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Cost-Benefit Analysis of Mixed Measurement Model

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ABSTRACT

Since the current financial reporting uses various measurement attributes for measuring assets and liabilities, it is often referred to as the "mixed measurement model." This paper addresses the issues related to why and how different measurement attributes, notably fair value and historical cost, are used in financial statements. The cost-benefit analysis is adopted as a research methodology throughout this paper by formalizing as mathematical functions the preparer's measurement cost and the users' benefits of accounting information that the preparer produces.
The cost-benefit analysis suggests that the mixed measurement model can be justified through the preparer's economic incentives for minimizing cost. It also suggests that the cost-minimization solution in the marketplace would represent a consensus among the interests of the preparer and the users within a constraint in which only one set of accounting information is provided. This paper also identifies the situations in which providing two sets of accounting information is preferable.

Key Words: Cost-benefit Analysis; Mixed Measurement Model; Fair Value; Relevance; Faithful Representation; Comprehensive Income

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1. Introduction

Since the current financial reporting uses various measurement attributes for measuring assets and liabilities in a set of financial statements, it is often referred to as the "mixed measurement model." Critics have stated that the mixed measurement model does not provide consistency of measurements in financial reporting (Barth 2007), and imposes a cost on the users of financial statements because those users are unable to identify whether a line item on the statement of financial position represents a measurement of fair value or historical cost without reading carefully the accompanying notes to the financial statements. This paper addresses the issues related to why and how different measurement attributes, notably fair value and historical cost, are used in the financial statements. This paper provides a theoretical framework for the selection of fair value and historical cost in measuring assets and liabilities.

From time to time, accounting standard-setters, including the U.S. Financial Accounting Standards Board (FASB) and the International Accounting Standards Board (IASB), have attempted to enhance consistency in financial reporting. For example, the asset and liability view (FASB 1976) was adopted to provide a consistent set of the definitions of the elements of financial statements (FASB 1985; IASC 1989). Although this view successfully has eliminated the items that do not meet the definitions of assets and liabilities from the statement of financial position, it seems that the view still does not provide a consistent basis for the measurement of those elements.

During the late 1990s and the 2000s, the standard-setters tried to introduce fair value accounting for all financial assets and liabilities, stating that it is an ultimate goal for them (for example, FASB 1998; IASB 2008). However, even for financial assets and liabilities, fair value would not likely be a single measurement attribute in practice currently and in the foreseeable future (IASB 2010a; FASB 2013).

The selection of measurement attributes for assets and liabilities has an effect on determination of income. Generally, if an asset or liability is measured at fair value, the change in fair value should be recognized through net income (profit or loss) for the period. If an asset or liability is measured at historical cost, any change is not recognized until that item is removed from the statement of financial position unless the transaction price is systematically allocated.

Measuring assets and liabilities at any attribute imposes a cost upon a reporting entity. Although such a measurement cost may be ignorable for some assets and liabilities, it would be enormous for others. For example, measuring real estates or intangible assets at fair value would require the entity to spend costs for training its employees or hiring an outside expert. The benefits that users gain from accounting information should also be considered to determine the optimal accounting policies in a social context. In this paper, the cost-benefit analysis is adopted as a research methodology by formalizing as mathematical functions the preparer's measurement cost and the users' benefits of accounting information that the preparer produces.

The cost-benefit analysis was developed originally in economics and has become one of the most popular theoretical methods of analysis in other social science disciplines (Layard and Glaister 1994, 1–56). It has also been applied to accounting research, especially in the agent-principal setting. In accounting standard-setting, the balance between cost and benefit is often mentioned as a constraint for developing accounting standards for specific issues. For example, the IASB's and the FASB's conceptual frameworks treat the cost constraint on reporting certain information as a factor that should be justified by the benefits of reporting that information (IASB 2010b and FASB 2010a, QC35–39). However, the cost-benefit analysis in accounting standard-setting does not seem to be consistently applied, partly because it is difficult to formalize the cost and benefit functions that reflect differences in accounting policies.

The cost-benefit analysis is a tool for solving economic problems that are subject to given constraints. If there was no constraint, the preparer could produce limitless volumes of information and the users could utilize such information without considering any cost of interpretation. However, in the real world, accounting always faces cost-benefit issues, which are often described as the tradeoffs between different objectives. For example, Dye and Sridhar (2004) focuses on the aggregation of information, which is treated as a constraint, and clarifies that it creates tradeoffs between reliability and relevance.

The cost-benefit analysis suggests that the mixed measurement model can be justified by the preparer's economic incentives for minimizing measurement cost. It also suggests that the users' benefits from relevance and faithful representation would affect the optimal scope of fair value measurement, and the solution in the marketplace would represent a consensus among the interests of the preparer and the users within the constraint of the single criterion regime, where only one set of the scope of fair value measurement is selected. Next, the analysis is extended to the multiple criteria regime, where two sets of the scopes of fair value measurement are selected. This paper identifies situations in which the multiple criteria regime is preferable in terms of achieving a more cost-saving solution in the marketplace as a whole.

The paper proceeds as follows. In the next section, I review recording systems in accounting and typical accounting measurements, including historical cost and fair value. I also review the static and dynamic descriptions of firm value and discuss how accounting numbers are related to those descriptions. In section 3, I develop a framework for the cost-benefit analysis of the mixed measurement model by formalizing the preparer's cost and the users' benefits. In section 4, the constraint is relaxed to the multiple criteria regime, and I discuss how and in what condition the multiple criteria should be adopted. Section 5 concludes the paper.

2. Accounting and Firm Valuation

2.1 Accounting Measurements: Historical Cost and Fair Value

Broadly stated, accounting has two different recording systems for the economic activities of an entity. Firstly, the activities of an entity are generally recorded when transactions occur. Transactions are easily observable by a measurer because, in a transaction, one party exchanges goods or services with another party, where the transaction price is clearly stated in monetary terms. Accounting uses the identification of goods or services exchanged and the monetary unit stated in the transaction price for recording that transaction in double-entry bookkeeping. Such a transaction-based recording system is discrete because nothing is recorded until the next transaction actually occurs. This system also leads inevitably to delayed recognition and causes conservatism (Beaver and Ryan 2000). Secondly, certain events related to an entity are recorded when such events occur, even though they are not transactions between parties. For example, as the market price of a certain asset changes, accounting might record such changes even though the entity does not transact anything with the other party. Such event-based recording system is continuous, at least conceptually, because the events (e.g. price movements) occur continuously and could be recorded continuously.

