Joint Cost Allocation Anomaly Detection in Not-for-profit Organizations (NPOs) Using Cluster Analysis

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Abstract
Not-for-profit (NPOs) often conduct joint activities that combine fundraising activities with program or management activities. Hence external users of NPO financials such as donors and resource providers want to know how much is spent on fundraising, program and management activities. The purpose of this article is to develop a data driven approach to provide such information that may be useful for donors, resource providers and the public. Data science based cluster analysis method is used to identify anomalies in NPO joint cost allocations based on Form 990 and audited financial statement data. The main findings are that some NPOs use joint cost allocations to manage program expense and fundraising cost ratios with a view to influence donor and resource provider decisions. This is revealed by the analysis and comparison of functional expenses of an NPO's audited financial statements, Form 990 and restated data using the hierarchical cluster method. Given the current emphasis on data science based methods, the proposed research will be a novel contribution to the accounting practice literature though a methodology that integrates financial statement and tax reporting data with data science techniques to better understand anomaly detection in joint activity reporting by NPOs.
Keywords: Not-for-profit Organizations (NPOs), Cluster Analysis, Joint Cost Allocation, Anomaly Detection, Accounting.

1. Introduction

Joint costs arise when the production of one product simultaneously and necessarily involves the production of one or more other products (Manes and Cheng 1988, Horngren et al. 2013, International Accounting Standards (IAS) 2.14). Joint products are indistinguishable as separate products until the processing reaches a split-off point and as pointed out by Baumol et al. (1982) and Biddle and Steinberg (1984) result in cost savings due to economics of scope rather than economies of scale; i.e. it is less costly to jointly produce a

given output of a set of products than to separately produce a subset of products. The transformation of crude into petroleum oil products in a refinery, the separation of synthetic oil from bituminous sands, natural gas and crude oil extraction and processing, mining for metals and minerals, the processing of timber (saw logs) into products (lumber), and meat packaging are some examples. Thus, joint costs are quite common in extractive, agricultural, chemical, and manufacturing industries.

Joint cost allocation is an important issue in accounting especially for cost-based product pricing, measurement of inventories, cost reimbursement under contracts, rate regulation, insurance settlement calculations and motivating desired employee behaviors (Zimmerman (1979), Bodnar and Lusk (1977), Lere (1986), Anthony (1984), Horngren et al. (2013) and Thomas (1971)). As per IAS 2.14, cost of inventories include all cost of purchases, cost of conversion and other costs incurred in bringing the inventories to their present location and conditions. Joint cost allocations result as costs of conversion when more than one product is produced simultaneously. As per the Price Waterhouse Cooper (PWC 2012) guidance on IFRS, when the costs of conversion of each product cannot be separately identified, they have to be allocated on a rational and consistent basis. While there are different practices in use, all aim at allocating costs to joint and by-products.

There are four practical accounting approaches to joint cost allocation which are based on physical measures and relative sales value at split-off method. These two methods are appropriate if products are sold at split-off point. However, if the joint products are further processed, more appropriate market based methods such as net realizable value method (NRV) or the constant gross margin percentage NRV method can be used (Horngren et al. 2013). The NRV method is often used when there is a significant difference between relative sales values of the joint products. In this situation, if the physical measure approach is used cost allocated to low value products may exceed their net realizable values and higher value product would result in super profits. The advantage of the physical measures approach is its observability and verifiability. Moreover, it implies economic plausibility as the actual physical process of production, and hence, cost flow reflects the economic facts of production activity (Horngren et al. 2013). The commonly used NRV method is circular if used for setting rates/cost-based pricing because product prices are a function of full costs and, at the same time, NRVs are based on these prices (Schneider 1986, Horngren et al. 2013, among others). The problematic nature of this circularity has been recognized by Biddle and Steinberg (1984), Slater and Wootton (1984), Cheng and Liao (1992), and Moon (1989). Horngren et al. (2013), Schneider (1986), Schneider and Jeroslow (1988) recommend the physical measures method for cost-based product pricing and rate regulation. Furthermore, volume of production is suitable where the net realizable value of each unit of production is similar (PWC 2012).

In addition to the typical joint cost allocation in extractive, agricultural, chemical, and manufacturing industries, joint cost also arises in not-for-profit organizations (NPOs). NPOs often conduct joint activities that combine fundraising activities with program or management activities (Capin and Tanenbaun 1998). More specifically, external users of NPO financial such as donors and resource providers want to know how much is spent on soliciting contributions (fundraising activities), to support the causes articulated in the NPO's mission (program activities) and general administration (management activities). One such example, of a joint activity of an NPO is a mailing costs which may include *program* material indicating audience to take action to fulfil its mission and a *fundraising* request for contributions (Capin and Tanenbaun 1998). Donors and resource providers favor NPOs which spend high proportion of the resources on program activities and look unfavorably on NPOs that spend higher proportion of resources on fundraising or management activities rather than program activities (Capin and Tanenbaun 1998, Khumawala et al. 2005).

