Analysis of Impacts of SDGs Activities on Firm Value and Utility: Proposals of SDGs Finance and Indices in Japan

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Abstract Previous empirical research papers suggest that CSR, ESG, and SDGs might have positive impacts on the firm value (Khan, Serafeim, and Yoon 2016 etc.) while a plethora of papers also suggest that some CSR and ESG factors have no or negative impact on the firm value (Kawamura and Nagata 2016 etc.). We analyze the impact of SDGs on the firm value by theoretical analysis distinguishing the firm value as cash-based value which is derived from the Discount Cash Flow method incorporating the magnitude of cash flow, market risk, and life span of the corporation, and recognized value derived by considering the investors’ utility to SDGs contribution in addition to cash-based value. Our analysis suggests that firm’s contribution to SDGs have positive impact on the firm value if it could increase the investor base, that is, SDGs could improve the recognized firm value. However, if the investors and shareholders care both SDGs contribution and the firm value, the cash-based firm value might be compensated. Mixed empirical results are consistent with our models because the positive impact of SDGs on the firm value via increment in investor base might be offset by the destruction of the cash-based firm value by the excessive investment to SDGs. In order to reach conclusion whether SDGs have positive impact on the firm value, we need to conduct more careful analysis constructing the SDGs index associated with the SDGs contribution by the firm. Additionally, our analysis suggests that if we desire to achieve SDGs at higher level, we need to understand the utility of investors and shareholders and consider the scheme providing the incentives for managers in order to make them maximize the utility of shareholders who care both SDGs and the firm value.

Keywords : SDGs, ESG, SRI, GPIF, PRI

1. Introduction

One of the most perceived corporate objects is value maximization. Firm value is determined by equation (1).

$$V = \frac{E(CF_t)}{(1+r_f+\pi)^t} + \frac{E(CF_t)}{(1+r_f+\pi)^2} + \ldots + \frac{E(CF_t)}{(1+r_f+\pi)^n}$$ (1)

where, $V$ is the value of the corporation (cash-based value, hereafter), $CF_t$ is free cash flow at time $t$, $r_f$ is risk free rate, $\pi$ is market risk premium, $n$ is expected life span of the corporation. According to equation (1), in order to improve the cash-based firm value, the corporate should 1. improve the expected free cash flow, 2. reduce the market risk premium, or 3. improve the expected life span of the corporation. Someone might claim that equation (1) does not take real options into consideration. However, real options value could be captured by equation (1). For example, if the corporation has exit options, it could exit from the project if the NPV of the project is negative. In this sense, expected cash flow of the corporation increases by exercising the exit options. Existence of these real options might reduce the $\pi$, if they could reduce the market risk.

If we could reasonably assume that the corporate maximizes the firm value, and if pursuing Sustainable Development Goals (SDGs) has the positive impact on the firm value through these three factors mentioned above, the corporate would naturally pursue SDGs. In this case, a question is whether SDGs related activities would improve the cash-based firm value or not.

SDGs emphasize the sustainability. Sustainability implies longevity. We would like to compare if corporations surviving long time have higher firm value or not. According to Teikoku Databank (2009), average Profits Margin / Sales for corporations surviving longer than 100 years (longevity corporations, hereafter) and those for the other corporations are 19.97% and 23.45%, respectively. Additionally, average Operating Profits / Sales for longevity corporations and those for the other corporations are 1.88% and 1.91%, respectively. These facts indicate that longevity corporations are not necessarily more profitable than the other corporations. We could infer that pursuing SDGs might not be corresponding to the value increments through cash flow improvements.

However, firm value still might be improved if investors care about not only the firm value or returns from
investments but also doing something good for the society via investments. If this statement is true, recognized value of the corporation could be higher than cash-based value through the increment in the investor base (Merton 1987). In other words, CSR, ESG, and/or SDGs related activities might improve the firm value not by through the cash flow improvements but by the investor’s preference on the investment.

In this paper, we would like to discuss whether SDGs and the firm value are positively related or not. Additionally, we would like to discuss what are the appropriate measurements of SDGs to encourage corporations to commit SDGs related activities. Furthermore, we would like to discuss how SDGs could be achieved from the view of corporate finance and economic theory by literature review and theoretical models. First of all, we would like to explain briefly what CSR, ESG, and SDGs are in order to understand differences among them in Chapter 2. We review the literatures in order to analyze the impact of CSR, ESG, and SDGs on firm value in Chapter 3. We introduce theoretical models in order to discuss the impact of firms’ contribution to SDGs on the firm value in Chapter 4. We propose financial schemes in order to achieve SDGs in Japan in Chapter 5. Chapter 6 concludes this paper.

2. CSR, ESG, and SDGs

Differences among Corporate Social Responsibility (CSR), Environment, Social, and Governance (ESG), and SDGs are summarized in Table 1. Carrol (2008) states that 1953 is the formal birth year of CSR when Howard R. Bowen wrote the book entitled “Social Responsibilities of the Businessman”. Friedman (1970) quoted that “there is one and only one social responsibility of business–to use it resources and engage in activities designed to increase its profits so long as it stays within the rules of the game, which is to say, engages in open and free competition without deception or fraud” from his book Capitalism and Freedom. CSR has already recognized since 1970 as in the Friedman’s comments. Carrol (1991) summarizes that CSR considers three components namely Ethics, Legal, and Economics. In 1968-73, there were many unethical issues in the corporation. To solve these issues, CSR was developed (Carrol 2008). Since 2000 when Global Reporting Initiative (GRI) launched the Sustainability Reporting Guidelines on Economic, Environmental, and Social Performance, 92.2% of the world top economies have regulated mandatory reporting systems associated with CSR (Wen 2017).

ESG starts from the investment of funds by Christianity since 1900 (Gender Equality Bureau Cabinet Office (GEBCO) 2015). The word of ESG has been used since 2006 when Principal of Responsible Investment (PRI) were launched. PRI is the leading proponents of responsible investment. PRI was started by the initiative of United Nations and an investor group from institutions in 12 countries all over the world1.