Those two recording systems would lead to the use of different measurements. In current practice, a variety of measurement attributes are utilized. Examples include historical cost, depreciated cost, amortized cost, fair value, current cost, net selling price, net realizable value, present value of future cash flows, value in use, and so on.

In this paper, accounting measurement attributes are considered to be broadly categorized into historical cost measures and current value measures. Historical cost measures are the measures that are produced based on historical transaction data, which includes depreciated or amortized costs that utilize historical transactions data and a systematic periodic allocation. Current value measures are measures that are produced based on the current market or entity-specific data at the measurement date, where historical transaction data are ignored. Current value measures include fair value, which uses current data that is agreed upon by the market participants, and value in use (or entity-specific value), which uses current data that is specific to the reporting entity itself (FASB 2000). In this paper, I focus on fair value in comparison with historical cost, because fair value is widely used for measuring assets and liabilities in practice by allowing the measurer to consider not only observable market data but also his or her assumptions about the market participant's view. I avoid using value in use in the analysis, because it is based on the measurer's own assumptions about the entity's usage of the asset, which could make the value more subjective. More importantly, since value in use could be interpreted as the joint value of the asset in question and its related intangibles, it would not be appropriate to assign such a joint value solely to that asset by ignoring the contribution by the related intangibles.

Each of two recording systems has a preference in terms of selecting accounting measurement attributes. The discrete recording system is more consistent with historical cost, because the system leaves the carrying amount of an asset or liability unchanged until the consequent transaction occurs. Conversely, the continuous recording system is more consistent with fair value, because the carrying value of an asset or liability can be tracked with movements in fair value even before the consequent transaction occurs.

2.2 Static and Dynamic Descriptions of Firm Value

In this paper, I extended the framework presented by Hitz (2007, 336–338). The firm value of an entity can be described in a static manner as the sum of the fair values of N positions of assets at date t, which include identifiable assets as well as unidentifiable (not separable) assets. To obtain fair values of unidentifiable assets, a complete market is assumed conceptually as a starting point. Liabilities are treated as the assets whose values are negative hereafter in this paper. By setting the identifiable assets to have M positions ($M \leq N$), the remaining unidentifiable assets are supposed to have $N - M$ positions.

In a more formal manner, the firm value of the entity at date t, denoted as V_t, can be expressed as

$$V_t = \sum_{i=1}^{N} FV_{i,t} = \sum_{i=1}^{M} FV_{i,t} + g_t \tag{1}$$

Here, $FV_{i,t}$ denotes the fair value of asset i ($i \in$ natural numbers) at date t, and g_t denotes the value of goodwill at date t. This expression of firm value is static, because all variables are the value at the same date t. If V_t is separated into the sum of the fair values of identifiable assets and the goodwill, the value of the goodwill g_t represents the sum of the fair values of the unidentifiable assets ($\sum_{i=M+1}^{N} FV_{i,t}$).

Alternatively, V_t can be expressed as the sum of the values in use of all identifiable assets (Barth and Landsman 1995, 101), as

$$V_t = \sum_{i=1}^{M} VIU_{i,t} = \sum_{i=1}^{M} FV_{i,t} + g_t \quad (2)$$

Here, $VIU_{i,t}$ denotes the value in use of asset i at date t. Again, if the V_t is separated into the sum of the fair values of identifiable assets and the goodwill, the value of the goodwill g_t should represent the sum of the differences between the value in use and the fair value of each identifiable asset, which is generally termed as the present value of the entity's excess earnings power ($\sum_{i=1}^{M}(VIU_{i,t} - FV_{i,t})$). The value in use is fundamentally determined by discounting the future cash flows that are generated by the usage of each asset. The future cash flows are often estimated as a joint product of the usage of an asset group. If we estimate the future cash flows that are generated by the usage of all assets of the entity, we can determine V_t as a discounted value of the future cash flows. When the cash flow expected at date t that the firm would generate at the end of period $t + \tau$ is denoted as $E_t[CF_{t+\tau}]$ and the cost of capital is denoted as k (assumed constant), V_t can be expressed as

$$V_t = \sum_{\tau=1}^{\infty} \frac{E_t[CF_{t+\tau}]}{(1+k)^{\tau}} \quad (3)$$

Such an expression of the firm value is dynamic in the sense that the value is described by a series of variables at different dates in the future.

Next, according to many researchers (for example, Feltham and Ohlson 1995; Barker 2010), an entity's activities are generally categorized into two types of activities for valuation purposes: financing activities and operating activities. In this paper, I would like to make rather a broad interpretation that operating activities produce joint cash flows by business unit comprised of identifiable and unidentifiable assets, whereas financing activities produce cash flows independently through the utilization or disposition of each asset. I assign L positions of financing assets ($L \leq M \leq N$) to the financing activities. For financing assets, no goodwill is involved because the financing assets yield gains through the marketplace, independently from the entity's other assets (especially, knowledge and other intangibles). Therefore, the value of financing activities equals to the sum of the fair values of financing assets.

On the other hand, the remaining $M - L$ positions of operating assets (assets $(L + 1)$ through M) are assigned to the operating activities. Inevitably, operating assets involve goodwill, which is depicted here as differences between the value in use and the fair value of operating assets. The value of the operating activities as a whole is not expressed by the sum of the fair values of operating assets, but rather it is expressed by the present value discounted at k of the cash flows $E_t\left[CF_{L+1,t+\tau}^{M}\right]$ that are expected at date t that the entity would generate at the end of period $t + \tau$ from its operating activities that are comprised of the assets $(L + 1)$ through M. The firm value at date t is described as

$$V_t = \sum_{i=1}^{L} FV_{i,t} + \sum_{\tau=1}^{\infty} \frac{E_t[CF_{L+1,t+\tau}^{M}]}{(1+k)^{\tau}} \quad (4)$$

Estimates of future cash flows are anchored to how well the operating assets are grouped into business units. Therefore, determining L out of N positions influences the users' ability to project the future cash flows expected to be generated by the operating assets. Because the cash flows are generated jointly by utilizing a group of assets, estimating the cash flows is more difficult if the group of assets is inconsistent with the management's view on the grouping.[1]

Two terms of the firm value in equation (4) have different properties in terms of the accounting information and its usage by its users.[2] The first term, the value of financing activities, can be provided directly as part of the accounting information, if the financing assets are carried at fair value on the statement of financial position. The second term, the value of operating activities, is not provided directly by accounting. Rather it is estimated by users who read accounting information about the operating activities, as implied by the expected value $E_t[\cdot]$. That accounting information is often characterized by accounting stocks and flows together in a persistent way in which the users would find them useful in estimating a series of future cash flows.