Khumawala et al. (2005) argue that in spite of the American Institute of Certified Public Accountants (AICPA) Statement of Position (SOP) No. 98-2, the opportunity for NPO executives to use joint cost allocations to manage program expense and fundraising cost ratios with a view to influence donors and resource providers still remain. More specifically, there are incentives for NPOs to minimize the amount of reported fundraising cost so that they appear operationally efficient. Yogus (1998) highlight that using joint cost allocation rules is one of the easiest methods to achieve the required efficiency ratios. Furthermore, Baber et al. (2002) show that increased spending ratio of program activities are correlated with executive compensation. A recent BARRON'S article titled "Spotting Nonprofit Accounting Tricks" by Gary Weiss (2016) argues that donors should dig deeper into NPO financials rather than simply consider the reported numbers on face value. For example, NPO watchdog group (CharityWatch, n. d.) recommends vetting non-profits as rigorously as for-profit public companies since there is room for fast accounting moves and lax accounting practices.

Given that it is pretty difficult for donors to pick on deceptive accounting practices as a result of joint activities, this article deals with using data science based cluster analysis to identify anomalies in NPO joint cost allocations. More specifically, the objective of this article is to use Form 990 data filed by NPOs, and audited financial statement data with hierarchical cluster analysis to detect anomalies in NPO joint activity reporting. Given the emphasis on data science based methods, the proposed research will be a novel contribution to practice. The article contributes to the accounting practice literature though a methodology that integrates financial statement and tax reporting data with data science techniques to better understand anomaly detection in joint activity reporting. The article is organized as follows. Section 2 provides a literature review of joint cost allocation schemes drawn from both the economics and accounting literatures. Section 3 discusses the accounting joint cost allocation methods and

why they are more practical than economic theory models. Section 4 discusses SOP 98-2 pertaining to joint activity reporting by NPOs and tax filing requirements for NPOs. In Section 5 Hierarchical cluster analysis method used for anomaly detection is presented. Section 6 illustrates the proposed approach for detecting joint activity anomalies. Section 7 Concludes with a discussion on limitations of the proposed approach.

2. Literature Review on Joint Cost Allocation Schemes

The rationale for incurring joint cost by NPOs is the expectation that program, fundraising and administration costs can be reduced if conducted simultaneously. Joint cost incurred by NPOs hence should be allocated to each of the three activities -program, fundraising and administration in a reasonable and fair manner taking into consideration the plausible cause and effect relationship between cost incurred and the activity. However, due to jointness, judgement plays a role raising questions about the accuracy and reliability of the NPO financial reporting. Prior to the issuance of SOP No. 98-2, the previous guidance SOP No. 87-2 did not provide specific guidance for joint cost allocation but only examples. Consequently, Tishlias (1992) discuss the difficulties auditors face in determining the reasonableness of NPO joint cost allocations and argue that such allocations may have a serious impact on how efficiently a NPO is run. Several methods of joint cost allocation are suggested in Tishlias (1992), exploring the bounds of reasonable allocations.

Tinkleman (2005) discuss the implications of legal precedence pertaining to NPOs' on the materiality of information on allocation of expenses. More specifically, the author argues that NPOs may be legally liable for intentional misallocation of expenses to mislead donors in believing more money is spent on programs than actually the case. NPOs face competitive pressure to "look good" due to charity tracking websites providing ratings based on spending ratio data to safeguard donors. Tinkleman (2005) argue that intentional misrepresentation of fundraising costs can be a basis for fraud action and calls upon accountants to approach and check the cost allocation process with due diligence. More to the point, in addition to adhering to all applicable professional standards governing cost allocation accountants should also scrutinize allocation procedures to provide defense in case charges are files against unreasonable allocations.

Petrovits et al. (2011) empirically investigates the internal control weaknesses in the non-profit sector using a sample of public charities over a nine-year period considering the fact that NPO managers are accountable to donors and grantors who provide capital. While highlighting that there are significant fiduciary responsibilities of non-profit managers and a regulatory weak oversight, the study points out that there is a need for more rigorous corporate governance practices especially in relation to internal control design. Although, NPOs face tremendous pressure to focus on mission specific program related activities, the study provides evidence that underinvestment in administration resources (for example, internal controls) negatively affect the achievement of program mission

and efficient resource allocation in this sector. It is shown that improved internal control in NPOs will reduce monetary losses from fraud and accounting errors in addition to enhancing effectiveness of program service delivery and raising scares resources supporting the point that artificially low spending on administration activities is detrimental in the long run.

