is an essential source of growth in a sense that only strong ownership through the grass-root efforts in doing community development results in a sustainable growth.

This paper uses the data at a county level in the 1970s to verify the issue of whether social capital plays a role in increasing the growth rate of agricultural production together with other kinds of capital. A modified neoclassical growth regression that includes the proxy for social capital as well as stocks of physical and human capital provides a description of the cross-county performance. In addition, I focus on the idea that social capital is endogenous and shows reverse causality by which initial income level, village ties and governance system are employed within communities.

1.2 Participatory mechanism in rural community development

1.2.1 Rural community development program

The nationwide community-level infrastructure development program was initiated by the government in 1970. The Ministry of Home Affairs (1974)[1] reiterates that "The goal of *Saemaul Undong* is to better not just myself but also my neighbor, village, and people of Korea" especially in the rural farming and fishing regions. It also emphasizes "the development of the community where benevolent neighbors help each other for improving the welfare in society".

The comprehensive community development initiatives started to make rural communities better places for living because rural areas based on agricultural sector lagged behind compared to urban due to low agricultural productivity. In addition, since Korea experienced rapid economic development starting from urban areas where light industries brought economic prosperity to, the income gap between urban and rural areas had been widened in the absence of the non-agricultural sector in rural parts of Korea. The farm household income was about two third of urban household income in 1970[2].

The Ministry of Home Affairs was in charge of the implementation of *Saemaul Undong* in cooperation with local governments. The government provided materials including cement and steel wires to be utilized only in community development projects with each village, about 32,000 villages throughout the country. The fact that materials were allocated to a "village" not an individual explains how *Saemaul Undong* could be successfully completed in mobilizing people's positive participation in community-level projects. A village naturally generated based on rice cultivation activities was assigned as a

[1] The Ministry of Home Affairs published annual reports on *Saemaul Undong*. This borrows from *Saemaul Undong: from the beginning to today* (1974).
[2] Ministry of Home Affairs (1978)

strategic development unit for *Saemaul Undong*[3].

In a sense that farmers' cooperative group has been traditionally operated at a village level and neighbors help out on each other's farms in rural areas, the village-level development design and support was a key successful factor of *Saemaul Undong*. Not only physical supports but also evaluations and rewards were executed based on village-level. The village itself was a good instrument to encourage the competition between neighbor villages as well as induce the village people's participation in communal projects. In the case of large-scale project[4] which requires participation and cooperation across several villages, for example, when building the bridge in the river over several villages, it was less likely to successfully complete projects due to the lack of effective coordination and cooperation among different stakeholders by community.

The Ministry listed up about 20 projects such as construction of access roads to villages, bridges, roof, public baths, small reservoirs, dike, water ways, and river arrangement etc. and recommended to villages which projects could be mostly undertaken by types of village[5]. In doing so, the government drew up the concrete guideline and manual for the projects while facilitating technical assistances by dispatching counsellor officials or extension agents to rural villages.

In the most of case, the village project was selected through voting among village members with the town council held. *Ri-jang*, representative figure of village and administrative supporter to the local government office introduced and explained about community projects after going through "*Ri-dong*[6] Development Committee". Village

[3] Base on author's interview with Former Prime Minister Goh, Kun (November 24th, 2011)
[4] It is called "Cooperative project".
[5] Villages are classified based on regional characteristics such as mountain village, semi-mountain village, plain village, coast village and island.
[6] Korea's administrative units under the county level

residents discussed the priority of projects and made decisions on which projects should be undertaken first, how to allocate resources, responsibilities, and roles. Such process reinforced participation of all stakeholders in decision-making over the allocation of public resources and the design of projects as well as in monitoring projects.

According to the annual reports of *Saemaul Undong* published by Ministry of Home Affairs in 1974[7], *Saemaul* project operation is divided into three parts: village infrastructure development, agricultural infrastructure development, and public facilities construction for income generation. In early days of *Saemaul Undong* the priority was given to the village infrastructure development such as the construction of village roads and housing improvement. In 1974, agricultural infrastructure development projects accounted for two third of total number of *Saemaul* projects.

As a result of *Saemaul* projects in 1973[8], for example, a 17,630-kilometer road was constructed and 480 thousand households made over the roof of house. The length of river and sewage arrangement was 5,161 km. Electricity was supplied to 308 thousand households and public telephone was installed in 700 spots. More than 17,455 of public facilities such as town hall, storehouse, and day care center were constructed in each village. In addition to environmental improvement projects, successful achievement of agriculture-related projects to increase agricultural productivity is reported. Agricultural water management was improved by arranging small reservoirs, dikes, water ways, etc. which reach to 5,393 cases. The number of agricultural machines including the cultivator, weeding machine, chemical sprayer, threshing machine, and so on increased to 36 thousand machines. Total 24,000 *ha* of farmland was irrigated. The total output from *Saemaul* project operation in 1973 increased 12-13 percentage point compared to the level of 1972.

[7] Ministry of Home Affairs (1974)
[8] Ministry of Home Affairs (1974)

The government set the annual target as well as the mid- and long-term development plan. According to the long-term target until 1980 (Table 1), village infrastructure projects and agricultural infrastructure projects such as expansion and construction of village roads, farm roads, bridges, reservoir, waterways, and sewage system exceeded the targets whereas construction of facilities related to income generation activities shows the low level of achievement. Production activities at the village level were not successfully performed in that village projects such as construction of storehouse, workplace, or shed was achieved 64 percent, 18 percent, and 14 percent respectively.

In order to successfully implement village projects, the government introduced the rewarding scheme that supports first to the village which shows the outstanding progress on village projects. Villages are categorized by three levels based on the degree of progress on village projects, such as "Self-reliant village", "Self-help village", and "Basic village". Once the village is evaluated as "Self-reliant village", the village is privileged in conducting village projects with more material supports in a higher priority. The government supported the outstanding villages not based on efficiency but competition and discriminatory mechanism.

In particular, rural electrification was powered in conjunction with the performance of *Saemaul* projects and achieved almost 100 percent of electrification by 1978 throughout the country. Electricity was supplied first only to outstanding villages evaluated in *Saemaul* projects even though the selective provision of electricity is not economically feasible and efficient[9]. Despite the doubled cost, the government avoided the free rider problem by excluding the provision of electricity to the neighbor village that showed low performance but might be benefited by the provision of electricity to high-performing neighbor village (Figure 1). The strict result-based scheme accelerated the community development once the

[9] Based on author's interview with Former Secretary to President for *Saemaul* Han, Ho-Sun served from 1972 to 1979 (September 6th, 2012)

tangible achievement of neighbor villages such as the supply of electricity was appeared in reality.

1.2.2 Resource mobilization in community project operation

The resources for community development projects are twofold: government supports and people's donation (Table 2). Fiscal supports from the government sector were provided in the form of grants and loans from central and local government. During 1971-79, total cost of *Saemaul* projects is about 2.75 trillion won and 49 percent of project cost was funded by village residents by average. In fact, in 1970 the government secured the budget and mobilized 3 trillion won[10] to finance *Saemaul* projects. For example, among the total cost of 98.4 billion won for *Saemaul* projects in 1973[11], 39.7 billion won which accounts for 41 percent of the total cost was supported by the government while 56.6 billion won, 57 percent of the total cost was financed by village people.

Village people participated to projects mostly through three channels: cash offer or payment in-kind, donation of land, and provision of labor force. The biggest part of village people's participation came from the provision of their labor force. Village residents were systematically engaged in infrastructure construction projects and provided their labor with and without compensation. When they got compensated they donated some portion of compensation for village projects. The participation of village residents in the form of donation of physical capital and labor force strengthened ownership and self-help efforts for community development projects. It is the unique and salient feature of *Saemaul Undong* in that community development programs rely solely on the government support in many developing countries.

[10] Kim (2006)
[11] Ministry of Home Affairs (1974)

Ri-jang and village leader played a key role to call people together and coordinate village issues. In order to conduct village projects such as construction of town hall, village access road, farm road and land reclamation, some residents should donate not only their labor and time but also their land to communal projects. In early days of community projects village people were reluctant to readily donate their property, especially land, which is the most invaluable asset in rural areas.

When villages planned to expand farm roads, for example, the land should be secured first. The government recommended expanding farm roads as a priority because road expansion facilitates the use of agricultural machines such as tractors and motors and it results in increasing labor productivity by saving labor hours. Furthermore, it reduces transportation costs of agricultural inputs and outputs by improving the distribution of agricultural products. Therefore, village people favorably participated in village projects because most of village projects did coincide with farmers' interests.

The village leaders have taken the initiative and set an example of donation while *Ri-jang* have kept communicating with village residents and persuading them to donate for the mutual benefit of projects in the future by using family ties and associational network across the village. The first project in most of villages was to construct a town hall. In general, the village leaders donated the building site in the middle of village. The pioneering endeavors from leadership brought out the higher participation of other village members.

The diary of *Shin Kwon-shik*, who served as *Ri-jang* during 1973-76 in *Pyungtak, Kyunggi-do* describes such difficulties in mobilizing resources and managing *Saemaul* projects[12]:

[12] This part borrowed heavily from Kim (2012).

> Every day there are as many opinions as the number of village residents in conducting *Saemaul* projects. Fights broke out as usual between villagers in making decision whether to put *anggo* (?) first or to install the drainage behind *Insung*'s house… it is hard to manage village issues… In the middle of town meeting about the construction of farming road, [he] did not want to donate his land and blamed me. He appeared again and looked drunk, and suddenly hit me with a hoe… I felt painful and started to bleed from ears… (Kim, 2012)

Shin suffered severe brain damage that he could be convalesced after undergoing the brain surgery twice in Seoul. Nevertheless, he blocked the police to investigate the case and tried to protect the attacker. Shin as a village leader wanted to protect the community and his old neighbor. Accordingly, the attacker felt sorry and got to donate his land in the end. The village could successfully accomplish the construction of farming road. Despite difficulties in donating land and labor, conflicts were resolved with the dedicated efforts of *Saemaul* leaders under the name of 'village work'.

The benevolent behavior from the village leader brought the goodwill and trust among village people. The trust accrued from the reciprocity in that village people started to help each other in the expectation that others will help me out in the future based on trust. Such trust within a community avoided opportunistic behaviors, reduced transaction costs, and facilitated the cooperation and participation in conducting village-level infrastructure development projects. Once the village projects started to produce tangible results and benefits for village residents, spontaneous cooperation and voluntary participation was just employed by social capital.

1.2.3 Agricultural productivity and social capital

Rice yield was dramatically increased in the 1970s. The average rice yield is 333 kg per 10a in 1971 and it reaches its peak, 488 kg per 10a in 1977[13], almost a 50 percent increase in rice

[13] Data source: KOSIS (Korea Statistical Information Service)

yield (Figure 2) within only 6 years. The growth in rice production is largely due to the Green Revolution which started in 1971 when the modern high-yielding variety (HYV) called *Tongil* was introduced. By 1974 the area of *Tongil* variety planted exceeded one fourth of total rice planted area and the average production of *Tongil* variety per 10a is 473 kg while average production per 10a of ordinary rice variety, 353 kg (Figure 3)[14]. Agricultural extension agents from farm village counsellor office under the local government disseminate new agricultural techniques and guideline by visiting individual farmers.

In addition to the adoption of new technology, the growth of agricultural productivity is closely related to *Saemaul Undong* in that most of projects in early days of the initiative focused on building agricultural infrastructure such as reservoirs, dike, water ways, drainage, river arrangement, pumping station, farm road, conduit, and so on. Along with *Saemaul* projects at a village level, "Agricultural Development Corporation" was established in 1970 in accordance with "Agricultural Community Modernization Promotion Act[15]" to promote agricultural productivity through the construction of large-scale agricultural production base including dam, irrigation, land consolidation, etc.

Rice yields are responsive to modern inputs such as agricultural machinery, chemical fertilizer, and pesticides as well as traditional inputs such as water and farm population. The utilization of chemical fertilizers was widely expanded by building fertilizer factories. In the mid-1970s, the self-sufficiency rate of fertilizer exceeded 100 percent. In addition, the government unified the supply channel of fertilizer to "Agricultural Cooperatives" and distributed at lower prices than market prices. In the case of pesticide, even though the amount of consumption varies from year to year because the demand of pesticide is related to weather condition, blight, and insect attacks, the production of pesticide continued to increase.

[14] Shin et al. (1976)
[15] Act No. 2199, January 12, 1970

The amount of production in 1975 was more than triple of that in 1970 (Table 5).

As farm population started to decrease since 1968 due to the rural exodus to urban industrial sector, labor shortage in agricultural sector accelerated around the mid-1970s. The government specified "Agricultural Mechanization Plan" in 1971 in order to increase the use of agricultural machinery, and thus, develop commercialized farming. Agricultural machine was rapidly supplied through "Agricultural Cooperatives" backed by government with long-term loans at lower interest rates. In the case of tractor, less than 1 percent of total farm household had a tractor in 1970, however, 14 percent of the total possessed. The number of tractor increased approximately 30 times in a decade (Table 6).

In addition to modern and traditional inputs, agricultural productivity is sensitive to the third input "social capital" as well. Social capital employed by doing community-level projects together during the 1970s facilitated cooperation and participatory mechanism by reducing transaction costs. The close ties through clan, neighbor, and community provided solidarity and trust that requires promoting communal projects in the expectation of future benefit. The accumulation of social capital through relations among village people increased the returns to agricultural production. Although the community development program was the government's initiatives to improve farm income, voluntary participation of farmers and residents was the key to enhance the efficiency and effectiveness of the projects.

This is in line with Putnam's argument on social capital. Putnam (1993) defines as social capital "features of social organization, such as trust, norms, and networks that can improve the efficiency of society by facilitating coordinated actions." He explains that the differences in the economic performance between northern and southern regions of Italy are corresponded by the differences of social capital. Putnam argues that societies embodied by higher levels of social capital experience more rapid economic development, and better

institutional performance as well.

Agreed with Putnam, some studies argue that social capital promotes economic growth (Greif, 1989; Narayan and Pritchett, 1996; and Knack and Keefer, 1997). Greif (1989) claims that "coalition," an economic institution based on a reputation mechanism encouraged trust and reduced transaction costs associated with asymmetric information, and therefore, Mediterranean trade contributed to the economic growth of southern Europe in medieval times. Narayan and Pritchett (1996) use the survey to measure associational activity as a proxy of social capital in rural Tanzania. They find that the level of social capital measured by "associational membership" affects the level of household income. However, Knack and Keefer (1997) find that horizontal networks – as measured by membership in groups - are unrelated to trust and civic norms and to aggregate economic growth. Nevertheless, they find that trust and civic norms are stronger in nations with higher and more equal incomes, with good institutions.

1.2.4 Measurement of social capital

Social capital is commonly measured at a national level using the available macro indexes such as Worldwide Governance Indicators (WGI)[16] or International Country Risk Guide (ICRG)[17] rates regarding social infrastructure and institutions while survey of individuals is mostly used to measure membership of association and level of trust and cooperation.

Knack and Keefer (1997) use the World Value Surveys from 29 market economies to create two measures of social capital, "Trust" and "Civic cooperation". The first indicator of "Trust" is the percentage of respondents answering "most people can be trusted" (Knack and

[16] "Worldwide Governance Indicators", http://info.worldbank.org/governance/wgi/index.aspx (assessed April 2014), The World Bank

[17] "International Country Risk Guide", https://www.prsgroup.com/about-us/our-two-methodologies/icrg (accessed April 2014), The PRS Group

Keefer, 1997). The second indicator, the norm of "Civic cooperation", is evaluated from responses to questions about individual's behaviors which "can be justified or not" (Knack and Keefer, 1997). Hall and Jones (1999) measure the social infrastructure by combining two indexes of government anti-diversion policies and trade openness.

Measuring social capital is so difficult, inaccurate, and problematic that may lead to the potential measurement errors. In particular, survey questions are ambiguous and general in a sense that the results depend on what respondents are thinking at the moment under their specific environment. In addition, selection bias may arise because the respondents to questionnaire are more likely to have different characteristics from non-respondents. Hence, this research measures the proxy for social capital in a quantitative approach in contrast to most of researches which use survey questionnaires by asking qualitative questions.

The proxy to measure social capital in Korea's rural region is village people's share in total project cost at the community level. Here, "people's share" is defined as village residents' donation of land, money, and labor which are computed in a monetary value. Since participatory mechanism of society based on trust and social ties within the limited and shared space are more likely to vary by village, they are more likely to explain the differences by regions in productivity growth. The proxy variable for social capital accumulated by doing agriculture-related project *j* at county *i* in year *t* defines:

$$Social\ capital_{it} = \frac{\sum_{j=1}^{n} PD_{ijt}}{\sum_{j=1}^{n} TC_{ijt}}$$

where *TC* denotes total village project cost and *PD* is village people's donation in common community development projects.

One thing to note here is that the proxy for social capital is rather endogenous in that

it has the reverse causality with (initial) level of output which also determines environment and nature of the society. The following equation summarizes the determinants of social capital:

$$Social\ capital_{it} = z_0 + z_1 \ln y_{it} + z_2 x_{it}' + \theta_i + \mu_t + \varepsilon_{it}$$

where y_{it} is the level of yield at county *i* in time *t* and x_{it}' is a vector of other explanatory variables such as kinship tie which is not directly correlated to growth of yield. Interpersonal trust based on blood ties is a significant factor in making decisions of participation and donation to village projects in rural communities. The time-invariant unobserved characteristics θ_i and the year effect μ_t will be captured. The idiosyncratic error term is expressed as ε_{it}.

1.2.5 Endogeneity of social capital: kinship, village networks and governance

Putnam (1993) suggests that dense horizontal networks reinforce trust and civic norms. Knack and Keefer (1997) find, however, that horizontal networks – as measured by membership in groups - are unrelated to trust and civic norms and to aggregate economic growth. Instead, they find that social capital is associated with independence of courts, income inequality, ethnic homogeneity, and number of students in law. How could social capital be generated in low-income rural communities in Korea?

Social capital in Korea's rural communities is endogenous in that family and kinship ties within villages are closely associated with people's attitudes towards participatory mechanism in community projects. In fact, some village members admit that in the early days of initiative they reluctantly donated the land because they could not refuse requests from the leader who was their relatives or old neighbors at the same time. Once some of pioneers donated their assets for the public use, information flowed freely within a small village, and

other village members followed to participate due to the peer pressure. The family networks and ties enforce and monitor the community projects.

In addition to personal ties, participatory village governance is related to the accumulation of social capital. Horizontally organized groups of village people such as youth group (4-H), farmers' and women's association filled the margin created from the vertically delivered policies from the central and local government. *Saemaul* leader and *Ri-jang* are the channel to link between two in that they closely cooperated with the local government and agricultural extension officials from farm village counsellor office by delivering government policies to village people while representing the village's interests to the government at the same time.

Unlike the conventional idea that the old generation was in the middle of decision-making process on village projects in rural areas, the young generation was the major driving force. According to a survey[18] of 106 villages regarding *Saemaul* leader and *Ri-jang*, average age of *Saemaul* leader is 39 and leaders aged between 31 and 40 represented 48 percent of the total. Regarding their academic background, 58 percent of *Saemaul* leaders graduated from middle school or higher level of education. Compared to the situation of rural areas during the 1970s, they were quite educated. 76 percent of leaders were born in the same village and the rest of them were from other village. Around 71 percent, a new figure became a village leader along with *Saemaul* initiative. The village leadership had been transitioned in that the young and educated started to emerge as new leadership in traditional rural community.

Kim (2009) also defines same characteristics of village leaders as aforementioned survey results based on statements from village people. According to her research the leader and *Ri-jang* who were actively engaged in rural community development can be

[18] See "Monthly report, August", published by Ministry of Home Affairs (1974)

distinguished by some common factors: young, educated, experienced but having failed. They were around 40s and experienced the military or more advanced regions than their home town. They were exposed to the secondary or higher education in cities but finally came back to their home town.

In fact, *Saemaul* leader and *Ri-jang* were major driving forces in completing community projects. Based on the survey of 106 villages[19], more than half of village residents point out that the biggest contribution to the successful project outcome was made by village leaders. 24 among 100 leaders volunteered to take the leadership so that they wanted to dedicate themselves for the prosperity of their home town[20]. 76 leaders were selected to become a leader through the recommendation of township office because they had been passionately engaged in village issues.

The diary[21] written by *Shin, Kwon-shik*, who served as *Ri-jang* during 1973-76 in *Pyungtak, Kyunggi-do* narrates his daily work as an administrative assistant to the local government as well as a village leader for community projects. He recorded that he was so busy in dealing with village works that he could not even farm his own land at all. The basic duties of *Ri-jang* are to conduct the village administrative work, facilitate *Saemaul* projects, purchase and distribute farming materials including fertilizers and plastic, and so on. Also they received mandates to participate in local government's events and get trainings.