3. Cost-Benefit Analysis of Accounting Measurements

3.1 Minimization of the Preparer's Measurement Costs

As I discussed in the previous section, accounting measures are grouped into the two categories of historical cost and fair value, which concur with discrete recording and continuous recording, respectively. Therefore, the determination of the scope of assets measured at fair value would broadly determine the accounting policies of an entity. For a perspective of firm valuation, L positions of financing assets would be a promising alternative for a scope of fair value measurement. Theorists may contend that M positions of identifiable assets should be measured at fair value. However, as is often observed in the standard-setting process, the preparers necessarily agree neither on categorizing their activities into financing activities and operating activities (FASB 2008) nor on measuring all financing assets at fair value. In order to observe the preparers' incentives, I would like to develop a framework for the cost-benefit analysis of the selections of accounting policies, focusing on the determination of the scope of assets that are measured at fair value.

To neutralize the size of the firms, I divide the positions of the assets by N and put the quotients on the horizontal axis.[3] I thereby obtain $\frac{N}{N} = 1$, $\frac{M}{N} = m$, and $\frac{L}{N} = l$, each of which expresses certain percentage of positions in proportion to all asset positions of the entity ($0 \leq l \leq m \leq 1$). The vertical axis represents the measurement costs to produce certain accounting information in any common scale (possibly, in a dollar amount).

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1 However, it should be also noted that the basis of grouping is not limited to L, as long as the cash flows from the group of assets that are not measured at fair value can be estimated. For example, if the J positions of assets ($J \leq M \leq L$) are measured at fair value, CF_{J+1}^{M} should be estimable for valuation purposes.

2 For example, Holthausen and Watts (2001) states that value relevance studies appear to use two different theories: direct valuation theory and inputs-to-equity valuation theory. The former would concur with the first term and the latter would concur with the second in equation (4).

3 In the previous section, "positions" could be defined as any physical or monetary units as longs as the fair value and the value in use are attributable to each of them. Technically, in this section, positions should be defined more narrowly, in order to describe the behavior of certain cost as a linear function based on the positions. For example, they can be defined in terms of monetary units based on initial acquisition costs.

Then, I define a θ $(0 \leq \theta \leq 1)$ as the scope of fair value measurements. The remaining $1-\theta$ represents the scope of historical cost measurements. Assume that the costs change continuously for θ, so that the costs can be differentiated on θ. The measurement costs in this analysis include various direct and indirect costs in the entity's departments of accounting, internal control, and other functions that are necessary to measure the assets at a certain attribute and apply the related accounting policies to them. Any constant measurement costs against θ are ignored because they are indifferent in solving the cost minimization problem, although the total of constant and variable costs should be overcome by the potential total benefits.

The cost of fair value measurement changes depending on the scope of fair value measurement, θ, and therefore it can be expressed as a function of θ, which is denoted as $CFV\ (\theta)$. The cost of historical cost measurement changes depending on the remaining scope of historical cost measurement $1-\theta$, and therefore it can also be expressed as a function of θ, which is denoted as $CHC(\theta)$. The total cost of the measurement is denoted as $TC(\theta)$. Assuming $\alpha > 0$ and $\beta \geq 0$, those cost functions can be defined as

$$CFV(\theta) = \alpha\theta^2 \tag{5a}$$

$$CHC(\theta) = \beta(1-\theta) \tag{5b}$$

$$TC(\theta) = CFV(\theta) + CHC(\theta) = \alpha\theta^2 + \beta(1-\theta) \tag{5c}$$

In those settings, some strong assumptions are introduced. For the cost of fair value measurement, it would be acceptable to assume that that cost for each asset position would be different,[4] and that $CFV'(\theta) > 0$ and $CFV''(\theta) > 0$ when asset positions are sorted in ascending order of the measurement cost. For the sake of simplicity, the measurement cost of fair value is described as a quadric function, in which the cost increases more steeply as θ increases toward one. The parameter α is the measurement cost incurred when $\theta = 1$ (all asset positions are measured at fair values) and can be seen as the cost indicator of fair value measurement. Historical cost is defined rather broadly in this analysis as transaction-based measurements, including zero measurement (immediate expensing), depreciated or amortized cost, as well as original transaction price. For the sake of simplicity, the cost function of historical cost measurement is described as a linier function, which has a property that $CHC'(\theta) \leq 0$ and $CHC''(\theta) = 0$. The cost of historical cost measurement would likely decrease at a more stable proportion per position, because entities use transaction data for historical cost measurement similarly for each asset position. The parameter β is the measurement cost incurred when $\theta = 0$ (when all asset positions are measured at historical costs), and can be seen as a cost indicator of historical cost measurement.

The theories of firm valuation indicate that clean surplus accounting may result in the same value regardless of differences in accounting policies (Peasnell 1982; Ohlson 1995). As a first step, here I assume that the users enjoy the same benefit regardless of θ (i.e. I ignore the difference in the users' benefits regarding θ). In this setting, the preparer would select a certain θ that minimizes his or her total measurement cost.

[4] Fair values of asset positions are supposed to be measured in a certain frequency (e.g. daily, weekly, or monthly).

Therefore, the optimal scope of fair value measurement for the preparer, denoted as θ^*, is determined by solving the problem for θ to

$$\text{Minimize } TC(\theta) = \alpha\theta^2 + \beta(1-\theta)$$
$$\text{Subject to } 0 \leq \theta \leq 1. \tag{6}$$

Solving this problem, we obtain

$$\theta^* = \begin{cases} \frac{\beta}{2\alpha}, \text{when } \beta < 2\alpha \\ 1, \text{when } \beta \geq 2\alpha. \end{cases} \tag{7}$$

Except for the extreme case where $\beta \geq 2\alpha$, the result tells us that θ^* becomes larger as β becomes larger, and that θ^* become smaller as α becomes larger. More importantly, the result indicates that, except for certain limited cases, the preparer has an economic incentive to adopt the "mixed measurement model," in which both fair value and historical cost are used in the same set of financial statements ($0 < \theta^* < 1$).