SOP No. 98-2 provide better guidance on joint cost allocation of NPOs, nevertheless, the new standard neither requires nor recommend specific allocation method and mangers continued to have discretion on which costs are considered joint and how joint costs are allocated. (Jones and Roberts, 2006). More specifically, using a set of hand collected data, Jones and Roberts (2006) investigate whether NPOs use joint-cost allocation to manage program ratios, a widely used measure of spending efficiency. A relatively large body of research has investigated the relationship between charitable donations and program ratios.   Prior research documents a positive association between donations levels and program ratios (Weisboid and Dominguez 1986, Posnett and Sandler 1989, Callen 1994, and Tinkelman 1999). Other research has studied the reputational effect of low program ratios compared with benchmark charity ratings by charity watchdogs (Gold 1993, Schuman 1993, and Barrett 1999). Baber et. al (2002) find that executive compensation is positively related to changes in the program ratios. Krishnan et al. (2006) and Leone and Van Horn (2005) investigate whether NPOs manage reported program ratios to achieve financial reporting objectives such as reduce changes in earnings and report high program ratios.   While prior research provide evidence of NPOs managing reported program ratios, Jones and Roberts (2006) show that NPOs manage program ratios to both mitigate decreases and increases in their program ratios because regulators may become suspicions when program ratios rise or reduce dramatically.

Several studies have also investigated tax avoidance and tax misreporting via income shifting. There is documented evidence that charitable organization use discretion to avoid paying taxes on their for-profit subsidiaries (Cordes and Weisbrod 1998, Yetman 2001, and Hofman 2007). Omer and Yetman (2007) point out that while the above studies document tax avoidance and not misreporting, tax avoidance was possible because of liberal tax laws covering expense allocation methods for NPOs. It seems that joint cost allocation could be used to misreport taxable income by overstating taxable expenses in Form 990s. More to the point, non-profit tax avoidance was primarily through cost allocation and shifting expenses from tax exempt to taxable activities via joint cost. Omer and Yetman (2007) indicate that although non-profits are tax-exempt, they are subject to unrelated business tax on profits from activities not closely related to their tax-exempt purpose. Interestingly, as the authors highlight, the concurrent operation of tax-exempt and taxable activities provides the incentive for non-profits to shift joint cost expenses from tax-exempt to taxable activities to minimize tax.

In an experimental research vein, Khumawala et al. (2005) examines how different groups perceive NPO disclosures pertaining to joint cost allocation vis-à-vis efficiency ratios. Three groups are considered in their experiment; preparers of financial statements (NPO accounting personnel), institutional executives (expert donors) and individual (novice donors). Their finding indicates that both preparers and expert donors accept the joint cost allocations via program ratios as reported in their validity. However, the novice donors are the individuals who scrutinize and pay most attention to the reported efficiency ratios in making decision with respect to donating. The results have to be considered with some caution since, experiments may sacrifice realism. Parson (2003) provides a review of charitable giving and value relevance. Arguing that there is limited research on understanding how NPO financial statements play a role in charitable giving, the article synthesizes the association between donation and reported numbers to postulate whether NPO accounting is relevant to donors. More specifically, Parson (2003) proposes a framework for examining the value relevance of NPO financial statements to users and discuss potential research issues for further investigation.

Tinklemen (1998) investigates the effect of allocated joint cost on large donors vs. individual donors. Published ratings by monitoring groups and program ratio (accounting ratio) is used as indictors of quality and efficiency respectively. The study provides empirical evidence that large donors are more sensitive to both quality and efficiency indicators while individual donors are not found to be sensitive to published ratings. In summary, both large and small donors consider joint cost data to be relevant and thus Tinklemen (1998) suggest more prominent presentation of joint costs in financial statements to increase donor awareness. Garven et al. (2016) provides an extensive literature review of published research article on program ratio management in non-profit organizations. The scholarly literature is divided into themes based on motivation, methods, consequences, evidence and mitigating factors of program ratio management. Agreeing with the growing consensus that the use of a simple expense ratio to evaluate NPOs is short-sighted, Graven et al. (2016) point out that future research should investigate the development of better methods for evaluating non-profit organizations and perhaps benchmark organizations that are best at managing their resources. Keating and Frumkin (2003) find that information differences in what is provided in NPO annual reports and that is required by Form 990. Consequently, donors are left with wide range and type of accounting data which are inconsistent requiring the data to be reconciled in order to make meaningful comparison.

With the hierarchical cluster analysis to detect anomalies in program expense ratios, our article takes into consideration the reported differences as identified in Keating and Frumkin (2003) between the annual report, Form 990 and restate the reported expenses using the Charity Watch methodology to identify clusters. This methodology is robust in identifying the clusters with the largest difference in

program ratios and indicating the likely years where program ratio management may have occurred.

