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Constructing an Investment Model for Environmental Social Governance of Museum Cultural Products

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ABSTRACT

Issues related to Environmental, Social and Governance (ESG) have received more and more attention. ESG investment principles are not only for the evaluation of corporation's financial performance; it also includes impact on environmental protection, social effect and corporate governance to measure how to invest the corporation. Sustainable investments are necessary to improve economies, societies, and environments in global communities.

This study intended to present an investment model for ESG in museum cultural products on the maximize profits that maximizes the present value of the profit stream over the operation period. The mathematical model showed that marginal cost equal to marginal revenue holds at each moment of an interval on which investment is greater than zero. The research serves not only contribute to the cultural economics literature, but also provides information to cultural authorities to make the strategy of cultural products.

Keywords: Environmental, Social and Governance, Sustainable investments, Museum Cultural Products, Cultural Economics.

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INTRODUCTION

Issues related to Environmental, Social and Governance (ESG) have received more and more attention. In the past, the corporations operated a traditional business model with the ultimate goal of pursuing maximization profit of shareholder, however, when the corporations developed economics reaches to certain level, it will encounter the issues such as environmental pollution, labor protection, climate change and energy consumption. Then the United Nations began to promote sustainable goals. However, corporations in addition to operate actively making profit, they can use ESG investment to improve society and the environment and promote the sustainable development of the earth. ESG takes into account the corporation's response to social and environmental responsibilities. That is to say, the authorities of corporations have the concept of taking from the society and using it for the society.

ESG investment principles are not only for the evaluation of corporation's financial performance; it also includes impact on environmental protection, social effect and corporate governance to measure how to invest the corporation. Therefore, everyone concerns about the issue whether the corporation have practices to improve sustainable development of society and environment. This trend has spread from Europe to Asia, more and more governments, enterprises and individuals know that they must take actions to protect their living environment and promote the sustainable development of society.

Verheyden, Eccles and Feiner [24] indicated the ESG issues such as environmental protection、social participation and corporate governance would be the important trends of sustainable portfolio management. ESG investing involves extra-financial analysis of corporate performance. Eccles et al. [5] provide evidence that high sustainability companies significantly outperform their counterparts over the long-term, both in terms

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of stock market and accounting performance. Jain, Jain, and Rezaee [10] found that short sellers considered ESG scores as values relevant in making investment decisions that management should integrate Corporate Social Responsibility (CSR) into strategic decisions and corporate reporting. Atkins and Maroun [2] indicated that investors regarded the integration of financial and environmental, social and governance metrics as a better understanding of corporation sustainability. Siew, Balatbat, and Carmichael [21] indicated that ESG disclosures had the potential to affect investors' asset allocation process.

Basically, when the corporations implemented ESG sustainability strategies, they should start with core values of corporations and linked to the key operating processes that would mitigate the negative effect of introducing ESG on corporation's operation process. In other words, corporations make investment of ESG alternatives to strengthen and connect various stakeholder relationships, create competitive differentiation for corporation, bring new operating revenue or low cost, and then improve overall financial and non-financial performance. Tanaka [23] investigates the model of multi-stakeholders to improve the sustainability social and economic systems.

The National Palace Museum (NPM) [16] is actively promoted as tourism attractions in tourism-related promotional materials and successfully attracted visitors from all over the world. The NPM has become a visit cultural destination for foreign visitors in Taiwan. To achieve cultural equality between the northern and the southern regions of Taiwan, the Executive Yuan approved the Southern Branch of the National Palace Museum (referred to as the "SBNPM") at Taibao, Chiayi County on Dec.31, 2004. In 2022, according to Executive Information System of Tourism Bureau in Taiwan, the number of visitors went to the NPM were 1,039,895, compared to 736,487

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in 2021, increased 303,408 (41.20%). Although the pandemic COVID-19 in these years, it showed that the number of visitors continued to grow.

In recent years, many corporations make effort to invest in ESG. However, how to evaluate the relevant performance after these investments is an issue that corporations must consider in the future. This study intended to present an investment model for ESG in museum cultural products on the maximize profits that maximizes the present value of the profit stream over the operation period. The research serves not only contribute to the cultural economics literature, but also provides information to cultural authorities to make the investment strategy of cultural products.