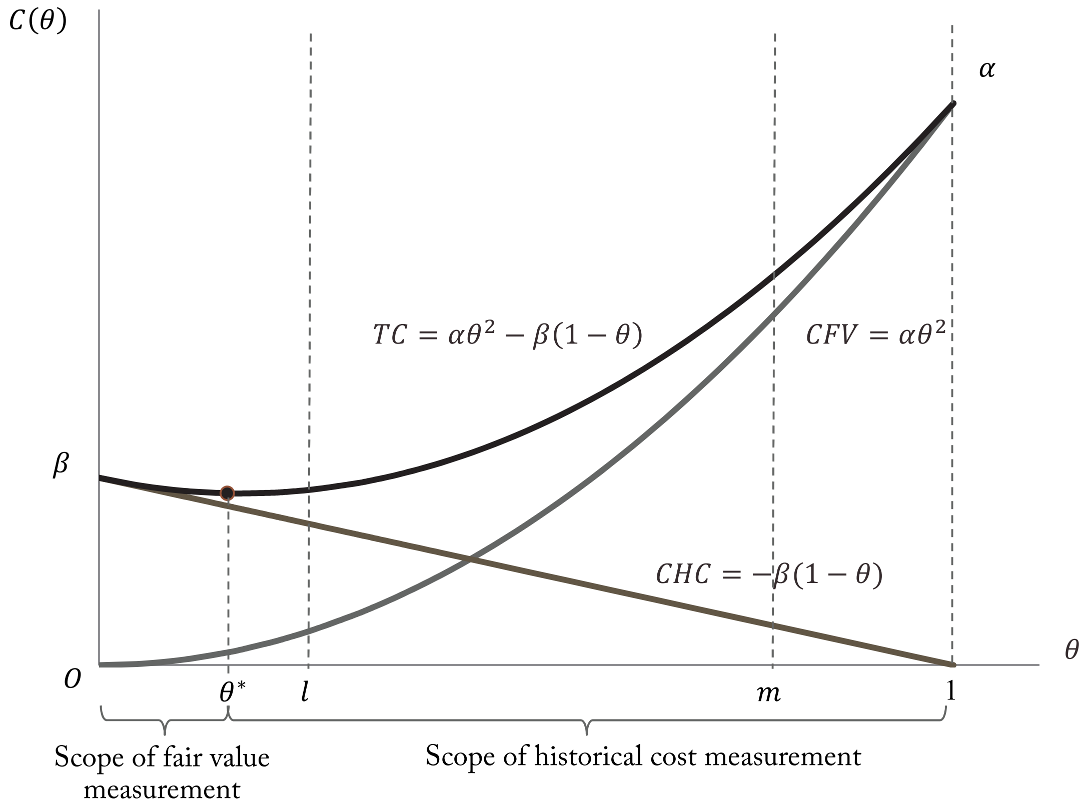
In order to confirm this, it would be useful to review the conditions for two extremes: the full historical cost accounting and the full fair value accounting. Firstly, the full historical cost accounting, in which all assets are measured at historical cost, is described as $\theta^* = 0$. Since $\alpha > 0$ is assumed, β should be zero. $\beta = 0$ means that the measurement cost of historical cost is indifferent regardless of θ. It could happen when every transaction is recorded at historical cost anyway for the purpose of managing and safeguarding the entity's assets. Secondly, the full fair value accounting, in which all assets are measured at fair value, is described as $\theta^* = 1$. To achieve this, $\beta \geq 2\alpha$ is required. Since this condition seems unrealistic, the full fair value accounting would not likely be the preparer's voluntary choice.

Figure 1 demonstrates how the optimal solution θ^* is determined. θ^* represents the scope of fair value measurement in which the total cost is minimized, and $1 - \theta^*$ represents the scope of historical cost measurement at the cost minimization. As Figure 1 suggests, the mixed measurement model is justified from a perspective of cost-benefit analysis insofar as the total cost function is convex downwardly for $0 \leq \theta \leq 1$.

It is also noteworthy that θ^* is determined independently from l or m ($l \neq \theta^*$; $m \neq \theta^*$) because it is determined solely by the preparer's incentive for cost minimization. Especially, this result indicates that the incentives for fair value measurement for financing assets are not predetermined. Some entities might not want to measure certain financing assets at fair value, if $\theta^* < l$. Others would be motivated to measure more assets at fair value beyond the scope of financing assets, if $l < \theta^*$. For those entities, the fair value option in the existing practice seems to accommodate their needs for measuring more assets at fair value, resulting in assisting their cost minimizations.

If only identifiable assets are measured at fair value ($\theta = m$), the total cost of measurement $TC(m)$ is usually smaller than the total cost of fair value measurement for all assets ($TC(m) < TC(1) = \alpha$) as long as $\theta^* = \frac{\beta}{2\alpha} < \frac{m+1}{2}$. If α is small enough to assure $\theta^* = \frac{\beta}{2\alpha} > \frac{m}{2}$ for certain

FIGURE 1: THE PREPARER'S COST MINIMIZATION



entities (for example, certain financial institutions), the total cost of fair value measurement for all identifiable assets might be smaller than the total cost of historical cost measurement for all assets ($TC(0) = \beta > TC(m)$). Especially, if $\theta^* \geq m$, the fair value accounting for all identifiable assets is supported.

3.2 Incorporating the Users' Benefits into the Analysis

The analysis in the previous section has not considered the users' benefits, or, stated differently, has considered that the users' benefits as a constant regardless of θ. Here, I would extend the framework of cost-benefit analysis so that the preparer's costs of measurement and the users' benefits from the usage of information are both considered. The users' benefits would include, but not limited to, improvements over the users' estimates for firm valuation. It would be reasonable to assume that the users' benefits vary depending on θ. I discuss the behavior of the users' benefits from two different viewpoints: relevance and faithful representation.

3.2.1 Relevance

When contending that the fair values have relevance to the user's firm valuation, such relevance works directly to the users' valuation in a sense that one unit increase in the fair value of an asset would lead to an increase in the firm value by the same amount as was discussed in the static description of firm value. Although in the IASB's and the FASB's conceptual frameworks, relevance itself is interpreted more broadly as the capability of making a difference in the decisions made by users (IASB 2010b and FASB 2010a, QC6–10), I use the term *relevance* in a narrower sense as a quality that helps the users evaluate the firm value more directly as discussed above. Such relevance is generally observed in the fair value measurements of financing assets because changes in fair value have a direct impact on the firm value. Therefore, the benefit function of the relevance by fair value measurement $BR(\theta)$ can be formalized as

$$BR(\theta) = \gamma\theta. \tag{8a}$$

Where γ is a benefit per position that the users enjoy when they obtain the information about fair value $(\gamma \geq 0)$. A linear relationship (i.e. $BR'(\theta) \geq 0$ and $BR''(\theta) = 0$) can be assumed, because incremental information about fair value would give the users a chance to revise their valuation equally for each asset position from a static view of the firm value.