Table 1: Summary of CSR, ESG, and SDGs

|       | CSR      | ESG      | SDGs      |
|-------|----------|----------|-----------|
| Concept Starts | Pre-1950’s | 1900’s   | 2015      |
| First use   | 1953     | 2006     | 2015      |
| Components  | Ethics, Legal, Economics, Philanthropic | Environment, Social, Governance | People, Planet, Prosperity, Peace, Partnership |
| Motivations | Solve legal and moral issues of corporation | Screening criteria of investment | Solve the global issues by all entities all over the world. |
| Entities Involved | Firms | Firms, Investors | Firms, Investors, Governments, Citizens |

Note: CSR stands for Corporate Social Responsibility, ESG stands for Environmental, Social, and Governance, and SDGs stands for Sustainable Development Goals, respectively.

SDGs are a set of actions in order to solve the global issues for peace, people, planet, and prosperity. SDGs consist 17 goals and 169 targets. All 193 countries which are members of United Nations adopted SDGs at United Nations General Assembly on September 25th, 2015. SDGs are replacement of Millennium Development Goals (MDGs). MDGs could not achieve some goals such as poverty in African countries, mortality rate, gender

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1 PRI website (https://app.powerbi.com/view?r=eyJrIjoiZjA2OTA5MWUtMzc4OC00MTZhLWIyZDYtYTc3NDMzOGE1OGFjIiwiidCI6ImZiYzI1NzBkLWE5OGYtNDFmMS1hOGFkLTEyYjEzMWJkOTNlOCIsImMiOjh9, accessed on April 8th, 2018)
equality, and CO₂ emissions. SDGs aims to solve these issues and new issues such as climate change, sustainable consumption, peace and justice. In total, SDGs aims to achieve 17 goals by the partnership of all entities such as governments, citizens, and firms.

In order to study if SDGs have positive impacts on the firm value, creation of indices for the corporation measuring the contribution to SDGs by the corporation is important. One of the difficulties to create such indices is that SDGs have more dimensions than ESG. In fact, SDGs set up 231 indicators to measure the achievement. Another difficulty is that each goal is interrelated (Zhou 2017 and Ito 2018). According to Zhou (2017), most targets have at least one target correlated negatively. That is, achievement of a typical goal implies that another goal might not be achieved or achievement might be delayed. In this sense, collaboration among all types of entities are essential in order to avoid the conflict among goals. Creation of indicators measuring the contribution of each firm for SDGs achievement needs the careful consideration of interrelatedness of each goal.

There is a plethora of literature on CSR and ESG while a few papers are written on SDGs as they are fairly new concepts. Considering similarities and differences between SDGs and CSR&ESG, we would like to develop the hypothesis to be tested in this paper in the next chapter.

3. Set of Hypothesis and Literature Review

A set of hypotheses we test in this paper is as follow;

H1: Pursing CSR and ESG improves the cash-based firm value.
H2: Pursuing SDGs improves the cash-based firm value.
H3: Pursing CSR and ESG improves the recognized firm value.
H4: Pursuing SDGs improves the recognized firm value.
H5: Shareholders are value maximizers and they only care about the firm value. Firm value is maximized but SDGs might not be achieved well.
H6: Shareholders are utility maximizers and they care about both firm value and firm contribution to the society (SDGs). Cash-based value might be compensated while recognized value might be increased due to the increment in investor base.

We set up the similar hypothesis but different hypothesis in regard to CSR&ESG and SDGs as CSR and ESG are just similar to SDGs but not exactly same.

A lot of papers discuss the relationship between CSR activities and the cash-based firm value but results are not consistent each other. In this paper, we would like to consider the source of the firm value increment and the types of firm value, cash-based or recognized, improved.

Let us consider the channels of cash-based value increment. As in equation (1), there are three possible sources improving the firm value. These sources are magnitude, risks, and timing of cash flow.

First, CSR could improve the value via the improvement of cash flow. Khan, Serafeim, and Yoon (2016) shows that the corporations which have high investment in material sustainable issues have higher growth in returns on sales two years or later from now using U.S.A. data. As results, monthly stock returns are higher for corporations which have high investment in material sustainability issues due to the higher alpha controlled by Fama-French three-factor model (Fama and French 1993). On the other hand, Ogata (2016) shows that profitability and environmental, society, and governance scores (ESG scores) are not positively correlated with profitability measures such as ROE. Ogata (2016) also shows that Socially Responsible Investment (SRI) funds in Japan chose corporations which have higher ROE than others in the portfolio but difference in ROE between firms in SRI funds and firms excluded from SRI funds are diminishing five years or later from the time of selection.

Second, CSR could improve the firm value via the reduction in discount rates. Lins, Servaes, and Tamayo (2017) shows that firms concerning CSR have higher returns during the crisis period by 4-7 %. This result indicates that corporations concerning CSR have lower risks in the crisis period. Orlitzky and Benjamin (2001) and Jo and Na (2012) show that investment in CSR would reduce both market risk measured by beta and firm-specific risk. Furthermore, Jo and Na (2012) shows that the impact of CSR on risk reduction is more significant in controversial industries such as tobacco, gambling, weapons, alcohol, adult entertainment, nuclear, oil, cement, and biotech industries. Shirasu (2011) which uses Japanese data shows that the average beta of corporations included in SRI funds is lower in crisis period than in normal period while average beta of other types of corporations is higher in crisis period. Corporations concerning CSR could reduce market risks in the crisis periods. Additionally,
Shirasu (2011) shows alpha\(^2\) of corporations in SRI funds is also positive and statistically significant. These results indicate that corporations concerning CSR manage a market risk in crisis period well and earn excess returns from the market. As a result, corporations concerning CSR create values to shareholders. Husted (2005) mentions that CSR can be considered as investments in risk management. CSR could reduce the risk of the firm as well as increase the future expected cash flow.

However, Goss and Roberts (2011) shows that firms with CSR concerns\(^3\) have higher spreads than corporations with less CSR concerns by 7-18 basis points. Investments in CSR strength are not correlated with the spread. Their paper concludes that too much emphasis on CSR might destroys the firm value due to the over-investment problem. Shirasu (2011) using Japanese data points out that stocks included in SRI showed significantly higher three- or longer year-returns than non-SRI stocks from 2004 to 2009. Additionally, SRI stocks have higher alpha returns controlled by Fama-French three-factors model than non-SRI stocks yet opposite results are observed in 2008, a crisis period. Shirasu (2011) concludes that Japanese SRI stocks have higher returns due to the higher market risk. Impact of CSR on risks of stock returns should be further investigated.