3. NPO Joint Cost Reporting and Tax Issues

The AICPA SOP 97-2 was used as a starting point for the current SOP 98-2 *Accounting for Costs of Activities of Not-for-Profit Organizations and State and Local Government Entities That Include Fund-Raising* which came into effect in 1998. The current guidance expanded the scope to include all costs of joint activities instead on merely joint cost to facilitate more consistent and meaningful reporting. It is much more difficult to justify joint cost allocation under SOP 98-2. The current standards permit the allocation of joint costs if the expenditure meets the criteria of *purpose*, *audience* and *content*. The purpose criteria are met if the joint activity furthers the mission of the NPO. The audience criterion is fulfilled if the joint activity is not targeted only towards individuals who are most likely to donate such as past donors. The content criteria are fulfilled if the joint activities require specific action on part of recipients to further the purpose of the NPO in some way other than just contributions. The standard requires that the activity must meet all three criteria for a NPO to report any cost of joint activity as functional activities other than fundraising. When all three criteria are met, the NPO can charge identifiable costs to a particular function and the non-identifiable costs be allocated among fundraising, program or management function.

The SOP 98-2 do not provide detail guidance to which joint cost allocation method should be used. However, the SOP 98-2 requires the allocation methods to be rational, systematic and to be applied consistently by NPOs given similar facts and circumstances (Capin and Tanenbaun 1998). In addition, SOP 98-2 has several disclosure requirements. The NPOs that allocate joint costs have to disclose the following: the types of activities for which joint costs have been incurred; a statement that such costs have been allocated; the total amount allocated during the period and the portion allocated to each functional expense category. The disclosures have to accompany the GAAP financial statements. Compared to SOP 97-2 the current SOP 98-2 standard is more stringent and justifying joint costs allocation is more difficult. Watchdog groups however are skeptical about allocation of joint costs to program expenses (Khumawala et al. 2005). For example, Barron's (See Kaplan 2016 and Weiss 2016) calls non-profit accounting

> "*arguably one of the last vast wastelands of corporate accountability: rules are lax, disclosure is minimal, and available data are usually months or even years old. ...A good accountant or bookkeeper working for a nonprofit can make it pretty hard for a donor to pick up on accounting issues. Accounting loopholes are legal and widely acceptable in the non-profit world*".

CharityWatch provides examples of NPOs where charities have been downgraded due to unwise spending of donor money. For anonymity, the NPO is labeled as NPO-X. The 2014 annual report of NPO-X shows that it is efficient

with 77% of expenditure going to worthwhile programs and the remaining for fundraising activities and administration expenses. However closer scrutiny by CharityWatch indicate that the rating should be "D" as only 50% of the expenses are spent on program activities. The Inland Revenue Services (IRS) Form 990 which is available to the public and details found in the independent audit reports were used by CharityWatch to arrive at the "D" rating for NPO-X. Two of the most common accounting red flags identified Barron's articles are "(1) where fund-raising costs are doing double duty as a program -- joint costs and (2) gifts-in-kind which are illiquid gifts booked as revenue".

This article uses the CharityWatch efficiency ratio calculation criteria for restating the audited financial statements when joint costs are reported. More specifically, CharityWatch in their financial analysis adjusts solicitation expenses out of the reported program expenses and adds them to fundraising expenses prior to computing a charity's efficiency ratios and letter grade ratings.

> *"Joint Costs: when a charity claims that it <u>spends 85% on programs</u> in a particular year , may donors do not realize that this 85% may include money the charity spends on activities such as telemarketing, direct mail solicitations, and consulting or other fees paid to professional fund raising companies. While accounting rules allow charities to report certain portions of their solicitation costs as program expenses, CharityWatch believes that many donors do not consider a charity's solicitation activities to be the true programs of a charity they are intending to support with their donations. For this reason, during our financial analysis we adjust such expenses out of the reported program expenses and add them to fundraising prior to calculating a charity's efficiency ratios and letter grade rating. Donors who agree with CharityWatch's treatment of joint costs should refer to the program and fundraising efficiency ratios displayed in the pie charts. Donors who consider direct mail, telemarketing and other joint cost solicitations to be true charitable programs should instead refer to the unadjusted efficiency ratios provided under the <u>joint cost</u> header of the Ratings and Metrics tab."* (CharityWatch, n.d.)

Notice that CharityWatch's approach is more conservative, which lends to a more suitable conservative accounting practice for NPO reporting.

