

Cost Benefit Analysis: Tokyo Skytree

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Executive Summary

This paper contains both financial and economic appraisals of Tokyo Skytree (TS) project in Japan. TS is a multi-functional business area incorporating digital broadcasting services, observatories and commercial facilities. Since its construction was completed in 2012, this study focuses on the estimation of both financial profitability and changes in social surplus to the Japanese society over the next 30 years. Results of our analysis suggest that the project is beneficial. Although the financial appraisal yielded a low benefit cost ratio, the project is expected to generate net positive social benefits regardless of different scenarios.

Tokyo Skytree's primary purpose is to provide better broadcasting signals to the Kanto area in Japan. The area has faced a necessity for a new broadcasting tower due to the increasing number of skyscrapers that impede signal transmission. In 2006, building a new tower was selected over an alternative that extends the current Tokyo Tower (TT). Throughout this paper, the plan for the extension of TT and the construction of TS are treated as without case and with case, respectively.

After introducing the project and the goal of our study, we provide the financial appraisal of the project. In our calculation, 30 years of project duration and 4% of discount rate are applied as these figures are assumed to be the norm in Japan. Since the construction cost of the project is the only actual figures as of writing, the rest of the estimations rely on projections made by Tobu Corporation, the operator of the project. In addition, some of the analytical techniques such as market analogy method are utilized in calculating future benefits and costs. The result indicates the profit for the next 30 years is approximately JPY 380 billion, but the benefit cost ratio is merely 1.13.

While the financial appraisal showed a low profitability, the project is anticipated to increase social surplus significantly. In economic appraisal, we assume the primary markets are digital signal broadcasting market and leisure market and estimate the changes in social surplus for each market. We also suppose three different scenarios in order to examine the sensitivity of the project. The analysis suggests that the project would increase the social surplus by JPY 340 billion and it would be still beneficial regardless of three different assumptions. Moreover, the total social surplus further increases when a horizontal value of the project is added.

Despite the comprehensive economic appraisal, there are still a few aspects that are not captured with numerical figures but are important in scrutinizing economic impacts of the project. We explain these factors quantitatively, and the quantitative analysis supports that the benefits of the project can be even greater. On the other hand, we also consider possible negative externalities from the project. Although both financial and economic appraisals suggest that pushing through with the project is a good decision, the factors in our qualitative analysis should be further investigated.

1. Introduction

1.1 Project Overview

The Tokyo Skytree (TS) is a multi-functional business area incorporating digital broadcasting services, observatories, and commercial facilities owned and managed by Tobu Corporation (Tobu). TS was in the works back in 2006 and construction began in 2008. After four years and an investment of JPY 138 billion, TS has opened its doors to the public from May 2012. Tokyo Skytree consists mainly of three areas. One is TS Tower, which serves as a structure for digital broadcasting transmission and has two observatories. As of date, it is the tallest free standing broadcasting tower in the world with a height of 634 meters. The two other areas are Solamachi and East Tower (hereafter referred to as TS Town), which are commercial facilities equipped with shopping malls, restaurant and other amusement attractions. In TS Town, there are 312 shops in the area of 52,000 square meters.

The primary purpose of the project is to provide digital broadcasting signal. Although the Tokyo Tower (TT) has provided broadcasting signals in the Kanto area in Japan since 1958, it has become necessary to have a new tower higher than the TT in order to provide digital broadcasting signals as the number of taller buildings has increased. After the need for a new tower has arisen, two alternatives were proposed. One proposal was extending the TT so that it could still provide digital broadcasting signal services. In 2007, the Nippon Television City Corporation, the operator of TT, suggested its plan to extend the tower with an investment of JPY 4 billion. The other proposal was building a new tower, the TS Tower. Tobu suggested building the TS in Sumida ward in Tokyo.

1.2 Goal of the Study

This study aims to analyze the financial feasibility of TS and its social benefits and costs to the Japanese society. Although many expect a significant economic impact from the TS, there are only a few studies that analyzed both TS' profitability and its effect on social surplus. Throughout the analysis, two alternatives, extending TT and building a new tower, will be compared to each other as with-case and without-case, respectively. With limited data availability, we applied different approaches in the conduct of both financial and economic appraisals. To illustrate, the market analogy method is used in financial appraisal while the travel cost method is utilized in the estimation of the change in social surplus. In addition, a qualitative analysis of social benefit of TS was carried out by utilizing existence value, asset valuation and contingent valuation methods.

In the next chapter, we first analyze the financial feasibility by examining the future profits and costs of TS. Chapter 3 consists of cost-benefit and sensitivity analyses of the project. Then, an

analysis of the qualitative aspects of TS that cannot be explained with explicit figures is conducted in Chapter 4. The last chapter provides conclusion and the limitation of the study.

2. Financial Analysis

Financial appraisal is important in that it examines the minimum level of feasibility of the project. The result of the analysis for TS suggests that the project is profitable although its benefit-cost ratio is slightly higher than 1. The summary of the financial appraisal is illustrated in Table 1. As shown in the table, the project duration is 30 years from the start of operation and the 4% of discount rate is applied.

Table 2.1 Summary of Financial Appraisal

Project Duration	30 Years
Discount Rate	4 %
Total Benefit	JPY 380 billion
Total Cost	JPY 335 billion
Benefit-Cost Ratio	1.13

Since the TS Tower and TS Town have different markets, the financial analyses for those two facilities were conducted separately. The whole analysis is basically based on the projection made by Tobu for the next three years, which is illustrated in Table 2. However, the estimations of future benefits and costs after the first three years rely on the market analogy of TT and Ikebukuro Sunshine City (ISC), respectively.