3.2.2 Faithful Representation

Although the wider use of fair value measurement would likely serve the users more, some might argue that it might impair the users' ability to estimate the firm's future cash flows. This holds especially true when measuring certain components in the group of operating assets at fair value, which would not help the users estimate the future cash flows from the operating activities because the cash flows are generated as a joint product of the group of operating assets, including unrecognized intangibles. The group of operating assets should be accounted for as a cash generating unit, and it would be better that each component asset is accounted for in a consistent manner within the group. Moreover, others might argue that measuring certain assets at fair value would introduce additional uncertainty in financial reporting (Landsman 2007) especially when measuring the assets whose fair value is costly to measure. Such uncertainty in measurement would impose more cost upon the users, because the users would have to adjust for the uncertainty in estimating the future cash flows. On the other hand, measuring financing assets at fair value would not be problematic in terms of difficulty in estimating the future cash flows or uncertainty in measuring the fair values. Rather, the users would be better served if more financing assets are measured at fair value.

I would use the term *faithful representation* to describe such behavior of the users' benefits in relation to θ, because the financial statements would be most faithfully represented when the financing assets and operating assets are measured in concurrence with the economic usages of them by the entity. More specifically, the users' benefits of faithful representation would be maximized if $\theta = l$, where all financing assets are measured at fair value and all operating assets are measured at historical cost, respectively. As θ moves away from l, the benefits will decrease. In this paper, I assume that the benefits decrease along with the product of a constant δ $(\delta \geq 0)$ and the square of the difference between θ and l. Therefore, the function of the users' benefits of faithful representation $BFR(\theta)$ can be expressed as

$$BFR(\theta) = -\delta(\theta - l)^2. \tag{8b}$$

When $\theta < l$, a marginal increase in the scope of fair value measurement would increase the users' benefit of faithful representation (i.e. $BFR'(\theta) \geq 0$). Conversely, when $\theta > l$, a marginal increase in the scope of fair value measurement would decrease the users' benefit of faithful representation (i.e. $BFR'(\theta) \leq 0$). In order to formalize the benefit of faithful representation, a quadric function is used in this analysis, because the errors in the users' projecting the entity's future cash flows or the errors in the preparer's measuring the fair values would likely impose a cost that increases in proportion to the square of the distance between θ and l. δ can be interpreted as another cost indicator that stems from faithful representation.

The IASB's and the FASB's conceptual frameworks give faithful representation a prestige of fundamental qualitative characteristics. They state that useful financial information should faithfully represent the phenomenon that it purports to represent, and that a depiction should be complete, neutral, and free from error to be a perfect faithful representation (IASB 2010b and FASB 2010a, QC12–QC16). That explanation does not define the benefit functions specifically, but at least it seems to be consistent with the terminology in this paper because financing assets and operating assets are both accounted for in accordance with the usages of the assets.

Then, we obtain a total benefit function $TB(\theta)$ as

$$TB\ (\theta) = BR(\theta) + BFR(\theta) = \gamma\theta - \delta(\theta - l)^2. \tag{8c}$$

To obtain a cost minimization in the marketplace as a whole, we have to define a net total cost function $NTC(\theta)$ by subtracting the total benefit from the total cost, such as

$$NTC(\theta) = TC(\theta) - TB(\theta) = \alpha\theta^2 + \beta(1 - \theta) - \gamma\theta + \delta(\theta - l)^2. \tag{9}$$

In order to find the optimized scope of fair value measurement in the marketplace, which is denoted as θ^{**}, we should solve the problem for θ to

$$\begin{aligned} &\text{Minimize } NTC(\theta) = \alpha\theta^2 + \beta(1 - \theta) - \gamma\theta + \delta(\theta - l)^2 \\ &\text{Subject to } 0 \leq \theta \leq 1. \end{aligned} \tag{10}$$

As is demonstrated in economics, it would be beneficial to discuss the problem in terms of marginal cost and benefit. The functions of marginal total cost and marginal total benefit, which are denoted as $MTC(\theta)$ and $MTB(\theta)$ respectively, are obtained by differentiating the functions of total cost and total benefit, as shown in equations (5c) and (8c), on θ as

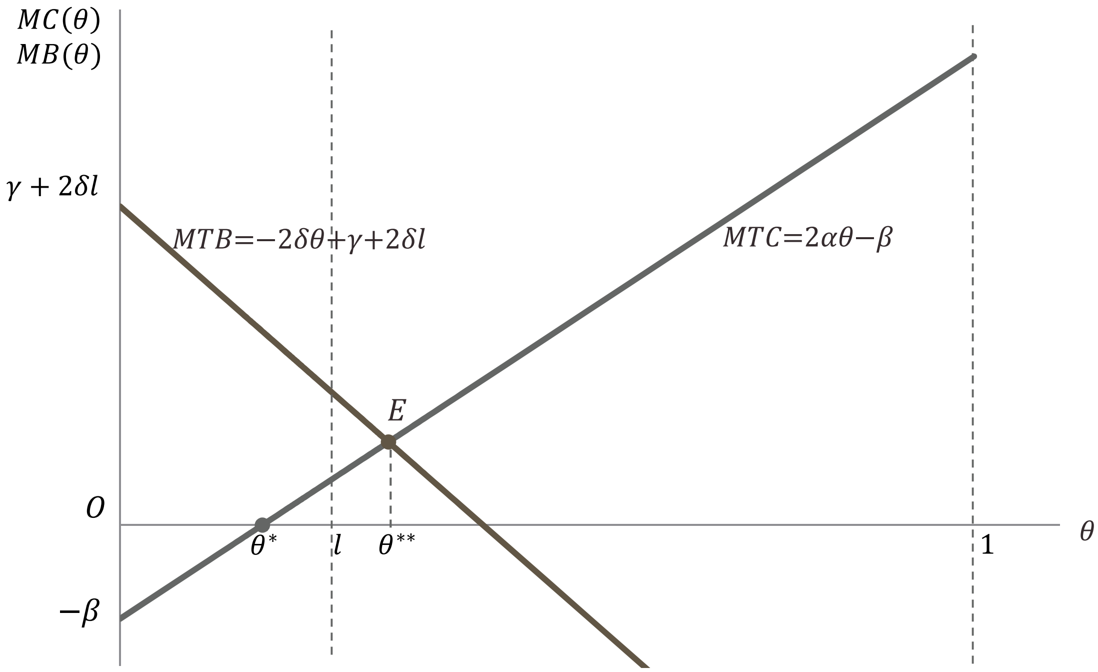
$$MTC(\theta) = \frac{dTC(\theta)}{d\theta} = 2\alpha\theta - \beta \tag{11}$$

$$MTB(\theta) = \frac{dTB(\theta)}{d\theta} = -2\delta\theta + \gamma + 2\delta l. \tag{12}$$

