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An evaluation of activity-based costing and functional-based costing: A game-theoretic approach

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Abstract

This study develops a theoretical product cost framework independent of cost assignment concepts. The framework is used in conjunction with cooperative game-theory concepts to develop constructs for evaluating the accuracy of competing cost systems. Cooperative game theory provides rational, non-arbitrary criteria for assigning joint benefits and defines two possible constructs; the set of imputations and the core. Using these two constructs to define accuracy, along with an operational measure of product diversity developed in the study, formal conditions are identified where activity-based costing (ABC) is theoretically closer to the true product cost than functional-based costing (FBC). Our results, therefore, provide a theoretical foundation for ABC.

Keywords: Activity-based costing; Cost system evaluation; Cooperative game theory

1. Introduction

Many factors influence the decision maker. Essential to many cost-based decisions, such as cost-plus pricing, is information related to product cost. Different product costing methods exist that can provide very different product cost assignments, which could lead to very different decisions. Activity-based costing (ABC) and functional-based costing (FBC) represent two competing product costing methods. FBC is a traditional approach using only unit-level drivers to assign costs to products. ABC differs from FBC in that it uses more cost pools, more cost drivers, and *both* unit-level and non-unit-level cost drivers. Decision makers, assuming information is relevant, prefer more accurate product cost information to less. Therefore, a desirable characteristic of a product costing system is the ability to provide accurate product cost assignments.

Few studies have addressed the comparative accuracy of ABC and FBC. Kee and Schmidt (2000) compared ABC and the theory of constraints in product mix decisions and Brierley et al. (2006) compared product costing practices in different types of manufacturing environments. Pierce and Brown (2006) examined the usage and perceived success of activity-based and traditional costing systems and found no major differences between the two types of systems. However, none of these

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studies address the issue of relative accuracy of ABC and FBC.

When ABC and FBC assignments differ, there are few methods by which to examine and evaluate the relative accuracy of each system. Prior studies (Datar et al., 1993; Banker and Johnston, 1993) seek to obtain a better understanding of underlying cost functions with the objective of obtaining materially different estimates of activity and product costs. When ABC produces numbers that are materially different from the numbers generated by FBC, it is believed that the new numbers will lead to desirable changes in cost-based decisions. However, Dopuch (1993, p. 618) states "no materiality study can demonstrate that one set of cost estimates is more accurate than another unless the researcher knows the true cost function."

Identifying the nature of the true cost function has significant appeal because it would allow an independent evaluation of competing cost systems. Of course, all other things being equal, if the true cost function were known in practice, then the true product cost would be used, the optimal cost system would be revealed, and there would be no need to evaluate the relative accuracy of competing cost systems. However, knowing the true product cost in practice is virtually impossible, which implies representations of the true cost function must be identified to assess the relative accuracy of ABC and FBC.

When evaluating product cost assignments, ABC proponents assume that the true product cost is identified under an idealized ABC structure when all cause-and-effect relationships are identified and used in assigning costs. This implies that the relative accuracy of a cost assignment increases as the number of cause-and-effect relationships identified and used increases. Thus, it is assumed that since ABC uses more cause-and-effect relationships in assigning costs than FBC, it provides better numbers for decisions. However, Datar and Gupta (1994) show that increasing the number of cost drivers and cost pools will not necessarily move product costs closer to the "true" product cost. Based on their examination, they also show that cases do exist where improving driver specification or degree of aggregation may not increase product-costing accuracy. Additionally, Homburg (2001) concludes that the accuracy of an ABC system is not dependent upon the number of cost drivers and finds that reducing the number of cost drivers in a system does not impair accuracy.

An idealized ABC structure has been used to evaluate loss of accuracy from misspecification of cost pools and/or cost drivers (Babad and Balachandran, 1993; Datar and Gupta, 1996). These studies calculate product-costing errors for ABC systems that vary based on the *level* of correctness in the specification of drivers and degree of aggregation, but do not explicitly compare ABC with FBC systems.

Using an idealized ABC structure to represent the true cost function must be regarded with some suspicion. While an idealized ABC structure may be useful to evaluate and improve less-than-ideal ABC systems, it says nothing about the relative accuracy of ABC if the true cost function does not correspond to the idealized ABC structure. Nor does it provide a fair evaluation of FBC systems. Thus, an *independent* representation of the true product cost is needed for evaluating competing cost systems. One possibility, developed in this paper, is to use criteria based on cooperative game-theory concepts.

Cooperative game theory provides defensible criteria that define how rational agents will share a cost in a non-arbitrary manner. Game-theoretic concepts, such as the core (Hamlen et al., 1977; Balachandran and Ramakrishnan, 1981), and the nucleolus (Hamlen et al., 1977; Barton, 1992) have been used to assess different joint cost allocation schemes. Joint costs, arising from the production of two or more products simultaneously, must be shared on the divisional level in a manner that prevents unprofitable suboptimal decisions by either independent divisions or any potential subcoalitions of divisions (Hamlen et al., 1977). This implies that joint cost allocations must be rational and stable allocations to meet this definition. In cooperative game-theory terms, rational allocations are referred to as imputations and stable allocations belong to the core.

The product-costing problem, where multiple products are produced independently in a single plant, is merely an example of the joint cost allocation problem. When a multiple product plant is observed, shared (common) costs are created that take on the same characteristics as joint costs. For example, in a multiple product setting, the cost of the common resources must be assigned to independent products in a manner that would prevent any of the managers of the products to leave the multiple product plant and operate independently. This implies a necessity for rational and stable cost