Along with the young and energetic village leaders, 4-H Club[22], another youth group

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[19] See "Monthly report, August", published by the Ministry of Home Affairs (1974).

[20] *Ri-jang* received 5,000 won per month in compensation for the village work. It is too small to give them any incentive to take the position. In addition, once taken the role leaders had to participate in many events and donations. Leaders could dedicate and passionate in doing village works without monetary compensation because of the commendation from the government and high acknowledgement from the society.

[21] Kim (2009)

[22] Originating in the early 1900's as "four-square education" in the U.S. the 4-H's (head-heart-hands-health) seek to promote positive youth development, facilitate learning and engage youth in the work

beginning at age 13 up to the age of 29 actively engaged in *Saemaul* projects. After the military service, young generation usually joined the 4-H Club and got trained for rural development. In fact, most of *Saemaul* leaders had been engaged and received the leadership training in 4-H Club when they were adolescents. Thus, *Saemaul* leaders could easily facilitate the collective action through the youth group and mobilize the youth labor force in conjunction with 4-H Club in proceeding village projects.

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of their community through the Cooperative Extension Service to enhance the quality of life. 4-H Club was organized at the village and school level in 1947 under Ministry of Agriculture and Forestry in Korea. It changed the name of organization as *Saemaul* 4-H Club in 1972, *Saemaul* 4-H Supporters in 1979, and Korea 4-H Supporters in 1988.

1.3 Empirical strategy

1.3.1 Model

Using a simple cross-section regression framework, the growth rate of yield in county *i* is determined by social capital and other variables as

$$g_i = a + \beta \ln y71_i + \mu SK_i + \theta x_i' + u_i.$$

Here g_i is the growth rate of rice yield and SK_i is a proxy for social capital. Proxy for social capital is a composite value which considers a different type of projects implemented in each village. Initial condition of wealth presented by rice yield, $y71_i$, is controlled in order to verify the convergence that the yield growth rate tends to be inversely related to the starting level of output or income as presented by Solow (1956), Barro and Sala-i-Martin (1992), and MRW (1992). The sign of coefficient β is expected to be negative and those of all other variables are to be positive.

The vector of other explanatory variables x_i' considers the land and labor saving technology such as consumption of chemical fertilizer and pesticide for paddy rice production, pesticide, and agricultural power machine. All values are adjusted by the cultivated area. In addition, other forces which reflect village networks and information delivery mechanism are summarized; i) membership of learning organizations including Agriculture Improvement Club (AIC), 4-H Club, and Farmland Improvement Association (FLIA); ii) number of *Saemaul* leaders who completed *Saemaul* training program; and iii) number of agricultural extension workers. Numbers are normalized by 1,000 farm population. Except the proxy for social capital and growth rate of farm population, all explanatory variables are in logarithm. u_i is a random error term.

Assume that the measure of social capital is exogenous and free from simultaneous

causality. Ordinary least squares (OLS) estimator is employed to estimate the effects of social capital on the growth of agricultural production at a county level. Robust standard errors will be reported.

1.3.2 Data

Data across 149 administrative counties *(gun)* over 7 provinces[23] from 1971 to 1977 are used to analyze the determinants of agricultural productivity. Averages over 7 year periods for each variable are calculated in order to observe the regional difference of agricultural growth pattern. Table 7 provides descriptive statistics of sample data across 149 counties.

The proxy for the key policy variable "social capital" comes mainly from *Statistical Yearbook* published by the local government at a province level except *Kyungsangbuk-do* province. In general, *Statistical Yearbook* contains three or four village projects such as roof improvement, land consolidation, expansion of farm roads, and small river arrangement, and describes total project cost, amount of government support, amount of residents' payment, number of projects, and number of participants to project under each project classification by county.

Other variables which may affect agricultural productivity are supplemented from *Statistical Yearbook of Province* and *Statistical Yearbook on Agriculture,* and *Statistical Yearbook on Crops*. It contains county-level data on the rice production, rice cultivated area, farm population, agricultural machinery, consumption of fertilizer and pesticide, national government employees in farm village counsellor office and so on. Variables related to agriculture such as rice production, fertilizer, pesticide, and machine are adjusted by the rice cultivated area because the farm size itself significantly matters for production. The number

[23] *Gangwon* (19), *Kyunggi* (22), *Kyungnam* (26), *Kyungbuk* (28), *Geonnam* (26), *Geonbuk* (16), *Chungbuk* (12)

of agricultural extension worker is adjusted by farm population.

Some stylized facts are observed in sample data. First, Figure 4-1 shows that growth rates of paddy rice yield vary across counties. The histogram illustrates the number of counties over 7 provinces that lie in various ranges for the growth rate of rice yield from 1971 to 1977. For 149 counties, the mean growth rate of rice yield is 5.4 per year and the standard deviation is 2.9. The highest growth rate is 17.9 (*Sokcho*) and the lowest is -0.9 (*Jinju*). Second, Figure 5-1 shows that the variation of proxy for social capital in composite value across 147 counties ranges from 6.3 to 81.4 with mean of 39.7. Total rice production (kg) per 10a continuously rises from 335 kg in 1971 to 494 kg in 1977. The pattern of increase in rice yield applies to the pattern of social capital accumulation (Figure 6-1).

1.4 Results

1.4.1 Main results

Table 10 provides the OLS regression results in comparison with four different measures of proxy for social capital as variables of interest. The specifications which control the proxy for social capital, initial condition, membership of learning organizations and number of leaders trained in *Saemaul* program explains almost 56 to 67 percent of cross-county variation in growth rate of output over 95 to 145 counties from 7 provinces in 1971-77.

The first proxy for social capital is a composite value which sums up a different type of village projects such as roof improvement, land consolidation, expansion of farm roads, and small river arrangement. Other three proxies are measured by an individual community project. All estimated coefficients of four proxies for social capital on growth rate of yield in specification (1) to (4) are positive and statistically significant (Table 10, Figure 7-1, 7-2, 7-3, 7-4).

The estimated coefficient of the proxy for social capital on growth rate of yield in the specification (1) is 0.0403 (s.e. = 0.0116). Figure 7-1 plots partial relation between growth rate of yield and the proxy for social capital, ceteris paribus. The coefficient predicts that a difference of 1 percent in the proxy of social capital is associated with a difference in growth rate of yield of 0.0403. The results are largely robust to different systems which add more control variables such as membership of learning organization and number of trained *Saemaul* leaders.

The estimated coefficient of number of trained *Saemaul* leaders on growth rate of yield in the specification (5) is 1.224 (s.e. = 0.349) while the estimated coefficient of number of membership of FLIA is 1.942 (s.e. = 0.442). Farmers obtain information on the modern

variety and new agricultural techniques by participating in various kinds of village organizations including FLIA, AIC and 4-H Club. These organizations have affected farmers' behavioral changes towards the decision of technology adoption and participatory mechanism. The estimated coefficients of membership of learning organization and number of trained *Saemaul* leaders are largely positive, but it is not robust to all systems.

The initial condition which is the natural logarithm of paddy rice yield for 1971 is controlled to verify the convergence. The estimated coefficients range from -9.85 to -17.72 and show the strong statistical significance in all systems. The empirical results confirm that counties with a lower initial endowment grow faster when other explanatory variables are controlled as Barro (1991) and Mankiw, Romer, and Weil (1992) suggested (Figure 8).

1.4.2 Robustness check

Data across 28 administrative counties (*gun*)[24] of *Kyungsangbuk-do* province from 1971 to 1976[25] are used to analyze the determinants of agricultural productivity. In most cases, averages over 6 year periods for variables are considered. Table 8 provides descriptive statistics of sample data across 28 counties.

The proxy for the key policy variable "social capital" comes from the output of "*Saemaul Undong"*constructed by University of *Sungkonghoe* (2008). This publication provides almost yearly time series on 26 different types of *Saemaul* projects by county in *Kyungsangbuk-do*, Korea's south-east province and describes total project cost, amount of government support, amount of residents' payment, number of projects, and number of participants to project under each project classification.

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[24] "*Ulleung-gun"* is excluded in empirical analysis due to its regional characteristics, island.

[25] The period of sample data overlaps with the onset of the Green Revolution when new high-yielding variety called *Tongil* first became introduced. In 1973, yield of *Tongil* reached its peak. Since data for *Tongil* in *Kyungsangbuk-do* is available only for 1973, I fail to control the effect of new variety on the growth rate of per capita yield.

There are 26 community-level projects regarding village infrastructure development, agricultural infrastructure development, and public facilities construction for income generation. In the empirical analysis, only 9 agriculture-related projects were selected: construction of small reservoirs, dike, water ways, and small river arrangement, pumping station, farm road, conduit, and so on (Table 9). A composite value for *Saemaul* projects is computed by summing the 9 projects values to see overall agriculture related projects' output.

Average number of total participants to community projects is 30,523 and average total project cost is about 90,083 thousand won. About 68 percent of total cost is financed by village people's donation including labor wage, land donation, and cash or in-kind payment. Measure of social capital is calculated using people's donation as a share of total project cost. It varies from 34 to 84 percent (Figure 5-2), where higher shares are assumed to be higher social capital accumulation.

Other variables which may affect agricultural productivity are supplemented from *Statistical Yearbook of Kyungsangbuk-do*. It contains county-level data on the rice production, rice cultivated area, farm population, agricultural machinery, consumption of fertilizer and pesticide, national government employees in farm village counsellor office and so on. Variables related to agriculture such as rice production, fertilizer, pesticide, and machine are adjusted by the rice cultivated area because the farm size itself significantly matters forproduction. The number of agricultural extension worker is adjusted by farm population.

Some stylized facts are observed in sample data. First, Figure 4-2 shows that growth rates of per capita rice yield vary across counties. The histogram illustrates the number of counties in *Kyungsangbuk-do* that lie in various ranges for the growth rate of per capita rice yield from 1971 to 1976. For the 28 counties, the mean growth rate of per capita yield is 6.8 per year and the standard deviation is 2.85. The highest growth rate is 13.98 (*Gimcheon*) and the lowest is 0.37 (*Daegu*). Second, total rice production (kg) per 10a continuously rises from

320 kg in 1971 to 400 kg in 1976. Third, farm population rapidly decreased and moved to urban industrial sector.

For 28 counties, the relation between the growth rate of per capita yield from 1971 to 1976 and the log of per capita yield in 1971 is negative and close to zero. Also, it is statistically insignificant. As Figure 10-1 shows, cross-county data in *Kyungsangbuk-do* province provide little evidence of absolute convergence.

Table 11 shows the OLS regression results in *Kyungsangbuk-do* province. The specification which controls three different kinds of capital explains almost 60 to 75 percent of cross-county variation in growth rate of output per capita.

The estimated coefficient of the proxy for social capital on growth rate of per capita yield in the specification (2) is 5.729 (s.e. = 2.640). Figure 11 plots partial relation between growth rate of per capita yield and the proxy for social capital, ceteris paribus. The coefficient predicts that a difference of 1 percent in the proxy of social capital is associated with a difference in growth rate of per capita yield of 0.057. In fact, counties with a higher social capital such as *Wolsung, Sangju*, and *Uljin* grow faster. Counties that are close to a lower social capital are *Andong, Kyungju,* and *Gunwi* and all three show slower growth rate of per capita yield ranged from 3 to 5.5 percent, which are below the mean growth rate of per capita yield, 6.8.

As a proxy for human capital variable, the number of agricultural extension workers adjusted by the number of farm population is used in regression analysis (2). The estimated coefficient of the logarithm of it is positive and statistically significant: 26.66 (s.e. = 7.394, Figure 12). It is worth to note that the magnitude of the coefficient is huge in a sense that 0.3 percent of increase in growth rate of per capita yield is resulted from a 1 percent increase in number of agricultural extension workers per farm household. In fact, government focused on

diffusion of new agricultural technology including modern high-yielding varieties and disseminated informative agricultural techniques and skill in order to improve farm household income during the 1970s. Extension workers visited each farmer in village and farm and shared the knowledge and technology. As a result, Korea could achieve self-sufficiency of rice in 1977.

The variable of initial condition is the natural logarithm of per capita rice yield for 1971. In the system (5), the estimated coefficient, -11.95 (s.e. = 2.961), supports the conditional convergence that has been shown in various conventional studies such as Barro (1991) and Mankiw, Romer, and Weil (1992). Compared to Figure 10-1, Figure 10-2, the partial regression plot, describes stronger negative correlation and clear convergence with other factors held constant.

Three physical capitals such as chemical fertilizer, pesticide, and agricultural machinery are included as a logarithm separately. The estimated coefficient of all three land and labor saving technology shows statistical insignificance. This result is somewhat unexpected in that the use of chemical fertilizer and machine increases agricultural productivity. During the observation period, the production and consumption of chemical fertilizer increased by 1.6 times along with the dissemination of modern variety *Tongil*.

1.5 Conclusion

This chapter attempts to endogenize the productivity growth through behavioral changes of village people in the face of comprehensive community development initiative in the 1970s. As I know this is the first attempt which empirically verifies the idea that social capital accumulated by doing collective coordination and cooperative work enhanced the growth of agricultural productivity. The adoption of new agricultural technology, of course, is the key factor to the remarkable increase in agricultural production.

I tried to focus on the mechanism of social capital accumulation in the historical context and story in rural villages. In the 1970s, village infrastructure projects such as an irrigation, land consolidation, and expansion of farm roads enhanced the level of social capital because village people are forced to interact each other by doing community project together.

The modified cross-section growth regression shows that social capital generated by doing the community-level infrastructure development projects increases the growth rate of agricultural output. Results are largely robust after controlling other explanatory variables including membership of learning organization, number of extension workers, number of trained *Saemaul* leaders, physical capital, etc. Counties grow faster because they accumulated the higher level of social capital which facilitates the implementation of community projects based on trust and cooperation by reducing transaction costs. Once the tangible results and economic benefits from village projects appeared in reality, the accumulation of social capital is accelerated.

Nonetheless, there are some limitations on this research. It is obvious that the introduction of modern high-yielding variety *Tongil* significantly increased the paddy rice yield, but I failed to control due to the lack of data availability. In addition, the proxy for

social capital is rather endogenous and not free from simultaneity bias because the social capital is affected by growth of productivity as well the environment of society.

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Former Secretary to President for *Saemaul* Han, Ho-Sun (September 6th, 2012)

Former President of Korea *Saemaul Undong* Center Lee, Jae-Chang (August 5th, 2014)

Table 1. Progress on *Saemaul* Projects

Village Project	Unit	Long-term goal as of 1971(A)	Result as of 1980 (B)	Achievement B/A (%)
Expansion of village roads	km	26,266	43,558	166
Farm roads	km	49,167	61,797	126
Small bridge	one	76,749	79,516	104
Town hall	dong	35,608	37,012	104
Store house	dong	34,665	22,143	64
Workplace	one	34,665	6,263	18
Shed	one	32,729	4,476	14
Reservoirs	one	10,122	13,327	132
Dammed pool	one	22,787	31,625	139
Waterway	km	4,043	5,161	128
River arrangement	km	17,239	9,677	56
Housing improvement	thousand dong	544	225	42
Town improvement	one	1,529	843	55
Portable water supply	one	32,624	28,130	86
Sewage system	km	8,654	15,559	179
Electricity	thousand hh	2,834	2,777.5	98
Phone	dong	18,633	18,633	100
Saemaul factory	one	950	717	75

Source: *30 Year History of Saemaul Undong* by Korea *Saemaul Undong* Center (2000)

Table 2. Resource mobilization in *Saemaul* projects (hundred million)

Year	Total (A + B)	Government support				Village residents' payment (B)	
		Total (A)	Central government	Local government	Loans		
1971	122	41	27	14	-	81	66 %
1972	313	33	20	13	-	280	89 %
1973	984	215	125	90	-	769	78 %
1974	1,328	308	121	173	14	1,020	77 %
1975	2,959	1,653	666	579	408	1,306	44 %
1976	3,226	1,651	484	396	771	1,575	48 %
1977	4,665	2,460	599	723	1,138	2,205	47 %
1978	6,342	3,384	654	773	1,957	2,958	47 %
1979	7,582	4,252	1,258	1,010	1,984	3,330	44 %
Total	27,521	13,997	3,954	3,771	6,272	13,524	49 %

Source: *10 Year History of Saemaul Undong* by the Ministry of Home Affairs (1980)

Table 3. Production of fertilizer (m/t)

Year	Nitrogen fertilizer	Phosphatic fertilizer	Potassium fertilizer	Total
1960	6,228	-	-	6,228
1965	75,271	-	-	75,271
1970	400,553	139,543	49,745	589,841
1971	408,001	144,676	46,785	599,462
1972	418,193	162,569	54,506	635,268
1973	447,255	159,292	65,172	671,719
1974	514,061	166,195	69,750	750,006
1975	582,740	195,475	81,509	859,724
1976	534546	214,780	83,831	833,157
1977	668844	309,310	110,796	1,088,950
1978	788540	420,912	120,686	1,330,138
1979	837788	487,788	111,854	1,437,430
1980	729413	493,558	106,762	1,329,733

Source: *Statistical Yearbook* by the National Agricultural Cooperative Federation (1981)

Table 4. Consumption of fertilizer (thousand m/t, %)

Year	Nitrogen fertilizer		Phosphatic fertilizer		Potassium fertilizer		Total	
	Quantity	Ratio	Quantity	Ratio	Quantity	Ratio	Quantity	Ratio
1962	191	64.3	90	30.4	16	5.3	297	100
1965	218	55.4	123	31.4	52	13.2	393	100
1970	356	63.2	124	22.1	83	14.7	563	100
1975	481	54.3	238	26.8	167	18.9	886	100
1976	361	56.2	142	22.1	140	21.7	643	100
1977	388	52.7	210	28.6	138	18.7	736	100
1978	461	53.3	231	26.6	174	20.1	866	100
1979	444	51.5	227	26.3	192	22.2	863	100
1980	448	54.1	196	23.7	184	22.2	828	100
1981	432	52	199	24	199	24	830	100

Source: *20 Year History of Agricultural Cooperatives* by the National Agricultural Cooperative Federation (1985)

Table 5. Production of pesticide (m/t)

Year	Germicide	Insecticide	Herbicide	etc.	Total
1970	10,677	9,456	5,889	313	26,335
1971	3,437	12,906	8,798	389	25,530
1972	4,461	18,088	10,438	318	33,305
1973	6,176	31,445	14,406	653	52,680
1974	4,983	30,757	18,089	490	54,319
1975	12,823	49,773	25,508	656	88,760

Source: *Statistical Yearbook* by the National Agricultural Cooperative Federation (1976)

Table 6. Supply of agricultural machinery

Year	Cultivator	Duster	Iron sprayer	Water pump	Thresher	Total[26]
1972	6,060	1,964	15,517	2,067	848	26,485
1973	7,736	1,850	15,500	2,927	1,350	29,394
1974	25,243	6,274	15,625	3,991	4,673	56,035
1975	27,970	8,013	17,859	3,718	5,288	64,005
1976	41,933	9,476	20,949	13,671	6,025	92,429
1977	41,387	11,478	27,476	14,476	6,110	103,689
1978	45,316	10,191	35,231	17,291	5,740	119,101
1979	53,534	12,068	44,897	9,717	6,023	137,453

Source: KOSIS

[26] The total number of agricultural machines includes tractor, transplanter, sowing machine, harvester, cutter and dryer as well as above appeared.