Third, CSR might improve the firm value through the increment of life span of the corporation. Attig, Ghoul, Guedhami, and Suh (2013) shows that all types of CSR scores\(^4\) except human rights have positive impacts on credits ratings. This result implies that most CSR activities reduce the probability of default, that is, increase the life span of the corporation. Additionally, Ghoul, Guedhami and Kim (2017) shows that CSR reduces the default probability and the impact of CSR on the reduction in default probability is enhanced in the country where business is strictly regulated. However, Goss and Roberts (2011) finds that there are nonsignificant differences between the loan spread of the firms with high CSR concerns and those with low concerns. This finding implies that impact of CSR on the default probability is not significant. Impact of CSR on the life span of the corporation should be also further analyzed.

A plethora of papers show the correlation between the firm value and CSR but many of these papers do not show how CSR improves or destroys the firm value. In other words, these papers test weather CSR improves the recognized value rather than cash-based value. Kawamura and Nagata (2016) shows that CSR and the firm value measured by Tobin’s Q are positively correlated if the firm’s percentage of foreign investors is ranked among the top 25% of all corporations in that year. This result indicates that the good governance structure might have positive impact on the firm value.

On the other hand, Kawamura and Nagata (2016) shows that if the firm’s percentage of shares by corporations is ranked among the top 25% in that year, CSR activity has negative impact on the firm value as Managers’ entrenchment is concerned. Ogata (2016&2013) shows that SRI funds returns are not significantly different from active funds. Equal weighted portfolio (EWP) of stocks included in SRI have significantly higher returns than EWP of stocks in active funds because of higher alpha returns and higher beta. However, some stocks are included in both SRI and active funds. Alpha returns of the stocks which are included in SRI funds but not included in active funds is not significantly different from zero.

How do SDGs improve the firm value, then? It depends on the goal. Barnett and Salomon (2006) suggests that the impact of CSR on the firm value depends on the types of CSR activities. Their paper uses the data of socially responsible mutual funds tracked by the Social Investment Forum\(^5\) and shows that community relations have positive impacts while consideration of equal employment and environmental issues have negative impacts on market risk adjusted returns. These results imply that activities associated with goal 11 (sustainable cities and communities) and goal 17 (partnerships for the goals) might have positive impact on the firm value while those associated with goal 5 (gender equality), goal 7 (affordable and clean energy), goal 10 (reduced inequalities), goal 13 (climate action), goal 14 (life below

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2 Expected excess return of the investment relative to the benchmark portfolio.
3 Goss and Roberts (2011) distinguishes two types of CSR related items, strength and concern items, following to KLD data. Strength (concern) indicates the positive (negative) impacts on the society. Strength includes generous giving, pollution prevention, and employment equality etc. Concern includes hazardous wastes, indigenous peoples relations concern, and health safety concern of employee etc. For more details, please refer MSCI ESG KLD STATS (available at https://www.wiso.uni-hamburg.de/bibliothek/recherche/datenbanken/unternehmensdaten/msci-methodology-2014.pdf)
4 Community, Diversity, Employee Relations, Environment, and Product Scores from MSCI ESG STATS.
5 WEB: http://www.socialinvestmentforum.org.uk/
water), and goal 15 (life on land) could have negative impacts.

On the other hand, Shirasu (2011) using several types of SRI funds and stocks included in these SRI funds argues that the impact of CSR activities on the firm value depends on the types of SRI. The abnormal stock returns of the corporations included in SRI concerning customer relations and environmental issues are higher than the corporations which are not included in SRI funds. This result indicates that goal 17 (Partnership for the Goals) which is associated with customer relation might have positive impacts on the firm value. This is consistent with Barnett and Salomon (2006). Additionally, the CSR activities concerning environment related to goal 13 (Climate Action), 14 (Life Below Water), and 15 (Life on Land) might have positive impacts on the firm value as well. These are contradictory to Barnett and Salomon (2006). Furthermore, Shirasu (2011) shows that there is no significant relationship between abnormal returns and SRI scores associated with employee friendly (providing equal opportunities etc.), corporate governance, contributions to the society, and working environment (life work balance etc.). These results imply that CSR activities associated with goal 5 (gender equality), goal 8 (decent work and economic growth), goal 10 (reduce inequalities), and goal 11 (sustainable cities and communities) might not have any significant impacts on the corporate performance.

While these findings of Shirasu (2016) are not consistent with the statement that there is positive relationship between abnormal returns and goal 8, Yamada, Usui, and Goto (2017) using the survey of Nikkei Newspaper shows that investment in the corporations which are workers friendly provide approximately 2% abnormal returns. We need more careful analysis to conclude the relationship between the firm value and contributions to SDGs.

One of the dimensions in the SDGs is peace (goal 16) as in Table 1. Peace is concerned in neither CSR nor ESG previously with our best knowledge. Jha and Shayo (2016) shows that higher exposures to the stock markets increase the tendency to vote for the peace. Their paper uses vote share for the left party as proxy of the support for the peace. They conduct the experimental studies in Israel. Their findings indicate that financial market or financial incentives might be useful to achieve goal 16.

When we consider the relationship between CSR activities associated with SDGs, interrelatedness of each goal should be considered. In other words, even if one of SDGs is achieved, achievement of other goals might be impeded. Unfortunately, there are negative correlation among goals. For example, all targets under goal 8 (Decent work and economic growth) are conflicting to target 9.4* according to Zhou and Moiuddin (2017). Ito (2018) using SDGs index provided by Sachs et al. (2017) shows that there are negative correlations between goal 12 (Responsible Consumption and Production) and most goals (goal 1 - 11, 14, and 16). When we analyze the impact of a SDGs activity on the firm value, we need to consider that the activity might obstruct achievements of other SDGs. As a result, through this process, increment in the firm value could be deteriorated.

The number of literatures we refer in this paper is limited but we could reasonably conclude that empirical findings mentioned above imply that impacts of activities associated with SDGs on the firm value depend on the features of 17 goals or 169 targets. Even if there is positive correlation between some CSR activities associated with some goals and firm performances, these CSR activities might have negative impact on the achievements of other goals. We have to consider carefully what kinds of indicators would be appropriate to measure the achievement of SDGs considering the interrelatedness.

4. Theoretical Models

4.1 Cash-Based Value and Recognized Value

In order to test H3 and H4 (CSR, ESG, or SDGs improves recognized corporate value), we would like to consider cash-based and recognized firm value using a theoretical model. Concepts of the model are shown in Figure 1.