NPOs are also required to file IRS tax filings which provides some disclosure on joint cost allocations. The filings include IRS Forms 990, 990-EZ, or 990N. Form 990 has to be used by tax-exempt nonprofits with the exception of most faith-based organizations, with gross receipts greater than or equal to $200,000 or total assets greater than or equal to $500,000 at the end of tax year. Gross receipts are the total amounts the organization received from all sources during the tax year, without

subtracting any costs or expenses. If an organization's gross receipts are less than $200,000 and total assets at the end of tax year are less than $500,000 they file Form 990-EZ. If an organization normally has gross receipts of $50,000 or less it must submit Form 990-N, Electronic Notice (e-postcard) for Tax-Exempt Organizations Not Required to File Form 990 and Form 990-EZ.

Joint costs are entered in Form 990 Part IX Statement of Functional Expenses Line 26. More specifically organizations that include in program service expenses (Column (B) of Part IX) any joint costs from a combined educational campaign and fundraising solicitation must disclose how the total joint costs of all such combined activities were allocated in Part IX between education and fundraising.

> "*A combined educational campaign and fundraising solicitation is conducted by an organization when it solicits contributions (by mail, telephone, broadcast media, or any other means) and includes, with the solicitation, educational material or other information that furthers a bona fide non-fundraising exempt purpose of the organization. Expenses attributable to providing information regarding the organization itself, its use of past contributions, or its planned use of contributions received, are fundraising expenses and must be reported in column (D). Don't report such expenses as program service expenses in column (B). Any method of allocating joint costs between columns (B) and (D) must be reasonable under the facts and circumstances of each case. Most states with reporting requirements for charitable organizations and other organizations that solicit contributions either require or allow reporting of joint costs under AICPA Statement of Position 98-2 (SOP 98-2), Accounting for Costs of Activities of Not-for-Profit Organizations and State and Local Governmental Entities that Include Fundraising, now codified in FASB Accounting Standards Codification 958-720, Not-for-Profit Entities-Other Expenses (FASB ASC 958-720)".* (2018-Instructions for Form 990 https://www.irs.gov/pub/irs-pdf/i990.pdf).

In Form 990, while Line 26 of Part IX Statement of Functional Expenses provide the joint cost associated with a combined education and fundraising solicitation, Part XI provides a Reconciliation of Expenses per Audited Financial Statements with Expenses per Return. One item that is of interest is Part XII 2(a) Donated services and use of facilities which when adjusted out will allow for reconciling with total expenses per filed return. In addition, Line 24 (e) in Part IX Statement of Functional Expenses which pertains to "all other expenses" is detailed out in Form 990 Attachment 4.

4. Joint Cost Allocation Methods Recommended under SOP 98-2

In this section for completeness, we reproduce the Appendix F of SOP 98-2: Accounting for Costs of Activities of Not-for-Profit Organizations and State and Local Governmental Entities that Include Fundraising.

Illustrations of Allocation Methods[1]

F.1. Some commonly used cost allocation methods follow.

Physical Units Method

F.2. Joint costs are allocated to materials and activities in proportion to the number of units of output that can be attributed to each of the materials and activities. Examples of units of output are lines, square inches, and physical content measures. This method assumes that the benefits received by the fund-raising, program, or management and general component of the materials or activity from the joint costs incurred are directly proportional to the lines, square inches, or other physical output measures attributed to each component of the activity. This method may result in an unreasonable allocation of joint costs if the units of output, for example, line counts, do not reflect the degree to which costs are incurred for the joint activity. Use of the physical units method may also result in an unreasonable allocation if the physical units cannot be clearly ascribed to fund raising, program, or management and general. For example, direct mail and telephone solicitations sometimes include content that is not identifiable with fund raising, program, or management and general; or the physical units of such content are inseparable.

Illustration
F.3. Assume a direct mail campaign is used to conduct programs of the entity and to solicit contributions to support the entity and its programs. Further, assume that the appeal meets the criteria for allocation of joint costs to more than one function.

F.4. The letter and reply card include a total of one hundred lines. Forty five lines pertain to program because they include a call for action by the recipient that will help accomplish the entity's mission, while fifty-five lines pertain to the fund-raising appeal. Accordingly, 45 percent of the costs are allocated to program and 55 percent to fund-raising.

Relative Direct Cost Method

F.5. Joint costs are allocated to each of the components on the basis of their respective direct costs. Direct costs are those costs that are incurred in

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[1] Source SOP -2 (1998), American Institute of Certified Public Accountants, Inc.

connection with the multipurpose materials or activity and that are specifically identifiable with a function (program, fund raising, or management and general). This method may result in an unreasonable allocation of joint costs if the joint costs of the materials and activity are not incurred in approximately the same proportion and for the same reasons as the direct costs of the materials and activity. For example, if a relatively costly booklet informing the reader about the entity's mission (including a call for action by the recipient that will help accomplish the entity's mission) is included with a relatively inexpensive fund-raising letter, the allocation of joint costs based on the cost of these pieces may be unreasonable, particularly if the booklet and letter weigh approximately the same and therefore contribute equally to the postage costs.