Table 7. County-level sample descriptive statistics, 7 provinces total, 1971-77

Variables	Obs	Mean	Std.dev.	Min	Max
Id by county	149	75	43.157	1	149
Agriculture					
Growth rate of farm population	148	-2.003	4.854	-10.151	28.015
Growth rate of rice yield, 1971-77	148	5.357	2.987	-0.923	17.979
Rice yield, 1971 (kg/10a)	149	327.168	37.529	154.000	385.000
Fertilizer per 10a (kg/10a)	105	253.274	587.955	3.234	2253.489
Pesticide per 10a (kg/10a)	73	1819.328	3607.441	45.739	12797.210
Power machine (unit/hh)	121	0.503	0.415	0.058	2.012
Learning organization					
No of AIC per 1000 farm pop	149	2.355	0.876	0.516	5.261
No of AIC member per 1000 farm pop	149	31.028	13.786	7.388	76.184
No of AIC leader per 1000 farm pop	149	2.585	1.094	0.520	6.146
No of 4H per 1000 farm pop	149	4.610	4.436	0.776	20.479
No of 4H member per 1000 farm pop	149	82.897	77.883	15.160	389.945
No of 4H leader per 1000 farm pop	149	10.343	10.344	1.929	46.041
Saemaul leader					
Trained leader per 1000 pop, total	121	0.900	0.695	0	4.246
Trained leader per 1000 pop, male	121	0.487	0.356	0	2.184
Trained leader per 1000 pop, female	121	0.244	0.347	0	1.920
Trained leader per 1000 pop, NACF	121	0.170	0.072	0	0.379
Extension service					
Extension worker	47	1.378	1.162	0.376	4.256
Proxy for social capital					
Proxy 1 in composite value (%)	147	39.690	18.087	6.337	81.381
Proxy 2 in roof arrangement (%)	79	53.168	28.904	6.337	87.884
Proxy 3 in land consolidation (%)	78	23.609	6.323	16.486	65.736
Proxy 4 in farm road (%)	37	63.228	15.607	26.756	92.258

Table 8. County-level sample descriptive statistics, *Kyungsangbuk-do*, 1971-76

Variables	Obs.	Mean	Std. dev.	Min	Max
Agriculture					
Average yield per capita (kg/10a), 1971-76	28	0.0085	0.011	0.0021	0.0414
Yield per capita (kg/10a), 1971	28	0.007	0.0091	0.0014	0.0363
Rice cultivated area (ha)	28	6958.4	4399.34	354.42	18207.6
Farm household	28	14556.2	7653.88	1554.33	31152.0
Farm population	28	83127.8	43690.9	9032.5	177194.7
Farm population, 20 < age < 50	28	26903.6	13652.3	3388.8	54804.0
Fertilizer (m/t/ha)	22	76.24	26.82	35.2	169.35
Pesticide (kg/ha)	28	678.08	96.7	542.7	882.21
Agricultural machinery (per household/ha)	28	5.3	2.0	2.0	11.8
Extension worker (per farm population)	28	0.00053	0.00022	0.00036	0.0012
Saemaul projects					
Total cost of village project (A) (1000 KRW)	25	90082.7	66489.3	3964.4	291188
Government support (1000 KRW)	25	23596.2	14718.8	2900.4	57351
Village people's donation (B) (1000 KRW)	25	66416.08	53437.4	1492.57	237191
B/A (%)	25	67.89	13.23	33.89	83.77
Participants	24	30522.69	22672.55	277.6	90506.6

Table 9. Agriculture infrastructure projects, *Kyungsangbuk-do*, 1971-76

Projects	Participants	Government support	People's donation (A)	Total cost (B)	Participation (A/B)
Farm roads	22822.68	5642.05	29736.68	35106.54	79.86
Waterway	3419.91	1447.94	3939.1	5375.99	73.27
Reservoir	1717.21	1786.17	3123.26	4858.39	65.04
Dammed pool	1173.72	816.59	2010.85	2731.68	72.14
River arrangement	5563.26	2535.05	6303.86	8626.84	71.11

Source: *Statistics on Saemaul in the 1970s* by *Sungkonghoe* University (2008)

Table 10. Regression for growth of rice yield, county total, 1971-77

Growth rate of Yield,	Ordinary Least Square											
1971-77	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Social capital												
SK in composite value	0.0403***				0.0364***				0.0803***			
	(0.0116)				(0.0108)				(0.0118)			
SK in roof arrangement		0.0550***				0.0544***				0.0583***		
		(0.00728)				(0.00755)				(0.00728)		
SK in land consolidation			0.0830***				0.0526*				0.0219	
			(0.0260)				(0.0274)				(0.0308)	
SK in farm road				0.0332*				0.0239				0.0203
				(0.0186)				(0.0192)				(0.0206)
Saemaul leader					1.224***	0.647*	0.900	0.589	0.201	0.670*	-0.421	1.088
					(0.349)	(0.347)	(0.587)	(1.117)	(0.261)	(0.389)	(0.352)	(1.055)
Learning organizations												
Membership of FLIA					1.942***	0.469	2.962***	-1.054				
					(0.442)	(0.400)	(0.463)	(1.200)				
Membership of 4H									0.897	0.631	0.171	2.274
									(0.816)	(0.782)	(0.817)	(1.535)
Initial condition	-13.52***	-15.66***	-15.86**	-10.24***	-12.09***	-14.90***	-17.72***	-11.08***	-14.88***	-15.33***	-13.44***	-9.805***
	(1.800)	(1.574)	(6.232)	(2.436)	(1.482)	(1.698)	(4.130)	(3.111)	(1.672)	(1.611)	(3.871)	(2.677)
Farm population	0.0196	0.00716	0.0352	0.0533	0.0308	0.0155	0.0885	0.0466	0.0248	0.00802	-0.187	0.0486
	(0.0334)	(0.0445)	(0.104)	(0.0934)	(0.0257)	(0.0484)	(0.0987)	(0.0964)	(0.0379)	(0.0434)	(0.137)	(0.0856)
Constant	82.01***	94.19***	95.88***	62.46***	68.00***	88.35***	98.06***	71.20***	85.13***	89.05***	82.86***	49.39**
	(10.40)	(9.051)	(36.20)	(14.27)	(8.970)	(10.37)	(23.51)	(20.66)	(11.44)	(11.00)	(24.09)	(20.22)
Observations	146	79	78	37	145	79	78	37	95	79	56	37
R-squared	0.390	0.684	0.111	0.438	0.558	0.708	0.418	0.456	0.670	0.708	0.180	0.502

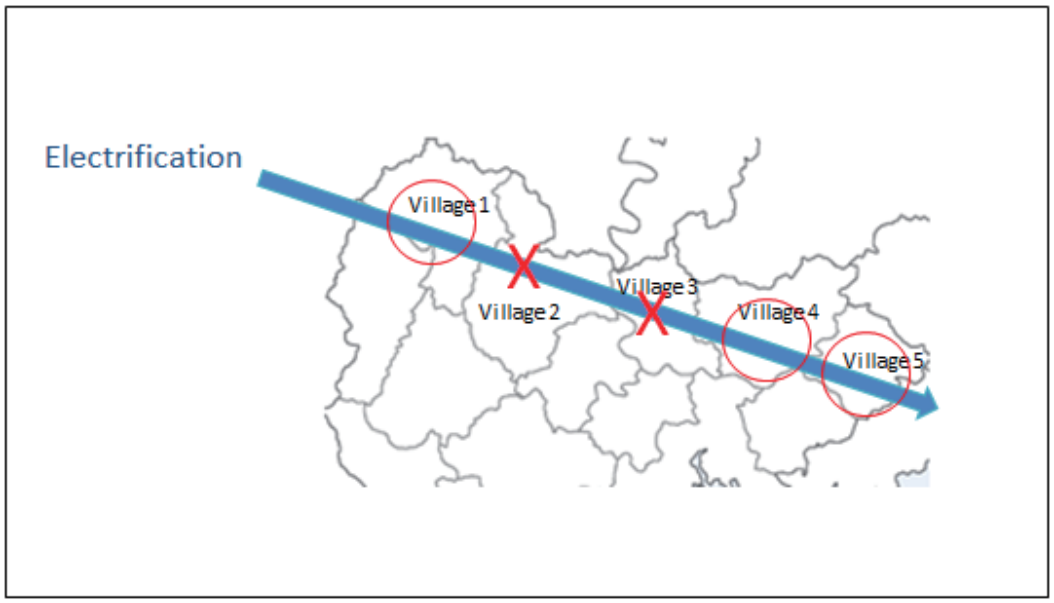
Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 11. Regression for growth of per capita rice yield, *Kyungsangbuk-do*, 1971-76

Growth rate of yield per capita, 1971-1976	Ordinary Least Square						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Social capital							
SK in composite value		5.729**		6.045*	5.737*	5.250	8.535**
		(2.640)		(3.233)	(2.874)	(3.383)	(2.872)
No. of participants			-0.380	-0.0271			
			(0.872)	(0.764)			
Learning organization							
Membership of AIC					0.101		
					(3.533)		
Membership of 4H						0.868	
						(3.169)	
Membership of FLIA							0.290
							(0.906)
Extension service	29.92***	26.66***	30.83***	27.67***	26.69***	27.29***	26.27**
Extension workers	(6.901)	(7.394)	(7.180)	(7.624)	(7.819)	(8.436)	(9.530)
Physical capital							
Power machines	0.00568	-0.0663	-0.439	-0.308	-0.0852	-0.0796	-0.228
	(1.039)	(0.880)	(1.146)	(1.059)	(1.230)	(0.906)	(0.974)
Chemical fertilizers	-1.674	-1.136	-2.542	-1.681	-1.153	-1.297	-2.516
	(1.669)	(1.724)	(2.245)	(2.321)	(1.905)	(1.989)	(1.950)
Pesticides	-0.580	-0.341	-0.594	-1.235	-0.338	0.217	0.942
	(3.906)	(3.043)	(4.475)	(3.224)	(3.175)	(3.532)	(3.356)
Initial condition	-12.90***	-11.95***	-13.21***	-12.13***	-11.97***	-12.35***	-11.96***
	(2.800)	(2.961)	(2.874)	(2.977)	(3.234)	(3.465)	(3.564)
Growth of Population	0.195	0.251	0.271	0.383	0.251	0.189	0.542*
	(0.295)	(0.248)	(0.345)	(0.305)	(0.260)	(0.301)	(0.283)
Constant	-35.59**	-59.56***	-29.43	-58.99**	-59.99*	-61.75***	-66.34**
	(12.31)	(19.54)	(17.98)	(26.15)	(28.49)	(19.47)	(26.33)
Observations	22	21	20	20	21	21	18
R-squared	0.590	0.652	0.608	0.673	0.652	0.654	0.758

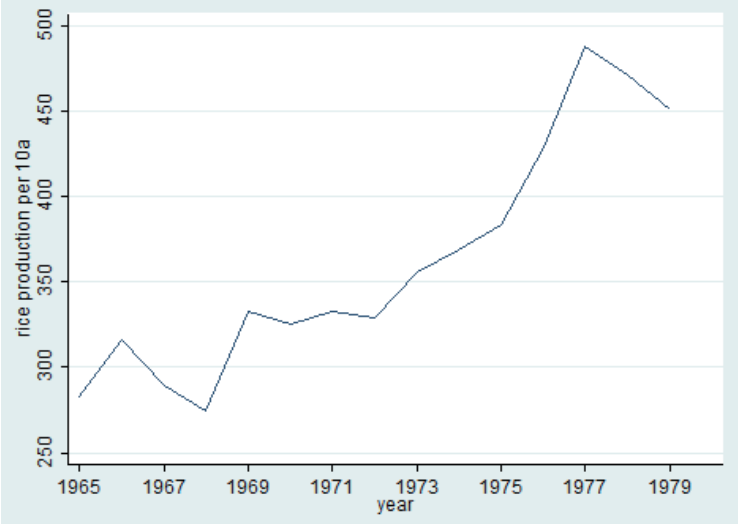
Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figure 1. Merit-based provision of electricity[27]



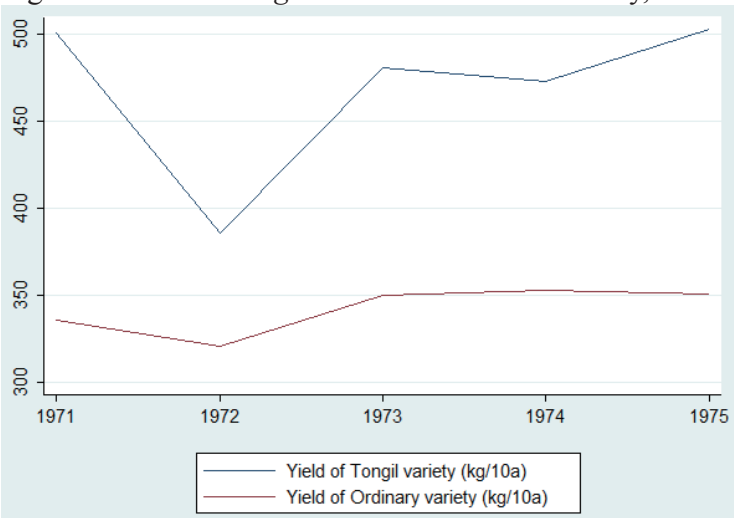
[27] Author's visualization based on Han, Ho-Sun's statement

Figure 2. Yield of paddy rice (kg/10a), 1965 - 1979



Source: *Year book of Agriculture and Forestry Statistics* by Ministry of Agriculture and Fisheries (various volumes)

Figure 3. Yield of *Tong-il* versus Traditional variety, 1971-75



Source: *Green Revolution in Korea* by Ministry of Finance and Strategy (2012)

Figure 4-1. Growth rate of rice yield, total 149 counties, 1971-77

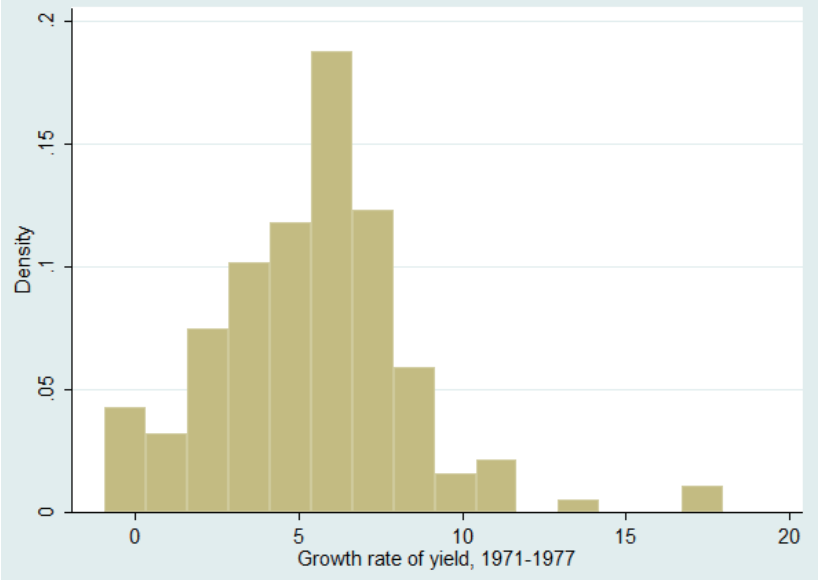


Figure 4-2. Growth rate of per capita rice yield, *Kyungsangbuk-do*, 1971-76

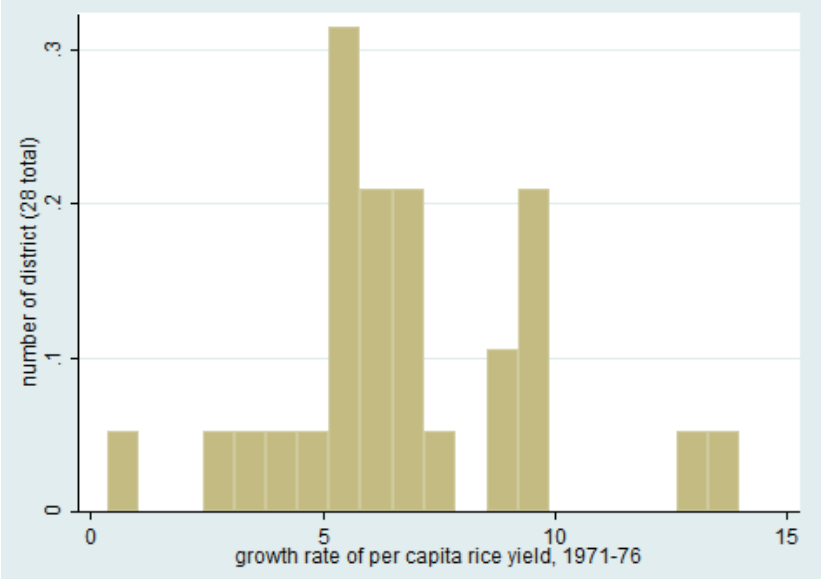


Figure 5-1. Proxy for social capital (%), total 147 counties, 1971-77

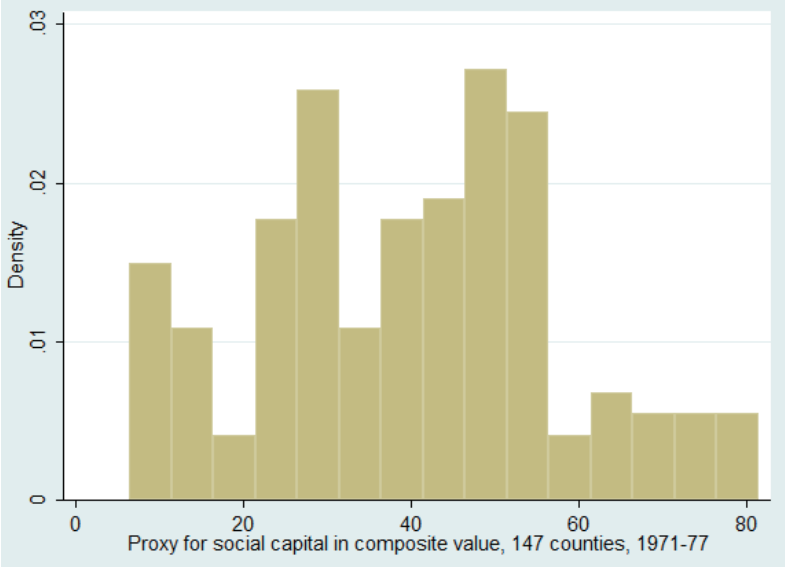


Figure 5-2. Proxy for social capital (%), *Kyungsangbuk-do*, 1971-76

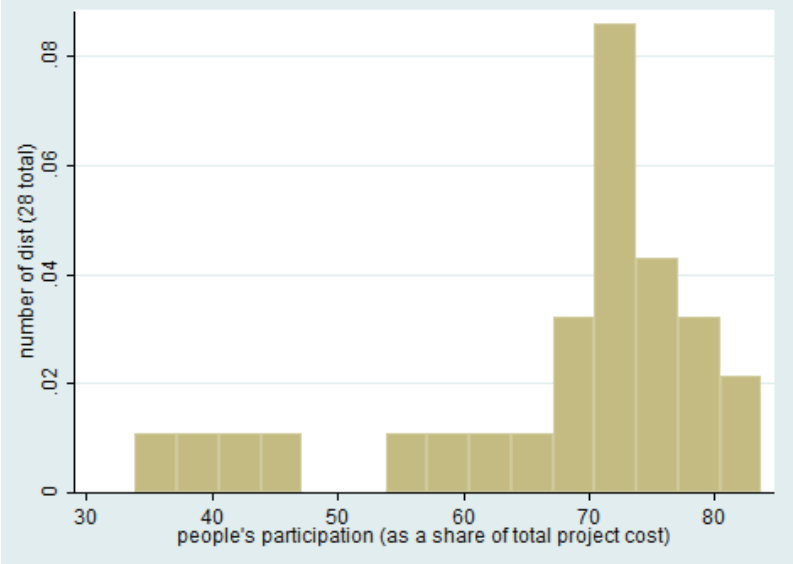
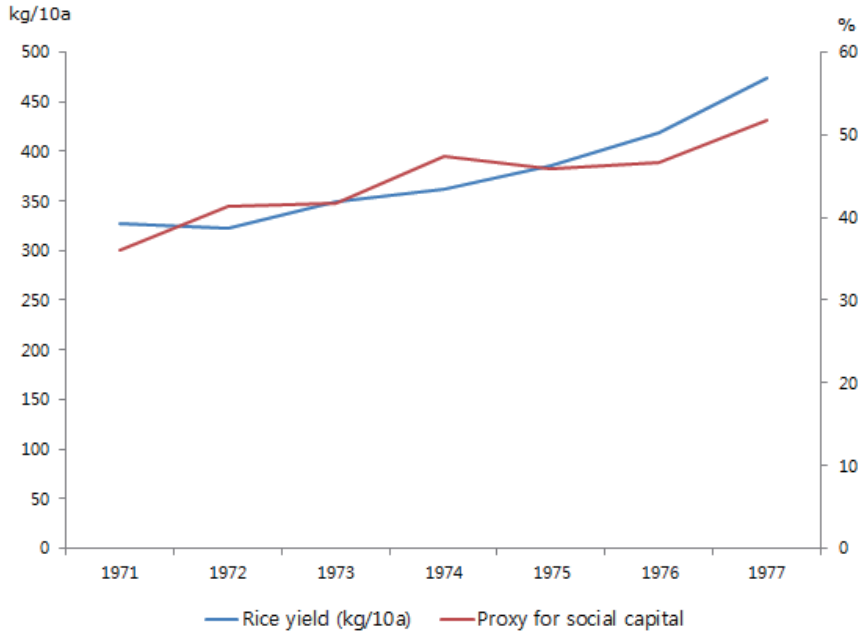
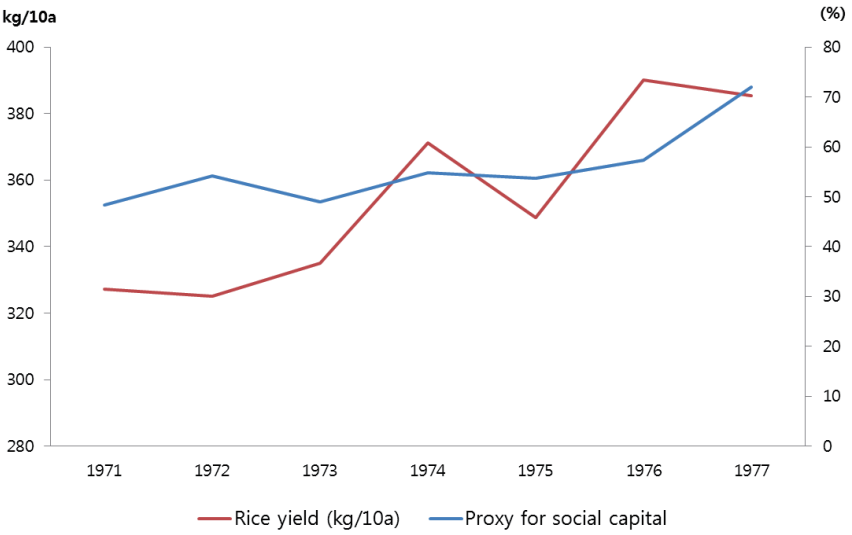


