RESEARCH OF UNIVERSITIES RESEARCH INDIRECT COSTS ALLOCATION BASED ON COOPERATIVE GAME

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Abstract: Universities engage in teaching and research activities, universities' research funds now mainly offset direct costs of research activities in China, indirect costs of research activities are mainly extracted about 5% management fee, but this is far from research activities should be assessed to make up for the share. At present, universities' research indirect costs mainly measure through the traditional function cost and advanced activity-based cost, but these methods have some shortcomings. This paper proposes a new universities research indirect cost allocation method based on the cooperative game theory, and an example is justified.

1 INTRODUCTION

To ensure teaching and research activities continued, efficient operation, universities require substantial funding for construction, acquisition and maintenance of buildings and equipment, also need to spend large sums of money for the integrated management of universities. Since these payments can not be directly traced to specific teaching and research projects, as opposed to retrospective obvious direct costs, this part of cost is known as indirect costs of university. Although indirect costs can not directly charged from a specific project, but universities did not invest these funds will lack of housing facilities and integrated management services, they will be unable to carry out any activities. Therefore, indirect costs must be allocated to all the benefits of university projects, and direct costs together constitute the full cost of the project, and obtained from the project completely compensate the client in order to ensure the normal development of all the activities of universities. Indirect costs funded policy of research projects is to support research projects of university housing facilities and management costs to compensate for the science funding policy is directly related to scientific research necessary for sustainable development and scientific research infrastructure maintenance and management system Increased. The teaching, research and service activities are mutually different and interrelated, making the indirect cost of

allocation methods of scientific research is full of complexity and uncertainty, resulting in indirect costs funding policy research university and become a hot issue in dispute between principals. Research of indirect costs and its contributions is just beginning, and mainly based on traditional cost methods, some scholars introduced ABC. Based on the cooperative game theory to study for universities' indirect costs compute model, this provides a theoretical basis for scientific computing full-cost of research projects, and develop scientific funding policy for the government.

Shi Jinghuan (2007) believed that the U.S. federal government payed full cost of research activities, including indirect costs incurred due to university bear research projects. Kang Xiaoming (2007) believed that perfection of government research indirect cost recovery mechanism should be increased efforts to support university research system to ensure stable operation of scientific system; Based on the quality of scientific research, establish and improve a stable funding mechanism for recurrent funding of scientific research; Based on scientific research cost, establish scientific proportion of indirect cost recovery of research projects. Jiao Hanwei (2008) analysis of the current status and problems of indirect costs of research university, compared to university research indirect costs compensation measures of european and American countries, proposed policy

recommendations for government to perfect research indirect cost recovery mechanism. Yuan Liansheng (2009) believed that the U.S. and British governments to develop standard methods of scientific research indirect costs, as government funding indirect research projects based on cost estimates to ensure that government indirect costs of university research and reasonable compensation. But the U.S. scientific research indirect cost rate established on the basis of direct costs, indirect cost rates UK universities established on the basis of the number of researchers. Li Zhimin (2009) discussed explore the full cost and ABC to university research projects cost management. Ouyang Hua (2009) believed that indirect costs of university research management is not mature, from the subsidy policy, budget and accounting proposals three aspects, and describes the operating cost in university research the use of indirect cost allocation. Zhan Yiqing (2010) believed that the indirect costs of U.S. research funding policy based on a scientific model of indirect cost rate basis. She believes that the full costs of university research projects, including research and artificial, including the direct costs and indirect costs of research assessment form. Review of scientific research at home and abroad through indirect cost management literature, I believe that indirect costs of university research management has the following problems: on the indirect costs for university research and the important role of lack of knowledge; indirect costs of research funding policy based on the lack of scientific theory; research indirectly The proportion of the cost of compensation far below the actual college; university research indirect cost allocation methods should be improved.

2 THE EXISTING UNIVERSITY RESEARCH INDIRECT COST ALLOCATION METHOD AND ITS SHORTAGE

According to the ownership of cost, the direct cost of university research that can be clearly directly attributable to, or higher accuracy directly assigned to specific research projects and costs; the indirect cost of university research that can not be clearly attributed to specific research projects, but it is essential for the normal cost maintain of university research activities. "Emplementation of the scheme on the subject of national research system regulations" states: direct costs of research projects

typically include personnel costs, equipment expenses and other research expenses. Indirect costs typically include the subject of payment service support unit staff costs and other administrative expenses, the existing equipment and housing fees, royalties or depreciation.