Illustration
F.6. The costs of a direct mail campaign that can be specifically identified with program services are the costs of separate program materials and a postcard which calls for specific action by the recipient that will help accomplish the entity's mission. They total $20,000. The direct costs of the fund-raising component of the direct mail campaign consist of the costs to develop and produce the fund-raising letter. They total $80,000. Joint costs associated with the direct mail campaign total $40,000 and would be allocated as follows under the relative direct cost method:

Program $20,000/$100,000 × $40,000 = $8,000
Fund raising $80,000/$100,000 × $40,000 = $32,000

Stand-Alone Joint-Cost-Allocation Method

F.7. Joint costs are allocated to each component of the activity based on a ratio that uses estimates of costs of items included in joint costs that would have been incurred had the components been conducted independently. The numerator of the ratio is the cost (of items included in joint costs) of conducting a single component independently; the denominator is the cost (of items included in joint costs) of conducting all components independently. This method assumes that efforts for each component in the stand-alone situation are proportionate to the efforts actually undertaken in the joint cost situation.
This method may result in an unreasonable allocation because it ignores the effect of each function, which is performed jointly with other functions, on other such functions. For example, the programmatic impact of a direct mail campaign or a telemarketing phone message may be significantly lessened when performed in conjunction with a fund-raising appeal.

Illustration

F.8. Assume that the joint costs associated with a direct mail campaign including both program and fund-raising components are the costs of stationery, postage, and envelopes at a total of $100,000. The costs of stationery, postage, and

envelopes to produce and distribute each component separately would have been $90,000 for the program component and $70,000 for the fund-raising component. Under the stand-alone joint-cost-allocation method, the $100,000 in joint costs would be allocated as follows: $90,000/$160,000 × $100,000 = $56,250 to program services and $70,000/$160,000 × $100,000 = $43,750 to fund raising.

5. Methodology

Cluster analysis is a type of a data reduction method that can be used for sorting cases, observations or variables into homogeneous groups that are distinct from each other. There are two main methods of cluster analysis: hierarchical where cases are merged sequentially and non-hierarchical, by initializing a cluster and choosing the closes cluster mean (*k*-means clustering) to assign. This article focuses on hierarchical agglomerative cluster analysis. In the accounting field, especially in auditing and fraud detection, cluster analysis would be a potentially useful statistical tool since it allows creating order within accounting data to construct meaningful groups. By grouping cases that are relatively homogeneous within the clusters and heterogeneous between clusters, the approach allows identifying dominant outlier groups of accounting data which we term as anomalies.

In hierarchical agglomeration cluster analysis, clusters or groups are sequentially created by merging similar groups. More specifically, each case is considered as a separate cluster and sequentially combined until all cases belong to one cluster. There are several algorithms available for hierarchical agglomerative clustering which one can choose from. The measurement of distance between cases and the type of linkage between clusters have to be chosen by the user. The distance is the statistic which measures the concept of similarity. If the distance between two cases reduces then similarity between cases will increase. The most commonly used distance measure is the squared Euclidean distance given by $\sum_i^k (X_i - Y_i)^2$.   The sum across variables $i \in (1..k)$ of the squared difference between scores on variable i for case X_i and the score on variable i for case Y_i. When there is more than one case per cluster a linkage measure has to be selected to link the two clusters. The primary choice of linkage measures consists of average linkage, complete linkage, and single linkage.

We use SPSS software for hierarchical cluster analysis in this article. The following are the steps for running cluster analysis on SPSS. First, select the cluster variables to include in the analysis. The three variables used in Section 6 example are the program to total expense ratios based on the Form 990, Audited Financial Statements and Restated data. All the three variables are continuous variables (see Table 3). Second, the cluster method and the cases analyzed has to be labeled. The cluster method selected is Hierarchical Cluster Analysis. Since we are interested in the year where an anomaly would have occurred, case label selected will be the reporting year. Third, the parameters for the distance measure and the linkage measure has to be specified. The default

option for the distance measure is the squared Euclidean distance measure and the default linkage measure is the between-group linkage (average linkage). There is also an option to transform the variables using Z scores so they are equally weighted. In this step, the proximity matrix, dendrogram and an agglomeration schedule should be selected as the output. When selecting the agglomeration schedule, a 2,3,4 and 5 cluster solution can be selected so the output can be carefully analyzed. Finally, the clusters can be compared using the independent t test for equality of means to see how the clusters differ from one another on the variables the were selected to cluster them.