The remainder of this paper organized as follows. Literature reviews for ESG investment were presented in section 2. Mathematical model developed for ESG investment was presented in section 3. The development conditions for cultural products by analyzing the Southern Branch Museum were introduced in section 4. The final section concludes.

LITERATURE REVIEW

From a long-term perspective, Sustainable investments are necessary to improve economies, societies, and environments in global communities. In 2006, the United Nations proposed the Principle of Responsibility Investment (PRI) that describes guidelines for sustainable environment, society, and governance (ESG) issues. Some studies discussed ESG and corporation value. Edmans [6] found that the best companies also exhibited significantly more positive earnings surprises and announcement returns.

Some studies discussed ESG and financial performance. Friede et al. [8] combines the findings of about 2200 individual studies and the results show that roughly 90% of studies find a non-negative relationship between ESG and corporate financial

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performance (CFP). The majority studies report positive findings. Siew, Balatbat, and Carmichael [21] suggested that a regulation of the quality and timing of ESG information would contribute to reducing the gap between more-informed and less-informed investors. Du Rietz [4] investigated how Nordic investors engaged with companies addressing ESG issues.Lee, Faff, and Rekker [12] examined whether portfolios comprising high-ranked corporate social performance (CSP) firms out/underperform portfolios comprised of low-ranked CSP firms.

Himick [9] examined the use of relative performance evaluation as a form of compensation and control, argued that continued focus on relative results may pose challenges to incorporating ESG factors. Li et al. [13] found a positive association between ESG disclosure level and firm value, suggested that improved transparency and accountability and enhanced stakeholder trust play a role in boosting firm value. Sodjahin, Champagne, and Coggins [22] investigated how the Canadian stock market reacts to changes in extra-financial ratings related to ESG factors. Albuquerque et al. [17] proposed an industrial equilibrium model that gives incentives to engage in corporate social responsibility (CSR) enables companies to obtain higher marginal benefits from it by modeling CSR as an investment that increases product differentiation.

Siu *et al*. [18] focused on analyzing museum visitors' behaviors, expectations and attitudes. Wilco *et al*. [26] investigated cultural museums' potential to be tourism products and made them successful from a supply side perspective. Museums are one of the most important tourism products, making tourists be familiar with the local culture. Huang *et al*., [7] examined the impact of consumer's willing to pay and transaction cost on the demand for travel products. Jansen Verbeke and Van Rekom [11] thought branding museums can attract more visitors to a region and then develop

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it as a cultural destination. Anderson [1] found customer demand across a product space takes the form of a Power Law. From a mathematical point of view, Mahanti et al. [14] indicated the Long Tail is a manifestation of power-law relationships. Nowadays, there is a lack of studies focusing on constructing mathematical models for ESG. Hence, in this study, we intended to present an investment model for ESG in museum cultural products on the maximize profits.

MATHEMATICAL MODEL

The purpose of this study is to present an investment model for ESG in museum cultural products on maximize the present value of the profit stream over the operation period $0 \le t \le \infty$. Assume the firm's problem of selecting ESG investment *I* to maximum profits where *p(t)* and c*(t)* are given functions of time indicating the unit price and unit cost of output *f(*K*).* Investment *I* have current value Hamiltonian as following.

$$H=pf(\mathrm{K})-CI+m(I-b\mathrm{k})$$

The following constrained maximization can represent the model:

$$\text{Max} \int_0^{\infty} e^{-rt}[p(t)f(K(t))-c(t)I(t)]dt \quad (1)$$

$$\text{s.t.} \quad K^{'}=I-bK, K(0)=K_0, I\ge 0 \quad (2)$$

Necessary conditions obeyed by a solution include

$$m(t)\le c(t), I(t)\left[c(t)-m(t)\right]=0 \quad (3)$$

$$m^{'}=(r+b)m-p\,f^{'}(K) \quad (4)$$

The marginal value *m* of a unit of capital cannot exceed its marginal cost *c*. If the marginal value is less than the marginal cost, then no investment occurs. On any interval that $I>0$, we have $m=c$ so $m^{'}=c^{'}$; making these substitutions into (4) gives the familiar rule for the optimal capital stock.