Figure 6-1. Social capital (%) and paddy rice yield (kg/10a), total, 1971-77



Source: Author's calculation based on *Statistical Yearbook of Provinces* (various volumes)

Figure 6-2. Social capital (%) and paddy rice yield (kg/10a), *Kyungsang-do*, 1971-77



Source: Author's calculation based on *Statistical Yearbook of Provinces* (various volumes)

Figure 7-1. Growth rate of yield versus proxy for social capital in composite value, total 146 counties

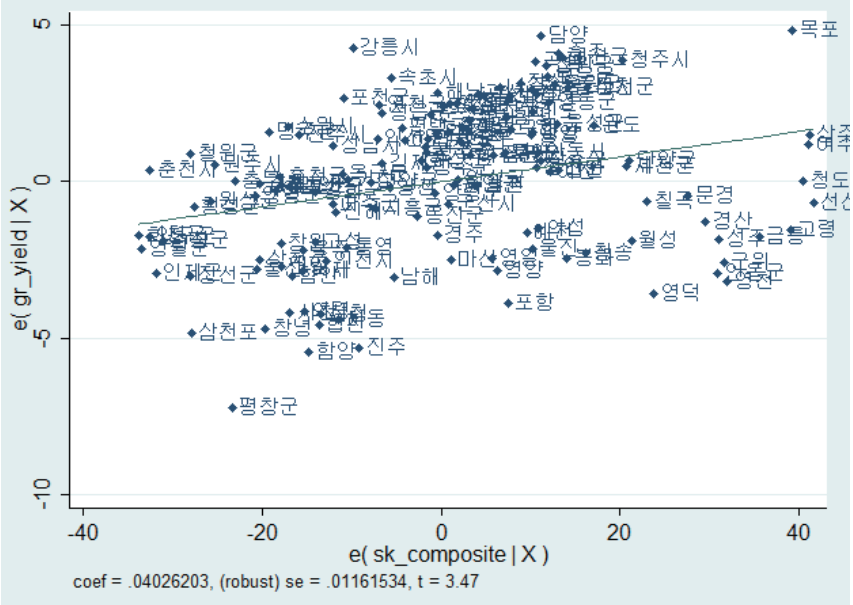


Figure 7-2. Growth rate of yield versus proxy for social capital in roof arrangement, total 79 counties

Figure 7-3. Growth rate of yield versus proxy for social capital in land consolidation, total 78 counties

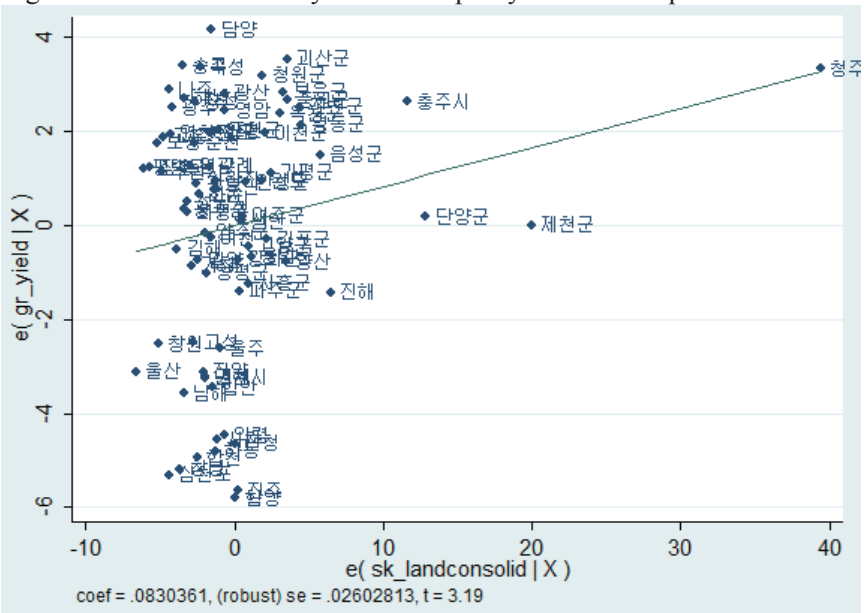


Figure 7-4. Growth rate of yield versus proxy for social capital in farm land, total 37 counties

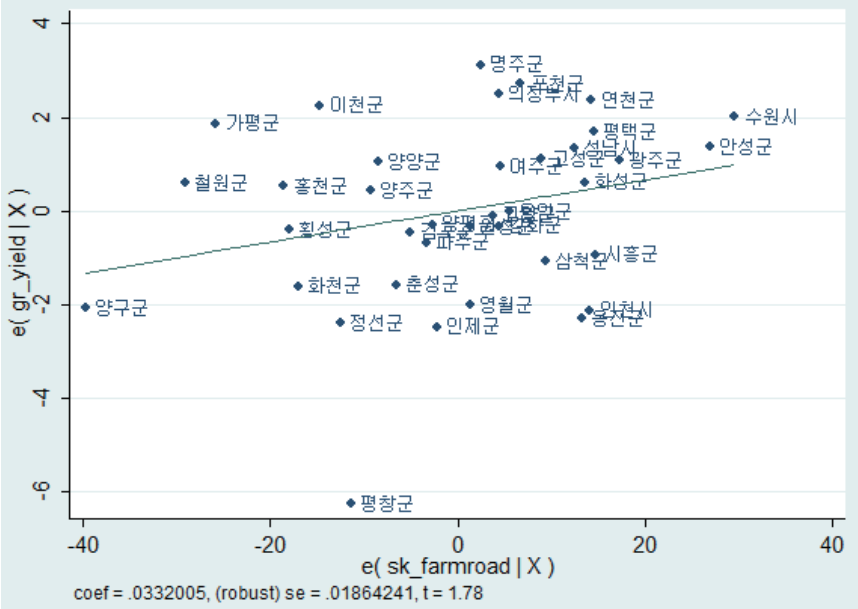


Figure 8. Growth rate of yield versus level of initial rice yield, total 146 counties

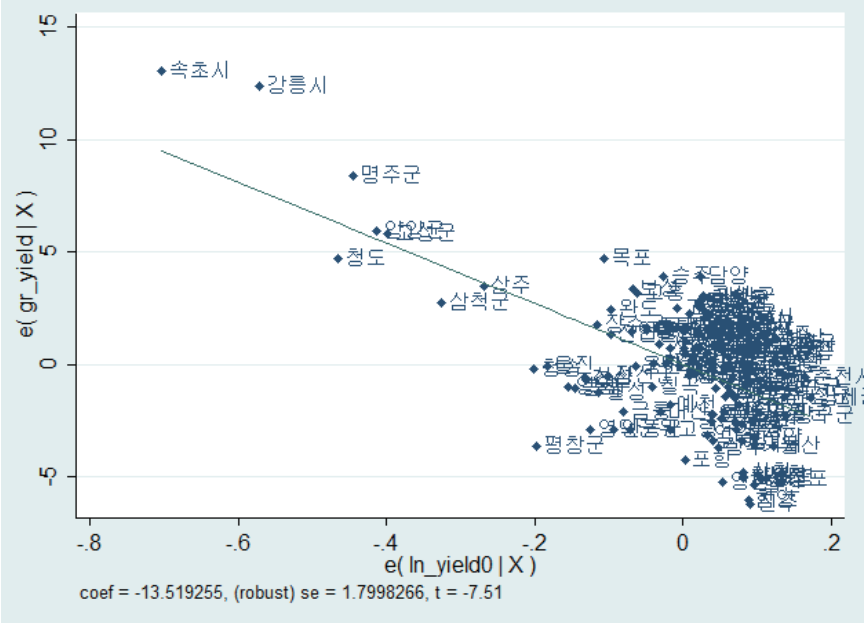


Figure 9. Growth rate of yield versus other variables, total 145 counties

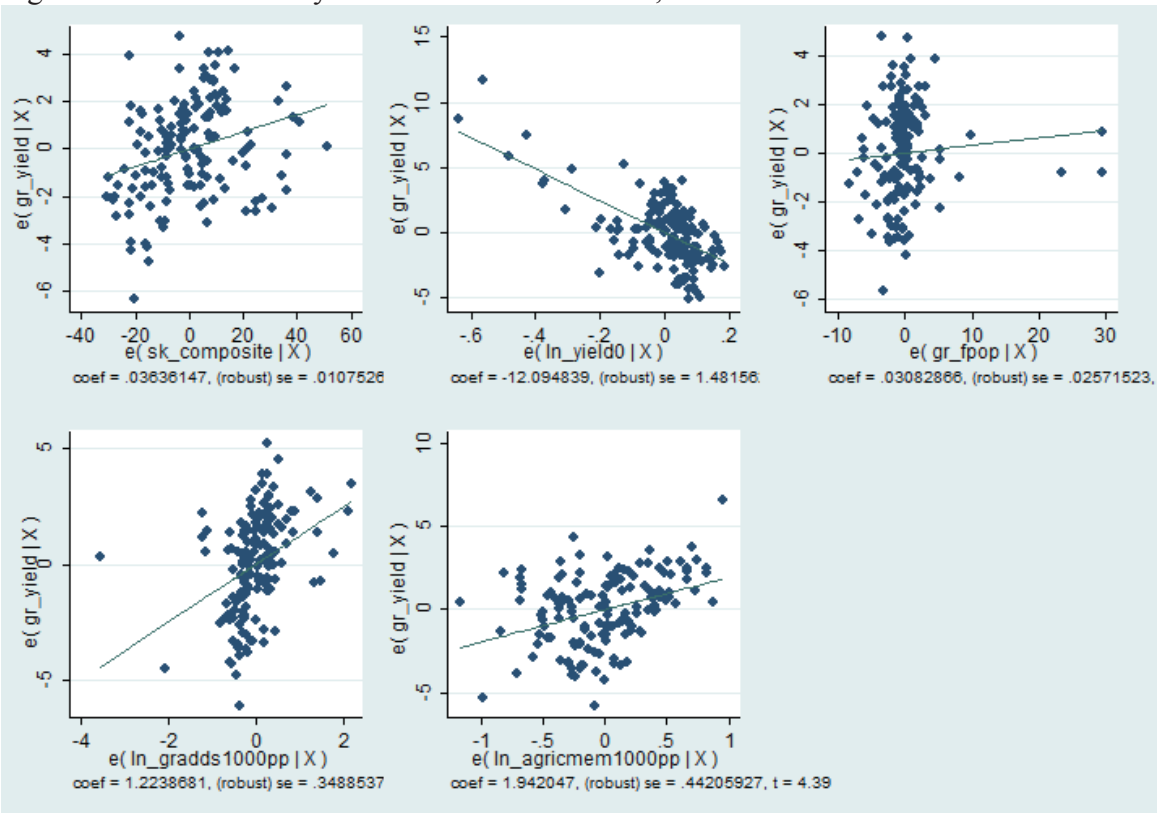


Figure 10-1. Growth rate of per capita yield versus level of per capital initial rice yield, *Kyungsangbuk-do*

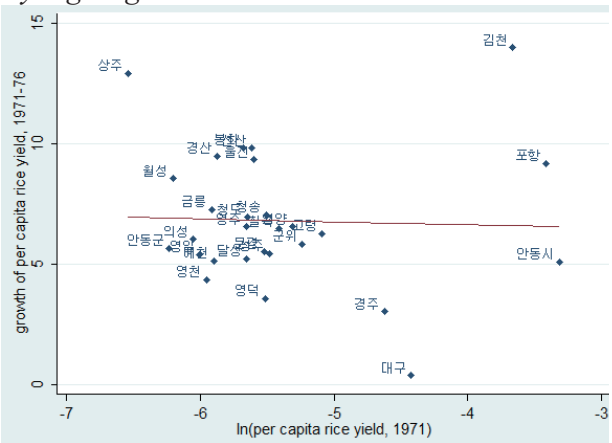


Figure 10-2. Growth rate of per capita yield versus level of per capita yield, *Kyungsangbuk-do*

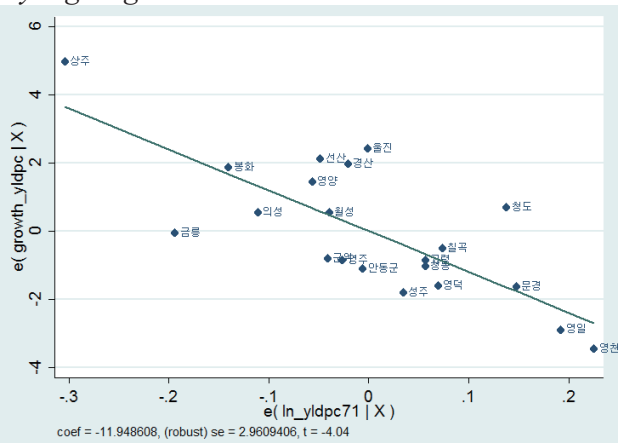


Figure 11. Growth rate of per capita yield versus proxy for social capital, *Kyungsangbuk-do*

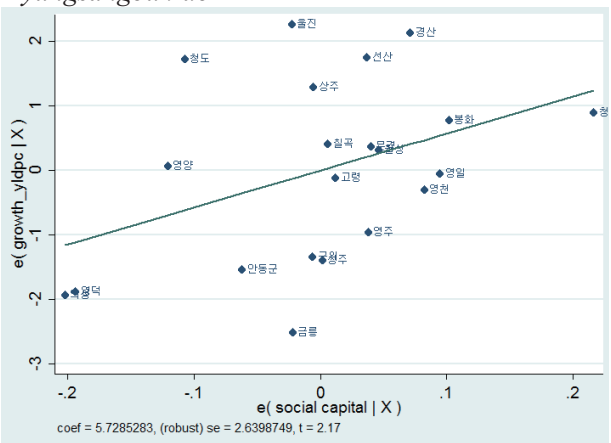
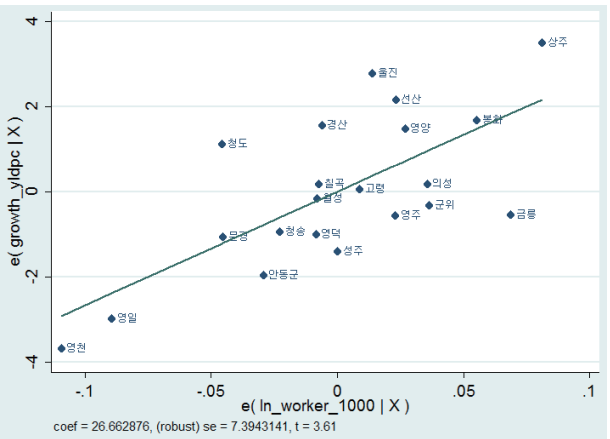


Figure 12. Growth rate of per capita yield versus log of Extension, *Kyungsangbuk-do*



Chapter 2

Profitability, Learning, and Technology Diffusion

2.1 Introduction

Technology adoption is fundamental to the growth of agricultural productivity. With appropriate technology adoption and diffusion, Asian countries such as Korea, Taiwan, and the Philippines experienced the dramatic increases in yield of rice and wheat varieties from the late 1960s, as known as the Green Revolution.

Rice production had been chronically short to meet the domestic consumption of Korea. The situation was worse than ever in the aftermath of the Korean War from 1950 to 1953 due to the destruction of production infrastructures. Korea imported massive amount of rice that by 1971, $206 million worth was imported. It accounted for one fifth of total export amount of $1 billion. Hence, the government set the goal to achieve self-sufficiency of food to save foreign exchange amid rapid industrialization during 1960s.

The continuous effort for technology development contributed to achieve self-sufficiency of rice when the modern high-yielding variety (HYV) named "*Tongil*" was widely diffused and cultivated in the late 1970s. The effort to increase agricultural productivity was initiated by government-supported agricultural research and extension services since the early 1950s. With public-supported technology development, the growth of agricultural productivity could be made possible during the 1970s.

Although the government made effort to develop and diffuse new technology the adoption of agricultural technology resulted mainly from an individual farmer's decision to plant the modern variety. Unlike the conventional idea that farmers compulsively complied with government policy and adopted the *Tongil* because the government forced them to cultivate it, farmers were independent decision-makers to adopt the modern variety. Farmers made decisions to choose between continuing to plant the traditional variety and starting to cultivate the modern variety considering the economic profit from adopting it.

It was not easy for an individual farmer to adopt a new technology because it is costly to take it. Farmers faced uncertain returns against economic costs and often suffered from credit constraints in rural poor areas. In addition, information on the new technology was so limited that learning the new technology from others is an essential process in the technology adoption.

This chapter aims at identifying whether the profitability guaranteed by the government and knowledge spillovers through learning organizations and extension services contributed to the adoption and diffusion of the modern HYV of *Tongil*. The fixed effect (FE) estimator is employed to estimate unbiased effect of observable variables which might be correlated with unobserved region-specific characteristics. The idea that learning through the government extension services and village-based learning organizations contributes to adopt the new technology is largely robust to both county- and province-level analyses.

2.2 Background of Korea's technology adoption and diffusion

2.2.1 Pattern of technology diffusion

The Green Revolution of Korea was not a random event and development of the high-yielding variety. It was a constant process of technology improvement through government-supported agricultural research and extension services since the early 1950s. The effort to increase agricultural productivity was initiated by institutional changes along with the "First Five-Year Development Plan for Expansion of Agricultural Production" in 1953. The main goal was to achieve food self-sufficiency through the supply of agricultural inputs, land reclamation, and research and extension service for increasing production.

Agricultural technology development was further systematized and strengthened by the establishment of the Rural Development Administration[28] (RDA) in 1962. The research and development of modern varieties was strongly promoted by the RDA in collaboration with the International Rice Research Institute (IRRI) in the Philippines. As a result of public-supported effort of research and development, the high-yielding variety named *Tongil* (*IR667*[29]) was introduced in 1971. Spread of *Tongil* variety[30] throughout the country was rapidly reached at an equilibrium level in a short time. By 1978, as much as 76 percent of the total paddy rice area was cultivated with *Tongil* variety (Figure 1). Although a rapid diffusion of *Tongil* was temporarily interrupted by natural calamities in 1972, the diffusion rebounded with a much higher yield which was almost 30 percent more than that of traditional rice variety in 1973.

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[28] The "Rural Development Law (1962)" denotes the missions of RDA: to contribute to improve the welfare of farmers by conducting agricultural research and development, agricultural technology transfer, and capacity building for farmers and rural leaders.

[29] *IR667* is a hybrid rice variety from the cross of three different types of variety: *IR8, Yukara*, and *TN1* (*Taichung Native 1*).

[30] There are more than 20 modern high yielding varieties such as *Yushin, Nopung, Raekyung, Milyang*, etc. The modern variety refers to *Tongil* variety, hereafter.

Diffusion pattern of *Tongil* variety has been featured by geographic differences, as represented in the case of hybrid corn in the United States[31]. The hybrid corn has been spread rapidly since the early 1930s and it showed marked geographic differences in the development (Griliches, 1957)[32]. In addition, some regions adopted *Tongil* variety earlier than others, and some regions made the transition much more rapidly than others. Some regions reached lower levels of equilibrium than others by the late 1970s. However, almost everywhere the general pattern of diffusion of *Tongil* variety followed an S-shaped growth curve like the pattern of diffusion of hybrid corn (Figure 2-1, Figure 2-2).

The speed of adoption and diffusion of *Tongil* variety was slow at first and was accelerated during the transition period. In the early stage of the diffusion process, in fact, the new technology of *Tongil* variety was imperfect, then the effort to improve seeds, tastes, and cultivation techniques has been continuously made throughout the whole process. When the technology has been enhanced after the initial stage, the diffusion speed of *Tongil* variety was rapid. The growth rate slowed down as the technology diffusion was completed in 1978.

The distribution of rice yields shows the close correlation with the distribution of rates of acceptance of *Tongil* variety: The higher the yield, the higher the rate of acceptance of the new technology. The production amount of *Tongil* variety accounts for 80 percent of the total amount of rice production in 1978 (Figure 3).