Table 2.2 Projection by Tobu Corporation

	TS Tower		TS Town		Number of Visitors
	Operating Revenue	Operating Cost	Operating Revenue	Operating Cost	
1 st Year	10.6	10.1	9.5	9.2	4 million
2 nd Year	12.3	9.4	10.8	9.5	4.6 million
3 rd Year	11.6	8.9	11.2	9.6	4.3 million

Unit: JPY billion

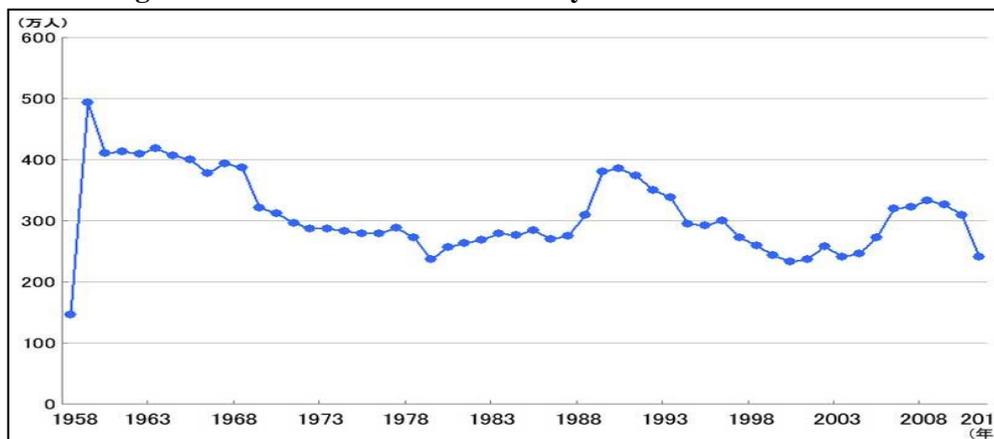
2.2 Tokyo Skytree Tower

The revenues for TS Tower mainly come from the rents paid by broadcasting companies and admission fees to the observatories. Assuming that the amount of revenues from rent would not

change significantly, the estimation of the benefit for the Tower was calculated by adjusting the projection of Tobu. In order to estimate the future demand for the observatory, the change in the number of visitors for TT was applied as a benchmark.

As in Figure 2.1, the demand for TT has consistently decreased. It is especially notable that there are roughly three trends: the first year with 500 million, the next 10 years with an average of 400 million, and the succeeding years up to 1988 with an average of 300 million. Two periods, around the early 1990's and 2010, were assumed as outliers since they are the times of the Japanese bubble economy and the Global Financial Crisis, respectively. Hence, it coincides with the generally accepted idea that the number of visitors for an observatory decreases significantly after the first year of operation.

Figure 2.1 Number of Visitors to Tokyo Tower from 1958 to 2011



Source: Nippon Television City Corporation (NTC)

Based on this analogy, Tobu's projection was adjusted by decreasing the projection of the demand for observatory. The estimated number of visitors for the first ten years except for the first year is 4 million. This number decreases to 3.5 million for the next 10 years and 3 million for the succeeding 10 years. (See Appendix 1)

In order to estimate the total costs for the TS Tower, construction, operating and maintenance costs were examined. First, the actual figures of construction costs and the projected operating costs were available in the announcement by Tobu as in Table 2.2. Assuming that the operation costs would not change significantly or perhaps it would decrease because of efficiency, the average of the costs for the first three years was applied to the future projection. In addition, the greatest attribution to the maintenance cost for the TS Tower was to be the cost of painting the facility since the TT paints for maintenance purpose every five years. However, the cost for painting was ignored here in the TS Tower's case since the provider of painting service guaranteed that there would be no need to repaint the Tower at least for the next 100 years.

It is notable that the TS Tower would lose money if the number of visitors is less than 3.5 million even though the total projection suggests positive profitability of JPY 25 billion. Additionally, the benefit cost ratio for TS tower is 1.16. (See Appendix 1) The construction cost was omitted when calculating the total profit since the costs for each year include depreciation costs.

2.3 Tokyo Skytree Town

The revenue from TS Town is largely the rents paid by business facilities. Thus, it could be assumed that the future revenue would not fluctuate unless there is a serious change in the occupancy rate of TS Town. Based on this assumption, the average of the revenues for the first three years is implied for the estimated revenues after those three years.

The total costs for TS Town was also broken down into three aspects: construction, operation and maintenance. As same as the TS Tower estimation, the actual figure of construction cost was used and the average of Tobu's projection was borrowed for the operation cost. To estimate the maintenance cost of TS Town, however, the market analogy of ISC was implied as a benchmark in that the ISC provides similar services and has similar size of business as to the Town. Indeed, the ISC provides a wide range of services from shopping mall and restaurants to an observatory.

According to the financial statements by ISC, it has spent approximately JPY 2 billion on average from 2007 to 2010. We then calculated the maintenance cost per square meter for the ISC and calculated the number by the size of business area of TS Town. As a result, the maintenance cost for square meter of TS Town was estimated as JPY 637 million per year. The financial analysis for the Town yielded 1.10 of benefit-cost ratio, lower than that of TS tower. (See Appendix 2)

As stated as in Table 1, the financial appraisal for TS is positive with profit of JPY 43 billion, although the benefit-cost ratio is very low. (See Appendix 3) However, the ratio could be possibly higher due to the uncertainty in the estimation of maintenance costs. Tobu only disclosed their projection of operating costs, and we added estimated maintenance cost when calculating the total cost for the project. There is a chance that the maintenance costs were double counted if maintenance costs were already included in the Tobu's projection of operation costs.

3. Cost-Benefit Analysis

As we mentioned above, TS has two functions, one is for broadcasting and the other is for commercial purpose, which can be divided into TS climbers and TS town shoppers. So, based on

these, the cost-benefit-analysis was implemented under following conditions or assumptions. First, the alternative project is without TS. And its primary markets are digital signal broadcasting (DSB) market and leisure market (climbers and shoppers). The main standings are consumers and producers of primary markets and government as well. Also, we expected that TS has indirect impacts on the employment, consumption and even local real estate markets, which need conducting quantitative analysis.

3.1. Methodology

Since different primary markets have different features, we have chosen to use different ways to estimate the Social Surplus (SS). These are:

- a. *For the DSB market: $SS = \text{Social Benefit (SB)} - \text{Social Cost (SC)}$*
- b. *For the Leisure markets: $SS = \text{Consumer Surplus (CS)} + \text{Producer Surplus (PS)} + \text{Tax Revenue} - \text{External Costs}$*

3.2 CBA on Primary Markets

3.2.1 DSB Market

One of the main purposes of constructing TS is to better signal transmission for the TV viewers in Kanto-area, while alternative choice is to extend the current Tokyo Tower. So for the DSB market, based on the “with and w/o” scenario, we calculate the change of SS of TS tower.

