A study of long-run trends of SDGs: the case of South Korea

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Abstract

This paper thoroughly investigates the progress of sustainable development of the Republic of Korea (RoK, South Korea) from 1990 to 2018 by utilizing the traditional method of calculating the sustainable development (SD) index. The SD index is derived by standardizing indicators for all available data, and assigning same weight to all indicators, so thereby taking arithmetic mean of standardized indicators. In addition, the trend of an individual sustainable development goals (SDGs) to the derived sustainable development index is specifically examined. The main findings are as follows. The main finding are as follows. First of all, South Korea has shown gradual improvement in sustainable development over the period with a notable fall in 1998 and a small-scale decreasing trend from 2014. Second, most of the goals (Goal 1, 2, 3, 4, 5, 6, 7, 8, 9, 11 ,12 and 17) demonstrate improving trends since 1990 and slow down or decline at the end of the period, around from 2015. Third, Goal 10, 14, and 16 remain stable in 1990s due to lack of data and all show a decreasing trend afterwards. However, while Goal 14 deteriorates continuously, Goal 10 and 16 show an improvement from 2010 and 2017, respectively. Finally, Goal 15 shows a decreasing trend over the years, and Goal 13 shows a steady trend with few fluctuations over the period.

Key words: RoK (South Korea), Sustainable Development Goals (SDGs), SD Index

JEL Classification: C43, O10, O53

1. Introduction

Developed from the notion of Millennium Development Goals (MDGs), the Sustainable Development Goals (SDGs) have been proposed by the United Nation in 2015 which contains 244 indicators within 17 specific goals balancing between the three dimensions (economic, social, and environmental) covering all the aspects of human life. As governments and societies are paying more attention to sustainable development and putting emphasis to achieve sustainable development, SDGs became a important indicator to examine the status of sustainable development of both developed and developing countries.

As one of the OECD countries in the world, the Republic of Korea (ROK; South Korea) has experienced a remarkable economic growth since 1960, which is often referred to "The Miracle on the Han River". Once a recipient country of Official Development Assistance (ODA), South Korea currently stands as a 16th largest donor by volume. Other developing countries were inspired by the case of South Korea, attempted to follow the experience and development strategy of South Korea. Some goals of SDGs improved with the economic growth of South Korea as they are highly correlated such as Goal 1, 2, 8, and 9. However, there is a doubt whether South Korea has achieved a balanced development between the three-dimension covering all the aspects of quality of life. As one of the successful models of development progress implemented by developing countries, it is important to examine the status and trend of sustainable development of South Korea.

Started to engage in sustainable development in 1992, the government of South Korea established Local Councils for Sustainable Development (LCSDs) in 1995, enabling civil society and local governments to engage proactively in environmental and governance strategy. In 2002, at the World Summit, the LCSD model of South Korea was introduced as one of the best practices on sustainable development (Voluntary National Review, 2016).

Despite certain successes, there remains some challenges South Korea faces. Critics argue that South Korea still prioritize economic growth and neglect the ecological and social aspects of sustainable development (Pak, 2015; Moon, 2006). The National Voluntary Review of the Republic of Korea pointed out problems such as the increasing income gap, continuous urbanization, environmental degradation, and underemployment that hinder sustainable development of the South Korea.

The study aims to examine the status of South Korea's sustainable Development. The study first investigates the progress of economic development and SD policies of South Korea. Then, it specifies the data utilized in analysis and analysis method. Further, it thoroughly explains the results of SD index, specifically examining the factors affecting the trend and result. Finally, it discusses some suggestions toward SD strategies, concluding with its limitation and further implication of the study.

2. Background – South Korea and Sustainable Development

Korean War (1950~1953) evoked not long after the Japanese colonial era (1910~1945), which led to collapse in Korean economy and infrastructure. ODA was the major source of capital, and it promoted South Korea to recover from the devastation by providing grants, concessional loans and other forms of financial investment, which enabled Korean economy to reconstruct social infrastructure, and achieve industrial development (ODA Korea). South Korea then came a donor county in the 1990s and this progress is well shown in per capita GDP trend of the South Korea shown in figure 1.