Higher education in the production of "products (students)" is often mass production, each batch of the product (the same subject in the same year) of the production process (curriculum, etc.) is indentical, consumption of resources, training costs spent almost are indentical, product cost and therefore can bulk of teaching accounting, and calculate the unit product cost of each batch, that the cost of a single object can reach the student objects. For the purposes of university research products, due to different nature of different research projects, scientific research and the production of different processes and resource consumption is not the same, so the cost is not the same in different research projects. Therefore, it is difficult to share teaching and research indirect cost allocation to individual research projects, and such activities can only be allocated to scientific research, scientific research and the cost of indirect cost allocation can only be the object of scientific research activities. Indirect costs of university research purpose is to share teaching and research activities in that part of the shared costs are divided according to the principle of benefit, be allocated to teaching, research and other activities. Apportionment of indirect costs, the function cost (FBC) and activity-based costing (ABC) represent two different costing methodologies.

Cost function is a traditional way, only with the unit level as the cost drivers, and as the common costs allocated to each of the product. As early production is not high degree of automation, management is simple, the market less competitive, companies mainly in large quantities, less variety of modes of production, mainly in the indirect cost of production labor hours or machine hours as a benchmark to the average linear distribution The cost of the product. The traditional method of product cost in addition to the direct cost of the product materials, direct labor, the rest are classified as manufacturing costs, and operating unit level cost drivers to allocate the common costs of imputation. The units of activity driver is the level of production changes, cost changes result in a number of factors. Unit level activity drivers used to allocate the costs of manufacturing products

imputation, assuming the product is actually consumed in these common products, the production cost and highly relevant. Traditional cost allocation methods are often used to allocate fixed manufacturing costs due to the standard unit of product output, direct labor hours, direct labor rates, machine hours, direct materials. As the basis of such allocation is closely related with the production, the traditional method known as the "number-based " cost allocation method. In previous single product structure, production equipment simple production environment, such as the cost driver unit level only, and accordingly the cost allocated to the linear products to cost-sharing method, did not show anything wrong place . But the knowledge economy, the cost and management theory and practice has been a huge challenge:

(1) high-tech development, especially in modern manufacturing technology, increasing the value of machinery and equipment, machinery and equipment maintenance costs, depreciation expenses increased significantly, resulting in significant changes in the structure of product cost, reduced direct costs, indirect costs significantly Improve and continue to use traditional assessment methods, likely to cause distortion of product costs;

(2) use of non-causal factors of the single standard indirect cost-sharing and prone to over-or underestimate the cost, resulting in a difference between products "cost shift " problem.

The basic principle of ABC is set according to different cost drivers, cost pools, respectively, and were consumed by a variety of products, amount of work in the corresponding cost-sharing the cost of the library, and then were aggregated total cost of operating a variety of products, calculated products of the total cost and unit cost. The calculation of the operation as the core, according to operations on the resources consumed by the consumption of resources will be allocated to the cost of operations, then the operating cost of the product based on cost drivers to trace the formation and accumulation, thus get the final product cost. ABC is a more accurate cost allocation method that can be reasonably stable allocation of indirect costs to products, it is applied to the calculation of indirect costs of university research is feasible, not only for the government to the university's research and provide the basis for indirect cost allocation, Universities can also provide cost control and financial decision-making to help

strengthen the effective use of university resources. But operating costs of Applied Research indirect cost method may encounter the following problems:

(1) On inadequate understanding of scientific research indirect cost accounting.

(2) University College is not conducive to the current accounting system, the implementation of activity-based costing. The implementation of ABC requires additional data, such as teachers in various activities and time spent, the current university accounting into the accounting system is not in its.

(3) Activity-Based Costing there own limitations. First, the implementation of activity-based costing is a systematic project, the division of work is a bottom-up or top-down process, its implementation requires in addition the financial sector with many sectors outside, especially the support of school leaders need to Coordination of various departments. Second, the job has a different level, and the university is a function of the operating process of the parallel-type structure, operations center to determine the division with the job inevitably have a certain subjectivity. Select the appropriate cost drivers in a distribution, and sometimes because of lack of appropriate data and judgments based on the subjective experiences and feelings. Again, the accurate calculation of costs, the need for each job to determine a cost driver, which requires the implementation of the higher costs, not cost-effective. Sometimes a job has multiple cost drivers, how to determine the cost drivers involved in one or more of product costing is also a problem.

(4) high cost of implementation. First, the implementation of activity-based costing systems need to develop operating costs, the development and operation and maintenance more expensive. Secondly, the successful implementation of ABC requires staff with appropriate quality and ability, and the current university accounting staff understanding of costing not much. Again, the implementation of activity-based costing in the first several years after, need to be tracking the implementation and evaluation, and implementation process, some of the problems corrected. Therefore, the successful implementation of activity-based costing requires a longer time.