Table 3.1 Digital Signal Broadcasting (DSB) Market

DSB market	w/o TS Tower	w/ TS Tower
Social Benefit	A	A
Social Cost	7.5	12
Social Surplus	A - 7.5	A - 12

Unit: JPY billion

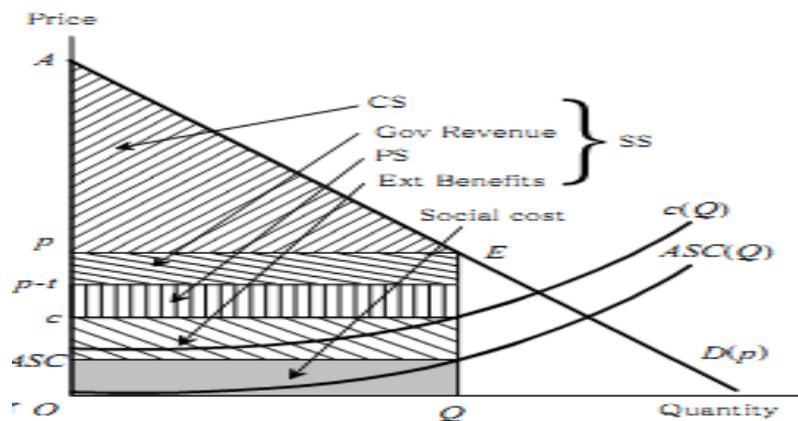
For SB, since both options have more or less the same impact on the improvement of audience reach and view quality, we assume a same positive value A both for “w/ and w/o”. For SC, the determining factor is the construction costs for extension of TT or TS Tower. Based on the projection by NTC, the estimated extension cost was JPY 7.5 billion. While for the TS Tower, though the total construction cost is JPY 60 billion, it is inappropriate to assign such amount to DSB market since there are other primary markets. To make it simple and reasonable, we put 20% of cost, or JPY 12 billion, as the SC based on the revenue ratio from the DSB marker for Tobu company. So, from the table, we can see clearly that the change of SS of TS Tower is minus JPY 4.5 billion.

3.2.2 Leisure Market (Climbers)

TS as a new landmark building in Tokyo will attract many visitors. Here we first focus on the climbers who pay the admission fee to go to the 350-meter and 450-meter high viewing decks called Tembo Deck and Tembo Galleria and enjoy the view of the Tokyo Metropolis and Mt. Fuji.

As we discussed above, we apply different method to calculate the change of social surplus. Another important assumption is that, since TS is a unique building, we regard TS as a new market, which means that we don't calculate the change of social surplus according to the price change in an existing market. So for the leisure market (both climbers and shoppers), we use the methodology which can be reflected in the figure below and we just calculate the value of each part. (e.g. CS ,PS, etc)

Figure 3.1 Methodology for the Leisure Market



Source: Economic Analysis of Public Policies class handout

A typical way of calculating the social surplus under this methodology is to derive the demand curve. Due to limited time and small, inappropriate sample base for surveys, we use alternative ways. The table below is the final outcome.

Table 3.2 Leisure Market (Climbers)

Leisure Market (Climbers)	w/o TS Tower	w/ TS Tower
Consumer Surplus	No market existed.	4.6
Producer Surplus	No market existed.	4.3
Taxes	No market existed.	1.3
External Cost	No market existed.	0
Social Surplus	-	10.2

Unit: JPY billion

For consumer surplus, we use travel cost as an estimate. Though some surveys (we will talk about it later) showed that the willingness to pay (WTP) is lower than the admission fee of TS Tower (3000 Yen), it still seems to be logical to make the assumption that the WTP should be the same, if not larger than, as the travel cost plus the admission fee. According to the projection of Tobu, the annual number of climbers will be 4.6 million (from 2013). And according to the Japanese National Tourism Organization, the average travel cost of visiting the TS will be JPY 1,000. So we get the annual consumer surplus as JPY 4.6 billion.

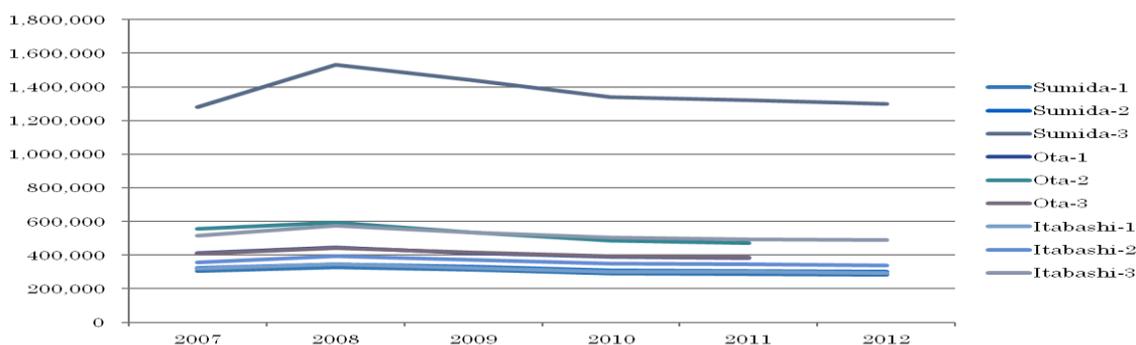
For producer surplus, we directly calculate that based on the financial appraisal and use the annual cash flow as an estimate of PS. Here annual cash flow equals the net profit plus the depreciation cost. In Year 2013 the profit is JPY 2.7 billion and depreciation cost is JPY 1.6 billion (80% of construction cost, or 48 billion, over 30 maturity years), so the annual producer surplus is JPY 4.3 billion (2.7+1.6).

For tax revenue, there are basically two kinds of tax. One is consumption tax at a rate of 5% and the other is corporate tax at a rate of 30%. So, we can calculate these taxes by multiplying the annual revenue and net profit with the said rates. In Year 2013, the annual revenue for TS Tower is JPY 11.8 billion and net profit is JPY 2.7 billion. So, consumption tax is JPY 0.5 billion (11.8*5%/105%) and corporate tax is JPY 0.8 billion (2.7*30%). All in all, annual tax revenue will be JPY 1.3 billion.

For external cost, TS seems to have some complex externalities, either positive or negative. To give a specific value to the external cost, we use the real estate market of the neighboring areas as a proxy. The figure below shows the land price of neighboring areas. We can see clearly that during 2011-12, when TS begins to operate, there is no change in the land price. In other words, the positive externalities are offset by the negative externalities. Thus, it is safe to say that the external cost is zero in this circumstance.