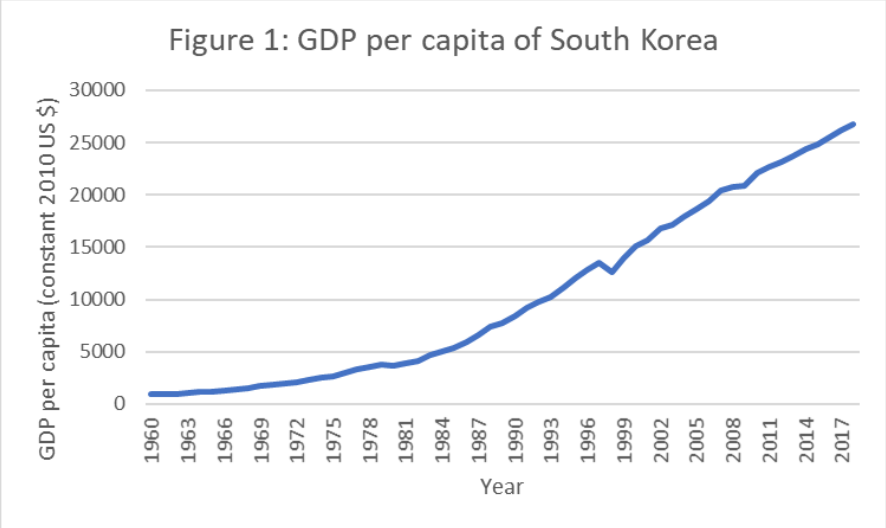
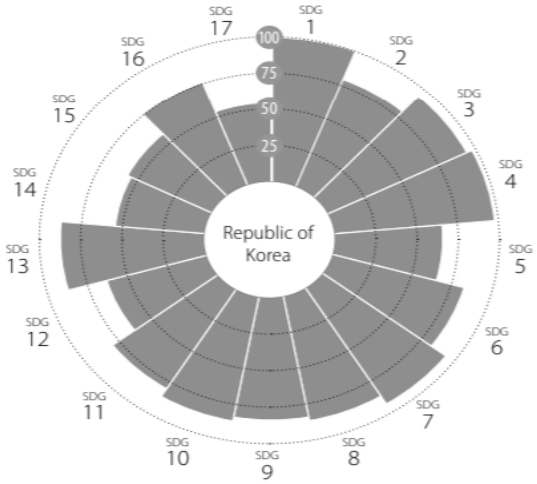


Figure 1 shows the level of GDP per capita of South Korea from 1960 to 2018. There is a continuously increasing trend from 944 USD in 1960 to 26,761 USD in 2018, with a noticeable

decrease in 1998 by 829 USD and a slight decrease in 1980 by 124 USD.[1] From 1960s to 1980s, South Korea's GDP grew with average of more than 8 percent per year by implementing rapid industrialization and export-oriented development strategy. Rapid industrial development and economic growth was carried out by military authoritarian government, where in 1980, mass democratization movement emerged in South Korea that could affected slight decrease in GDP in that year. In 1997, Asian Financial crisis evoked, where South Korean economy shrank quarterly at an average of -6.65 percent in 1998 (Koo and Kiser, 2001). Afterward, GDP per capita showed increasing trend until the present with slower growth rate.

UN Sustainable development Report tracked SDGs of 162 countries, collected 114 indicators and derived the SD index by weighting indicators equally (Sachs et al, 2019). South Korea ranked 18 of out of 162 countries in SDG global rank. Figure 2 identifies the performance of each goals in 2019, where higher score the better it performs. The report suggests goal 5 "Gender Equality", 13 "climate action", and 17 "partnerships for the goals" as major challenges to South Korea. The report argues that the trends of Goal 13 and 15 are decreasing, and the trends of Goal 5, 14, and 17 are stagnating. Trends of Goal 11 and 12 are unavailable. The report specifies areas for improvement such as for Goal 13, CO2 emission has increased, and for Goal 15, Red List index of species survival has decreased.

Figure 2: Average Performance by SDG of South Korea



Source. Sustainable Development Report 2019 (Sachs et al, 2019)

[1] GDP per capita in constant 2010 USD. (World Bank)

UN Sustainable development Report 2019 enables to comprehensively explore the trends of individual SDGs and areas of weaknesses. However, the trends of SDGs start from 2000 and it doesn't thoroughly examine the factors behind the changing trends.

Moon examined the status of sustainable development in South Korea in three dimensions (economic, social, and environmental) with emphasizing the environmental aspects. However, this paper was published on 2006, the data were collected randomly by the author as UN SDGS didn't exist, and broadly explored the trend of sustainable development in South Korea with analysis only on environmental issues.

A lot of previous studies related to sustainable development in South Korea mostly focused on narrow and specific areas of sustainable development such as sustainable community development, energy sources for sustainable development, and sustainable buildings (Ha, 2008; Ahn, Woo, and Lee, 2015; Tae and Shin, 2009).

The study will therefore, find the long run trend of South Korea SDGs from 1990 to 2018, investigate sustainable development on the broad context, compare the result and trends to the UN report, and further examine the determinants of changing trends.

3. Data Collection and Analysis Method

As mentioned above, UN states 17 SDGs with 244 indicators covering three aspects of economic development, social development and environment. However, 12 indicators overlap, remaining 232 separate indicators.[2] Moreover, 25 indicators are not targeted to individual countries, but measures the number of countries, which leaves 207 indicators (Kang and Jung, 2018). In addition, some data that are targeted specifically for developing countries or has weak relation to South Korea were not available such as indicator 17.3.2. Volume of remittances. Table 1 specifically shows the number of indicators for each goal, and the number of collected data of the study. ROK indicates the number of collected data for South Korea.