The pattern of technology diffusion also applies to increase in the use of other inputs including irrigation condition, farm equipment, fertilizer, pesticide, etc. Modern high-yielding variety of *Tongil* is characterized by a higher yield with a higher level application of chemical

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[31] See Griliches (1957).
[32] Studies regarding the diffusion of new technology in economics began with Griliches (1957) in his seminal study on the diffusion of hybrid corn.

fertilizer. Since lack of irrigation had been pointed out as a critical problem of low agricultural productivity of Korea, the construction of irrigation system was a prerequisite to apply fertilizer. As the irrigated field was expanded, more rapid diffusion and higher yield of the modern variety were expected (Figure 4).

2.2.2 Profitability of HYVs production

Adoption of high-risk modern variety requires strong incentive or guarantee for the expected yield. Despite the heavy public-supported propagation of the *Tongil* variety, it was not easy for farmers to decide to abandon the traditional variety. Uncertainty about yields of the modern variety was a main reason why farmers did not adopt it immediately considering the fact that the majority of farmers were small holders engaged in subsistence farming. In 1971, more than 65 percent[33] of total farm households owned less than 1 *ha* and the poorer farmers have suffered from credit constraints due to the heavy household debt from high-interest loans[34] since the 1950s.

The production cost of *Tongil* variety is higher than that of traditional variety, particularly, because of higher material costs created by purchasing more inputs such as chemical fertilizers, pesticides, polyethylene film sheets and so on. In spite of higher input costs in cultivating *Tongil* variety, the *Tongil* variety could not command higher market prices because it was not preferred by consumers[35]. Korean people have been accustomed to sticky and sweet tastes of traditional *Japonica-type* rice. Although the yield of *Tongil* variety is much higher than

[33] Author's calculation based on *Statistical Yearbook on Agriculture*
[34] See Lee, Myung-Hwi (2009).
[35] According to the survey in 1972 with 100 farmers of sample, however, 84 farmers answered the taste of *Tongil* is "good" and other 16 farmers responded "bad". All sample farmers wanted to the quality of *Tongil* to be improved not to get the lower price than that of the traditional variety in the market (Yu and Ban, 1973).

that of traditional variety by 30 percent, it did not results in economic profit due to higher input costs and lower market price in reality[36].

Correspondingly, the government intervened into the market and filled the gap between the quantity demanded in reality and quantity supplied by increase in production of modern variety through price and input subsidies[37]. The monopoly purchase of *Tongil* variety and monopoly sale of chemical fertilizers through the National Agricultural Cooperative Federation (NACF) worked as a mechanism to induce farmers to cultivate the modern variety through higher rice prices and lower inputs prices than equilibrium prices[38]. The government facilitated the supply of other complementary inputs such as pesticides and polyethylene film sheet in a timely manner. Seeds were provided by the government as well.

For farmers, therefore, there was no financial barrier to adopt the *Tongil* variety. Revenue from the adoption was guaranteed while the cost from the adoption was only the opportunity cost of labor and land that were no longer committed to the traditional variety. The presence of strong effort from the government and the necessary financial support increased the capacity to absorb new technology and make use of a new innovation in a shorter term.

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[36] There are several financial analyses which calculate costs and revenues in planting the HYV *Tongil* compared to the traditional variety (Shin et al., 1976; Yu and Ban, 1973; Shim, 1974). Shin et al. calculated that the net income in cultivating the HVY is 6,605 KRW higher than that of farm household with the traditional variety in 1974 while Yu and Ban demonstrated that the difference of net income between the HYV and traditional variety is 14,474 KRW in 1972. According to the calculation from Shim, the profit per 10a caused by cultivating *Tongil* variety compared to traditional variety is 6,000 KRW higher (May 22, 1974, *Chosun il-bo*).

[37] According to the survey conducted by Yu and Ban in 1972, among 100 farmers 89 farmers responded that they wanted to plant the HYV because the Government purchases it while 11 farmers cultivate the HYV for family consumption. Surprisingly, no farmers wanted to plant *Tongil* variety for the purpose of selling in the open market. In fact, Government sale, family consumption, and sale on the open market accounted for 49.5 percent, 20.5 percent, and 4.9 percent respectively of the HYV on the surveyed farms (Yu and Ban, 1973).

[38] In 1975, the government set the rice price per 80 kg at 19,500 KRW which had been increased by 23.7 percent and planned monopolized purchase of 7 million *sum*. The rice purchasing price was determined based on increasing farm production costs and inflation rate of 20 percent for the sake of diffusion of *Tongil* variety (November 3, *Donga il-bo*).

The government started to award the high-yielding farmers with 100 thousand *won*[39] from 1973 to encourage the cultivation of *Tongil* variety. Not only farmers but also extension agencies and local governments were awarded by increase in production. Interestingly, high-yielding farmers were, in general, small holding farmers who possessed less than 1 *ha*[40]. Unlike the conventional idea that the poorer farmers are less likely to adopt the new technology because of credit constraints, and therefore, they are more likely to risk averse, small subsistent farmers, in fact, adopted more the *Tongil* variety and actively responded to new opportunity created by technology changes. Their profit-seeking interests and desires to become wealthier were exactly matched by the government policy in the 1970s amid rapid industrialization.

However, heavy financial supports including price subsidies, agricultural loans, and awards have burdened the government with financial deficits. The government had maintained the high rice price policy since 1968. As the diffusion speed of modern variety was much more rapid than expected, financial deficits were largely created in the middle of the 1970s[41]. The government responded to deficits by encouraging rice consumption since 1977 in order to reduce expenditures in holding rice inventory.

The Green Revolution of Korea was successfully completed within a shorter period in that required public goods such as agricultural research, extension services, and infrastructure were suitably provided with huge financial supports from the government. Although it was not a sustainable measure, the government effort to achieve rice self-sufficiency and the balanced growth between rural and urban areas was worthy of compliment considering that exploitation of

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[39] It is equivalent to the price of a cow in 1973.
[40] *Annual Report on Rural Extension Service*, 1976
[41] The accumulated deficit by supplying chemical fertilizers at a cheaper price is 42.4 billion KRW by 1973. It is expected to reach 193.2 billion KRW by the end of 1976. In order to eliminate the deficit, price of fertilizers should be increased by 172 percent at least (December 20, 1975, *Maeil Business Newspaper*).

agriculture to promote industrialization was rather universal to many developing countries (Anderson and Hayami, 1986).

2.2.3 Information-sharing: learning organizations and extension services

It took no more than a decade to successfully complete the Green Revolution in Korea. The continuous effort to achieve self-sufficiency of rice resulted in success because of effective technology diffusion through village organizations and heavy extension services. Farmers obtained information on the modern variety and new agricultural techniques by engaging in various kinds of village organizations which have served as a channel for information-sharing. The organizations have affected farmers' behavioral changes towards the decision of technology adoption[42].

Village organizations could be largely divided into three types: learning organizations, associations, and cooperatives. By 1971, a total of 77,895[43] learning organizations including 4-H Club, Agricultural Improvement Club, and Home Economic Club had been organized and efforts were underway to provide a systematic opportunity to increase knowledge and skills of their members. By the end of the 1978 when the Green Revolution was completed, the number of learning organizations has nearly doubled and reached 134,362[44].

The youth aged from 13 to 24 joined 4-H[45] and they have learned the latest agricultural

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[42] The U.S. Military Government during the post-war established the Agriculture Improvement Institute in 1947 and educated Korean people to cultivate unconventional crops in order to resolve food shortage through 4-H. Therefore, one of main activities of 4-H was the introduction of new agricultural techniques such as introduction, cultivation, and preservation of Canada potato (*Kyunggi* Association of 4-H Club, 1949).

[43] Author's calculation extracted from *Statistical Yearbook on Agriculture*

[44] Author's calculation extracted from *Statistical Yearbook on Agriculture*

[45] It has been a conventional perspective from historians and sociologists that learning organizations in rural communities had represented and followed the government policy since the 1950s. Rhee Syngman government utilized Credit Cooperatives and Korea Farmers Association to culture the physical and

techniques. Contrast to traditional varieties, the modern HYV is a 'semi-dwarf' which has short stems for sustaining more grain yields while the yield of *Tongil* responds to a higher level of fertilizers with an unconventional application methods[46]. Therefore, proper rice-breeding techniques for modern variety have been introduced and exchanged between members of learning organizations to keep novices up-to-dated.

As a result of information sharing and effective knowledge spillover through 4-H, many members have been awarded in that they harvested the highest yield of the year in the country. In fact, more than half of farmers awarded for the highest yield of the year were the members of 4-H Club (Ahn, 1986). Even female members[47] were awarded and actively participated in learning process through organizations.

Male members of 4-H have become members of Agricultural Improvement Club when they were over the age of 24 after the completion of their military services while female members belonged to Home Economic Club automatically. During the development era from the 1960s to 80s, in fact, all of individual in rural areas were exposed to the high opportunity of learning and education via compulsory primary education, learning organizations, military services, associations, and cooperatives throughout their whole life. These organizations on each community provided a means whereby individuals enable to increase their capability and learn cooperation through teamwork during the transition period faced by rapid technology changes.

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ideological foundation (Lee, 1998) while Park Chunghee government utilized Agriculture Cooperatives to mobilize rural society (Han, 1998). The 4-H has been also regarded as one of government-supported organizations for the political sakes. However, 4-H had a clear vision and mission and especially played an important role in delivering new agricultural techniques and knowledge.

[46] For example, farmers used to prefer to apply nitrogenous fertilizers and it resulted in soil acidification, and therefore, autumn declining phenomenon was frequently observed. The 4-H publicized to utilize calcium fertilizers which are more suitable to Korean geographical feature with acid soils. It contributed to improve soil quality as well.

[47] Kim, Hee-Nam, 22 years-old female member of 4-H from *Gangneung, Gangwon* province was awarded by the high yielding of *Tongil* variety with the record of the production of 670 kg per 10a (*Annual Report on Rural Extension Service*, 1973).

Learning organizations based on traditional village boundary closely have worked with the government extension agency. The history of extension work has been started by the foundation of Agriculture Improvement Institute (AII) in 1957 followed by the recommendation of the 'U.S. Macy report' published in 1956 regarding strategy of Korea's agricultural development[48]. Besides, institutional infrastructure for the extension service has been equipped with the creation of the RDA as an independent government organization in the early 1960s. With institutional set up for extension services, the nationwide effort for increasing agricultural production with the diffusion of modern HYV has been initiated along with the community-driven development with the *Saemaul Undong* since the early 1970s.

Extension services controlled by the RDA have delivered the on-the-job training and assigned the group work for 4-H members to build capacity as professional farmers. In 1973, 80 members who were selected all across country have studied new agricultural techniques in the United States for two years with fully sponsored by the RDA[49].

As a means of dissemination of the modern variety, the RDA undertook the demonstration program which installed the demonstration complex for collective farming of *Tongil* variety and delivered new scientific rice breeding techniques. As a result, the *Tongil* variety showed higher yielding than that of traditional variety did in the neighbor plot by 40 to 50 percent[50]. It was 55 percent increase in yield compared to the previous year's yield from the same plot (Table 1). Meanwhile, the RDA provided training sessions on the operation of

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[48] The International Cooperation Administration (ICA) started to provide a longer-term technical assistance rather than a one-shot and fragmented assistance in the late 1950s. Community Development Program in the 1960s is in line with the ICA's policy and it became the foundation for the *Saemaul Undong* in the 1970s.

[49] *Annual Report on Rural Extension Service*, 1974

[50] The yield of *Tongil* variety per 10a in demonstration plots is 537 kg on average. Compared to the production of traditional variety of 371 kg in neighbor plots, yield has been improved by 45 percent (*Annual Report on Rural Extension Service*, 1973).

agricultural machines to farmers by setting up 100 training centers at the county level[51]. Responding to labor shortage due to rural exodus, the RDA introduced the mechanized labor-saving technology along with "Agricultural Mechanization Promotion Act".

Under the RDA as a control tower, more than 7,000 extension workers from 9 province-level and hundreds of county-level extension service agencies visited farmers, figured out problems, and transferred techniques and recommendations based on region-specific environment and characteristics. The dialectic interaction between farmers and extension workers was highly effective because farmers' demand and trouble in cultivating the modern variety were reported immediately to the central authority. At the same time, the feedback from the research and development was delivered to farmers in a timely manner. Extension system in the 1970s largely contributed to increasing agricultural productivity in that three components connecting R&D, extension agencies, and farmers are closely related and collaborated.

2.2.4 Risk-sharing: social capital and rural sociology

With the profitability secured by the government's policy, *Tongil* variety has been spread rapidly throughout the farm belt of *Jeonnam* province and the rest of the country. While huge subsidies for inputs and rice prices were major incentives for small holding farmers to adopt a high-risk but high-yielding modern variety, social capital accelerated the diffusion of new technology through risk-sharing accrued by trust and cooperation among farmers.

As noted earlier, social capital accumulated by doing village projects together increased agricultural productivity in rural Korea in the 1970s. Furthermore, social capital also played a role as a catalyst for the adoption and diffusion of new technology. Social capital induced by

[51] 32,885 farmers completed trainings on use and fix of agricultural machines (*Annual Report on Rural Extension Service*, 1973).

doing *Saemaul Undong* based on principles of self-help and cooperation helped the modern variety to be disseminated rapidly. Simultaneously, village people have participated more actively in village projects in providing their labor and capital in that they were able to better off because of increase in income by selling extra rice production occurred by the appropriability of the new agricultural technology. The diffusion of the modern variety have commoved with the accumulation of social capital (Figure 5).

One of the characteristics of *Tongil* variety is higher yield potential to more fertilizer application. In order to efficiently apply chemical fertilizers, the water should be controlled first considering the fact that more than half of paddy field in Korea in 1971 was not irrigated paddy fields. Therefore, water management was identified as an urgent issue in adopting *Tongil* variety. The agricultural infrastructures as well as water control systems including reservoirs, dikes, and water ways were improved through *Saemaul* projects along with the diffusion of *Tongil* variety.

Among agricultural infrastructure projects, for example, land consolidation has been considered a priority in increasing agricultural productivity and funded by the government as well as farm household since the 1960s. Along with land consolidation, farm roads have been newly constructed or expanded, and thus, it resulted in greater access to the outside by vehicles and the higher efficiency in agricultural work. Therefore, once the government had sponsored the land consolidation, the village people accordingly responded and donated their land and labor. Land consolidation was one of the prerequisites in rapid diffusion of the *Tongil* variety.

This is in line with Aoyagi et al. (2014). They study the mechanism of social capital accumulation using artefactual field experiments of trust game and find that communal physical infrastructure such as an irrigation system enhances the level of social capital because people are physically built-in the irrigation infrastructure system and thus people are forced to interact each

other institutionally (Aoyagi et al., 2014). The maintenance and productive use of the irrigation system require regular cleaning of the canals, necessitating collective coordination and cooperative work among community members (Aoki, 2001; Hayami and Godo, 2005).

New cultivation techniques have developed along with the introduction of *Tongil*. It encouraged the accumulation of social capital in that more group work and collaboration with individual farmer were required when the modernized agricultural methods were introduced. For example, unlike traditional variety, *Japonica*, it was fundamental for *Tongil* variety, which is a hybrid rice of traditional variety and tropical variety of *Indica*, to secure a longer cultivation period. The early planting cultivation method, which is raising seeds covered with polyethylene film[52] sheet, allowed earlier seedling by preventing cold injury. With this technique, a group of farmers should work together and collaborate as a team to install seedbeds covered with polyethylene film in a timely manner. Farmers were able to overcome the small subsistent farming by working together.

Correspondingly, the risk of shirking was minimized because farmers were forced to work together in the farm while working as a member of groups in constructing public goods in communities. Farmers are able to reduce the risk involved in the adoption of *Tongil* variety through cooperation and trust accumulated by doing co-work.

[52] Since 1970 mass polyethylene film production system has been developed due to the construction of the petrochemical complex in *Ulsan*. Since then, polyethylene film was supplied at a lower price to farmers.

2.3 Empirical strategy

2.3.1 Model

To identify whether profitability and knowledge spillovers through learning organizations and extension services contributed to the adoption and diffusion of the modern HYV of *Tongil*, the fixed effect (FE) estimator is employed. The FE estimator is used to estimate unbiased effect of observable variables which might be correlated with unobserved region-specific characteristics. Unobservable factors are related to geography, local people's political orientation, weather, etc. In addition, the government-supported effort for Green Revolution in disseminating the HYV implies that the bias is likely to be practically generated.

The estimates are obtained from a fixed effect model which removes time-constant, unobserved attributes μ_i:

$$y_{it} = \alpha + \beta \Delta yield_{it} + \gamma learning_{it} + \theta x_{it}' + \mu_i + \delta_t + u_{it}$$

where y_{it}, outcome variable, denotes the percentage of planted area of the HYV to the total planted area of paddy rice in province/county *i* at year *t*. The explanatory variable of interest, $learning_{it}$ is the membership of learning organizations including 4-H Club and Agriculture Improvement Club as well as extension workers in province/county *i* at year *t*. Other explanatory variable, $\Delta yield_{it}$, is the previous year's yield difference between the high yielding variety (HYV) and traditional variety (TV) of paddy rice. The yield difference is controlled to reflect the profitability of the new technology adoption. The difference of yield between the HYV and TV is

$$\Delta yield_{it} = yield_{it-1}^{HYV} - yield_{it-1}^{TV}$$

The bigger the difference the more adoption of the modern variety is expected in the following year.

This is because the farmer's problem at time *t* in the region *i* is optimizing inputs usage to maximize the expected profit subject to credit constraints,

$$\max_{z \geq 0} E(\pi_{it}) = \varphi_{it} f(z_{it}') - z_{it}'$$

where φ_{it} is a multiplier for technology diffusion such as learning organizations, extension services and rural networks and z_{it}' is a vector of agricultural inputs while the production function $f(z_{it}')$ is linearly homogeneous in all inputs. Prices of inputs and output are normalized to 1 in that there are no differences in prices by region. Farmer's decision for the adoption of new technology is

$$\begin{cases} D = 1 & if \quad \varphi_{it} f(z_{it}') > z_{it}' \\ D = 0 & if \quad \varphi_{it} f(z_{it}') \leq z_{it}' \end{cases}$$

x_{it}' is the vector of regressors which include; i) a proxy for social capital accumulated by doing village projects[53], ii) land and labor saving technologies including chemical fertilizers, agricultural power machines, and pesticides; iii) socioeconomic factors such as farmers characteristics of average age, pure farming, and small holding, and; iv) land condition including cultivated area of Farm Land Improvement Association (FLIA) and irrigated land.

The estimate of interest is γ, the effect of learning on technology adoption and diffusion at an area *i* at time *t*, which is expected to be positive. Since the new technology of *Tongil* variety was introduced first through government sector intervention and neighbor farmer's experiences,

[53] As pointed out in the earlier chapter, the proxy for social capital has endogeneity problems which might be related to unobservable area-specific attributes or other covariates.

the learning organizations at villages and extension workers became the channel for knowledge spillovers. It will be a small contribution to the literatures that utilize individual-level data to estimate the effect of learning from other neighbors.

In addition, as the data of yield from the modern variety are only available at the province level from 1975 to 1978, the paddy rice yield and the cultivated area of the HYV of previous year are alternatively utilized in order to reflect the profitability and experience respectively. μ_i denotes the area effect and δ_t the year effect. u_{it} is a random error. Each regression also contains a full set of year dummies.

2.3.2 Data

Data are constructed at province and county levels drawn from various sources[54] from 1970 through 1980. Main data at a province level come from the *Statistics Yearbook of Agriculture*[55]. The strength of the Yearbooks is its all-inclusive information on the agriculture-related statistics as well as climate and demographic characteristics in 11 provinces in a consistent manner. Although individual farmer's socioeconomic characteristics are not reported by this data set, it was able to be inferred by demographic figures classified by age groups, farm size, assets, and so on in a broader perspective. Some information from the *Statistical Yearbook on Agriculture* and *Statistical Yearbook on Crops* are matched to the main dataset.

One salient feature to use province-level data is that not only the yield of the traditional variety but also that of the HYV are reported so that the yield difference between two varieties are able to be controlled in a sense that the yield difference in previous year results in

[54] *Statistical Yearbook of Province, Statistical Yearbook of County, Statistical Yearbook on Agriculture, Statistical Yearbook on Crops, Annual Report on Rural Extension Service*, etc.
[55] Ministry of Agriculture, Forestry, and Fishery has published the yearbook of statistics.

profitability and it would motivate farmers to adopt the modern variety more or not to adopt. For inputs variables including chemical fertilizers, power machines, number of trained *Saemaul* leaders, and number of members of learning organizations, all figures adjusted for farm area of 10*a* are utilized. For socioeconomic variables based on farm size, percentage of farm households which hold less than 0.5 *ha*, 1 *ha*, and 2 *ha* are calculated. Only weakness in using the province-level dataset is that I failed to include the yield difference between the HYV and TV in the early stage of technology adoption during 1971-74 because the data is not available.