Consequently, the total annual social surplus is JPY 10.2 billion (4.6+4.3+1.3).

Figure 3.2 Trends in Real Estate Market



Source: Land General Information System, Ministry of Land, Infrastructure, Transport and Tourism

3.2.3 Leisure Market (Shoppers)

To prompt the tourism, TS has also built a complex shopping mall called Solamachi. Basically the method we use in calculating the SS of the TS climbers market can also apply in the TS shoppers market.

Table 3.3 Leisure Market (Shoppers)

Leisure Market (Shoppers)	w/o TS Town	with TS Town
Consumer Surplus	No market existed.	12.6
Producer Surplus	No market existed.	3.4
Taxes	No market existed.	0.8
External Cost	No market existed.	0
Social Surplus	-	16.8

Unit: JPY billion

For consumer surplus, according to the projection by Sumida City government, the annual shoppers will be 12.6 million. And the average travel cost is same with TS climbers, which is JPY 1000. So, the annual consumer surplus is JPY 12.6 billion. For producer surplus, in Year 2013, the net profit is JPY 0.8 billion and the depreciation cost is JPY 2.6 billion (the whole construction cost of TS Town, JPY 78 billion, over 30 years). So, the annual producer surplus is JPY 3.4 billion. For taxes, since the revenue will be 10.8 billion and net profit will be JPY 0.8 billion in Year 2013, the consumption tax will be JPY 0.52 billion and corporate tax will be JPY 0.25 billion. So, the annual taxes will be JPY 0.8 billion. External cost is zero, same as TS tower. So, the total annual social surplus will be JPY 16.8 billion (12.6+3.4+0.8).

3.3 Changes in Social Surplus from the Three Markets

We follow the same methodology in the previous section for computing the present value of benefits for the succeeding years. It should be noted that the present value of social benefits in the first year is adjusted since Tokyo Skytree opened in May 2012. For the other years, the values reflect benefits for the full year. Adding up all values gives total social benefits of more than JPY 338.7 billion. The breakdown of this amount is shown in Table 3.4. Details of the computation are in Appendix 4.

Table 3.4: Breakdown of the Change in Social Surplus

Source	Net Change in Social Surplus
---------------	-------------------------------------

Digital Signal Broadcasting Market	(4,500,000,000)
Leisure Market (Climbers)	129,263,889,253
Leisure Market (Shoppers)	214,006,405,829
Total	338,770,295,082

Unit: JPY

3.4 Horizon Value

The net social benefit from TS is assumed to continue indefinitely. Although the time frame of the analysis in the previous section is for 30 years only, there will still be a need for TS Tower beyond 2041. It is expected that TS Tower will continue to provide broadcasting services. It is reasonable to say that no new skyscrapers will be built such that TS Tower's broadcasting function is compromised. Thus, constructing a taller tower will not be necessary. Furthermore, technological advancements are assumed not to have any adverse effects on the existence of TS Tower. In the case of TS Town, it is presumed to continue providing office and store spaces for lease. The Town's attractiveness to both businesses and visitors will not wane mainly due to its strong association with TS Tower and Tobu's constant innovation in amusement and leisure activities. Given all these assumptions, TS will not become obsolete and the Japanese society will derive net benefits from it over a long period of time.

A simplified computation of the net present value of TS' horizon value is obtained through the following formula from Boardman, Greenberg, Vining and Weimer (2010):

$$PV = \frac{A}{i} \quad (i > 0)$$

where A is the amount of net benefits received each year in annuity and i the interest rate. In our computation, TS's annual benefits from the 31st year onwards is equal to the net benefit in the 30th year, or around JPY 8.65 billion. Given the social discount rate of 4%, the horizon value is calculated to be more than JPY 216.4 billion.

$$PV = \frac{\text{¥8,657,888,197}}{0.04} = \text{¥216,439,704,025}$$

All in all, the total change in social surplus from TS is the present value of the net benefits for the first 30 years, as computed in the section 3.4, plus the horizon value, or a total of JPY 555.21 billion.

3.5 Partial Sensitivity Analysis

A comprehensive CBA would not be complete without looking at possible changes in the factors that affect the value of a project's net social benefit. We analyze the effects of exogenous changes in three factors, namely, the social discount rate, consumer demand, and acts of God.

A. An upward change in the social discount rate (SDR)

According to Otani (2012), the 4% SDR in Japan is derived from the yield on long-term government bonds. This figure may increase due to two major factors. First, the SDR would shoot up definitely if the Japanese government defaults from its debt. The likelihood of defaulting would remain high if the Japanese government does not lower its debt to GDP ratio. Second, the SDR may breach the 4% level if the system bases its calculation on the return rate on private investment and/or market interest rate. These rates are usually higher than the yield on government bonds.

B. Negative demand shock

We look at scenarios wherein the demand for TS is lower than what is projected by Tobu. The level of attention that TS is enjoying now may not be sustainable for a long period of time. Preferences of the two leisure markets are dynamic and any unfavorable change overtime would lower the social surplus derived from TS. This could be due to factors such as Tobu's shortcomings in meeting or surpassing climbers and shoppers' expectations or an exogenous drop in consumer patronage. We look at the effect of a drop in demand by 20%, 50%, and 80% for both leisure markets beginning on the second year of operation. The demand from the digital signal broadcasting market is assumed to be constant.

C. Acts of God

A team from the University of Tokyo predicts that there is 75% likelihood that an earthquake with a magnitude of at least 7 would hit Tokyo in the next four years.¹ The Japanese government has a less alarming but still gloomy prediction: 70% chance in the next 30 years. Considering this, we choose arbitrarily that the long overdue massive earthquake would hit Tokyo in 2020. We assume that Tokyo Skytree would remain standing, as it survived the great Tohoku earthquake last 11 March 2011, but would be damaged badly. For purposes of calculating the value of such an effect, we assumed that the one-time reconstruction expense would equal TS' initial construction cost of JPY 138 billion.