[2] Overlapped indicators are the following. (1)8.4.1/12.2.1; (2)8.4.2/12.2.2; (3)10.3.1/16.b.1; (4)10.6.1/16.8.1; (5) 15.7.1/15.c.1; (6) 15.a.1/15.b.1; (7) 1.5.1/11.5.1/13.1.1; (8)1.5.3/11.b.1/13.1.2; (9)1.5.4/11.b.2/13.1.3 (https://unstats.un.org/sdgs/indicators/indicators-list/, retrieved on July 17, 2019)

Table 1: Data Description

Category	Goals	Description	SDGs	ROK
Economy	Goal 1	No poverty	14	9 (6)
Economy	Goal 2	No hunger	14	5 (3)
Society	Goal 3	Good health	26	23 (22)
Society	Goal 4	Quality education	11	7 (6)
Society	Goal 5	Gender equality	14	4 (4)
Environment	Goal 6	Clean water and sanitation	11	8 (3)
Environment	Goal 7	Renewable energy	6	4 (3)
Economy	Goal 8	Good jobs and economic growth	17	15 (15)
Economy	Goal 9	Industry, innovation and infrastructure	12	8 (8)
Economy	Goal 10	Reduced inequalities	11	3 (3)
Society	Goal 11	Sustainable cities and communities	15	7 (5)
Society	Goal 12	Responsible consumption	13	5 (3)
Environment	Goal 13	Climate action	8	3 (1)
Environment	Goal 14	Life below water	10	7 (5)
Environment	Goal 15	Life on land	14	5 (3)
Society	Goal 16	Peace and justice	23	4 (4)
Society	Goal 17	Partnerships for the goals	25	5 (5)
	Total		244	122 (99)

Note: Out of 122 data available, 99 data were used in the analysis, indicated as 122 (99).

To utilize accurate data and data with the longest period, data are collected from various sources such as international organizations like UN, World Bank, ILO, WHO, OECD, IHME, Ocean Health Index, etc., and from institution of South Korea like KOSIS, Ministry of Environment, Ministry of Employment and Labor, etc.

The study aimed to obtain data from 1990 to 2018, and collected total 122 data, but excluded 23 data as they were insufficient to analyze. To be specific, data with only 1 year, same values over years, and not in exact number (e.g. <0.5) were removed.

With 99 data of indicators, the study utilized the traditional method to derive the SD index of South Korea, which is expressed as equation (1).

$$SD_{ROK}(N_i, I_{ij}) = \frac{1}{N_i}\sum_{j=1}^{N_i} I_{ij} \quad (1)$$

SD_{ROK} is the SD index of South Korea. N_i is the number of indictors that belong to the ith goal, and I_{ij} is the value of jth standardized indictor in ith goal. [3]

First, the missing values of certain years were compensated with their imputed values. Exploiting interpolation method, the missing values between the collected values were imputed by its mean, and the missing values before and after the collected values were replaced by the first and the last data collected respectively. After imputation, the data that indicates negative trend with increasing values were converted to their inverse values so that their negative effects to SDGs are modified. After modification, indicators were standardized by using z-score as they were measured with different units. Then, the indicators were categorized by 17 goals by simply calculating the arithmetic mean of the indicators as the study assumes constant weight to the contribution of all the indicators. Finally, the SD index for each goal was derived by normalizing the goals again using z-score, and taking the arithmetic mean of standardized goals led to the total SD index of South Korea.

4. Results

Figure 2 to 4 shows annual trends of each 17 Sustainable Development Goals.

Figure 3 describes the trends of Goal 1 to Goal 6. Goal 1 targets to "end poverty in all its forms everywhere".[4] Goal 1 shows an increasing trend with a large decrease in 1998 similar to Figure 1 where GDP per capita decreased also in 1998 due to financial crisis. This was specifically measured in death rate per 100,000 population where it shown large increase in 1998 to 1.3 deaths compared to 0.07 deaths in 1997. While domestic government health expenditure increased continuously, direct economic loss attributed to disasters relative to GDP increased fourfold in 2016 compared to 2015 and continued to increase that led to decreasing trend in Goal 1 from 2016. Although the direct economic loss to disasters increased by 0.00003% of GDP, which is not significant, as the contributions of indicators to SDGs were weighted equally, the trend of Goal 1 has shown decrease from 2016.

[3] The equation is modified from Kang and Jung (2018).

[4] Targets of each goal are referred from the 2030 Agenda for Sustainable Development, not paraphrased for precise description.