In this analysis, we use the expression of recognized firm value \( v_I \) which incorporates both cash-based firm value and the impact of increment in investor base on the firm value. In other words,

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\begin{align*}
V_i & = f \left( V_I, \text{Investor base} \right), \\
V_I & = g_i \left( \text{CF} \left( \text{SDG}_i \right), n_i \left( \text{SDG}_i \right), \pi_i \left( \text{SDG}_i \right) \right) \\
\text{Investor base} & = g_z \left( \text{SDG}_i \right),
\end{align*}
\]

where \( V_i \) is firm \( I \)'s cash-based value, \( \text{Investor base} \) is a sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities.

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6 Target 9.4: By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally
change in the number of investors (shareholders) for firm $I$ due to the firm $I$’s contribution to SDGs. $SDG_{I,J}$ is firm $I$’s contribution to $J$th SDG. $CF_I$, $n_I$, $\pi$, are cash flows, expected life span, and market risk premium of corporate $I$, respectively as in equation (1) and they are function of $SDG_{I,J}$ as they might be related to $SDG_{I,J}$.

Equation (2) implies that SDGs are associated with the cash-based value if SDGs affect cash flows, market risk, or life span of the firm as in equation (1). On the other hand, SDGs could improve the recognized firm value via the increment in investor base without improving the cash-based value.

Impact of change in the investor base on the firm value (stock price of the firm) due to the SDGs is described in Figure 1.

Figure 1: Demand and Supply Curves of the firm with and without SDGs commitment.

Note: $x$ axis is the quantity demanded or share outstanding and $y$ axis shows the firm’s stock price. Supply curve is horizontal line. Sloped line in the left (right) is demand curve of the firm without (with) SDGs commitment. $S_S$ and $S_{NS}$ indicate stock price of the firm with and without SDGs commitment, respectively.

Let us assume that the firm’s supply curve of their shares is described as vertical line in Figure 1. It implies that the firm do neither issue or split their stocks nor repurchase their stocks whatever the price level is. That is, share outstanding in this market is always $Q$ as in Figure 1. Let us further assume that there are two firms which have exactly same characteristics including the cash-based value, $V_I$, except their contribution to SDGs. One contributes while the other does not. We simply assume that $V_I$ does not depend on SDGs unlike equation (2).

Let us also assume some investors do not care about the firm’s commitment to SDGs and while others do. This assumption is reasonable because some stock indices such as Solactive Sustainable Development Goals World Index (SOGOALEU) provided by Solactive, a Germany-based index provider, has selection criteria which exclude the firms which do not have any contributions to SDGs. While a few indices clearly mention that their indices or funds investing in SDGs related securities, quite a few funds invest in firms following to CSR or ESG criteria. These facts are consistent with our assumption that investor base for the firms with SDGs contribution is higher than those without SDGs contribution. Under this assumption, demand curve of the firm with SDGs contribution is sited to the right from the demand curve of the firm without SDGs as shown in Figure 1. As a result, equilibrium stock price of the firm with SDGs, $S_{SDG}$, is higher than the equilibrium stock price of the firm without SDGs, $S_{NSDG}$.

In this case, relationship between cash-based value and recognized value of the firm with and without SDGs contribution is expressed as

$$V_{NSDG} = V_{SDG} = v_{NSDG} < v_{SDG}$$

where $V_{SDG}$ and $V_{NSDG}$ are cash-based value of the firm with SDGs and without SDGs, respectively, $v_{SDG}$ and $v_{NSDG}$ are recognized value of the firm with and without SDGs, respectively. $Q$ is the number of share outstanding for both firms.

Thus, SDGs contribution by the firm could improve the recognized firm value without improving any cash flows or risks of the firm if SDGs could be attractive features of the corporations to the investors. In this sense, popularity of SDGs would be the matter. Bialkowski and Starks (2016) suggests that investment inflow to SRI are converged from 1999 to 2011. Same phenomena might be observed to SDGs in the future.

We need more research to validate this theory by polishing theoretical model and empirical analysis7. For corporate performance, Bialkowski and Starks (2016) shows that SRI funds have higher investment inflows than other types of funds in the US. Higher investment flow implies higher returns particularly in 2005-2011. They are consistent with the persistency of ESG scores of funds which have higher inflows. However, inflow to SRI funds are converged recently (1999-2011).
example, this argument of the impact of investor base is inconsistent with Separation Theorem (Tobin 1958) and the Capital Asset Pricing Model (CAPM, Sharpe 1964 and Lintner 1965 etc.) which states that all investors’ portfolio consists certain mutual funds and risk-free assets. However, these papers take risk and returns but not ESG factors into account. We need to carefully consider whether the CSR, ESG, and SDGs factors are priced in securities markets. In other words, it is important to consider how these factors improve or destroy the firm value. These factors might be associated with beta, but they might have original impact on the securities’ prices. If latter is true, SDGs factors are priced, and our proposals make sense. As mentioned above, empirical findings show mixed results. We would like to continue to research on this matter.

4.2 Value Maximizers and Utility Maximizers

In order to test H5 and H6 (Firm values and its contribution to SDGs depend on the types of shareholders, value maximizers or utility maximizers), we would like to introduce other theoretical models. Concepts of the models are shown in Figure 2.

Arguments whether investors (shareholders) are value maximizers or utility maximizers are reasonable because as in the quote of Friedman (1970), investors previously just care about the profitability and the stock prices. In this case, investors are value maximizers whose utility function can be expressed as shown in the left side of Figure 2. However, recent movements of CSR, ESG, and SDGs are one of the evidences that investors come to care how the firms contribute to the society. Another evidence is that Toda, a Japanese construction corporation, issued green bond which offering annual interest rate of 0.27% while other 5-year BBB+ rated bond which is same as Toda’s green bond have paid 0.33% interests on average according to Onish, Hanada, and Ban (2018). This difference of 0.06% (= 0.33% - 0.27%) could be considered as ESG premium paid by investors in order to contribute to the environmentally friendly society. Investors are likely concerning both firm value and firm’s commitment to the society, e.g., SDGs. In this case, investors are utility maximizers whose utility function is expressed as in the right side of Figure 2.