At the optimized scope of fair value measurement θ^{**} in the marketplace as a whole, the $MTC(\theta^{**})$ and $MTB(\theta^{**})$ should concur with each other. Then, we obtain θ^{**} as

$$\theta^{**} = \begin{cases} \frac{\beta + \gamma + 2\delta l}{2(\alpha + \delta)}, \text{ when } \beta + \gamma + 2\delta l < 2(\alpha + \delta) \\ 1, \text{when } \beta + \gamma + 2\delta l \geq 2(\alpha + \delta). \end{cases} \tag{13}$$

FIGURE 2: THE MARGINAL TOTAL COST AND THE MARGINAL TOTAL BENEFIT



Since $\beta + \gamma + 2\delta l \geq 0$ and $\alpha + \delta > 0$, always $\theta^{**} \geq 0$. However, when $\beta + \gamma + 2\delta l \geq 2(\alpha + \delta)$, θ^{**} should remain one.

Figure 2 illustrates the functions of MTC and MTB, and shows an intersection point E, at which the values of the two functions concur with each other and the net marginal cost is zero. The optimal solution $\theta^{**} = \frac{\beta+\gamma+2\delta l}{2(\alpha+\delta)}$ is the abscissa at E. If we ignore the users' benefit ($\gamma = 0, \delta = 0$), the solution θ^* is shown as the intersection point of MTC and the horizontal axis. It should be noted that $\theta^{**} \neq \theta^*$, unless $\gamma = 0$ and $\delta = 0$. This suggests that the preparer would have to adopt the scope of fair value measurement that is different from the scope of its own cost minimization. Therefore, some sort of regulation is necessary to require the preparer to adopt the scope of fair value measurement that realizes the cost minimization in the marketplace.

Figure 2 also demonstrates that as α (cost indicator of fair value measurement) becomes larger, MTC should shift upward with steeper inclination, letting θ^{**} become smaller. As β, γ, or l becomes larger, θ^{**} should become larger. As for δ, the effect is mixed because the change in δ changes both of the intercept and the inclination of MTB at the same time.

4. The Multiple Criteria Regime

So far, the framework of the cost-benefit analysis has provided a single optimal solution of measurement criterion for $0 \leq \theta \leq 1$. A θ can be interpreted as an overall accounting criterion, because it determines the scope of fair value measurement and, accordingly, the scope of historical cost measurement, defining broadly other related accounting policies. As only one θ is determined in the previous section, we could say that that framework belongs to the single criterion regime. In that regime, we have to consider all the factors that affect the cost-benefit analysis to find an optimal single criterion. As a result, an optimized solution would be achieved as a consensus among the participants in the marketplace.

In this regard, one might argue that we could set forth more than one measurement criteria and require the preparer to disclose more than one set of accounting information. The multiple criteria regime might enhance the users' benefits because different users have different interests and those different interests could be served better with multiple sets of accounting information. Of course, any increase in the preparer's measurement cost by adopting the multiple criteria regime should be considered.

A typical discussion of the multiple criteria regime can be found in AAA (1966), which recommends that two sets of information of historical costs and current values be provided to accommodate the various needs for information of various stakeholders. Also, FASB (2010b) once proposed that both amortized cost and fair value would be presented on the face of the statement of financial position for certain financial instruments. Another discussion can be found in the standard-setting for reporting of financial performance. One of the most controversial issues in reporting financial performance is whether one or two summary result(s) of financial performance should be disclosed; i.e. whether only comprehensive income should be displayed or a pair of net income (profit or loss) and comprehensive income should be disclosed. Net income and comprehensive income are determined based on two different criteria for the scope of fair value measurement. When the changes in fair value of certain investments are recognized through other comprehensive income, such changes are not recognized in net income as if the investments were measured at historical cost, although they are actually measured at fair value on the statement of financial position. In this sense, two different criteria are applied to the reporting of financial performance, although this is less obvious than in the proposals by AAA (1966) and FASB (2010b).

To perform a cost-benefit analysis in the multiple criteria regime, I assume that a pair of two θs (θ_x, θ_y) can be selected (assume $0 \leq \theta_x \leq 1; 0 \leq \theta_y \leq 1;\ \theta_x \leq \theta_y$) in a manner in which the net cost in the marketplace is minimized. Because two different scopes of fair value measurement are selected, the asset positions that fall in the difference between two scopes should be measured at historical cost by the first criteria and at fair value by the second criteria.

As $\theta_x \leq \theta_y$, the maximum scope of fair value measurement is θ_y, which determines the cost of fair value measurement. Also, as $1-\theta_x \geq 1-\theta_y$, the maximum scope of historical cost measurement is $1-\theta_x$, which determines the cost of historical cost measurement. Therefore, the preparer's cost functions in (θ_x, θ_y) space are redefined as

$$\text{Measurement cost of fair value: } CFV(\theta_x, \theta_y) = \alpha\theta_y^2 \tag{14a}$$

$$\text{Measurement cost of historical cost: } CHC(\theta_x, \theta_y) = \beta(1-\theta_x) \tag{14b}$$

$$\begin{aligned}\text{Total measurement cost: } TC(\theta_x, \theta_y) &= CFV(\theta_x, \theta_y) + CHC(\theta_x, \theta_y) \\ &= \alpha\theta_y^2 + \beta(1-\theta_x).\end{aligned} \tag{14c}$$

Next, we have to formalize the users' benefit in (θ_x, θ_y) space. As $\theta_x \le \theta_y$, the users use θ_y as the criterion for relevance. In terms of faithful representation, θ_x should be used for the analysis that is specific in the multiple criteria regime.[5] Thus, the users' benefit functions are redefined as

$$\text{Benefit from relevance: } BR(\theta_x, \theta_y) = \gamma\theta_y \tag{15a}$$

$$\text{Benefit from faithful representation: } BFR(\theta_x, \theta_y) = -\delta(\theta_x - l)^2 \tag{15b}$$

$$\begin{aligned}\text{Total benefit: } TB(\theta_x, \theta_y) &= BR(\theta_x, \theta_y) + BFR(\theta_x, \theta_y)\\ &= \gamma\theta_y - \delta(\theta_x - l)^2.\end{aligned} \tag{15c}$$

From equations (14c) and (15c), the net total cost function in the marketplace in the multiple criteria regime is formalized as

$$\begin{aligned}TNC(\theta_x, \theta_y) &= TC(\theta_x, \theta_y) - TB(\theta_x, \theta_y)\\ &= \alpha\theta_y^2 + \beta(1 - \theta_x) - \gamma\theta_y + \delta(\theta_x - l)^2\end{aligned} \tag{16}$$