6. Illustration: The Case of NPO-X

NPO-X is a charity that has been in existence for approximately 15 years. The charity has audited financial statements as well as Form 990 published on its website. Table 1 illustrates the reconciliation of audited financial expenses with the total expenses reported on Form 990. This article follows the conservative disclosure approach suggested by CharityWatch to restate the expenses pertaining to program (P), fundraising (F) and management (M) activities. More specifically, the restated expenses in each functional category is computed by subtracting the solicitation expenses (i.e. joint costs) allocated to program activities and adding it to fundraising activities. The joint activity cost associated with a combined education and fundraising solicitation is obtained from Form 990.

Table 1: Reconciling Expenses

Reconciling Expenses per Audited Financial Statements with Expenses per Return in $	
Expenses per audited financial statements	270,211,475
Less: Donated services and use of facilities	(39,027,136)
Add: Investment expenses not included in Form 990	643,006
Total expenses reported on Form 990	231,827,345

Hierarchical cluster method is used to analyses the functional expenses of NPO-X. Using the statistical software SPSS, data clusters pertaining to the expense categories (1) functional expenses based on audited financial statements; (2) functional expenses based on Form 990 and (3) functional expenses based on restated data are analyzed. The agglomeration schedules, and the dendograms for both 2 and 3 cluster solutions are presented in Figures 1, Figure 2, and Figure 3. The dendogram essentially provides the same information that is found in the agglomeration schedule. The two and three cluster dendrograms for restated financial data and the Form 990 are identical with the two cluster solution given by (Y06,Y07, Y08,Y09, Y10, Y11, Y12, Y13) and (Y14, Y15, Y16, Y17) and the three cluster solution given by (Y06,Y07, Y08,Y09, Y10, Y11), (Y12, Y13), and (Y14, Y15, Y16, Y17). The two and three cluster solution for the audited financial statement data are different; the two cluster solution is given by (Y06,Y07, Y08,Y09, Y10, Y11, Y12) and (Y13, Y14, Y15, Y16, Y17) and three cluster

solution given is by (Y06,Y07, Y08,Y09, Y10, Y11, Y12), (Y13, Y14, Y17) and (Y15, Y16).

While the difference in the two and three cluster solutions from audited financial data indicate some difference in the accounting treatment of joint activity of NPO-X in the twelve-year period, in order to get a better idea of the difference, the program to total expense ratios are next analyzed.   The program to total expense ratios based on the Form 990, Audited Financial Statements and Restated data indicate large discrepancies and hence cluster analysis may provide more information on the accounting treatment of joint-activities conducted by NPO-X. These are presented in Table 2. As expected the program to total expense ratios from the restated stated data are lower, since the disclosures are conservative compared to the audited financial statement based ratios. Next we again use hierarchical cluster analysis to develop two and three cluster solutions on the program ratio difference of Audited Vs Restated. The two and three cluster solutions are presented in Figure 4. The two and three cluster dendrograms for the difference in program ratios indicate an interesting pattern with the two cluster solution given by (Y08,Y09, Y10, Y11, Y12, Y13, Y14) and (Y06, Y07, Y15, Y16, Y17) and three cluster solution given by (Y08,Y11, Y12,Y13, Y14), (Y09, Y10), and (Y06, Y07, Y15, Y16, Y17). The highest program to expense ratios were observed in the second cluster of the three cluster solution namely years Y09 and Y10. The second highest program to expense ratios were observed in cluster 2 of the three cluster solution ((Y08, Y11, Y12, Y13, Y14). The lowest program to expense ratios were observed in the thirds cluster of the three cluster solution, namely (Y06, Y07, Y15, Y16, Y17).

Table 2: Program to Total Expense Ratio

	Ratios-Program to Total Expenses		
Year	Form990	Audited	Restated
2006	0.75652067	0.75652067	0.6686055
2007	0.78521265	0.78695456	0.74107979
2008	0.64157544	0.82515124	0.5620626
2009	0.61695738	0.81319029	0.48034735
2010	0.64919131	0.81985812	0.45472597
2011	0.67877329	0.82779855	0.55026929
2012	0.72870501	0.81587431	0.57989797
2013	0.74141718	0.79922648	0.57707567
2014	0.76433041	0.80640171	0.59934659
2015	0.74633785	0.77510335	0.61226939
2016	0.70497638	0.75511467	0.60715219
2017	0.71534024	0.75365354	0.64485769