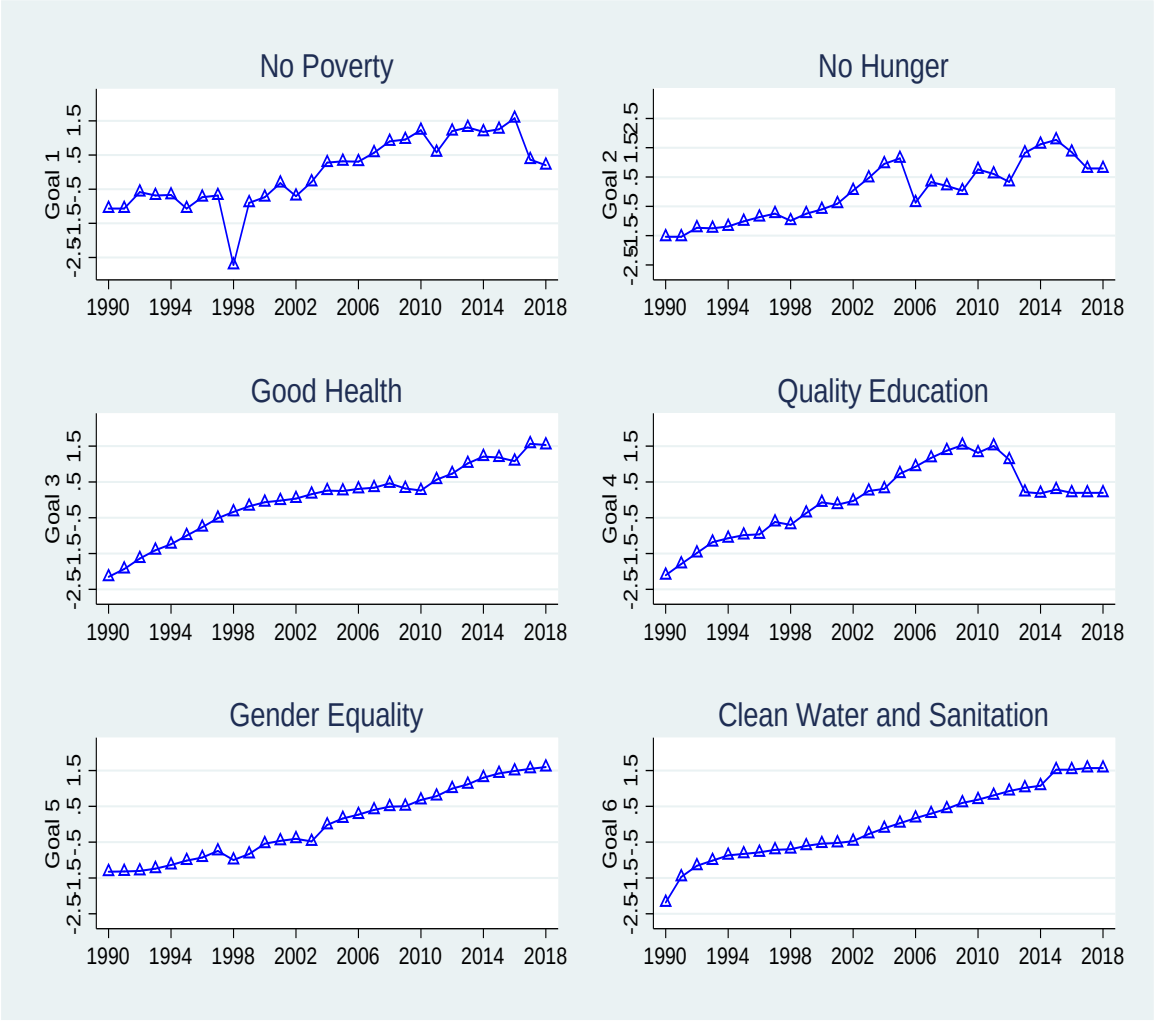


Figure 3: Trends of SDGs 1-6

Goal 2 targets to "End hunger, achieve food security and improved nutrition and promote sustainable agriculture". Goal 2 seems to improve throughout the period with a notable fall in 2006. Goal 2 deteriorated in 2006 mainly due to increase in undernourished population in South Korea. Prevalence of undernourishment then showed decreasing trend from 2007. While agriculture, forestry, and fishing, value added per worker increased, prevalence of wasting in children increased from 0.9% in 2003 to 1.2% in 2010.

Goal 3 targets to "ensure healthy lives and promote well-being for all at all ages". Collected 22 indicators from 26 indicators, goal 3 shows a gradually increasing trend. Various mortality rates decreased, and immunization of various diseases increased since 1990. Slight decrease from 2008

to 2010 could been cause by increase in suicide mortality rate per 100,000 population from 26.8 in 2005 to 34.1 in 2010. Afterward, mortality rate decreases steadily. Goal 3 slightly decreased in 2016 and this could be due to decrease in ODA to Health R&D from 271.59 million USD in 2015 to 234.66 million USD in 2016.

Goal 4 targets to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all". Goal 4 shows an increasing trend until 2010 and decreases from 2011 to 2013 and remains constant from 2014. Both decrease in tertiary and primary school enrollment from 2011 to 2013 has led to decrease in Goal 4. For example, primary school enrollment decreased from 98.7% in 2011 to 94.3% in 2013. Nevertheless, pupil-teacher ratio has decreased and rural to urban parity index for achievement in reading showed increasing trend since 1990.