We have to solve the problem for (θ_x, θ_y) to

$$\begin{aligned}&\text{Minimize } TNC(\theta_x, \theta_y) = \alpha\theta_y^2 + \beta(1 - \theta_x) - \gamma\theta_y + \delta(\theta_x - l)^2\\ &\text{Subject to } \theta_x < \theta_y.\end{aligned} \tag{17}$$

The critical point of $NTC(\theta_x, \theta_y)$ in (θ_x, θ_y) space is determined by differentiating $NTC(\theta_x, \theta_y)$ on θ_x and θ_y, respectively, as

$$\begin{cases}\dfrac{\partial NTC(\theta_x,\theta_y)}{\partial\theta_x} = -\beta + 2\delta\theta_x - 2\delta l = 0\\ \dfrac{\partial NTC(\theta_x,\theta_y)}{\partial\theta_y} = 2\alpha\theta_y - \gamma = 0.\end{cases} \tag{18}$$

Therefore, the critical (minimum) point (θ_x^*, θ_y^*) is obtained as

$$(\theta_x^*, \theta_y^*) = \left(l + \frac{\beta}{2\delta}, \frac{\gamma}{2\alpha}\right). \tag{19}$$

Since the condition for (θ_x^*, θ_y^*) to become the optimal solution in the multiple criteria regime $(\theta_x^{**}, \theta_y^{**})$ is $\theta_x^* < \theta_y^*$, the following inequality should be met as

$$l + \frac{\beta}{2\delta} < \frac{\gamma}{2\alpha}. \tag{20}$$

[5] Technically, $|l - \theta_x| < |l - \theta_y|$ is a condition for using θ_x as the criterion for faithful representation. However, if $l \le \theta_x < \theta_y$ (a condition for the multiple criteria regime as noted in the discussion about inequality (20)) is met, always $|l - \theta_x| < |l - \theta_y|$ is met.

This inequality suggests the circumstances where the multiple criteria regime would be preferable to the single criterion regime. To stay in the multiple criteria regime, l, α, and β should be smaller, and γ and δ should be larger. Inequality (20) also suggests that θ_x^* is always no less than l, because $\beta \geq 0$ and $\delta > 0$. Therefore, when inequality (20) is met, always $l \leq \theta_x < \theta_y$. This provides an interesting implication that at least all financing assets should be measured at fair value in the multiple criteria regime. The optimal solution $\left(\theta_x^{**}, \theta_y^{**}\right)$ is described as

$$\left(\theta_x^{**}, \theta_y^{**}\right) = \left(l + \frac{\beta}{2\delta}, \frac{\gamma}{2\alpha}\right), \text{when } l + \frac{\beta}{2\delta} < \frac{\gamma}{2\alpha}. \tag{21}$$

Although one might make *a priori* arguments that $\left(\theta_x, \theta_y\right)$ should be $(0,1)$, $(0, m)$, $(l, 1)$, (l, m), or (θ^*, l) in the multiple criteria regime,[6] none of them seems to be justifiable by the cost-benefit analysis.

If $\theta_x^* \geq \theta_y^*$ and $l \leq \theta_x^*$ (i.e. $l + \frac{\beta}{2\delta} \geq \frac{\gamma}{2\alpha}$), then we have to minimize the net total cost subject to $\theta_x = \theta_y$. Thus, the problem is for $\left(\theta_x, \theta_y\right)$ to

$$\begin{aligned} &\text{Minimize } NTC\left(\theta_x, \theta_y\right) = \alpha\theta_y^2 + \beta\left(1 - \theta_x\right) - \gamma\theta_y + \delta(\theta_x - l)^2 \\ &\text{Subject to } \theta_x = \theta_y. \end{aligned} \tag{22}$$

Solving this problem, we obtain the optimal solution as

$$\left(\theta_x^{**}, \theta_y^{**}\right) = \left(\frac{\beta+\gamma+2\delta l}{2(\alpha+\delta)}, \frac{\beta+\gamma+2\delta l}{2(\alpha+\delta)}\right), \text{when } l + \frac{\beta}{2\delta} \geq \frac{\gamma}{2\alpha}. \tag{23}$$

This result is consistent with the optimal solution θ^{**} in the single criterion regime as in (13), because $\theta_x = \theta_y$ actually implies the single criterion regime.

In summary, we have obtained the optimal solutions in $\left(\theta_x, \theta_y\right)$ space as

$$\left(\theta_x^{**}, \theta_y^{**}\right) = \begin{cases} \left(l + \frac{\beta}{2\delta}, \frac{\gamma}{2\alpha}\right), \text{when } l + \frac{\beta}{2\delta} < \frac{\gamma}{2\alpha} \\ \left(\frac{\beta+\gamma+2\delta l}{2(\alpha+\delta)}, \frac{\beta+\gamma+2\delta l}{2(\alpha+\delta)}\right), \text{when } l + \frac{\beta}{2\delta} \geq \frac{\gamma}{2\alpha}. \end{cases} \tag{24}$$

The discussion in cost-benefit analysis in the multiple (two) criteria regime is depicted in Figure 3. If we try to draw the net total cost functions in $\left(\theta_x, \theta_y\right)$ space, the indifferent contours of the net total cost function are drawn as a set of ellipses that have the same center of $(\theta_x^*, \theta_y^*) = (l + \frac{\beta}{2\delta}, \frac{\gamma}{2\alpha})$ as

$$\frac{\left(\theta_x - \left(l + \frac{\beta}{2\delta}\right)\right)^2}{\alpha} + \frac{\left(\theta_y - \frac{\gamma}{2\alpha}\right)^2}{\delta} = Z. \tag{25}$$