3 COOPERATIVE GAME THEORY APPLY TO INDIRECT COST ALLOCATION OF SCIENTIFIC RESEARCH

Game theory studies the behavior of making a direct interaction between the main decision-making and that decision when the balance. It has two branches: cooperative game and non-cooperative game. Non-cooperative game emphasizes individual rational, individual optimal decision. Cooperative game emphasizes group rationality, emphasis on efficiency, impartiality and fairness. Allocation method from the scientific perspective, cooperative game theory omitted the co-operation in the formation of a rational process, but the distribution of benefits of alliance or cost sharing. In fact, so that all parties is the nature of alliance cost sharing, but also the core of cooperative games, applications cooperative game can be a reasonable allocation of indirect costs to provide a feasible and fair way. Cooperative game is given a limited set of participants N, the characteristics of cooperative game type is an ordered number on the (N, C), where V is characteristic function $2^N = \{ s \mid s \subseteq N \}$ to the set R^N of real numbers from the mapping, and $C(\phi) = 0$. Cooperative game has an implicit assumption that all people are able to participate in forming an alliance, but when a coalition of participants may act in the interests of other production externality, the alliance is not necessarily formation, that cooperation does not necessarily is stable. Cooperative game theory allocation sets and defines the core set, the two sets of cost-sharing technology to provide a theoretical basis.

(1) Distribution set. If for $i \in N$, has $x_i \leqslant C(I)$, cooperative game solution satisfies individual rationality, which x_i expressed the cooperative game solution; if $\sum x_i = C(N)$, the cooperative game solution to meet the collective rationality. Distribution of the game is also set to meet the individual rationality and collective rationality of the solution set. Participants in the evaluation of a rational distribution of the program, will participate in co-operation will be co-benefits in and out of the interests of individual actions can be compared, if the former is large, the participants will stay to continue cooperation; if the latter is large, Participants will exit to go it alone. In the co-benefits (cost) distribution, if the participants continue to work to stay, then the allocation method consistent with individual rationality. If the cooperation of all participants assigned to return

(cost) is just equal to the sum of the income of all participants (cost), after the formation of the alliance will work from all participants (cost) is just assigned to each participant and distribution completed , The allocation method consistent with collective rationality.

(2) Core set. Independence of the inspection requirements in terms of every little alliance, assigned to the minor leagues, the cost of all the participants and may not be available to more than the cost of a separate alliance. In the cost-sharing is $\forall S \subset N$ for the game, $\sum x_i = C(S)$, which S is the minor leagues. Distribution through independent test set is the core set. Distribution set from the perspective of individual participants, but the alliance, the number of participants leaving the original form of mutual cooperation League minor league, the benefits may be greater, which means that the Alliance does not leave more than a few participants Alliance to form a minor league better.

In the cooperative game, the rational allocation is Assignment Set and the Core is stable at a reasonable cost allocation method. For accuracy, the distribution of cost allocation system provides the results of cooperative game theory is defined by a reasonably stable set, that have the same characteristics as the real product cost, distribution of results than those who do not belong to the cost of reasonable and stable set of system accuracy. One of the basic elements of cooperative game is the game the main basis of party to join the alliance, is to find a way to fair and reasonable and accurate distribution of alliance costs (or gains), so that all parties to cooperate to join the alliance. This approach can be successful, must be made in each of the players joined the league after the distribution of costs (or gains) than his acting alone low cost (high), or alliance will not set up. Many types of cooperative game solution, almost all the specific issues for each class of solutions specifically defined. Satisfy the individual rationality and collective rationality conditions, and through cost-sharing programs test for independence and stable cooperation for the rational allocation. Cost allocation in cooperative game theory, assuming the first i, X_i alliance cost of personal gain, C(N) the total cost incurred for the cooperation, C_i participants alone for the costs incurred, the cost of internal stability can be assessed more than cooperation Game:

$$\begin{cases} \sum_{i=1}^{n} x_i = C(N) \\ x_i \le C_i & \forall\, i \in N \\ \sum_{i \in s} x_i \le C(S) & \forall\, S \subseteq N \end{cases}$$