Goal 5 targets to "achieve gender equality and empower all women and girls". Similar to Goal 3, Goal 5 improves continuously throughout the period with a slight decrease in 1998. It was attributed by a decrease in the ratio of female to labor force participation rate (LFPR), which implies that female employees suffered from more layoff than the male employees. Nevertheless, proportion of seats held by women in national parliaments has shown significant improvement from 5.9% in 2000 to 17% in 2018. Although 17% is not a satisfactory result in achieving gender equality, it is showing positive projection. In addition, ratio of female to male LFPR increased by almost 10% from 64% in 1990 to 72% in 2018.

Goal 6 targets to "ensure availability and sustainable management of water and sanitation for all". Goal 6 shows a consistently increasing trend with a noticeable increase in 2015. This was mainly attributed by improvement in access to improved water source from 96.1% of population with access in 2014 to 98.8% in 2015. Besides, prevalence of populations using unsafe sanitation decreased significantly from 8.5% in 1990 to 1.4% in 2018. In addition, a high increase in 1990 was due to these two factors.

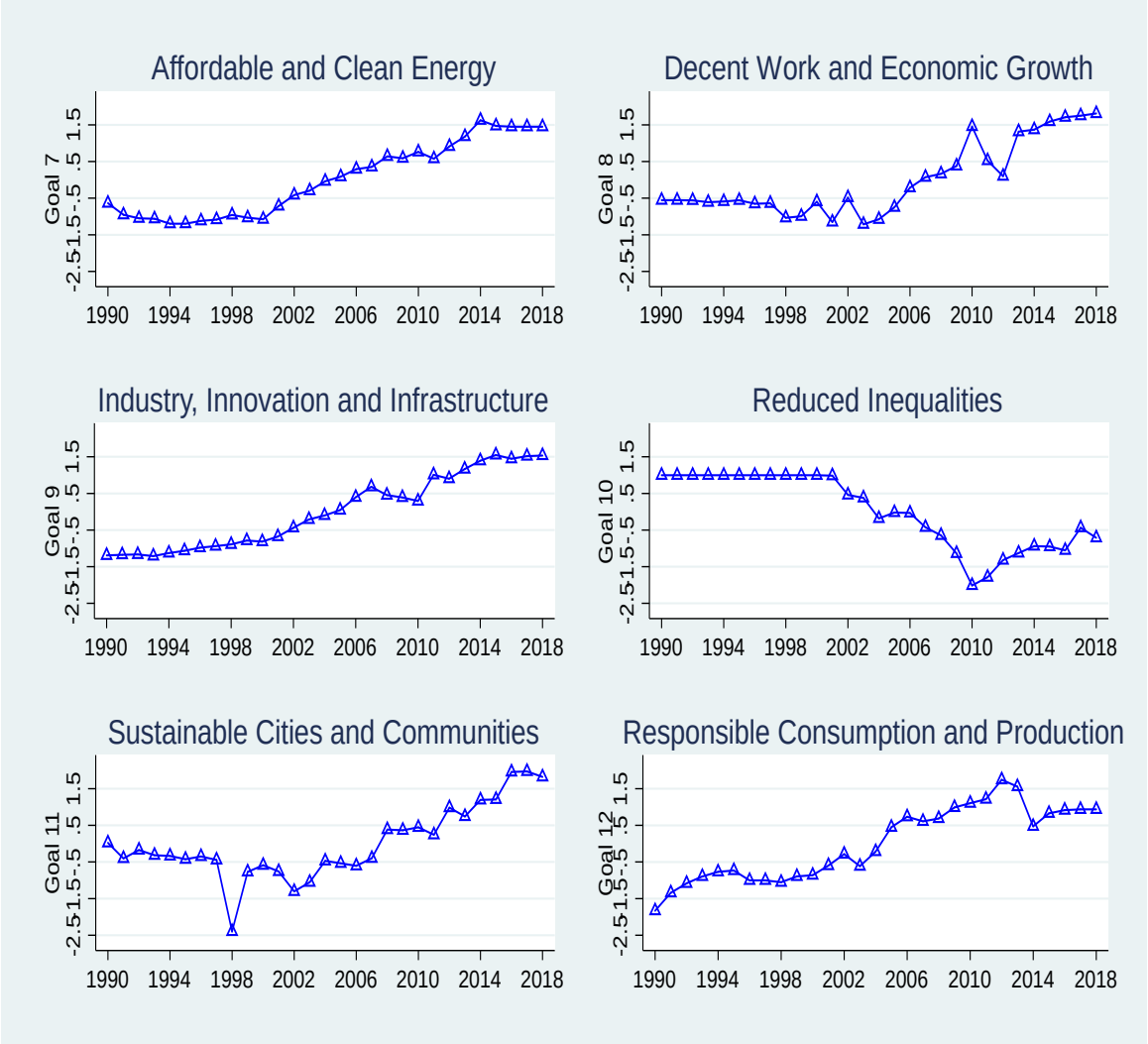


Figure 4: Trends of SDGs 7-12

Figure 4 describes the trends of Goal 7 to Goal 12. Goal 7 targets to "ensure access to affordable, reliable, sustainable and modern energy for all". Goal 7 shows a general increasing trend with slight decrease in 2011 and remaining stable from 2015. Although access to clean fuels and technologies for cooking decreased on a small scale from 96.8% in 2010 to 96.68% in 2011, and energy intensity level of primary energy only increased by 0.004% in 2011 compared to 2010, since only 3 data were utilized to measure Goal 7, small changes resulted in an observable drop in the graph. Despite Goal 7 shows significant improvement, renewable energy consumption remains low as 2.7% of total energy consumption in 2015, which is showing progress but in slow phase.