However, data at a county-level provide information on the proxy for social capital other things being equal and supplement the provincial level analysis. County-level data mainly come from the *Statistical Yearbook of Province* which was utilized in the earlier chapter. But not every province is included. Data across 55 administrative counties (*gun*) of *Kyungsangbuk-do* and *Kyungsangnam-do* provinces from 1970 through 1978 are estimated with the proxy for social capital. Proxy for social capital is measured by the same method as aforementioned in the earlier Chapter. People's share defined as village residents' donation of land, money, and labor which are computed in a monetary value compared to total project costs in doing village projects is calculated.

Average three projects' composite cost of *Kyungsangnam-do* is 351,333 thousand won. About 58 percent of total cost is financed by village people's donation and it shows large variation from 17 to 100 percent among counties, where higher shares are implied to be higher social capital accumulation. One thing to be mentioned is that types of village projects are different between two provinces because different local governments had implemented village projects according to their own priority and methods.

In the case of *Kyungsangbuk-do*, same proxy measured by using 9 different agriculture-

related village projects as presented in the Chapter 1 was estimated while the composite value from 3 different village projects such as land consolidation, small-scale irrigation, and village beautification is utilized as a proxy for social capital of counties from *Kyungsangnam-do*. Although the specific project type is distinct, the important features are common in that they are all agriculture-related village projects in which village people have participated. In addition, the method to measure the proxy of social capital is consistently applied.

Diffusion pattern of the modern variety *Tongil* at a county level is nearly matched by its province level diffusion pattern as aforementioned demonstration in Figure 2-1 (Figure 2-2). Regarding the pattern of *Kyungsangnam-do*, it shows a sharp reduction in 1973 due to the lower yields performance in 1972 when natural disasters such as hurricane, typhoon, and flood hugely affected people worldwide. However, higher yield performance of 1973 has boosted rapid diffusion of *Tongil* variety since 1974[56].

Table 2 provides descriptive statistics of key variables at a province level while the Table 3 summarizes descriptive statistics of sample data across counties from both provinces.

[56] Observation year is different between both provinces. Available data observation years of *Kyungsangbuk-do* are 1973 and 1975 through 1978 regarding the cultivated area of *Tongil* variety while the cultivated area of *Tongil* variety of *Kyungsangnam-do* are fully observed from 1971 through 1978.

2.4 Results

2.4.1 Main results

Table 4 provides estimation results on the effect of learning and profitability in adopting the modern variety at a province level from 1975 to 78. Data across 11 provinces are analyzed by the fixed effect (FE) model. The knowledge spillovers through learning organizations and extension services are estimated by the membership of 4-H Club and the number of extension workers which are adjusted by cultivated area.

The number of extension workers is estimated to have a positive and significant effect on the cultivated area of the HYV in the FE model. It is inferred that the dialectic interaction regarding new agricultural technology between the individual farmer and extension worker was effective to the adoption and diffusion of the modern variety. The result also confirms that extension service under the RDA was successful to disseminate information and techniques through continuous R&D investment. The effect of learning organizations is estimated to be positive and statistically significant. The membership of 4-H Club adjusted by cultivated area is positively correlated with the percentage of adopted area of the HYV. Farmers responded to the knowledges from the other neighbor farmers in their information networks.

The remarkable thing to note in Table 4 is that the specification is able to control the yield difference between the HYV and TV which reflects the profitability of the modern variety. The estimated coefficients are strongly positive and statistically significant, ranged from 11.07 to 12.51. That is about 0.12 percent increase in the cultivated area of the HYV as an additional unit increase in the yield difference between two varieties. In fact, individual farmers decided to accept the modern variety not because of the government strong recommendation but because of

its profitability.

2.4.2 Robustness checks

Table 5 provides estimation results on the effect of learning and profitability in adopting the modern variety at a county level from 1971 to 78. Data on 55 counties from two southeast provinces of *Kyungsangbuk-do* and *Kyungsangnam-do* are utilized as sample observations.

According to the estimated results of fixed effect (FE) model with unobserved region-specific characteristics, the effects of the membership of learning organizations are estimated to be positive and statistically significant. In particular, the number of Agriculture Improvement Club (AIC), adjusted by cultivated area, is strongly correlated with the percentage of adopted area of the HYV. The result implies that learning organizations closely worked with the government extension agency and adopted new agricultural techniques. They served as a channel for information and knowledge sharing places between extension workers and individual farmers as well as among farmers.

The important thing to note in estimation results is that coefficients on the previous year's cultivated area of the HYV are largely robust. Furthermore, coefficients on the previous year's paddy rice yield are positive and statistically significant in the system (2). These two variables are alternatively controlled in lieu of the variable of yield difference between the traditional and modern variety. The result strongly suggests that farmer's cultivation experience of the modern variety positively correlates to the diffusion of the technology while the higher the yield of paddy rice the more likely it is that farmers adopt more modern variety in the following year because the yield of the HYV accounts for 80 percent of the yield of paddy rice in 1978. Once the adoption of the *Tongil* proved its high yielding attributes and it resulted in profitability to farmers,

the speed of diffusion process was accelerated.

The proxy for social capital does not show the statistical significance on the adoption and diffusion of the new agricultural technology. Even though the social capital accumulated by doing village projects together encourages more rapid diffusion of cultivated area of *Tongil* variety as a catalyst, there was no direct effect on the adoption of new agricultural technology.

2.5 Conclusion

The new high-yielding variety *Tongil* was rapidly adopted and diffused in the 1970s because of two: its profitability guaranteed by the government price subsidy and knowledge spillovers through social networks based on each village. Since the uncertainty in adopting the modern variety was eliminated by the monopoly purchase of *Tongil* variety and monopoly sale of inputs from the government, the farmers had no barriers to adopt it. Individual farmers adopted more the *Tongil* variety and actively responded to new opportunity from technology changes. Their profit-seeking interests and desires to become wealthier were exactly matched by the government policy in the 1970s amid rapid industrialization.

In addition, learning organizations such as 4-H Club and Agricultural Improvement Club as well as associations and cooperatives provided a systematic opportunity to increase knowledge and skills regarding the new technology through social interaction based on community. These organizations on each community provided a means whereby individuals enable to increase their capability and learn cooperation through teamwork during the transition period faced by rapid technology changes. Learning organizations closely worked with the government extension agency.

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매일경제, 1975.12.20

Table 1. Outcome of the demonstration complex for collective farming of *Tongil* variety

Province	No. of complex	Farm household	Cultivated area (ha)	Yield per 10a			Increase	
				Year 1973 (kg)	Before 1973 (kg)	Neighbor land (kg)	Before 1973 (%)	Neighbor land (%)
Seoul	1	11	4.7	552.0	310.0	358.0	178	154
Pusan	1	22	3.2	439.0	308.0	316.0	143	139
Kyunggi	140	2968	1173.3	523.7	347.6	382.5	151	137
Gangwon	40	718	232.7	525.2	303.2	349.3	173	150
Chungbuk	60	934	319.1	617.2	356.0	391.4	198	158
Chungnam	140	2055	720.2	547.6	364.9	388.9	150	141
Geonbuk	140	2029	700.0	529.7	353.5	375.3	150	141
Geonnam	172	3087	892.2	510.0	348.0	359.7	147	142
Kyungbuk	166	3700	883.3	577.5	331.2	355.4	174	163
Kyungnam	140	2928	700.0	503.7	343.4	358.6	147	141
Total	1000	18452	5628.7	536.7	346.1	370.7	155	145

Source: *Annual Report on Rural Extension Service* by Rural Development Administration (1974)

Table 2. Province-level sample descriptive statistics, 11 provinces total, 1970-78

Variable	Obs	Mean	Std.Dev.	Min	Max
Id by province (si-do)	99	6	3.178	1	11
Total farm household	99	217714.600	148063.000	4324	466075
Cultivated area of paddy rice	99	108578.200	78901.870	696	207114.6
Cultivated area of traditional variety	55	62425.160	55443.080	495	160579.9
Cultivated area of high-yielding variety	84	34386.550	43602.410	0	186797.0
Percentage of cultivated area of HYV	83	24.764	25.515	0	93.16
Yield of paddy rice (kg per 10a)	99	370.849	71.610	160	552
Yield of traditional variety (kg per 10a)	55	387.382	58.180	265	652
Yield of high-yielding variety (kg per 10a)	52	478.769	64.773	291	610
Yield difference between TV and HYV	52	64.058	51.783	-64	260
Cultivated area by FLIA (ha)	83	33786.240	26629.340	39.600	91662.200
Irrigated area (ha)	88	56224.100	42720.630	365.900	139718.500
Percentage of small holder (< 1 ha)	88	63.249	8.393	46.740	84.107
Chemical fertilizer (kg per 10a)	88	27.379	67.173	3.473	404.971
Power machine per household	88	0.204	0.108	0.042	0.569
No of 4-H Club	88	3045.523	2230.881	35	7655
No of 4-H Club membership	88	53913.450	41701.510	580	174765
Extension worker	66	582.379	385.220	24	1239
Extension office	66	108.803	84.479	3	251

Table 3. County-level sample descriptive statistics, 55 counties total, 1971-78

Variable	Obs	Mean	Std.Dev.	Min	Max
Id by county (si-gun)	495	28	15.891	1	55
Cultivated area of paddy rice	488	6706.846	7288.454	45.6	138754
Cultivated area of HYV	316	2367.717	2833.889	0.3	18327.9
Percentage of cultivated area of HYV	316	35.595	29.037	0.125	100
Yield of paddy rice (kg per 10a)	405	349.783	47.256	203	498
Yield of HYV (kg per 10a)	78	487.628	57.643	341	613
No of Agriculture Improvement Club (per 10a)	375	0.0040	0.0061	0.0003	0.0526
No of 4-H Club (per 10a)	428	0.0038	0.0041	0.0002	0.0526
No of 4-H Club member (per 10a)	428	0.0673	0.0688	0.0025	0.8114
No of 4-H Club leader (per 10a)	428	0.0100	0.0137	0.0004	0.1908
Cultivated area by FLIA (ha)	302	1765.003	1885.798	21.5	11432.5
Irrigated area (ha)	344	3515.520	2449.955	0.300	11770.6
Chemical fertilizer (kg per 10a)	326	11.099	30.170	0.697	538.526
Power machine (no. per 10a)	346	5.221	4.744	0.112	42.057
Proxy for social capital	404	57.785	27.022	0	100
Percentage of small holder (< 0.5 ha)	309	39.125	13.194	13.207	83.189

Table 4. Regression analysis for percentage of cultivated area of HYV at a province level

Percentage of cultivated area,	Fixed Effect			
HYV, 1975-78	(1)	(2)	(3)	(4)
Learning				
Extension service	41.70***	47.33***	41.09***	49.27***
	(10.49)	(8.787)	(10.35)	(10.59)
Membership of 4H	36.25**	41.57*	37.55*	30.85
	(14.75)	(19.61)	(19.81)	(22.99)
Profitability				
Yield difference, HYV and TV	11.07**	11.65**	11.24***	12.51***
	(3.627)	(4.455)	(3.379)	(2.672)
Land condition				
Cultivated area of FLIA	0.380	0.420	0.386	0.516
	(0.386)	(0.436)	(0.393)	(0.322)
Small holder		-0.664		
		(0.791)		
Physical inputs				
Chemical fertilizer			2.064	5.895
			(14.99)	(12.97)
Power machine				19.00
				(24.87)
Year dummy	Yes	Yes	Yes	Yes
Observations	37	37	37	37
Number of id_sido	11	11	11	11
Within R-squared	0.954	0.954	0.954	0.956
Between R-squared	0.187	0.193	0.184	0.294
Overall R-squared	0.005	0.001	0.004	0.017

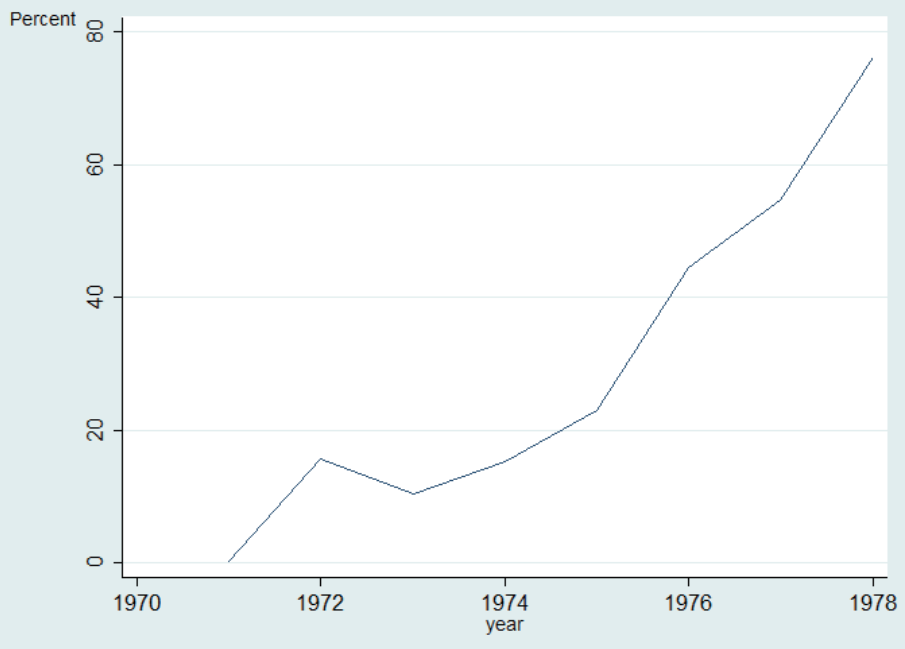
Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 5. Regression analysis for percentage of cultivated area of HYV at a county level

Percentage of cultivated area, HYV, 1971-78	Fixed Effect							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Learning organization								
No. of AIC	6.317***				7.016**			
	(2.074)				(3.296)			
No. of 4H		11.82**				15.69		
		(4.555)				(10.97)		
Membership of 4H			1.369				6.058	
			(4.632)				(4.791)	
Leader of 4H				6.127**				10.25***
				(2.658)				(2.774)
Profitability								
Rice yield,	7.363	9.551*	7.314	6.636				
previous year	(4.794)	(5.630)	(5.513)	(5.343)				
Experience								
Cultivated area of HYV,					0.345*	0.369**	0.375**	0.340**
previous year					(0.182)	(0.174)	(0.177)	(0.160)
Proxy for Social capital								
	-0.0417	-0.0372	-0.0440	-0.0383	-0.0677	-0.0658	-0.0573	-0.0535
	(0.0371)	(0.0380)	(0.0367)	(0.0392)	(0.0546)	(0.0569)	(0.0556)	(0.0542)
Land and labor saving technology								
Irrigated area	0.0613	0.0775**	0.0985**	0.0836**	0.0581	0.0451	0.0577	0.0530
	(0.0395)	(0.0326)	(0.0424)	(0.0324)	(0.0493)	(0.0538)	(0.0561)	(0.0414)
Chemical fertilizer	11.14**	8.697	13.71**	12.14**	3.288	2.847	6.888	5.763
	(5.061)	(6.036)	(5.923)	(4.695)	(5.348)	(6.039)	(6.261)	(4.772)
Power machine	0.833	-2.514	-1.631	-1.969	7.732	5.328	8.134	6.958
	(4.153)	(3.953)	(4.322)	(3.798)	(6.633)	(7.053)	(7.064)	(6.375)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	182	182	182	182	142	142	142	142
Number of id_sigun	44	44	44	44	43	43	43	43
Within R-squared	0.911	0.909	0.906	0.910	0.909	0.907	0.906	0.916
Between R-squared	0.383	0.368	0.410	0.380	0.731	0.639	0.655	0.618
Overall R-squared	0.715	0.706	0.728	0.719	0.813	0.775	0.790	0.776

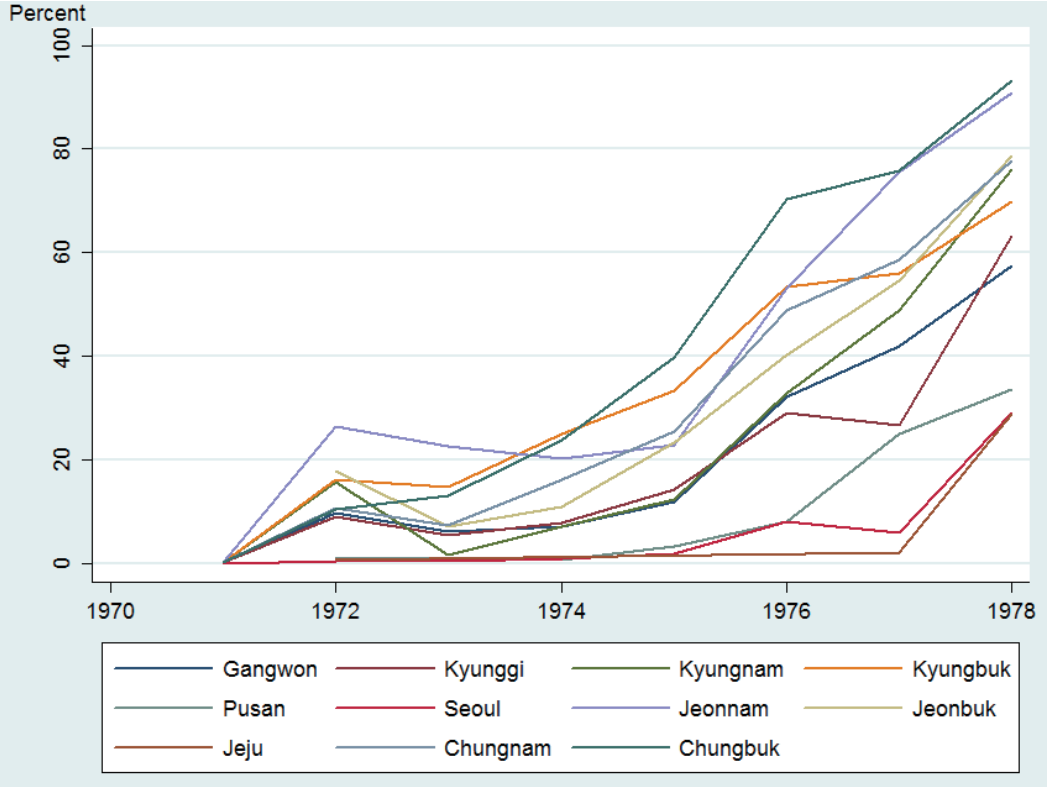
Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figure 1. Percentage of planted area of HYV to total paddy rice field, total, 1971-78



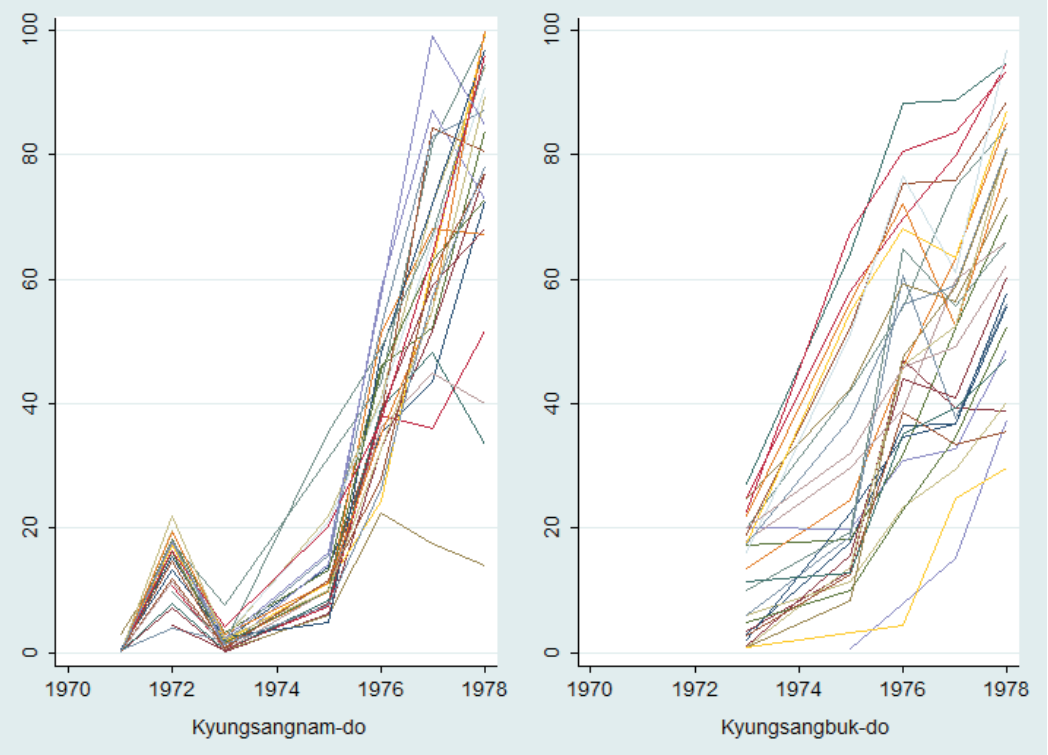
Source: Author's calculation based on *Year book of Agriculture and Forestry Statistics* by Ministry of Agriculture and Fisheries (various volumes)