First of all, let us consider a case of a shareholder who is a value maximizer. That is, the shareholder only cares about the recognized value of the corporation $I$, $v_I$, and do not care about the corporation $I$’s contribution to the $J$th SDG through CSR activities ($SDG_{I,J}$). In this case, utility function of the shareholder $K$, $U_K (v_I)$, or indifference curves given the level of utility, can be expressed as straight dashed lines as shown in the left side of Figure 2. Next, in order to consider possible combinations of $SDG_{I,J}$ and $v_I$, let us assume that the relationship between $SDG_{I,J}$ and $v_I$ can be expressed as U-shaped function (a solid line in Figure 2). We argue that this assumption is valid as emphasis on the CSR could improve the corporate value (Serafeim 2014b etc.), however, too much emphasis could destroy the corporate value (Kawamura and Nagata 2016). If this assumption is valid, an optimal point which maximizes $U_K (v_I)$ is the top of the U-shaped curve (a point labeled as Optimal in the left side of Figure 2).

Second, let us consider another type of shareholder who is a utility maximizer, that is, the shareholder who cares both $v_I$ and $SDG_{I,J}$. If this is the case, the shape of indifference curves is convex as expressed as dashed lines in the right side of Figure 2. It means that the shareholder allows the corporate to commit to CSR activities which destroy the firm value. In this case, an optimal point which maximizes $U_K (v_I, SDG_{I,J})$ is a point shown in the right side of Figure 1. The optimal point of the utility maximizer realizes lower $v_I$ but higher $SDG_{I,J}$ than the optimal point contributing the society aggressively attract more investors than firms do not do activities having bad impact on the society.
of the firm value maximizer. If this is true, shares of this corporation might come to be popular by investors who concern SDGs. As a result, these firms might increase the investor base and could increase their stock price.

Now, let us consider the optimal amount of SDGs investment using numerical examples. First of all, let us assume the shareholder is a value maximizer who concerns only firm value. Furthermore, the relationship between contribution to SDGs and firm value can be expressed by quadratic function. We simply assume that the impact of SDGs investment by the firm on the firm value is deterministic. In this sense, SDGI,J can be considered as the value which is proportional to investment amount. The optimization problem is expressed as in equation (3).

$$\text{max } U_K (v_I) = v_I$$
$$\text{ s.t. } v_I = a + bSDG_{I,J} + cSDG^2_{I,J}$$

(3)

where $U_K()$ is utility function of shareholder $K$. $v_I$ is the firm value and we assume $v_I \geq 0$. SDGI,J is corporate $I$’s contribution to $J$th SDG. For simplicity, SDGI,J is measured as a score ranging from 0 to 100. 100 means that all of the corporate activities are associated with SDGs and 0 means that minimal contribution or negative contribution to SDGs. Relationship between SDGI,J and $v_I$ is expressed as quadratic function as too much investment on SDGs would destroy the firm value (Fatemi, Fooladi, and Tehranian 2015 and Kawamura and Nagata 2016). This implies that $a \geq 0$ as $v_I \geq 0$ and $c < 0$.

Thus, amount of SDGI,J which maximizes firm value (e.g. shareholder’s utility) is $-b/2c$. For example, if we assume $a = 100$, $b = 1$, $c = -0.02$, and $\gamma = 0.5$, contribution to SDGs which maximizes $v_I$ is 25 and maximum $v_I$ is 112.5.

Second, let us assume that the shareholder is a utility maximizer and concerns both realized value of the firm ($v_I$) and contribution to SDGs (SDGI,J). We simply assume that the type of the utility function of shareholder $K$ can be expressed as Cobb-Douglas utility function as in equation (4). The problem we need to solve is the optimization problem maximizing the utility of the shareholder shown in equation (4).

$$\text{max } U_K (v_I, SDGI,J) = v_I^\gamma SDG^1_{I,J}$$
$$\text{ s.t. } v_I = a + bSDG_{I,J} + cSDG^2_{I,J}$$

(4)

where $U_K()$ is the utility function of the shareholder $K$. $\gamma$ represents how much the shareholder gain the utility from $v_I$. In other words, if $\gamma > (1 - \gamma)$, the shareholder put more weight on $v_I$ and if $\gamma < (1 - \gamma)$, the shareholder put more weight on SDGI,J. We further assume $0 < \gamma < 1$. It implies that the shareholder is risk averse. According to Jensen’s inequality, as the utility function is strictly concave,

$$U_K E[v_I, SDGI,J] > E[U_K (v_I, SDGI,J)]$$

for any SDGI,J

$$U_K (v_I, E[SDGI,J]) > E[U_K (v_I, SDGI,J)]$$

for any $v_I$.

While we do not consider uncertainty in $v_I$ and SDGI,J in this paper, our utility function with $0 < \gamma < 1$ implies that the shareholder is risk averse. We would like to extend our analysis considering uncertainties in the future research paper. We also assume that amount of SDGs investment is positive.

Thus, SDGs investment amounts which maximize the firm value is

$$SDGI,J = -b - \sqrt{b^2 - 4ac(1-\gamma)(1+\gamma)} / 2c(1+\gamma)$$

Proof is shown in the appendix.

For example, if we assume $a = 100$, $b = 1$, $c = -0.02$, and $\gamma = 0.5$, meaning that we assume that the SDGs and firm values are equally important for the shareholder. In this case, the optimal amount of investment in SDGs which maximizes the utility is 60.76 and $v_I$ is 86.92. Comparing this result with the case of the value maximizer, SDGs investment increased from 25 to 60.76.

This result indicates that in order to achieve SDGs, we need to show that the significant and positive relationship between the firm value and SDGs investment to shareholders who are value maximizers because shareholders let manager to pursue SDGs to improve the firm value. This is true even for the utility maximizers. Actually, in case of utility maximizers, they invest more to SDGs. Changing the mind of investors so that they appreciate the contribution to SDGs might be important to achieve SDGs further through the investment.

However, in case of utility maximizers, more contribution to SDGs is achieved by compensating the firm value by 51.74 ($= 112.5 - 86.92$). The relationship between SDGI,J and $v_I$ and $U_K$ for utility maximizers is shown in Figure 3.

theoretical model.
Figure 3: The impact of SDGs Investment on the Firm Value ($v_I$) and Shareholder K’s utility ($U_K$)

Note: $x$ axis shows the contribution to $J$th SDG by firm $I$ ($SDG_{I,J}$), $y$ axis shows the firm value ($v_I$) and the level of utility ($U_K$). Solid line indicates the $v_I$ and dashed line indicates $U_K$.