As summarized in Table 3.5, TS remains beneficial to the Japanese society. Even if the SDR doubles or quadruples (8% and 16%, respectively), the new social surplus is still positive. This is not surprising considering that the internal rate of return stands at around 19.4%. Furthermore, negative

¹ From reports in BBC News Asia (January 2012) and International Business Times (March 2012)

demand shocks do not bring the present value of social benefits in the red. A dramatic drop by 80% in the demand of the two leisure markets results in a new social surplus with a positive value of JPY 15.21 billion. In terms of a one time increase in cost due to an earthquake in 2020, the social surplus is valued at around JPY 454.4 billion. These scenarios show that in spite of changes in the three parameters (all other things constant), TS' net present value is still positive.

Table 3.5 Social Surplus from Tokyo Skytree Given Changes in Parameters

Three Parameters	Change	New Social Surplus Value (in JPY)²	Is Tokyo Skytree still beneficial? (Y/N)
A. Social discount rate	↑ to 8%	212,670,000,000	Yes
- An increase due to the impact of the Japanese government defaulting from its debt	↑ to 16%	33,840,000,000	Yes
B. Demand shock	↓ by 20%	420,210,000,000	Yes
- Actual arrival figures are lower than projections due to weak consumer demand	↓ by 50%	217,710,000,000	Yes
	↓ by 80%	15,210,000,000	Yes
C. Acts of God	↑ cost by	454,374,751,710	Yes
- Massive earthquake in 2020 causes a one time cost increase	JPY 138 billion		

4. Qualitative Analysis

4.1 Existence Value

Some observed changes in consumption of a good whose price or quantity is affected by the policy change (situation change) allow WTP to be estimated. For applications of CBA, analysts can reasonably assume that such estimates capture the entire WTP. However, in some applications of CBA, especially those involving changes to unique environmental and social resources, people may be willing to pay for the existence of “good” that they themselves will never actually “consume.” Although conceptualizing and measuring such existence values poses a challenge to the application of CBA, we consider existence value of TS as an additional category of benefit.

4.2 Active and Passive Use Value

The first and the most obvious benefit category arising from “active use” of a good is

² The new social surplus takes into account changes in both the net present value of social benefits and horizon value.

“rivalrous consumption” of goods. In the case of TS, when people climb up to the observation deck of TS or when people go shopping at the mall, TS can be categorized into “rivalrous consumption goods.” The other use categories are for nonrivalrous goods. In particular, “indirect nonrivalrous consumption” takes place offsite. Those consumed onsite,(i.e., watching TS from afar and buying picture and postcard of TS at shops in different places) are labeled direct nonrivalrous consumption. Expenditures of time and money on offsite nonrivalrous consumption provide some information for estimating its value, though much less reliably than the other use category.

In terms of motivations of “passive use” benefits, four categories can be distinguished. The first category, option value, is the amount that someone is willing to pay to keep open the option of use, active or passive, in the future. It is only passive in the sense that it would not be fully captured by estimates of WTP based on observations of active use.

4.3 Attitude Surveys

According to the survey by Toyo Keizai Inc., which was conducted just after the opening of TS, more than 43% of respondents from different areas in Japan responded that they strongly want to or, if possible, want to go to TS.

Table 4.1 Outline of Attitude Survey

Survey method	Toyo Keizai Inc
Survey period	June 2, 2012- June 3, 2012
Sample Size	1,000

Table 4.2 Result of Attitude Survey

	Total number	Already	Strongly want to	If possible, want to	Don't want to	Don't know
Hokkaido	53	1.9	7.5	30.2	47.2	13.2
Tohoku	50	0.0	4.0	48.0	40.0	8.0
Kanto	404	1.7	10.1	34.9	39.9	13.4
Chubu	140	0.0	10.0	39.3	35.0	15.7
Kinki	203	0.0	6.4	29.1	50.2	14.3
Chugoku	56	0.0	4.2	45.8	29.2	20.8
Shikoku	24	0.0	4.2	45.8	29.2	20.8
Kyushu	70	0.0	7.1	37.1	38.6	17.1
Total	1000	0.8	8.2	35.7	41.7	13.6

Option value

While people in Hokkaido and Kinki might not be so enthusiastic about TS because of the distance or the rivalrous relationship between Kanto and Kansai, nearly 44% of people in Japan who haven't visited but want to go to TS in the future, which can be option value. The second category, pure existence value, arises because people believe the good has intrinsic value apart from its use. For example, some people might be willing to pay to TS because they think that it is right that the symbolic, the highest tower exists in Tokyo, as the largest metropolitan area in the world. As TS survived from the big earthquake in March 2011, this tower is an embodiment of Japan's advance technology in architectural engineering. Some people might feel a sense of pride in TS as a symbol of re-establishment of Japan after the earthquake. The remaining two categories are based on altruistic existence values: gift to the current generation and bequest to future generations. Given the fact that TS was constructed for the future multi-channel broadcasting systems or further development of Sumida and Koto areas, an old town of Tokyo, the altruistic existence values might be focused on the value to future generations.

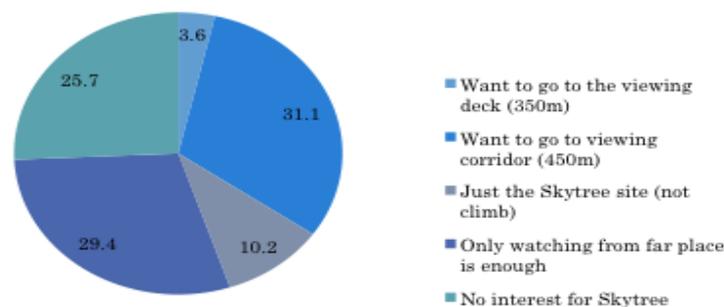
There is another attitude survey conducted by a travel agency regarding more details of preferences for TS. The survey asked respondents about their preferences in using or non-using, and possible partitioning of WTP.

Table 4.3 Outline of WTP Survey

Survey method	Questionnaire in the website of 4 travel.jp
Survey period	December 27, 2011- January 5, 2012
Sample Size	993

Q1: Do you want to go to TS? (%)

Based on the survey conducted by 4 Travel (travel agency), 74.3% of Japanese residents are willing to go to TS or have interested in TS. In other words, they give TS a positive value. Thus, we can generally get positive benefits of existing value.