Figure 2-1. Percentage of planted area of HYV to total paddy rice field by province, 1971-78



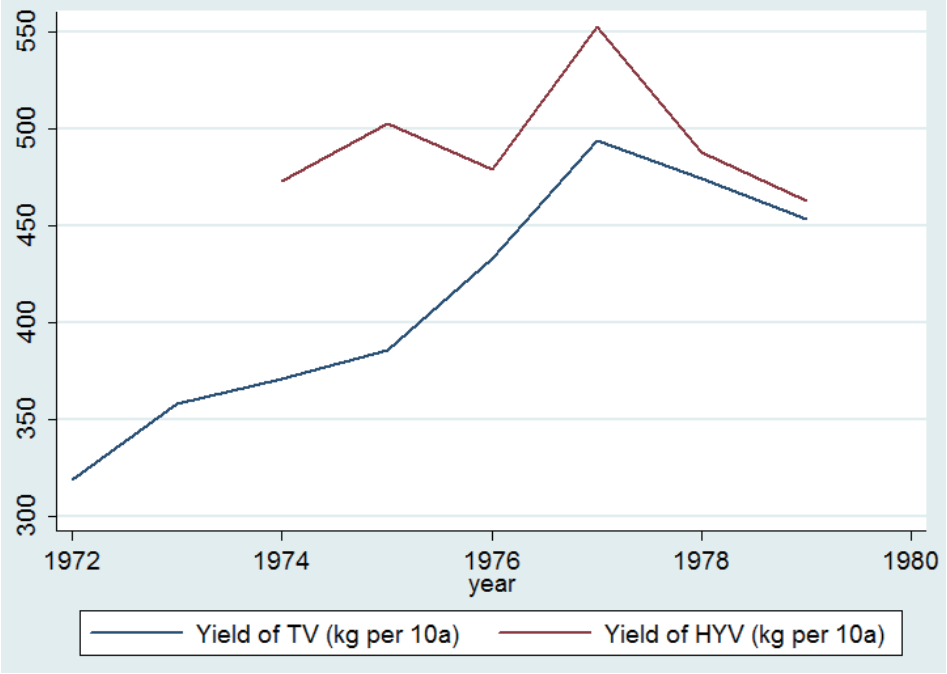
Source: Author's calculation based on *Year book of Agriculture and Forestry Statistics* by Ministry of Agriculture and Fisheries (various volumes)

Figure 2-2. Percentage of planted area of HYV by county, *Kyungsang* Provinces



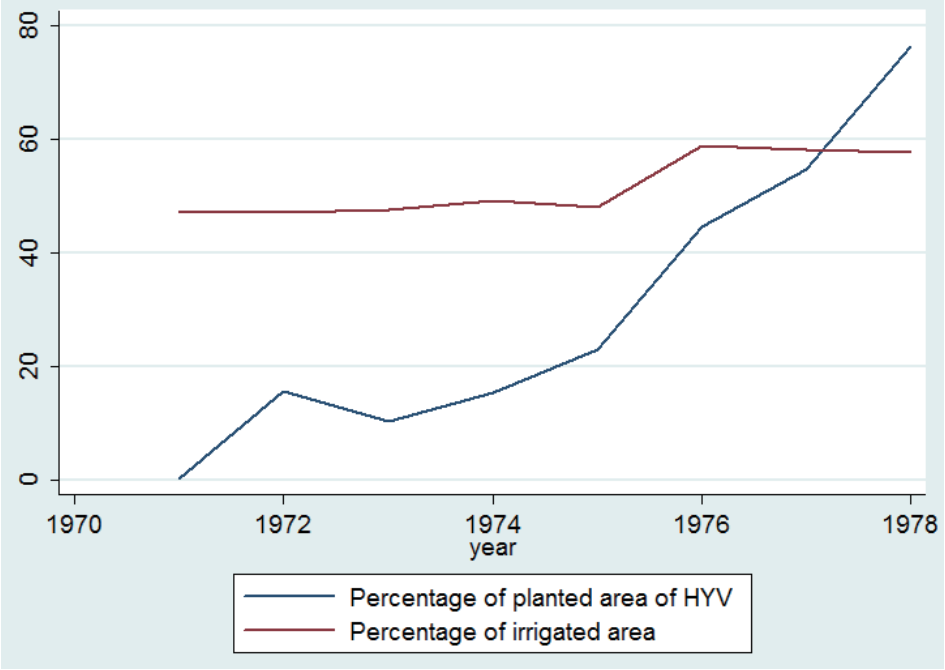
Source: Author's calculation based on *Statistical Yearbook of Province* by *Kyungsangbuk-do* and *Kyungsangnam-do* (various volumes)

Figure 3. Yield of traditional variety versus yield of HYV



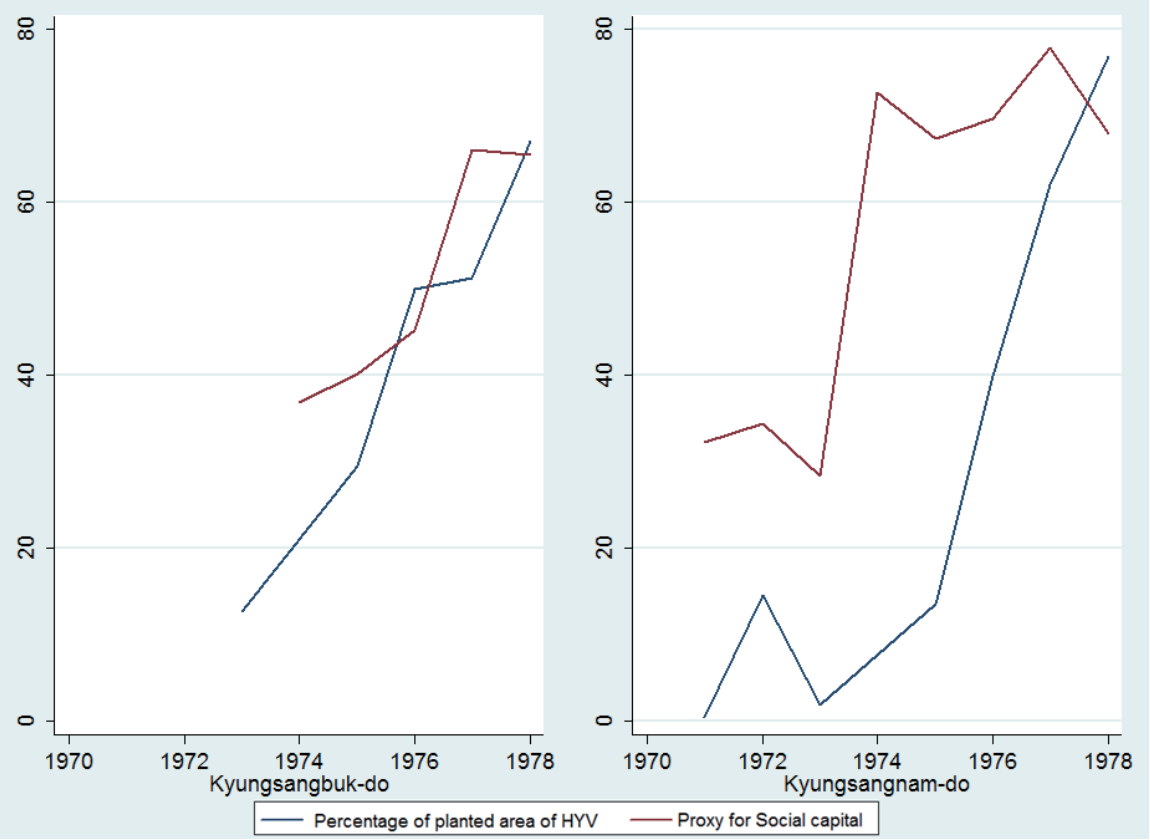
Source: *Year book of Agriculture and Forestry Statistics* by Ministry of Agriculture and Fisheries (various volumes)

Figure 4. Percentage of planted area of HYV versus percentage of area improved by irrigation



Source: Author's calculation based on *Year book of Agriculture and Forestry Statistics* by Ministry of Agriculture and Fisheries (various volumes)

Figure 5. Social capital versus percentage of planted area of HYV by province



Source: Author's calculation based on *Year book of Agriculture and Forestry Statistics* and *Statistical Yearbook of Province* (various volumes)

Chapter 3

Distributive Pattern of Government Grants in the Community Development Program

3.1 Introduction

Community development programs have tended to be one of top priorities in developing countries for an effective poverty reduction and sustainable development. The international development aid agencies and NGOs recognize that the community development approaches and actions are fundamental elements to build up self-help, mutual trust, neighborhood integration and capacities so as to encourage collective action in doing communal projects. The World Bank alone has invested about $85 billion over the last decade on development assistance to promote participatory development through community development projects and local decentralization (Mansuri and Rao, 2013). Involvement of communities in designing and implementing projects could help to achieve a higher level of cooperation and make government more accountable.

However, the successful cases of community development programs are rarely observed in practice because inducing civil society participation and leading to collective action require highly systematic efforts sustained over a longer period. Therefore, the demand for Korea's successful experience of community development is rapidly growing across the world, especially from those countries which are in their take-off period. In fact, the model of *Saemaul Undong* is in top of demand lists submitted by beneficiary countries of the

Knowledge Sharing Program[57] (KSP). When it comes to the issue of what the successful factors of *Saemaul Undong* are, however, it is rather difficult to generalize because community development should be a grassroots process by which communities: each has a different context based on their own culture, tradition, members' disposition, environmental condition, etc.

That said, one salient feature that could apply universally to developing countries is the unique evaluation and support system of *Saemaul Undong* from the perspective of public administration. The Korean government classified rural villages into three categories based on the visible changes of the villages after the implementation of *Saemaul* projects and provided the preferential support to villages which showed the self-help efforts and improvement compared to the previous year. The performance-based support system is rather unique approach considering the fact that the political bias and corruption are rampant problems in allocating resources in developing countries. In addition, the performance-based supports reinforce the project outcome based on rigorous assessments.

The purpose of this chapter is to investigate the mechanism that guided the allocations of development resources across villages along with the nation-wide community development program of *Saemaul Undong*. According to the anecdotal evidences from the *Saemaul* practitioners[58] in the 1970s, one of the widely-accepted ideas regarding the evaluation and support system is that the government provided the development resources only to the better-performing and promoted villages compared to the previous year's performance. So far, however, there is no empirical evidence that verifies the conventional idea that the government only supported villages which showed the remarkable changes after the

[57] The Korea Development Institute (KDI) has been implementing the Program since 2004. Until 2013, KSP has been involved in research and consultations with 134 countries and 606 topics (http://www.ksp.go.kr/ksp/information.jsp).

[58] I interviewed several practitioners of *Saemaul Undong* in the 1970s: Former Prime Minister Goh, Kun (November 24th, 2011), Former Secretary to President for *Saemaul* Han, Ho-Sun (September 6th, 2012), and Former President of Korea *Saemaul Undong* Center Lee, Jae-Chang (August 5th, 2014).

implementation of *Saemaul* projects.

To identify whether the government distributed grants selectively to high-performing villages or randomly, three estimation methods including pooled OLS, random effects and fixed effects are employed. The most straightforward approach would be to match the name of each village categorized as “Basic”, “Self-help”, and “Self-reliant” with the name of villages awarded by government grants. Since the names of villages are not available, however, I alternatively use the number of villages promoted to the higher levels and the number of grant-awarded villages. If both numbers are close to each other, then the government grants are distributed selectively only to better-performing villages.

The empirical analysis is limited in one southern province of Korea because the performance indicators of villages are only appeared in the *Statistical Yearbook of Kyungsangnam-do* province at a county level. According to the regression results, it does not seem that the government provided the support only to the better-performing and promoted villages compared to the previous year’s performance. However, it does not necessarily mean that the government allocated development resources in an egalitarian manner or randomly.

3.2 Analysis of *Saemaul* evaluation system and government grants

3.2.1 Evaluation and support system of *Saemaul Undong*

Performance-based evaluation and support system of the village performance on *Saemaul* projects was one of contributing factors to enable remarkable development of rural villages through the provision of right incentives. The government classified rural villages into three categories based on the visible changes of the villages after the implementation of *Saemaul* projects and provided the preferential support to villages (Table 1 and Table 2). The evaluation and support system was designed and intended to encourage competition among neighbor villages and stimulate villages lagged behind.

Goh Kun[59], Former Prime Minister of Korea, said that "One of the most challenging parts of the *Saemaul Undong* was the evaluation of the performance of rural villages". In order to correctly assess the outcomes of *Saemaul* projects, central and local government officials frequently visited rural villages and cross-checked outcomes of the village projects. Hwang[60] (1980) indicates that it was possible to evaluate and categorize villages in accordance with the performance because of the government monitoring and evaluation package throughout all administration levels – village, county, district, and province. Vertically delivered administration system helped to provide materials and financial supports in a timely manner. Since the number of *Saemaul* villages reached more than 26,000 in its peak, the provision of materials itself was a challenging task for the government.

The government evaluated the performance of *Saemaul* projects mostly based on visual changes of villages. The government established criteria in evaluating and classifying villages that eight dimensions of outcome changes after *Saemaul* Project implementation

[59] He played the key role in planning and designing *Saemaul* projects as Director of the *Saemaul* Bureau during 1971-75.
[60] See Hwang (1980).

were considered to categorize villages as "Basic", "Self-help" and "Self-reliant" villages: village roads, farm roads, river arrangement, irrigation, agricultural machine, cooperative farming, village fund, and household income[61] (Table 3).

The local government provided materials and guidelines for the next step tailored to the development status of villages. For the Basic villages, the lowest level in the development status among three levels, the government tried to encourage self-help spirits first among village members with simple projects implementation for the better living environmentwhile focusing on the non-farming income generation activities for the Self-help villages. Once the villages reached the highest development stage of Self-reliant villages, the priority was to increase the social and cultural wellbeing of village members.

By early 1973, for example, the government classified villages based on the outcome of *Saemaul* projects in 1972. For 18,415 Basic villages, simple projects such as farmroads constructions and roof improvement projects were encouraged and supported by the government while for about 13,943 Self-help villages, the government supported high-cost projects such as electrification and construction of local amenities. For 2,307 Self-reliant villages, guidelines and support for doing business for the higher income generation were provided[62].

As noted in the earlier chapter, rural electrification was powered in conjunction with results of *Saemaul* projects and achieved almost 100 percent of electrification by 1978 throughout the country. Electricity was supplied first only to outstanding villages evaluated in *Saemaul* projects even though the selective provision of electricity is not economically

[61] *10 Year History of Saemaul Undong* by the Ministry of Home Affairs, 1980
[62] *Saemaul Undong: from the beginning to today* by the Ministry of Home Affairs, 1973

feasible and efficient[63]. Despite doubled cost, the government tried to avoid the free rider problem by excluding the provision of electricity to the neighbor villages that showed low performance but might be benefited by the provision of electricity to outstanding neighbor villages (Figure 1 in Chapter 1). The strict merit-based scheme accelerated the community development once the tangible achievement of neighbor villages such as the supply of electricity was appeared in reality.

Along with the supports with priority of orders, the government provided different amount of financial supports according to the development level of villlages. For example, the government supported 80 percent of total project cost for the Self-reliant village, on the other hand, only 60 percent and 50 percent of total cost were provided for the Self-help and Basic village, respectively[64]. It is essential not to unilaterally hand down development resources but to selectively distribute, while suggesting further guidelines customized to the peculiar development status of each village.

The government provided total grants of KRW 57,183 million for 39,932 villages from 1972 to 1979 (Table 2). The government grants were classified into *Saemaul* project grants, outstanding village grants, rivulet arrangement grants, electrification grants, special village grants, success case of village grants and simultaneous support grants from 1974 to 1979[65] (Table 4). The type of grants varied by year, however, four types including *Saemaul* project grants, outstanding village grants, rivulet arrangement grants, and electrification grants were provided relatively in a consistent manner. The number of grant awarded villages and the amount of the government grants reached its peak in 1976 (Table 2, Table 4, Figure 3 and Figure 4).

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[63] Based on author's interview with Former Secretary to President for *Saemaul* Han, Ho-Sun served from 1972 to 1979 (September 6th, 2012)
[64] See the news article from *Kyunghyang* newspaper (November 13, 1973)
[65] *Saemaul Undong: from the beginning to today* by the Ministry of Home Affairs, 1974 - 1979

"Central Committee for *Saemaul Undong"* was set up to discuss implementation strategies and coordinate policies between central and local governments and among ministries. The Minister of Home Affairs was the president of the Committee while relevant Ministers participated and coordinated implementation policies as committee members. In addition, the "*Saemaul* Bureau" within the Ministry of Home Affairs was created in charge of planning and designing *Saemaul* projects as a control tower. The "Monthly *Saemaul* Meeting" attended by ministers, high ranking officials, local government officials, and village leaders was held to report the implementation status and review the strategy while troubleshooting bottlenecks faced by the implementation through immediate policy responses directly from the President.

3.2.2 Spatial diffusion of Self-reliant villages

The government classified rural villages into three levels based on the development status: Basic villages, Self-help villages, and Self-reliant villages. In accordance with the development level of villages, different government supports and annual targets were provided regarding income increase, improvement of living environment, the development of a village fund to provide resources for future development projects, etc. In addition, villages were required to satisfy the specific criteria[66] constructed by the government so as to be promoted to a higher level and to get more government supports with a priority (Table 3).

In 1972, the number of Basic, Self-help, and Self-reliant villages are 18,415, 13,943, and 2,307, respectively among total 34,655 villages[67] (Table 1). 16,250 villages which showed the outstanding performance in *Saemaul* projects of 1971 received 500 bags of

[66] Eight dimensions of outcome changes after *Saemaul* Project implementation are considered to promote villages to Self-help and Self-reliant villages: village roads, farm roads, rivulet arrangement, irrigation, farming base, cooperative life, village fund, and income projects.
[67] *Saemaul Undong: from the beginning to today* by the Ministry of Home Affairs, 1974 - 1979

cements and 1 ton of steel wire while the rest of villages, 18,415 villages of basic stage were excluded in the government supports. However, the surprising thing happened in that 6,108 villages which were not supported by the government continuously participated in *Saemaul* projects even without government supports and became the Self-help villages only with villages' efforts and resources in 1973[68].

The share of villages categorized as Self-reliant started to increase rapidly after 1975 while there were no marked geographic differences in the spatial diffusion of Self-reliant villages particularly during the first half of the 1970s (Table 1, Table 6, Figure 1, Figure 2-3, and Figure 5). In 1976 - 1977, small regional variation was appeared that counties such as *Miryang, Haman,* and *Hadong* had less Self-reliant villages than neighbor counties in *Kyungsangnam-do* province while counties such as *Jinju, Hamyang, Sanchung, Namhae, Sacheon,* and *Tongyoung* had more Self-reliant villages (Figure 5). However, almost every region reached the highest levels of equilibrium by 1979 in that 97 percent of total villages were classified as Self-reliant villages, compared to only 7 percent in 1972 (Table 1). 84 percent of total villages in *Kyungsangnam-do* were classified as Self-reliant villages in 1978 (Table 5 and Figure 5).

Basic villages had disappeared by 1976. At the final stage of *Saemaul Undong* in the late 1970s, all the rural villages were promoted to Self-help and Self-reliant levels[69] (Table 1, Table 6, Figure 1, and Figure 5). Along with the development of villages living environment and infrastructure through the implementation of *Saemaul* projects, rural household income had increased and exceeded that of urban wage rate since 1974 (Table 5).

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[68] *Saemaul Undong: from the beginning to today* by the Ministry of Home Affairs, 1974

[69] By 1980, the government set the different criteria to newly categorize villages as "Self-reliant", "Self-employed", and "Welfare" villages adapting to changing household income and living environment in rural villages. According to the Ministry of Home Affairs, the Self-reliant village is equipped with improved production infrastructure and living infrastructure while the Self-employed village has capacities to manage the business for themselves. In order to become a Welfare village, the household income should be more than 4 million KRW (November 11, 1980 from *Maeil Business*).

3.2.3 Random or performance-based: distributive pattern of government grants

The performance-based support system is one of the most salient features of *Saemaul Undong*. It is worthy of compliment considering that political bias and corruption in resources allocation have been rather universal in many developing countries. However, there are no empirical investigations regarding the mechanism that guided the allocation of resources across villages. Therefore, this section attempts to find the linkage between the outcomes of *Saemaul* projects and the allocation of government grants in the 1970s.