We also conduct sensitivity analysis to consider how the shareholder’s preference to SDGs contribution $(1-\gamma)$ changes the level of $SDG_{I,J}$ maximizing the utility level as in equation (3). We assume $a = 100$, $b = 1$, $c = -0.02$, and $\gamma = 0.5$, same as previous examples. Results of sensitivity analysis is shown in Table 2.

Table 2: Sensitivity Analysis: $SDG_{I,J}$ which maximizes $U_K$ depending on $\gamma$.

| $\gamma$ | $1-\gamma$ | $SDG_{I,J}$ | $v_I$ | $U_K$ |
|------|----------|-----------|-----|-----|
| 1.0  | 0.0      | 25.00     | 112.50 | 112.50 |
| 0.9  | 0.1      | 34.05     | 110.86 | 98.52 |
| 0.8  | 0.2      | 41.25     | 107.22 | 88.57 |
| 0.7  | 0.3      | 47.85     | 102.06 | 81.31 |
| 0.6  | 0.4      | 54.28     | 95.35  | 76.11 |
| 0.5  | 0.5      | 60.76     | 86.92  | 72.67 |
| 0.4  | 0.6      | 67.47     | 76.42  | 70.92 |
| 0.3  | 0.7      | 74.57     | 63.36  | 71.01 |
| 0.2  | 0.8      | 82.21     | 47.04  | 73.52 |
| 0.1  | 0.9      | 90.61     | 26.42  | 80.10 |
| 0.0  | 1.0      | 100.00    | 0.00   | 100.00 |

Note: $\gamma$ is a parameter of Cobb-Douglas utility function as in equation (3). $SDG_{I,J}$ is firm $I$’s contribution to $J$th SDG. $v_I$ is the firm value. $U_K$ is the utility level of the shareholder $K$.

According to Table 2, even though the shareholders are slightly concerned about the SDGs, that is, even if $1-\gamma$ is small, contribution to SDG significantly increases. If $1-\gamma$ changes from 0 to 0.1, $SDG_{I,J}$ increases from 25.00 to 34.05. However, it compensates the firm value by 1.64 ($= 112.50-110.86$).

We implicitly assume shareholders are both principal as investors and agents as managers who decide the investment to SDGs as implied by equation (3) and (4). However, in reality, this is not always the case. For example, shareholders might not be able to control or even observe whether managers make decisions appropriately in regard to SDGs contribution. In fact, Kawamura and Nagata (2016) finds that the impact of CSR on the firm value depends on the governance structure. We would like to extend our model and analysis considering principal-agent problem and information asymmetry in order to see how optimal combinations of the firm value and SDGs contribution differ for the managers and shareholders and also to consider how to make managers maximize the utility of the shareholders for future research.

4.3 Utility Maximizers who Care Number of Shares

Lastly, we would like to introduce interesting phenomena using simple theoretical model. Concepts and models are shown in Figure 4 and 5.

Analysis in this section is different from 4.2. We consider an individual investor who could control neither the amount of SDGs investment by the firm nor the firm value (e.g. stock price) in this section while we consider the investors who could control both SDGs contribution and the firm value in section 4.2.

First of all, let us assume that the individual investor cares both SDGs contribution and amount of cash in hand. We simply assume that cash in hand represents the utility provided by the consumption. We further assume that utility of the investor due to the SDGs contribution is proportional to the number of shares of the firm contributing to SDGs as shown in equation (5).

$$individual\ SDG_{I,J} = \frac{SDG_{I,J}}{Share\ Outstanding_I} \times Q \quad (5)$$

where $individual\ SDG_{I,J}$ indicates the amount of SDGs contribution by the individual investor, $Share\ Outstanding_I$ indicates the number of firm $I$’s share outstanding and $Q$ is the number of shares held by the investor. We simply assume $SDG_{I,J} / Share\ Outstanding_I$ is constant. $Q$ affects the utility of the individual investor due to the contribution to SDGs.

Please note that what the individual investor care is the number of shares but not the dollar amounts of the value of the shares invested. In other words, the individual investor cares amount of money in hand and the number of
shares they have. After monetizing the shares, it counts for the utility level of the individual investor. In this case, utility function of the individual investor is \( U(M, Q) \) where \( M \) is amount of money in hand for future consumption. The utility level of the individual investor increases as the amount of money in hand increases or the number of shares increases as shown in equation (6).

\[
\frac{\partial U(M, Q)}{\partial M} > 0, \quad \frac{\partial^2 U(M, Q)}{\partial M^2} < 0 \quad \frac{\partial U(M, Q)}{\partial Q} > 0, \quad \frac{\partial^2 U(M, Q)}{\partial Q^2} < 0
\]

Furthermore, a budget constraint line for the individual investor is expressed as equation (7).

\[
I = M + PQ \quad \text{or} \quad M = I - PQ \quad (7)
\]

where \( I \) indicates the total budget the individual investor can use, \( P \) is the stock price of the firm contributing to SDGs.

Given the initial budget, \( I_0 \), and the current stock price, \( P_0 \), an initial budget constraint line is expressed as equation (8)

\[
I_0 = M + P_0Q \quad \text{or} \quad M = I_0 - P_0Q \quad (8)
\]

The individual investor choses the optimal combination of the amount of money, \( M_0 \), and the number of shares, \( Q_0 \) so that \( U(M_0, Q_0) \) is the maximum level of utility obtained by the individual investor given the initial budget constraint as in Equation (8). The initial optimal point, \( (M_0, Q_0) \), is shown in Figure 4. \( (M_0, Q_0) \) is derived so that the point marginal rate of substitution and the slope of the budget line are equated as shown in equation (9).

\[
\frac{\partial U(M, Q)}{\partial Q} - \frac{\partial U(M, Q)}{\partial M} = -P
\]

Here, let us consider how the change in the stock price in the future affects the optimal choice of cash in hand, \( M \), and the number of shares, \( Q \), and how the level of utility, \( U(M, Q) \) given that the individual investor choses \( (M_0, Q_0) \) as of now.