Q2: The appropriate price of the ticket to the viewing corridor (450m) for you? * Actual Price: 3,000 yen

Preferences of people who	Willingness to Pay to Visit TS
Want to go to the viewing deck (350m)	1,699 yen
Want to go to viewing corridor (450m)	1,689 yen
Just the TS site (not climb)	1,220 yen
Only watching from far place is enough	1,284 yen
No interest for TS	1,008 yen
Average of overall	1,380 yen

A manifest fact, according to the results of the surveys, is that although 74.3% of people feels positive about TS, the appropriate price of ticket for them is quite low, compared with the actual price to the viewing corridor (3,000 yen) . Given such a huge difference in ticket price between TS and Tokyo Tower⁵, the price of TS's ticket can be a reason that people might reluctant to visit TS repeatedly. It implies that, after the end of booms of TS, people's demand for TS might be changed drastically as we pointed out at the part of "sensitivity analysis."

4.4 Difficulty with non-use value

While most economists accept the general idea that people may derive value from the existence of unique assets, clearly defining nonuse value⁶ is a complicated issue and there is not yet a clear consensus on its precise as following points.

- Definition of non-use is not clear
- A good may have both use and non-use values
- Non-use value cannot be directly observed, only discovered through stated preferences

One difficulty arises in drawing a sharp line between use and nonuse. In terms of standard consumer theory, any good that a person values is an argument in his or her utility function. However, the quantity of a pure public good such as national defense, for instance, is "consumed" by individuals passively. In this sense, existence value can also be thought of as a pure public good. It is nonrivalrous - the value one person derives from it does not diminish the values derived by others. It is nonexcludable- no one can be excluded from deriving value from the quantity of the good, which is

⁵ The ticket price of Tokyo Tower's observatory is 820 yen and the total price to the special observatory is 1,420 yen. In terms of proximity to the center of Tokyo and the ticket price, Tokyo Tower should have the price competitiveness.

⁶ The notion that people may place a value on the very existence of "unique phenomena of nature" that they neither visit, nor ever anticipate visiting was introduced into the CBA literature by John V. Krutilla.

provided commonly to all. Viewed as a public good, it seems more appropriate to describe existence value as passive use rather than nonuse.

Another difficulty arises because individuals derive both use and nonuse value from a given asset. A person's WTP for TS may be motivated by the anticipation of visiting TS in future and the pleasure of knowing that future generations will be able to enjoy much broader and stable services due to construction of TS. While the person's total WTP, or as it is often called in the context total economic value, is conceptually clear, the division between two categories of value is ambiguous because the order of valuation is generally relevant.

The third difficulty has to do with differences in the way quantify changes affect use and nonuse benefits. In general, nonuse benefits tend to be less quantity sensitive than use benefits.

Finally, the non-use category raises issues of motivation which are usually overlooked by economists. In case that nonuse does not leave a behavioral trace, then non-use value cannot be directly observed but only discovered through stated preferences.

4.5 Potential danger of electromagnetic wave (Other Concerns)

There is another discussion regarding the impact of the electromagnetic wave on human health. As part of its Charter to protect public health and in response to public concern, the World Health Organization (WHO) established the International EMF Project in 1996 to assess the scientific evidence of possible health effects of EMF.⁷ Although the cause and effect relationship has not been fully established, strong signals from tower generates electromagnetic wave and negative impact of electromagnetic wave is becoming issue. As we can easily observed through internet, many people across the countries concerns of the negative impact on health (ex. childhood leukemia) by exposure to electromagnetic fields (EMF).⁸

Each country sets its own limit level of EMF wave. In Europe where the adverse effects are clearly recognized, each country set the following level.

- Italy: $10\mu\text{W}/\text{c m}^2$
- Russia, Switzerland : $2 \sim 4\mu\text{W}/\text{c m}^2$
- Around Tokyo tower: More than $10\mu\text{W}/\text{c m}^2$

⁷ <http://www.who.int/peh-emf/en/>

⁸ <http://www.babycom.gr.jp/eco/kodomo/s5.html>

On the other hand, as some NPO, groups and activities also point out, the level of EMF around Tokyo Tower is the same or even higher than that of the regulation level in some countries. If the correlation between EMF and its negative impact on human health, the location of TS and TT and the strength of the signals can be questioned. Moreover, the existence value of TS leads to a fundamental change.

As CBA is increasingly applied to environmental and health issues, concern about existence values among analysts will almost certainly grow. Unless methods of measurement improve substantially, however, deciding when and how to include existence values in CBA will continue to be difficult. By being aware of the limitations of these methods, analysts can be better producers and consumers of CBA.

5. Conclusion & Limitations

As our CBA research shows, the project is profitable for Tobu Corporation. TS is expected to generate significant social benefits regardless of different scenarios. However, at the same time, our research has some limitations due to the time constrain and data availability. The credibility of the analysis can be enhanced thorough contingent analysis such as more detailed attitude surveys. In particular, further developing analysis, which includes external effects and the possible synergetic effects between TS and other business units of Tobu Corporation, will give our CBA more comprehensive perspective and social significance.

< References >

1. Japanese Sources:

第一生命経済研究所「第二東京タワーの経済波及効果」2006年5月10日
(Dai-ichi Life Research Institute, Economic Effects of the Second Tokyo Tower)

墨田区地域振興部「新タワーによる地域活性化等調査報告書」2008年1月
(Sumida Ward Office, Economic Effects of the New Tower on the Community)

あしぎん総合研究所「東京スカイツリータウン開業による栃木県への経済波及効果」2012年4月25日
(Ashigin Research Institute, Economic Effects of the Skytree on Tochigi Prefecture)

東部鉄道株式会社「2011年度決算説明資料」2012年5月11日
(Tobu Corporation, Press Release)

株式会社サンシャインシティ「有価証券報告書」第42基、第43基、第44基、第45基
(Sunshine City Corporation, Financial Reports)

日本電波塔株式会社「記者説明会資料：完全デジタル時代の東京タワー」2007年9月21日
(Nippon Television City Corporation, Press Release)

2. English Sources:

BBC News Asia. *Big Tokyo Earthquake Likely Within the Next Few Years*. 23 January 2012.
<http://www.bbc.co.uk/news/16681136>

Boardman, A. E, D. H. Greenberg, A. R. Vining and D. L. Weimer. *Cost-Benefit Analysis: Concepts and Practice*, Fourth Edition. Prentice-Hall, Upper Saddle River, NJ, 2010.