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$$pf'(K) = (r+b)c - c' \text{ while } I > 0 \quad (5)$$

I is selected to maintain (5), as long as that is feasible. Differentiate (5) totally with respect to *t* to get an explicit equation involving *I*.

To see what conditions hold while *I*=0, use terms in *m* in (4) and integrate:

$$e^{-(r+b)t} m(t) = \int_t^{\infty} e^{-(r+b)s} p(s) f'(K(s)) ds \quad (6)$$

From (6) we used the assumption that $\lim t \to \infty e^{-(r+b)t} m(t) = 0$ to evaluate the constant of integration. Also, by the fundamental theorem of integral calculus,

$$e^{-(r+b)t} c(t) = -\int_t^{\infty} \left[d(e^{-(r+b)s} c(s)) / ds \right] ds$$

$$= \int_t^{\infty} e^{-(r+b)s} \left[c(s)(r+b) - c'(s) \right] ds \quad (7)$$

Combining (3), (6), and (7) gives

$$\int_t^{\infty} e^{-(r+b)s} \left[p(s) f'(K(s)) - (r+b)c(s) + c'(s) \right] ds \le 0 \quad (8)$$

with equality in case *I* >0. Therefore, capital is not acquired at any time that the discounted stream of revenue produced by a marginal unit of capital is insufficient to cover the corresponding discounted stream of user cost. Suppose that *I*(*t*)=0 on $t_1 \le t \le t_2$ with *I*(t) >0 just prior to t_1 and immediately after t_2. Thus,

$$\int_t^{\infty} e^{-(r+b)s} \left[pf' - (r+b)c + c' \right] ds = 0 \quad (9)$$

for $t = t_1$ and for $t = t_2$. It follows that

$$\int_t^{t_2} e^{-(r+b)s} \left[pf' - (r+b)c + c' \right] ds \le 0, t_1 \le t \le t_2 \quad (10)$$

with equality for $t = t_1$.

Therefore, the myopic rule (5), marginal cost = marginal revenue holds at each moment *t* of an interval on which *I* >0. Furthermore, it holds on average over an interval $t_1 \le t \le t_2$ that *I* =0. Over an interval between investment periods, the integral of

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discounted cost of capital employment equals the discounted marginal value of its product [15].

CASE of Southern Branch of National Palace Museum

In this section, we introduced the National Palace Museum (NPM) and Southern Branch of the National Palace Museum (SBNPM), data sources came from the website www.south.npm.gov.tw. The NPM located in Taipei and SBNPM located in Taibao, Taiwan, have a permanent collection of ancient Chinese imperial artifacts and artworks. The NPM is actively promoted as tourism attractions in tourism-related promotional materials and successfully attracted visitors from all over the world. To achieve cultural equality between the northern and the southern regions of Taiwan, the Executive Yuan approved the Southern Branch of the National Palace Museum (SBNPM, referred to as the “Southern Branch Museum”) at Taibao, Chiayi County on Dec.31, 2004, positioning the museum as "an Asian art and Culture Museum". The SBNPM aims to "Focus on Asia" and to "Broaden Perspectives", striving to exhibit the cultural concepts and artistic accomplishments of Asia through interacting with overseas museum regarding exhibitions, research, preservation and maintenance paradigms.

From the SBNPM website showed that December 10, 2016 to March 5, 2017, the SBNPM launched “Japanese Art at Its Finest: Masterpieces from the Tokyo and Kyushu National Museums,” it was the finest exhibition of Japanese masterpieces with the largest scale that Taiwan has ever held. On July 3, 2017, the Southern Branch of the National Palace Museum signed an official memorandum of understanding for cooperation with Asian Art Museum of San Francisco. In order to achieve the mission of cultural equity between the NPM and SBNPM, the SBNPM continue to promote cultural diversity in Asia.