First, let us consider the case that stock price increases from \( P_0 \) to \( P_U \). In this case, a new budget, \( I_U \), will be \( M_0 + P_UQ_0 \). \( P_U > P_0 \) implies \( I_U > I_0 \). A new budget constraint line is shown as equation (10).

\[
I_U = M + P_UQ \quad \text{or} \quad M = I_U - P_UQ \quad (10)
\]

Now, let us consider the optimal choice when the stock price goes up from \( P \) to \( P_U \). In this case, the slope of the budget constraint line will be steeper as its slope is equal to the stock price, \( P_U \) which is higher than \( P_0 \), as shown in equation (8) and (10). A new optimal point will be \( (M_U, Q_U) \) as shown in Figure 4. That is, more money is in hand while a smaller number of shares held because \( Q_U < Q_0 \) and \( M_U > M_0 \). This result indicates that the individual investor can achieve higher level of utility by selling more shares and use more money for the consumption as the stock price goes up. In other words, the indifference curve which touches the new budget line is located further than the initial optimal point as shown in Figure 4. In short, \( U(M_U, Q_U) > U(M_0, Q_0) \).

![Figure 4: Budget Lines and Indifference Curves when Stock Price Goes up](image)

Note: \( x \) axis shows the number of shares held by the individual investor \( (Q) \). \( y \) axis shows the amount of money held by the individual investor \( (M) \). Subscripts of 0 and \( U \) indicate the initial level and the time stock price going up, respectively. Straight lines show the budget constraint lines. One of them is the initial budget constraint line, \( M = I_0 - P_0Q \), and the other is the new budget constraint when stock price goes up, \( M = I_U - P_UQ \). \( P_0 \) (\( P_U \)) indicates the initial stock price (stock price when going up). \( I_0 \) (\( I_U \)) indicates the initial budget (the budget when stock price goes up). Curves are indifference curves. Utility function is described as \( U(M, Q) \). We assume that individual investors care about the number of shares but not the amount of money invested in the share of the firm contributing to SDGs.

Next, let us consider the case the stock price goes down from \( P_0 \) to \( P_D \). In this case, a new budget, \( I_D \), will be \( M_0 + P_DQ_0 \). \( P_D < P_0 \) indicates \( I_D < I_0 \). A new budget constraint line is expressed as equation (11).

\[
I_D = M + P_DQ \quad \text{or} \quad M = I_D - P_DQ \quad (11)
\]
In this case, the slope of the budget constraint line will be less steep as its slope is \( P_D \) which is smaller than \( P_0 \) as in Equation (8) and (11) and Figure 5. A new optimal point given the budget constrain shown in Equation (11) will be \((M_D, Q_D)\). That is, the investor can achieve higher level of utility by buying more cheap shares of the firm contributing SDGs and hold less money for the consumption as shown in Figure 5 because \( Q_D > Q_0 \) and \( M_D < M_0 \). In short, \( U(M_D, Q_D) > U(M_0, Q_0) \).

Figure 5: Budget Lines and Indifference Curves when Stock Price Goes down
Note: \( x \) axis shows the number of shares held by the individual investor \((Q)\). \( y \) axis shows the amount of money held by the individual investor \((M)\). Subscripts of 0 and \( D \) indicate the initial level and the time stock price going down, respectively. Straight lines show the budget constraint lines. One of them is the initial budget constraint line, \( M = I_0 - P_0Q \), and the other is the new budget constraint when stock price goes down, \( M = I_D - P_DQ \). \( P_0 \) indicates the initial stock price (stock price when going down). \( I_0 \) indicates the initial budget (the budget when stock price goes down). Curves are indifference curves. Utility function is described as \( U(M, Q) \). We assume that individual investors care about the number of shares but not the amount of money invested in the share of the firm contributing to SDGs.

Thus, as shown in Figure 4 and 5, we can conclude that \( U(M_D, Q_D) > U(M_0, Q_0) \) and \( U(M_D, Q_D) > U(M_0, Q_0) \). That is, individual investors feel happier than now no matter the price of the share goes up or down assuming the individual investor’s utility level depends on the number of shares rather than amount of money invested in the firms contributing to SDGs. If the stock price goes up (down), individual investors could achieve higher level of utility by selling (buying) shares of the firm contributing to SDGs and having more (less) money for the future consumption. Securities corporations might be willing to sell these kinds of shares or funds to individual investors as the stock price movement would not be the issue in this case.

5. Proposals

Our analysis and empirical research suggest that we need further analysis in regard to firm’s contribution to SDGs and its impact on the firm value. In order to enhance the SDGs, there is no doubt that the research on the relationship between the firm value and the firm’s contribution to SDGs is essential. While a lot of previous research attempts to answer this question, channels of the value increment due to the SDGs contribution must be considered. The channels are summarized as bullet points below.

1. SDGs change cash-based firm value?
   1-1. SDGs change cash flow?
   1-2. SDGs change market risk premium?
   1-3. SDGs change life span of the firm?

2. SDGs change recognized firm value?
   2-1. SDGs change investor base?

3. What is the expected consequence?
   3-1. SDGs improve both cash-based and recognized firm value?
   3-2. SDGs destroy cash-based firm value but improve recognized firm value (-\( \Delta \)cash-based value < \( \Delta \)recognized value)?
   3-3. SDGs destroy cash-based firm value and recognized firm value (-\( \Delta \)cash-based value > \( \Delta \)recognized value)?
   3-4. -\( \Delta \)cash-based value = \( \Delta \)recognized value

4. How each SDG is interconnected?
   4-1. Both SDGs have positive relation each other and positive impact on the firm value?
   4-2. Both SDGs have positive relation but one of them has negative impact on the firm value?

A plethora of research analyze the impact of CSR, ESG, and SDGs on the firm value using the rate of returns. However, it might overlook the SDGs’ positive impact on the recognized value which is offset by the negative impact on the cash-based value. This phenomenon is still desirable as the stock markets enhance the achievement of SDGs as the shareholders and investors prefer to invest in the firms contributing to SDGs.

In order to enable these analysis, construction of the measurement of SDGs contribution is vital. We need to measure the level of firms’ activities associated with SDGs.
and how much these activities have impact on one of or some SDGs.

Additionally, construction of financial schemes associated with SDGs contribution would be helpful. World bank issued Notes Linked to SDGs index in March 2017. However, the payoff is related to the stock returns of the firm pursuing to SDGs, not the measures associated with SDGs contribution. This bond would not work well to make firms to contribute SDGs in order to attract more investors who care the contribution to SDGs (Moridaira, Ito, and Kobayashi 2018). If the cash flow from the securities are associated with SDGs, investors more carefully analyze how these securities provide the payoffs, how corporate contribute to SDGs. Firms come to consider the SDGs activities in order to attract investors. Alternatively, we could offer the incentives to managers so that they pursue SDGs. A possible incentive is that managers’ salary level is associated with both firm value and SDGs contribution so that firms’ activities maximize the utility of shareholders who are utility maximizers. As a result, the firm value could improve due to the SDGs through market system.