International Business Times. *Japan Earthquake 2012: Tokyo at Risk for Major Disaster in Near Future*. 15 March 2012.

<http://www.ibtimes.com/articles/314733/20120315/japan-earthquake-2012-tokyo.htm>

Otani, Satoru. *Research to Advance the Evaluation Methodology of Public Works Projects*.

Research Center for Land and Construction Management. 2012

<http://www.nilim.go.jp/english/annual/annual2012/80.pdf>

< Appendix 1: Financial Appraisal for Tokyo Skytree Tower >

Year	No. of years after opening	Discount Rate: 4%	No. of Visitors	Revenue (After Discounting)	Cost (After Discounting)	Net Profit Before Tax
2011		1.04			62,400,000,000	-62,400,000,000
2012	1	1.00	4,000,000	10,600,000,000	10,173,333,333	426,666,667
2013	2	0.96	4,600,000	11,826,923,077	9,144,230,769	2,682,692,308
2014	3	0.92	4,300,000	10,724,852,071	8,330,251,479	2,394,600,592
2015	4	0.89	4,000,000	9,601,160,674	7,654,258,648	1,946,902,025
2016	5	0.85	4,000,000	9,231,885,263	7,359,864,085	1,872,021,178
2017	6	0.82	4,000,000	8,876,812,753	7,076,792,389	1,800,020,364
2018	7	0.79	4,000,000	8,535,396,878	6,804,608,067	1,730,788,811
2019	8	0.76	4,000,000	8,207,112,383	6,542,892,372	1,664,220,011
2020	9	0.73	4,000,000	7,891,454,214	6,291,242,665	1,600,211,549
2021	10	0.70	4,000,000	7,587,936,744	6,049,271,793	1,538,664,951
2022	11	0.68	4,000,000	7,296,093,023	5,816,607,494	1,479,485,530
2023	12	0.65	3,500,000	6,300,935,036	5,592,891,821	708,043,215
2024	13	0.62	3,500,000	6,058,591,381	5,377,780,597	680,810,784
2025	14	0.60	3,500,000	5,825,568,636	5,170,942,882	654,625,754
2026	15	0.58	3,500,000	5,601,508,303	4,972,060,463	629,447,840
2027	16	0.56	3,500,000	5,386,065,676	4,780,827,368	605,238,308
2028	17	0.53	3,500,000	5,178,909,304	4,596,949,393	581,959,911
2029	18	0.51	3,500,000	4,979,720,485	4,420,143,647	559,576,838
2030	19	0.49	3,500,000	4,788,192,774	4,250,138,122	538,054,652
2031	20	0.47	3,500,000	4,604,031,513	4,086,671,271	517,360,242
2032	21	0.46	3,500,000	4,426,953,378	3,929,491,607	497,461,771
2033	22	0.44	3,000,000	3,773,968,978	3,778,357,314	-4,388,336
2034	23	0.42	3,000,000	3,628,816,325	3,633,035,879	-4,219,554
2035	24	0.41	3,000,000	3,489,246,467	3,493,303,730	-4,057,263
2036	25	0.39	3,000,000	3,355,044,679	3,358,945,894	-3,901,215
2037	26	0.38	3,000,000	3,226,004,499	3,229,755,667	-3,751,168
2038	27	0.36	3,000,000	3,101,927,403	3,105,534,296	-3,606,892
2039	28	0.35	3,000,000	2,982,622,503	2,986,090,669	-3,468,166
2040	29	0.33	3,000,000	2,867,906,253	2,871,241,028	-3,334,775
2041	30	0.32	3,000,000	2,757,602,166	2,760,808,681	-3,206,514
Total				182,713,242,839	157,638,323,421	25,074,919,419

< Appendix 2: Financial Appraisal for Tokyo Skytree Town >

Year	No. of years after opening	Discount Rate: 4%	Revenue (After Discounting)	Cost (After Discounting)	Net Profit Before Tax
2011		1.04		81,120,000,000	-81,120,000,000
2012	1	1.00	9,500,000,000	9,501,333,333	-1,333,333
2013	2	0.96	10,384,615,385	9,569,230,769	815,384,615
2014	3	0.92	10,355,029,586	9,293,639,053	1,061,390,533
2015	4	0.89	9,778,959,945	8,787,729,005	991,230,940
2016	5	0.85	9,402,846,101	8,449,739,428	953,106,673
2017	6	0.82	9,041,198,174	8,124,749,450	916,448,724
2018	7	0.79	8,693,459,783	7,812,259,087	881,200,696
2019	8	0.76	8,359,095,945	7,511,787,584	847,308,362
2020	9	0.73	8,037,592,255	7,222,872,676	814,719,579
2021	10	0.70	7,728,454,091	6,945,069,881	783,384,210
2022	11	0.68	7,431,205,857	6,677,951,809	753,254,048
2023	12	0.65	7,145,390,247	6,421,107,509	724,282,739
2024	13	0.62	6,870,567,545	6,174,141,835	696,425,710
2025	14	0.60	6,606,314,947	5,936,674,841	669,640,106
2026	15	0.58	6,352,225,911	5,708,341,194	643,884,717
2027	16	0.56	6,107,909,530	5,488,789,609	619,119,921
2028	17	0.53	5,872,989,933	5,277,682,317	595,307,616
2029	18	0.51	5,647,105,704	5,074,694,535	572,411,169
2030	19	0.49	5,429,909,331	4,879,513,976	550,395,355
2031	20	0.47	5,221,066,665	4,691,840,362	529,226,303
2032	21	0.46	5,020,256,408	4,511,384,963	508,871,445
2033	22	0.44	4,827,169,623	4,337,870,157	489,299,466
2034	23	0.42	4,641,509,253	4,171,028,997	470,480,256
2035	24	0.41	4,462,989,666	4,010,604,805	452,384,862
2036	25	0.39	4,291,336,218	3,856,350,774	434,985,444
2037	26	0.38	4,126,284,825	3,708,029,590	418,255,235
2038	27	0.36	3,967,581,562	3,565,413,068	402,168,495
2039	28	0.35	3,814,982,271	3,428,281,796	386,700,476
2040	29	0.33	3,668,252,184	3,296,424,804	371,827,380
2041	30	0.32	3,527,165,562	3,169,639,234	357,526,327
Total			196,313,464,510	177,604,176,442	18,709,288,068