The first two conditions for the weak condition, the definition of the distribution set, which is the core set of necessary conditions to meet the first two conditions at the same time meet the third condition of the allocation method is the core allocation. Cooperative game there is no single solution, it is difficult to have a solution can meet all of the "fair" understanding of the most challenging game so the cooperation is to create a unified "solution ", that is, from a variety of different Well-selected nature of the solution in the only configuration or cost allocation plan. Applications in economics, more than the current Cost Allocation method for solving the cooperative game model including Shapley value method, the core method, quadratic programming and cost-sharing gap method. Shapley LS Shapley value is given an n person cooperative game solution, it can not only solve the effective distribution of economic activities issues, and social activities can be estimated in the rights of groups or factions. Suppose (N, C) as a cooperative game, for a given characteristic function can be assessed to determine the specific vector $x = \{x_1, x_2, ..., x_n\} \in R^n$ to satisfy anonymity, availability, and virtual sex plus the unique solution of the four properties:

$$x_i = \sum_{\{S | i \in S\}} W(|S|) * [C(S) - C(S \setminus i)] \qquad i = 1, 2, ..., n$$

$$其中, \quad W(|S|) = \frac{(n - |S|)! * (|S| - 1)!}{n!}$$

Among them, $x = \{x_1, x_2, ..., x_n\} \in R^n$ known as the Union's Shapley value; $|S|$ that contained members of the League of the number of S, C is defined on all subsets of N, a cost function that represents all the possible formation of N in the replacement cost of the best groups, n Is the number of the players, N is the set of all the players. Shapley value that the member i of the coalition S i increase the cost $C(S) - C(S \setminus i)$ of the weighted average of the weights $W(|S|)$ that the players in any n-permutation, i is the probability of only part of the Union S.

4 NUMERICAL EXAMPLE

Suppose a university engaged in teaching, research and the other three types of activities, operating in accordance with the college faculty approach to management, that is, all income and expenses according to the three types of activities a separate accounting for all costs occur within the university are to be assessed Commitment to these three types of activities. The university is divided into eight large departments, where the costs incurred by hospital administered an example in this research and indirect costs are allocated between the activities of three classes of problems.

Court administered the indirect costs incurred, including labor costs, materials costs, depreciation of fixed assets and office costs and other expenses. The past, these costs mainly by teaching and other activities to share, bear the indirect costs of research activities are mainly extracted a small percentage of faculty of management fees. But the House leadership recognized that due to research activities in the faculties of the spending account for a large proportion of the cost of the current distribution of this simple way does not really reflect the real burden of each type of activity the cost of education may lead to crowding out expenditure on research spending. Thus, according to university in the past financial data, and use cooperative game mode on the possible costs of hospital administered by the situation as described below.

Administered by the School teaching, research and other activities of 1,2,3 collection for the three types of N = [1,2,3], then S = ({1}, {2}, {3}, {1,2}, {1,3}, {2,3}, {1,2,3}) 3 types of activities on behalf of all the alliances possible. When the three types of activities independently, they should bear the indirect costs, that their characteristic function is: v ({1}) = 8, v ({2}) = 6, v ({3}) = 4. When the two two leagues, due to the presence of fixed costs, making the alliance more expensive than the cost of both separately and low, Union Square characteristic function is: v ({1,2}) = 12, v ({1,3 }) = 10, v ({2,3}) = 8. When the three formed the Alliance, the total value of the characteristic function: v ({1,2,3}) = 15. According to Shapley value formula, the three alliances, their respective costs should be allocated x1, x2, x3 can be calculated as: x1 = 7; x2 = 5; x3 = 3. The following results on the Shapley value for authentication.

(1) Super additive. v ({1,2,3}) = 15 ≤ v ({1}) + v ({2}) + v ({3}) = 18.

(2) Groups is reasonable. x ({1}) + x ({2}) + x ({3}) = x ({1,2,3}) = 15.

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(3) Individual rationality. v ({1}) = 8 ≥ x1 = 7; v ({2}) = 6 ≥ x2 = 5; v ({3}) = 4 ≥ x3 = 3.

Proven, Shapley value solution to meet the characteristics of cooperative games to three types of activities on the allocation of indirect costs result should be acceptable.

5 CONCLUSIONS

With the continuous development of universities, research activities, more and more important for universities, research university indirect costs accounted for the proportion of the total indirect costs are also increasing, the simple, low percentage of management fees have not effectively compensate for the consumption of common resources research activities . In the traditional system can not be reasonably cost-effective distribution of indirect costs will be allocated to the related activities, the operating cost method is the first choice of indirect cost allocation, allocation results when the operating cost method are not satisfied, based on cooperative game theory of indirect cost allocation method has been widely Application. Despite the advanced nature of ABC caused by early theorists and practitioners of the attention, but has certain practical difficulties and shortcomings, can not find the cost drivers or cost driver is difficult to find, contrary to the principle of cost-effectiveness. Cost allocation based on cooperative game cost driver technology eliminates the need to find the difficulties caused by direct of indirect costs, and assigned to stakeholders. But these three can not replace each other sharing technologies, but the coexistence of the three technologies together under the premise of the development of the practical application of university and will not be limited in some way, should be based on the actual situation and determine which method to choose.

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