Lastly, we need to consider the investor and shareholder’s preference on the SDGs contribution in comparison to the firm value is important. How they weight on SDGs contribution and the rate of returns when investing must be further analyzed. We could come up with the way to attract investors. If investors weight more on SDGs, brokers could stress the investment allows them to contribute to SDGs through investment. If investors weight more on the firm value, brokers could appeal more SDGs contribution imply higher returns.

Therefore, the construction of SDGs indices of the firm level and understanding the utility of investors are vital.

6. Conclusion and Future Research

Previous empirical research and our theoretical consideration suggest that firm’s contribution to SDGs might have positive impacts on the firm value (Khan, Serafeim, and Yoon 2016 etc.). In this case, firms naturally contribute to SDGs in order to improve the firm value and also our analysis shows that SDGs could be achieved somehow as shown in Figure 2. In this case, conducting the research showing the positive relationship between the firm value or profitability and SDGs contribution might be effective to let managers commit SDGs activities.

Alternatively, constructing the finance scheme aligning with SDGs contribution and the firm value might work.

However, if we desire firms to contribute SDGs more, achievement of SDGs depend on the mind of the shareholders, that is, whether their utility function depends on the level of contribution to SDGs through the investment. As shown in Table 2, if the shareholders concern more about SDGs contribution, SDGs will be achieved more. In other words, too much investment in SDGs might happen. This phenomenon is consistent with the empirical findings (Kawamura and Nagata 2016). We need further research how the SDGs are associated with the firm values.

As for future research, we would like to continue to work on the creation of SDGs index in order to measure each firm’s contribution to each SDG by considering the interrelatedness among SDGs. Furthermore, we would like to analyze how the firm value is increased by SDGs contribution by decomposing the firm value in to cash-based and recognized value. In other words, how SDGs affect the cash flow, risks, life span, and investor base. We also would like to research how the corporations can have incentives to pursue both firm value and SDGs. Lastly, based on these analyses, we would like to develop the securities pricing model incorporating not only returns and market risks but also CSR, ESG, and SDGs dimension considering the utility of investors to these factors.

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### Appendix

#### A.1 17 Goals of SDGs

1. No Poverty
2. Zero Hunger
3. Good Health and Well-Being
4. Quality of Education
5. Gender Equality
6. Clean Water and Sanitation
7. Affordable and clear Energy
8. Decent Work and Economic Growth
9. Industry Innovation and Infrastructure
10. Reduced Inequalities
11. Sustainable Cities and Communities
12. Responsible Consumption and Production
13. Climate Action
14. Life below Water
15. Life on Land
16. Peace, Justice and Strong Institutions
17. Partnership for the Goals

#### A.2 Proof of Optimization Problem

If a shareholder is utility maximizer, that is, he/she concerns both firm value ($v_I$) and SDGs. Optimization problem we would like to solve is as in equation (4).

$$
\max_{v_I, SDG_{1,j}} U_K (v_I, SDG_{1,j}) = v_I^S SDG_{1,j}^{1-x} \\
\text{s.t. } v_I = a + bSDG_{1,j} + cSDG_{1,j}^2
$$

Taking natural logarithms of both side of equation (4) changes the maximization problem as

$$
\max_{v_I, SDG_{1,j}} U_K = \gamma \ln(v_I) + (1-\gamma) \ln(SDG_{1,j}) \\
\text{s.t. } v_I = a + bSDG_{1,j} + cSDG_{1,j}^2
$$

As taking natural logarithms is monotonic transformation,
solution to equation (4) and (A1) are exactly same. SDG_{I,J} which possibly maximize the utility of the shareholder \((U_K)\) implies
\[
\frac{\partial U_K}{\partial SDG_{I,J}} = \frac{\gamma}{v_{I,J}} \frac{\partial v_{I,J}}{\partial SDG_{I,J}} + \frac{(1-\gamma)}{SDG_{I,J}} = 0
\]
\[
\frac{\partial v_{I,J}}{\partial SDG_{I,J}} = -\frac{1-\gamma}{\gamma}
\]
(A2)

Left-hand side of Equation (A2) is SDGs elasticity of firm value. Equation (A2) indicates that if the investment to SDGs increases by 1%, the firm value would increase by \(-\frac{(1-\gamma)}{\gamma}\). \(0 < \gamma < 1\) implies that the elasticity is always negative at the optimal which maximizes the utility of the shareholder. Absolute value of the elasticity is bigger as \(\gamma\), weight on the firm value, decreases. In other words, if the combination of SDGs investment and the firm value is optimal, further investment to SDGs destroy the firm value at the rate of \(-\frac{(1-\gamma)}{\gamma}\). This rate is higher as the weight on the SDGs is higher and the weight on the firm value is lower.

Furthermore, from the constraint from equation (A1),
\[
\frac{\partial v_{I,J}}{\partial SDG_{I,J}} = b + 2cSDG_{I,J}
\]
By substituting this to equation (A2), we obtain
\[
(b + 2cSDG_{I,J}) \frac{SDG_{I,J}}{a + bSDG_{I,J} + cSDG_{I,J}^2} = -\frac{(1-\gamma)}{\gamma}
\]
\[
bSDG_{I,J} + 2cSDG_{I,J}^2 + \frac{(1-\gamma)}{\gamma} (a + bSDG_{I,J} + cSDG_{I,J}^2) = 0
\]
\[
(1-\gamma) a + bSDG_{I,J} + c(1+\gamma)SDG_{I,J}^2 = 0
\]
Solution to this equation is
\[
SDG_{I,J} = \frac{-b \pm \sqrt{b^2 - 4ac(1+\gamma)(1-\gamma)}}{2c(1+\gamma)}.
\]
As \(c < 0\), thus, \(SDG_{I,J}\) which possibly maximize the utility of the shareholder is
\[
SDG_{I,J} = \frac{-b - \sqrt{b^2 - 4ac(1+\gamma)(1-\gamma)}}{2c(1+\gamma)}.
\]
a > 0 and \(c < 0\) imply
\[
b^2 - 4ac(1-\gamma)(1+\gamma) \geq 0, \text{ we always have the solution.}
\]
Finally, \(a > 0\) and \(0 < \gamma < 1\) imply that second order condition of the maximization problem,