Model

To identify whether the government distributed grants selectively to high-performing villages which showed the remarkable improvement compared to the previous year, or randomly, three estimation methods are employed: pooled OLS, random effects and fixed effects. The estimation equation is

$$y_{it} = \beta_0 + \beta_1 x_{it} + u_{it}$$

where y_{it}, dependent variable, denotes the percentage of awarded villages at the county *i* at the year *t*. The explanatory variable of interest, x_{it}, is the percentage of villages promoted to the higher level based on the performance of *Saemaul* projects at the county *i* at the year *t*.

For example, the number of Basic villages, Self-help villages and Self-reliant villages are 65, 109, and 29, respectively at the county *i* at the year *t*, and 44, 116, and 43 at the year t+1. The number of villages promoted from the level of Basic villages to the level of Self-help villages is 21 (= 65 - 44) and total of Self-help villages become 116 (= 109 + 21 - 14) because 14 villages are promoted from the level of Self-help (43 = 29 + 14) to the highest level of Self-reliant villages at the year t+1. Therefore, the total number of villages promoted to the higher level is 35 (= 21 + 14) at the year t+1.

Two assumptions regarding the *Saemaul* performance indicators are considered; first, villages which show outstanding changes are promoted by no more than one level in a year. If a village was categorized as a Basic village, the lowest level among three levels, in the year *t*, it is not possible to directly become a Self-reliant village, the highest level among three, in the year t+1 even though the village shows highly remarkable improvement within one year. Second, the development level of villages has never retreated. Once a village becomes a Self-help village in the year *t*, for instance, the village never drops to the level of the Basic village in the year t+α $(\alpha \geq 1)$ again. Villages move only towards upper levels.

The primary interest lies in testing the null hypothesis

$$H_0: \ \beta_0 = 0, \ \beta_1 = 1.$$

If the null hypothesis is true, then the government grants were distributed selectively only to better-performing villages without considering any political bias, economic condition, public finance, geography, year events, etc. In addition, interaction terms are included as following

$$y_{it} = \beta_0 + \beta_1 x_{it} + \delta_1 x_{it} * y76 + \delta_2 x_{it} * y77 + \delta_3 x_{it} * y78 + u_{it}.$$

Data

Data are constructed at a county level drawn from the *Statistics Year book of Kyungsangnam-do* during 1974-78. Performance indicators of villages are only appeared in *Kyungsangnam-do* province at a county level. Since data regarding the name of each village categorized as Basic, Self-help, and Self-reliant villages, and the name of villages awarded by government grants are not available, it is impossible to match the *Saemaul* outcome and Government grants allocation.

Based on the number of villages in three stages including Basic, Self-help, and Self-reliant, the number of villages promoted to the next development stage is calculated and

matched with the number of villages awarded by the Government grants. According to the sample observations from *Kyungsangnam-do,* only 8 percent of total villages were Self-reliant villages in 1972 and it increased to 84 percent in 1978 (Table 6 and Figure 5). Basic villages had disappeared by 1976 when the amount of government grant reached its peak as well (Table 2 and Figure 3). Percentage of awarded villages varies from 10 to 19 percent during 1974-78. Table 7 provides descriptive statistics of key variables.

Results

The estimation results are in Table 8. The coefficients on the percentage of better-performing villages compared to the previous year are almost same and statistically significant for the pooled OLS, random effects and fixed effects estimations. The null hypothesis is rejected in that the estimated coefficient of percentage of villages promoted is close to 0.25 while the estimated coefficient of the constant term is about 7.5. When the independent variable is interacted with the year dummies, it measures how the performance-based reward has changed over the period. In the system (6), for example, if the promoted village increases by 10 percentage points, the percentage of grant awarded village increases by 1 in 1975 and 2.3 percentage points in 1976 respectively.

3.3 Conclusion

In spite of the government documents regarding *Saemaul Undong* and statements from the *Saemaul* practitioners in the 1970s, in which the government selectively supported villages based on the performance of *Saemaul* projects, I could not find empirical evidence on it. According to the empirical investigation using the county-level data from *Kyungsangnam-do* province, it does not seem that the government provided the supports only to the better-performing villages compared to the previous year's performance. However, it does not necessarily mean that the government allocated development resources in an egalitarian manner or randomly.

One possible explanation would be that the villages which showed the outstanding results in *Saemaul* projects were supported first and more. The government would provide grants with the priority of orders as well as different amounts of rewards. It seems that the government did not exclude the villages lagged behind with low performances in the community development program. Nonetheless, these ideas are not empirically proven yet because data is not available.

The mechanism of the evaluation and rewards system in *Saemaul Undong* may not be so simple as we have thought to be so far. There might arise occasions when the government allocated development resources partially taking into account other information and environment such as political situation, financial status of local government, region-specific factor or originally disadvantaged villages.

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Former President of Korea *Saemaul Undong* Center Lee, Jae-Chang (August 5th, 2014)

Table 1. Village development level, 1972-79

Year	Basic village		Self-help village		Self-reliant village		*Saemaul* Villages
	No. of villages	%	No. of villages	%	No. of villages	%	
1972	18,415	53	13,943	40	2,307	7	34,665
1973	10,656	31	19,763	57	4,246	12	34,665
1974	6,165	18	21,500	62	7,000	20	34,665
1975	4,046	11	20,936	60	10,049	29	35,031
1976	302	1	19,049	54	15,680	45	35,031
1977	0	0	11,709	33	23,322	67	35,031
1978	0	0	6,114	18	28,701	82	34,815
1979	0	0	976	3	3,893	97	34,871

Source: *10 Year History of Saemaul Undong* by the Ministry of Home Affairs (1980)

Table 2. Government grants, 1972-78

		Kyunggi	Gangwon	Chungbuk	Chungnam	Geonbuk	Geonnam	Kyungbuk	Kyungnam	Jeju	Total
1972	Village	8		1	3		1	4	3		20
	Grant	53		2	3		1	63	13		135
1973	Village	420	304	273	387	474	621	650	557	22	3,708
	Grant	586	459	390	602	571	855	1,092	761	48	5,364
1974	Village	799	460	446	688	751	1,164	1,006	918	64	6,296
	Grant	1,063	820	628	1,034	964	1,535	1,581	1,370	103	9,098
1975	Village	652	377	379	662	741	1,280	1,012	947	53	6,103
	Grant	703	959	464	815	698	1,223	1,350	1,035	61	7,308
1976	Village	1,013	651	511	929	1,024	1,797	1,263	1,403	71	8,662
	Grant	1,335	988	830	1,239	1,355	2,103	1,912	1,788	126	11,676
1977	Village	741	458	712	798	697	1,372	1,140	798	39	6,755
	Grant	1,323	1,569	845	1,104	1,092	1,673	1,885	1,378	64	10,933
1978	Village	558	295	240	466	556	614	669	553	37	3,988
	Grant	801	443	358	702	792	943	1,012	835	55	5,941

Source: Reconstructed based on *Saemaul Undong: from the beginning to today* by the Ministry of Home Affairs (various volumes)

Table 3. Criteria for classification of villages

Project	Basic village	Self-help village	Self-reliant village
Village roads	Construction of main village roads	Construction of small village roads	-
Farm roads	Completion of main road to village	Completion of small farm roads	-
River arrangement	Reclamation of streams in villages	Reclamation of streams bt villages	Reclamation of surrounding streams
Irrigation rate	70 percent	70 percent	85 percent
Agricultural machine	-	Anti-insect (power-driven)	Threshing, Tiller (power-driven)
Cooperative farming	Cooperative working	Cooperative production	Cooperative production
Village fund	300,000 Won	500,000 Won	1 million Won
Household income	500,000 Won	800,000 Won	1.4 million Won

Source: Author's translation based on *10 Year History of Saemaul Undong* by the Ministry of Home Affairs (1980)

Table 4. Types of Government grants, 1974-79

Year	Category	Grant (KRW 1000)	Total grant (KRW 1000)	No. of awarded villages
1974	*1st Saemaul* project	500 - 1,500	9,118,952	6,364
	2nd Saemaul project	1,000		
	Outstanding village			
	Rivulet arrangement	700 - 2,020		
	1st Electrification			
	2nd Electrification			
1975	*1st Saemaul* project (railway)	500	6,961,763	6,266
	1st Saemaul project (fishing village)	500		
	2nd Saemaul project	1,000		
	Outstanding village			
	Electrification			
1976	*1st Saemaul* project	1,000	11,697,356	8,672
	2nd Saemaul project (railway)	500		
	2nd Saemaul project (fishing village)	500		
	2nd Saemaul project (mining village)	500		
	2nd Saemaul project (northern the river Han)			
	Rivulet arrangement	1,000 - 2,000		
	Outstanding village			
	Electrification	488 - 20,069		
1977	Outstanding village	1,500	10,951,500	6,763
	Special training village	1,000		
	Rivulet arrangement	1,000 -3,000		
	Success case of village			
	Simultaneous support	3,000		
	Electrification	125 - 11,310		
1978	Outstanding village	1,500	5,952,000	3,994
	Special training village	1,000		
	Success case of village			
	Simultaneous support	3,000		
1979	Outstanding village	1,500	6,153,000	4,044
	Success case of village			
	Simultaneous support			

Source: Reconstructed based on *Saemaul Undong: from the beginning to today* by the Ministry of Home Affairs (various volumes)

Table 5. Income between urban and rural area, 1970-78

Year	Urban wage worker (A)	Rural household (B)	B/A (%)
1970	381,240	255,804	67.1
1971	451,920	356,382	78.9
1972	517,440	429,394	83.0
1973	550,200	480,711	87.4
1974	644,520	674,451	104.6
1975	859,320	872,933	101.6
1976	1,151,760	1,156,300	100.4
1977	1,405,080	1,432,800	102.0
1978	1,916,280	1,884,200	98.3

Source: *10 Year History of Saemaul Undong* by the Ministry of Home Affairs (1980)

Table 6. Village development level and awarded village, *Kyungsangnam-do*, 1972, 1973-78

Year	Basic village		Self-help village		Self-reliant village		Awarded villages	
	No. of villages	%	No. of villages	%	No. of villages	%	No. of villages	%
1972	2,594	55.73	1,701	36.54	360	7.73		
1974	1,507	32.21	2,507	53.58	665	14.21	494	10.56
1975	734	15.56	2,749	58.29	1,233	26.15	620	13.15
1976	0	0	2,357	49.98	2,359	50.02	884	18.74
1977	0	0	1301	27.59	3,415	72.41	489	10.37
1978	0	0	755	16.29	3,880	83.71	458	9.88

Source: Author's calculation based on *Statistical Yearbook of Kyungsangnam-do* (various volumes)

Table 7. Sample descriptive statistics, *Kyungsangnam-do*, 1974-78

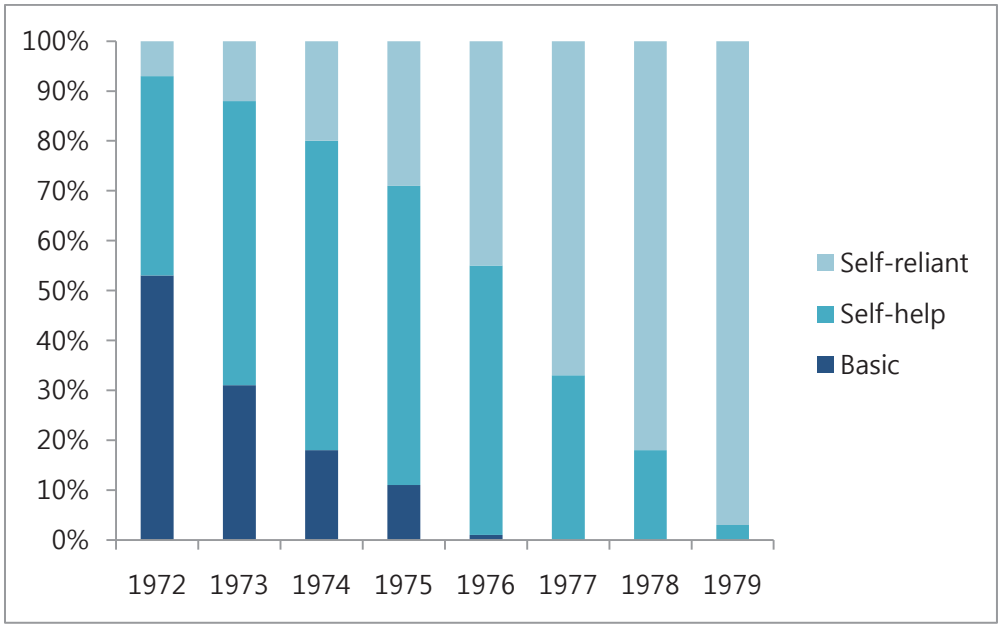
Variables	Obs	Mean	Std.Dev.	Min	Max
County ID	126	9.50	5.21	1	18
No. of awarded villages	90	32.72	13.46	17	91
Basic villages	108	44.77	57.81	0	230
Self-help villages	108	105.28	54.49	9	246
Self-reliant villages	108	110.30	80.41	11	326
Percentage of awarded villages	90	13.15	7.01	6.72	44.83
Percentage of Basic villages	105	17.69	21.07	0	56.32
Percentage of Self-help villages	108	39.84	17.48	3.50	67.69
Percentage of Self-reliant villages	108	42.97	30.22	5.31	96.50

Table 8. Regression analysis for percentage of grant-awarded villages, *Kyungsangnam-do*, 1974-78

Dependent variable: Percentage of awarded villages	(1) Pooled OLS	(2) RE	(3) FE	(4) Pooled OLS	(5) RE	(6) FE
Percentage of villages in progress	0.244***	0.244***	0.244***	0.0929	0.106	0.112
	(0.0824)	(0.0768)	(0.0778)	(0.0580)	(0.0834)	(0.0931)
Promoted*y1976				0.141*	0.130***	0.124***
				(0.0786)	(0.0355)	(0.0383)
Promoted*y1977				-0.110**	-0.125**	-0.132**
				(0.0539)	(0.0504)	(0.0513)
Promoted*y1978				-0.156*	-0.127**	-0.112*
				(0.0813)	(0.0593)	(0.0599)
Constant	7.533***	7.526***	7.522***	11.02***	10.80***	10.69***
	(1.713)	(1.097)	(1.973)	(1.432)	(1.399)	(2.016)
Observations	72	72	72	72	72	72
R-squared	0.196		0.298	0.319		0.464
Number of county_id		18	18		18	18

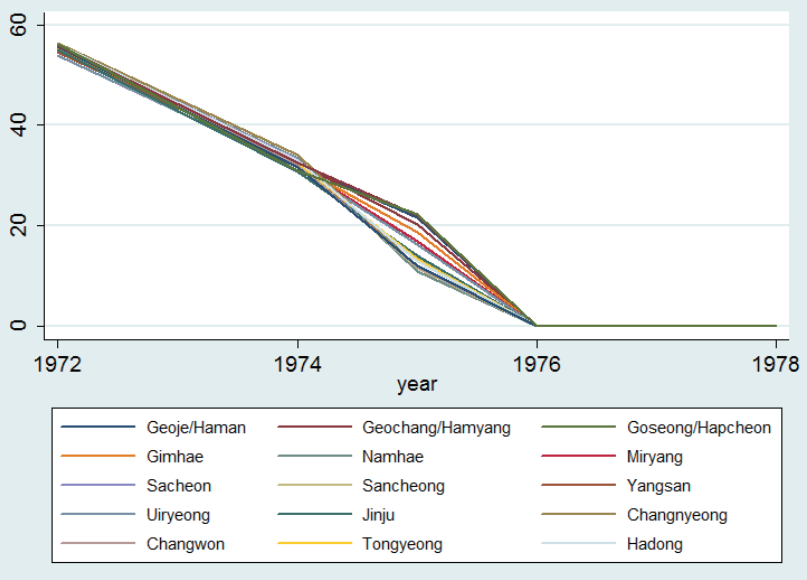
Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figure 1. Transformation of village development status, total, 1972-79



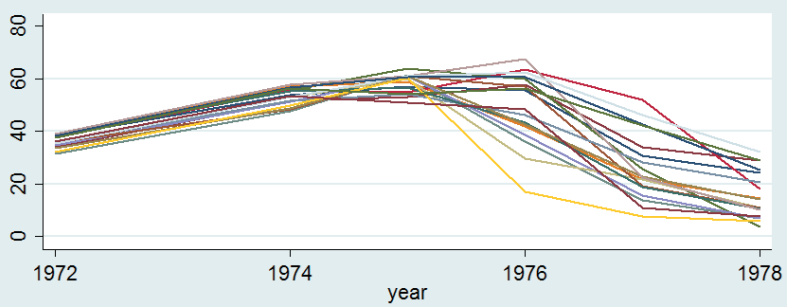
Source: *10 Year History of Saemaul Undong* by the Ministry of Home Affairs (1980)

Figure 2-1. Percentage of Basic villages by county, *Kyungsangnam-do*, 1972-78



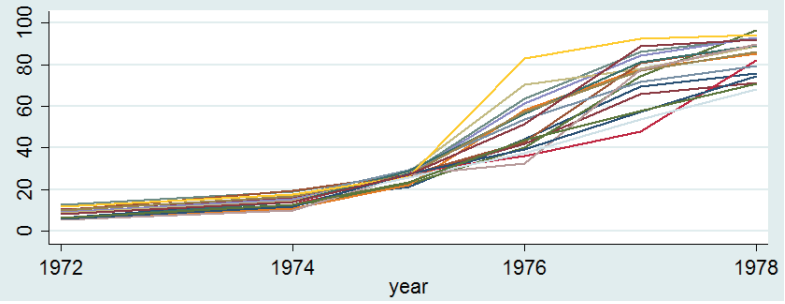
Source: Author's calculation based on *Statistical Yearbook of Kyungsangnam-do* (various volumes)

Figure 2-2. Percentage of Self-help villages by county, *Kyungsangnam-do*, 1972-78



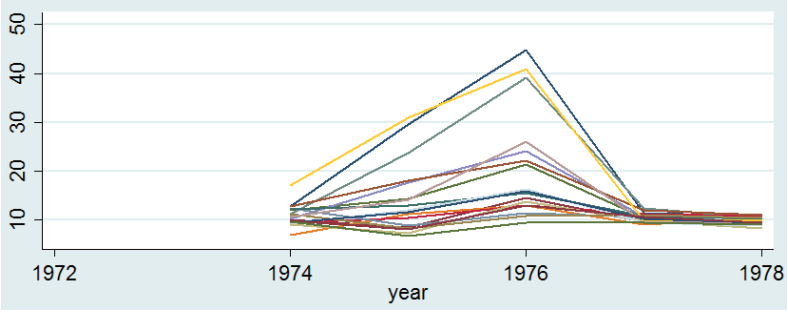
Source: Author's calculation based on *Statistical Yearbook of Kyungsangnam-do* (various volumes)

Figure 2-3. Percentage of Self-reliant villages by county, *Kyungsangnam-do*, 1972-78



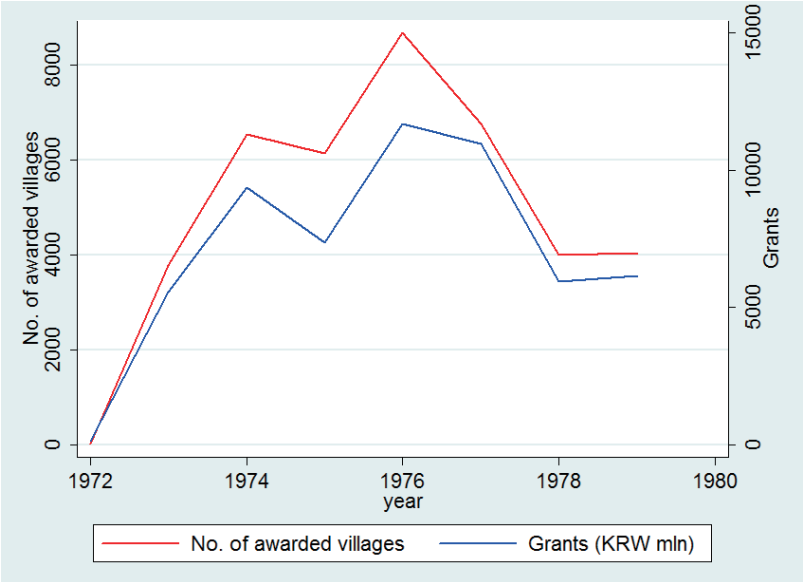
Source: Author's calculation based on *Statistical Yearbook of Kyungsangnam-do* (various volumes)

Figure 3. Percentage of Grant-awarded villages by county, *Kyungsangnam-do*, 1974-78



Source: Author's calculation based on *Statistical Yearbook of Kyungsangnam-do* (various volumes)

Figure 4. Number of Grant-awarded villages and total Grant amount, 1972-79



Source: Author's calculation based on *Saemaul Undong: from the beginning to today* by the Ministry of Home Affairs (various volumes)

Figure 5. Spatial diffusion of Self-reliant villages in *Kyungsangnam-do*