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NPM website showed the number of visitors went to the NPM in 2022 were 557,288, went to the SBNPM were 393,666. Figure 1 illustrates each month of visitors went to the NPM and SBNPM in 2022. Visitors went to the museum in January to February, July to August and November to December were the increased situation. In those periods were represented respectively Taiwan Lunar New Year, summer vacation and glorious December Festival. As shown in Figure 1, owing to the pandemic COVID-19 in 2022, there was no visitor to SBNPM in July to October. Silberberg (1995) found that museum visitors tend to be people with high education and income, the majority visitors tend to be seniors. Especially, schools arrange museum trips for their students during the week, on weekends, family groups are the main portion of visitors. Visitors are more interested in high quality, understandable and emotional experiences. In 2012, the NPM cooperated with Taoyuan International Airport to increase international visibility through the “Future Museum” exhibition which utilizes 3D display and interactive technologies for international visitors. The NPM intended to optimize digital access, NPM iPalace Channel is the cloud multimedia platform which tries to stimulate public activity in both the physical and digital dimensions of the museum.

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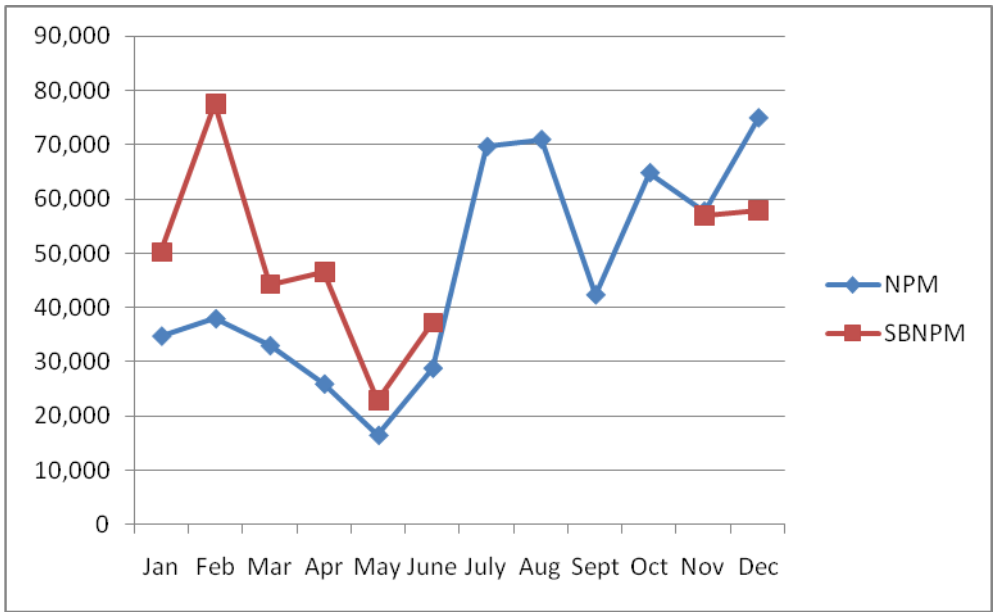

Figure 1. No. of Visitors Went to the NPM and SBNPM in 2022

CONCLUSION

Sustainable investments are necessary to improve economies, societies, and environments in global communities. Many corporations make effort to invest in ESG. However, how to evaluate the relevant performance after these investments is an issue that corporations must consider. Tanaka (2020c) investigates the model of multi-stakeholders to improve the sustainability social and economic systems. Albuquerque et al. (2019) proposed an industrial equilibrium model that gives incentives to engage in corporate social responsibility enables companies to obtain higher marginal benefits.

The purpose of this study is to present an investment model for ESG in museum cultural products on maximize the present value of the profit stream over the operation period. The mathematical model showed that marginal cost equal to marginal revenue holds at each moment *t* of an interval on which investment is greater than zero. Over an

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interval between investment periods, the integral of discounted cost of capital employment equals the discounted marginal value of its product

The NPM located in Taipei and SBNPM located in Taibao, Taiwan, have a permanent collection of ancient Chinese imperial artifacts and artworks. NPM website showed the number of visitors went to the NPM in 2022 were 557,288, went to the SBNPM were 393,666. Owing to the pandemic COVID-19 in 2022, there was no visitor to SBNPM in July to October. Visitors went to the museum in January to February, July to August and November to December were the increased situation. The research serves not only contribute to the cultural economics literature, but also provides information to cultural authorities to make the investment strategy of cultural products.

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