Goal 8 targets to “promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all”. There are some fluctuations, but Goal 8 shows improvement throughout the period. A decrease in 1998 was mainly due to increase in unemployment rate by 4.36%, reaching the highest unemployment rate of 6.96% in 1998. A notable fluctuation occurred during 2000~2003, where decreased in 2001 and recovered in 2003. The main factor of the decline was increase in children out of school increased more than twice from 0.8% of primary school age to 1.8% in 2001.It then reduces to 1.3% in 2003 and 0.3% in 2005. While tourism GDP as a proportion of total GDP deteriorated, passengers carried by air transport skyrocketed by 435.8%. Moreover, annual growth rate of real GDP declined, and unemployment rate increased compared to 1990, government expenditure of job creation increased significantly from 4,931,000 million won in 2003 to 157,796,000 million won in 2016.

Goal 9 targets to “build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation”. Goal 9 improves consistently with a notable fluctuation during 2006~2011. Goal 9 started to deteriorate from 2007 contributed by decrease in manufacturing employment as a proportion to total employment. While manufacturing value added as a proportion of GDP shows improvement, manufacturing employment as a proportion of total employment deteriorated during the period. The main contributors to the improvement were reduced CO2 emissions, and increased R&D expenditure, and the number of researchers in R&D.

Goal 10 targets to “reduce inequality within and among countries”. Goal 10 shows a different trend compared to other goals. This could be due to limited number of the collected data. Only 3 data are utilized, and all 3 data are measured from 2000 or beyond, attributing to constant trend until 2000. Since 2000, Goal 10 deteriorate until 2010, and shows an increasing trend afterward. The decrease was mainly due to decrease in labor share of GDP, and the increase was mainly due to improvement in proportion of tariff lines applies to imports with zero-tariff. Nevertheless, insufficient numbers of data imply that the trend is imprecise and unreliable.

Goal 11 targets to “make cities and human settlement inclusive, safe, resilient and sustainable”. Goal 11 shows a decreasing trend until 2002, and improves considerably afterwards. The drop in 1998 was caused by same factor of Goal 1 (overlapping indicator), increase in death rate. The major determinant of the decreasing trend until 2002 was a decrease in ratio of land consumption rate to population growth rate. It decreased significantly from 24% in 1990 to 3% in 2015. This

could be attributed by increase in housing price in urban areas and urban overcrowding. The improvement was led by an increase in government expenditure on protecting heritage, decrease in PM2.5 air pollution, and a substantial increase in land for public use.

Goal 12 targets to "ensure sustainable consumption and production patterns". Goal 12 generally shows an increasing pattern, highest in 2012 with a noticeable fall in 2014. The major factor of the fall was the twice increased combustible renewables and waste in 2014 compared to 2013. It increased from 0.37% of total energy in 2012 to 0.47% in 2013 to 0.9% in 2014. After 2014, it started to decrease again. Except for this indicator, other indicators contributed to improvement such as a reduction in domestic material consumption and material footprint.