< Appendix 3: Financial Appraisal for Tokyo Skytree >

Year	No. of years after opening	Discount Rate: 4%	Total Revenue	Total Cost	Net Profit Before Tax
2011		1.04	0	143,520,000,000	-143,520,000,000
2012	1	1.00	20,100,000,000	19,674,666,667	425,333,333
2013	2	0.96	22,211,538,462	18,713,461,538	3,498,076,923
2014	3	0.92	21,079,881,657	17,623,890,533	3,455,991,124
2015	4	0.89	19,380,120,619	16,441,987,654	2,938,132,965
2016	5	0.85	18,634,731,364	15,809,603,513	2,825,127,851
2017	6	0.82	17,918,010,927	15,201,541,840	2,716,469,088
2018	7	0.79	17,228,856,661	14,616,867,153	2,611,989,508
2019	8	0.76	16,566,208,328	14,054,679,955	2,511,528,373
2020	9	0.73	15,929,046,469	13,514,115,342	2,414,931,128
2021	10	0.70	15,316,390,836	12,994,341,675	2,322,049,161
2022	11	0.68	14,727,298,880	12,494,559,302	2,232,739,578
2023	12	0.65	13,446,325,283	12,013,999,329	1,432,325,954
2024	13	0.62	12,929,158,926	11,551,922,432	1,377,236,494
2025	14	0.60	12,431,883,583	11,107,617,723	1,324,265,860
2026	15	0.58	11,953,734,214	10,680,401,657	1,273,332,558
2027	16	0.56	11,493,975,206	10,269,616,978	1,224,358,228
2028	17	0.53	11,051,899,237	9,874,631,709	1,177,267,527
2029	18	0.51	10,626,826,189	9,494,838,182	1,131,988,007
2030	19	0.49	10,218,102,105	9,129,652,098	1,088,450,007
2031	20	0.47	9,825,098,178	8,778,511,633	1,046,586,545
2032	21	0.46	9,447,209,786	8,440,876,570	1,006,333,216
2033	22	0.44	8,601,138,601	8,116,227,471	484,911,130
2034	23	0.42	8,270,325,578	7,804,064,876	466,260,702
2035	24	0.41	7,952,236,133	7,503,908,535	448,327,598
2036	25	0.39	7,646,380,897	7,215,296,668	431,084,229
2037	26	0.38	7,352,289,324	6,937,785,258	414,504,066
2038	27	0.36	7,069,508,966	6,670,947,363	398,561,602
2039	28	0.35	6,797,604,775	6,414,372,465	383,232,310
2040	29	0.33	6,536,158,437	6,167,665,831	368,492,606
2041	30	0.32	6,284,767,728	5,930,447,915	354,319,813
Total			379,026,707,351	335,242,499,863	43,784,207,487

< Appendix 4: NPV for Tokyo Skytree in cost-benefit analysis >

Years	No. of Years After Opening	Discount Rate: 4%	SS for Climbers	After Discounting	SS for Shoppers	After Discounting	SS for DSB
2011		1.04	-48,000,000,000	-49,920,000,000	-78,000,000,000	-81,120,000,000	
2012	1	1.00	6,684,666,667	6,684,666,667	11,073,666,667	11,073,666,667	-4,500,000,000
2013	2	0.96	11,200,000,000	10,769,230,769	16,800,000,000	16,153,846,154	
2014	3	0.92	11,200,000,000	10,355,029,586	16,800,000,000	15,532,544,379	
2015	4	0.89	11,200,000,000	9,956,759,217	16,800,000,000	14,935,138,826	
2016	5	0.85	11,200,000,000	9,573,806,940	16,800,000,000	14,360,710,409	
2017	6	0.82	11,200,000,000	9,205,583,596	16,800,000,000	13,808,375,394	
2018	7	0.79	11,200,000,000	8,851,522,688	16,800,000,000	13,277,284,032	
2019	8	0.76	11,200,000,000	8,511,079,508	16,800,000,000	12,766,619,262	
2020	9	0.73	11,200,000,000	8,183,730,296	16,800,000,000	12,275,595,444	
2021	10	0.70	11,200,000,000	7,868,971,438	16,800,000,000	11,803,457,158	
2022	11	0.68	11,200,000,000	7,566,318,691	16,800,000,000	11,349,478,036	
2023	12	0.65	11,200,000,000	7,275,306,434	16,800,000,000	10,912,959,650	
2024	13	0.62	11,200,000,000	6,995,486,955	16,800,000,000	10,493,230,433	
2025	14	0.60	11,200,000,000	6,726,429,765	16,800,000,000	10,089,644,647	
2026	15	0.58	11,200,000,000	6,467,720,928	16,800,000,000	9,701,581,391	
2027	16	0.56	11,200,000,000	6,218,962,430	16,800,000,000	9,328,443,646	
2028	17	0.53	11,200,000,000	5,979,771,568	16,800,000,000	8,969,657,352	
2029	18	0.51	11,200,000,000	5,749,780,354	16,800,000,000	8,624,670,530	
2030	19	0.49	11,200,000,000	5,528,634,955	16,800,000,000	8,292,952,433	
2031	20	0.47	11,200,000,000	5,315,995,149	16,800,000,000	7,973,992,724	
2032	21	0.46	11,200,000,000	5,111,533,797	16,800,000,000	7,667,300,696	
2033	22	0.44	11,200,000,000	4,914,936,344	16,800,000,000	7,372,404,516	
2034	23	0.42	11,200,000,000	4,725,900,330	16,800,000,000	7,088,850,496	
2035	24	0.41	11,200,000,000	4,544,134,933	16,800,000,000	6,816,202,400	
2036	25	0.39	11,200,000,000	4,369,360,513	16,800,000,000	6,554,040,769	
2037	26	0.38	11,200,000,000	4,201,308,185	16,800,000,000	6,301,962,278	
2038	27	0.36	11,200,000,000	4,039,719,409	16,800,000,000	6,059,579,113	
2039	28	0.35	11,200,000,000	3,884,345,585	16,800,000,000	5,826,518,378	
2040	29	0.33	11,200,000,000	3,734,947,678	16,800,000,000	5,602,421,518	
2041	30	0.32	11,200,000,000	3,591,295,845	16,800,000,000	5,386,943,767	
total				146,982,270,553			-4,500,000,000