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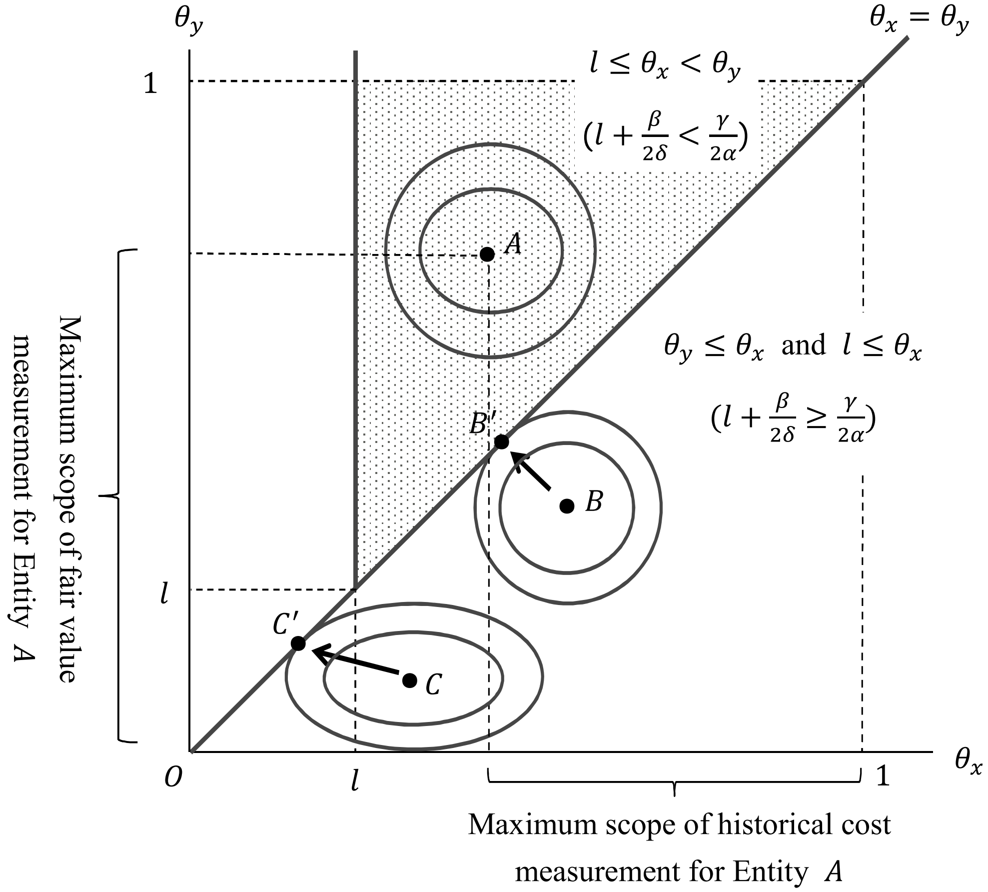
[6] For example, arguing that $\left(\theta_x, \theta_y\right)$ should be $(0,1)$ means that all assets should be measured at historical cost by the first criterion and all assets also should be measured at fair value by the second criterion.

FIGURE 3: THE MULTIPLE CRITERIA REGIME



$Z \geq 0$ is a constant that defines the height of the indifferent contour ellipses. As Z becomes smaller, the indifferent contour ellipses become lower in Z and smaller in (θ_x, θ_y) space, moving towards cost minimization at a point where $(\theta_x^*, \theta_y^*) = (l + \frac{\beta}{2\delta}, \frac{\gamma}{2\alpha})$ and $Z = 0$. The location of the ellipses in (θ_x, θ_y) space is defined by l, α, β, γ, and δ, and the flatness of the ellipses is defined by α and δ, both of which reflect the business characteristics of the reporting entities and the surrounding environment thereof. Figure 3 illustrates the business characteristics of entities A, B, and C by depicting each set of the indifferent contour ellipses that have the same center of points A, B, and C, respectively (although l is assumed to be indifferent among those entities in Figure 3). For example, some entities, like entity A, which face strong demand for fair value information by their users (larger γ), would locate their set of contour ellipses upward in (θ_x, θ_y) space. Other entities, like entity C, with a larger cost of fair value measurement (larger α) would locate their set of contour ellipses downward in (θ_x, θ_y) space and shape them horizontally flat.

In the area that meets $l \leq \theta_x < \theta_y$ (i.e. $l + \frac{\beta}{2\delta} < \frac{\gamma}{2\alpha}$ in the shaded area), the minimum point (like point A) should be the optimal pair $(\theta_x^{**}, \theta_y^{**}) = (\theta_x^*, \theta_y^*) = (l + \frac{\beta}{2\delta}, \frac{\gamma}{2\alpha})$. This is the solution in the multiple criteria regime. In this circumstance, two sets of accounting information that are prepared based on two different criteria, θ_x^{**} and θ_y^{**}, should be disclosed. When the minimum point, like points B and C, is in the area that meets $\theta_x \geq \theta_y$ and $l \leq \theta_x$ (i.e. $l + \frac{\beta}{2\delta} \geq \frac{\gamma}{2\alpha}$), the points B' and C', which represent the points of contact between the set of contour ellipses and the restriction line ($\theta_x = \theta_y$), should be the optimal scope of fair value measurement $\theta_x^{**} = \theta_y^{**} = \frac{\beta + \gamma + 2\delta l}{2(\alpha + \delta)}$. In this case, only one set of accounting information should be provided. Such disclosure belongs to the single criterion regime.

The restriction $\theta_x \leq \theta_y$ guarantees that every asset position is accounted for by historical cost measurement or by fair value measurement, because $(1 - \theta_x) + \theta_y \geq 1$. This characteristic of accounting can be described as *completeness*. Such completeness in accounting imposes some cost, which is represented by the excess of the net total cost that is realized by the optimized solution in the single criterion regime (i.e. $NTC(\theta_x^{**}, \theta_y^{**})$ where $\theta_x^{**} = \theta_y^{**}$) over the lowest net total cost that would be realized (i.e. $NTC(\theta_x^*, \theta_y^*)$) if the completeness were ignored.

The result also implies that not all entities would be required to disclose two sets of accounting information. Like entities B and C, in the case where $l + \frac{\beta}{2\delta} \geq \frac{\gamma}{2\alpha}$, entities would not have to disclose two sets of accounting information. As discussed earlier, in the multiple criteria regime, the entities should measure all financing assets at fair value. Even in the single criterion regime, some entities, like entity B, should measure all financing assets at fair value, but other entities, like entity C, would not even have to measure all financing assets at fair value.

5. Conclusions

One of the challenges in financial reporting is optimizing the balance between various often-conflicting interests in the marketplace. The balancing acts in such tradeoffs are a fundamentally inevitable task needed to solve the problems in financial reporting. I demonstrated a cost-benefit analysis for explaining the mechanism that determines the scopes of fair value measurement and historical cost measurement by focusing on various parameters that affect the incentives of the market participants. Accounting regulation is needed to achieve the optimal solution in the marketplace, which is not the preparer's voluntary choice. Adopting multiple criteria regime that produces two different sets of accounting information would provide more cost-effective solution if a certain condition is met. This result implies that the regime chosen depends on the parameters that describe the business characteristics and environment of the reporting entities, indicating that different accounting regulations are needed to encompass differences in business models.

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