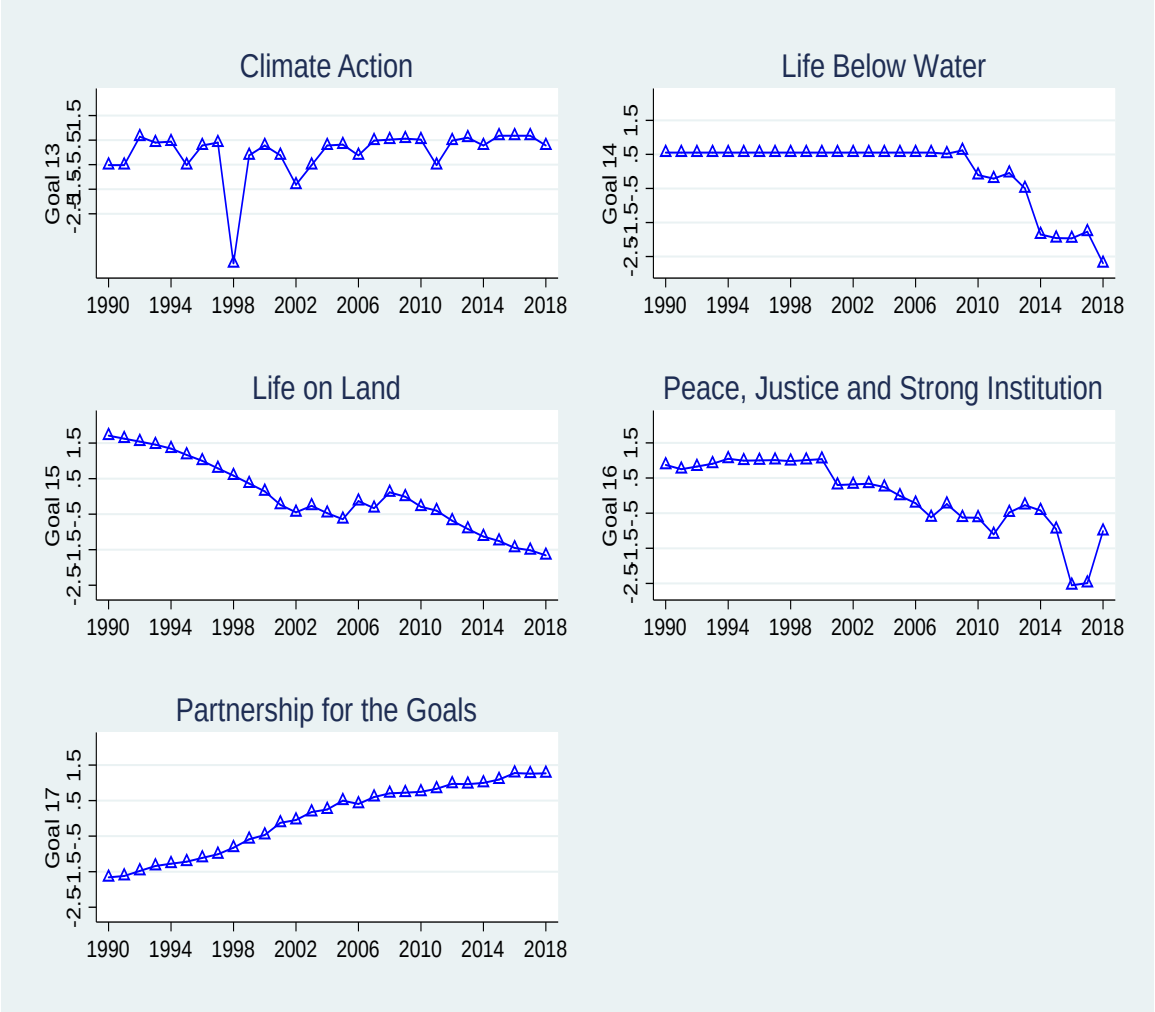


Figure 5: Trends of SDGs 13-17

Figure 5 describes the trends of Goal 13 to Goal 17. Goal 13 targets to “take urgent action to combat climate change and its impacts”. Interestingly, Goal 13 generally remains constant except 1998. This is due to lack of data. Similar to Goal 1 and Goal 11 containing an overlapping indicator, increase in death rate in 1998 caused an observable drop in 1998. As Goal 13 is measured only with 1 indicator, it is likely to be imprecise and unrealistic.

Goal 14 targets to “conserve and sustainably use the oceans, seas and marine resources for sustainable development”. Collected data were measured from 2007 or afterward so the graph remains constant until 2007. Goal 14 then deteriorates since 2007. This is largely due to depleted clean water and biodiversity of ocean in South Korea. Although marine protected areas has increased to some extent, destructing and overusing ocean and marine resources were more substantial and faster. Moreover, National ocean science expenditure as a share of total research and development funding shows a declining trend.

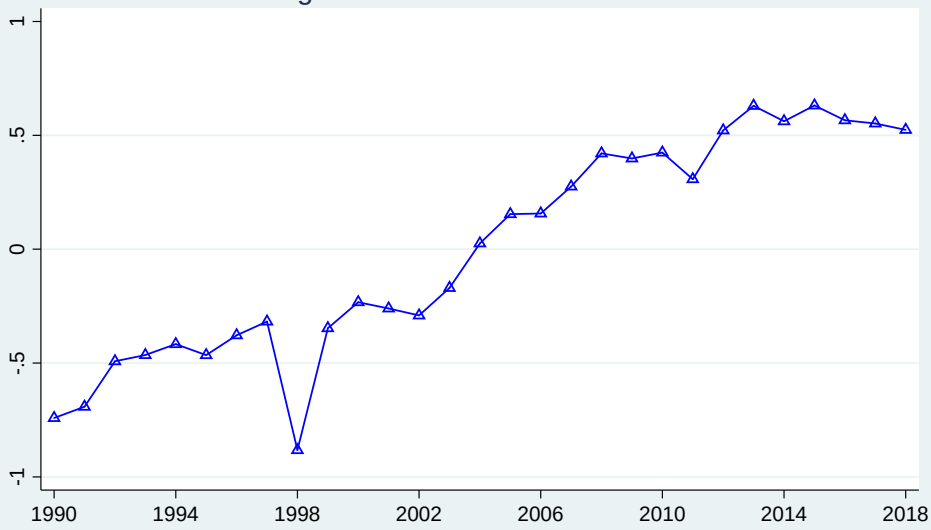
Goal 15 targets to “protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss”. Similar to Goal 14, Goal 15 decreases during the period. Forest area and red list index of species survival steadily decreases from 1990 to 2018. Also, Goal 15 shows a slight increasing trend between 2005 and 2008. This is mainly contributed by a moderate increase in proportion of Mountain Key Biodiversity Areas (KBAs) covered by protected areas from 24% in 2005 to 32% in 2008.

Goal 16 targets to “Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels”. Goal 16 stays stable until 2000 as collected data were available from 2000. Then, it shows a decreasing trend with a noticeable fluctuation during 2015~2018. The significant fall in 2016 was attributed by weapons export increasing more than quadruple compared to 2015. Then it showed recovery in 2018 main due to an improvement in the Corruption Perception Index. In addition, number of victims of intentional homicides shows a decreasing trend, and proportion of members in international organizations such as UN General Assembly declined slightly over the period.

Goal 17 targets to “strengthen the means of implementation and revitalize the Global Partnership for sustainable development”. Goal 17 improves consistently during the period; government revenue as a proportion of GDP, total net ODA, individuals using the internet, and percentage of well-certified deaths by a vital registration system all continuously increased from 1960 to 2018. To be specific, total net official development assistance (ODA) increased from 0.02% of GNI in 1990 to 14% of GNI in 2017. The most significant improvement was increase in individuals using the internet, where started as low as 0.02% of population in 1990 and currently, is as high as 95% of population in 2017.

In summary, most of the goals (Goal 1, 2, 3, 4, 5, 6, 7, 8, 9, 11 ,12 and 17) demonstrate improving trends since 1990 and slow down or decline at the end of the period, around from 2015. Goal 1, 11 and 13 show a decent fall in 1998 due to the overlapping indicator. Goal 10, 14, and 16 remain stable in 1990s due to lack of data and all show a decreasing trend afterwards. However, while Goal 14 deteriorates continuously, Goal 10 and 16 show an improvement from 2010 and 2017, respectively. Goal 15 shows a decreasing trend over the years, and Goal 13 shows a steady trend with few fluctuations over the period.

Figure 6: South Korea SD Index



Combining all 17 Goals to one index by taking arithmetic mean of all goals, the Sustainable Development (SD) index of South Korea is derived, where the overall trend is demonstrated in Figure 6. As most of the goals exhibit improvement over the years, SD index also displays an

increasing trend. Attributed by Goal 1, 11, and 13, SD index shows a decent fall in 1998, and as most of the goals slowed down or deteriorated at the end of the period, SD index decreases since 2014. Comparing to Figure 1, SD index displays a similar trend to the GDP per capita of South Korea. To be specific, both show a fluctuation in 1998 and show improving trend over the years.

5. Conclusion

The study aimed to examine the status of sustainable development of South Korea by deriving the SD index and investigating the long-run trend of SDGs of South Korea. Collecting 122 data of indicators out of 244 indicators and utilizing 99 data in analysis, SD index and long-run trends of each SDGs were investigated. The analysis was carried out by imputing missing values of data, standardizing it using z-score, and calculating the arithmetic mean of standardized indicators.

Through the analysis and graphing the result, the study found out that first, South Korea has shown gradual improvement in sustainable development over the period with a notable fall in 1998 and a small-scale decreasing trend from 2014. As GDP per capita of South Korea also has improved over the years with a fall in 1998, SD index and GDP per capita exhibits a similar trend.

Second, most of the goals (Goal 1, 2, 3, 4, 5, 6, 7, 8, 9, 11 ,12 and 17) demonstrate similar trend to the SD index of South Korea. Especially, Goal 1, 11 and 13 show a very similar trend with the SD index, as they display a decent fall in 1998 due to the overlapping indicator.

Third, some goals (Goal 10, 14, and 16) remain stable in 1990s due to lack of data and all show a decreasing trend afterwards. However, while Goal 14 deteriorates continuously, Goal 10 and 16 show an improvement from 2010 and 2017, respectively. Finally, Goal 15 worsen over the years, and Goal 13 shows a steady trend with few fluctuations over the period. However, Goal 13 only contains of one indicator implying that Goal 13 is imprecise and unreliable. There are more limitations to be indicated. First of all, collected indicators had some missing or unavailable data of certain years that led to stable trend in some graphs such as Goal 10 and Goal 14. The study will further be improved by collecting more and sufficient data.

Moreover, while deriving SD index is affected by various factors such as weights, range, and imputation method, the study assumes constant weight for all indicators. To be more precise, the

study should assign different weights for relevant indictors such as utilizing Principal component analysis (Kang and Jung, 2018). The study will further be improved by exploiting more adequate analysis method like PCA and comparing the results of different analysis method.

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[Data Source]

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WHO (https://www.who.int/countries/kor/en/)

OECD (https://data.oecd.org/)

IEA (https://www.iea.org/statistics/)

Transparency (https://www.transparency.org/cpi2018)

Ocean Health Index (http://ohi-science.org/ohi-global/scores#south_korea)

EPI (https://epi.envirocenter.yale.edu/epi-downloads)

IHME (https://vizhub.healthdata.org/sdg/)

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