Panel (A): Agglomeration

Agglomeration Schedule

	Cluster Combined			Stage Cluster First Appears		
Stage	Cluster 1	Cluster 2	Coefficients	Cluster 1	Cluster 2	Next Stage
1	1	2	.029	0	0	5
2	4	5	.059	0	0	3
3	3	4	.082	0	2	5
4	6	7	.129	0	0	8
5	1	3	.279	1	3	8
6	9	12	.302	0	0	9
7	10	11	.597	0	0	10
8	1	6	.987	5	4	11
9	8	9	1.058	0	6	10
10	8	10	2.830	9	7	11
11	1	8	10.402	8	10	0

Panel B: Dendrogram
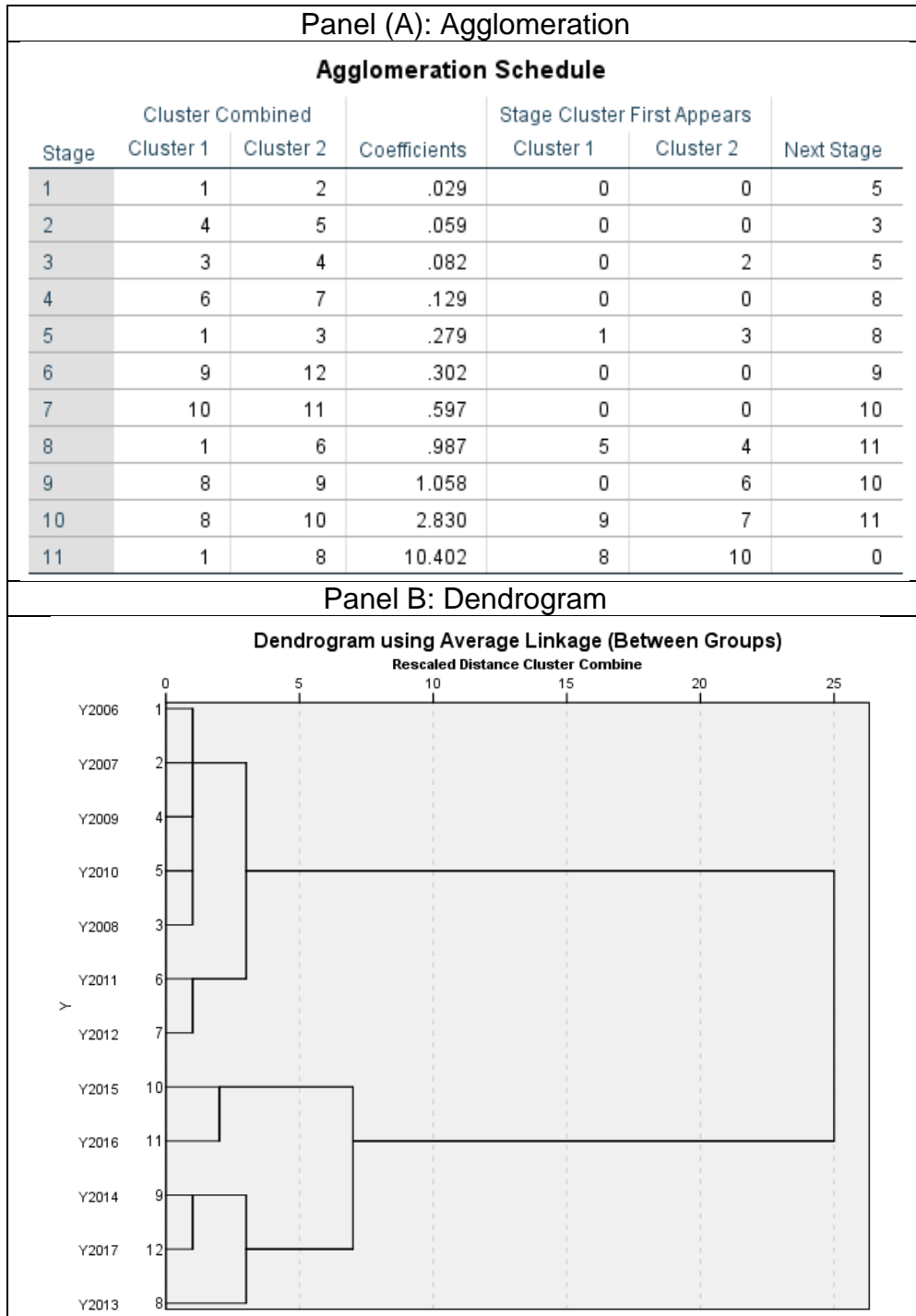
Figure 1: Audited Financial Statement Data

Panel (A): Agglomeration						
Agglomeration Schedule						
	Cluster Combined			Stage Cluster First Appears		
Stage	Cluster 1	Cluster 2	Coefficients	Cluster 1	Cluster 2	Next Stage
1	2	3	.029	0	0	3
2	4	5	.055	0	0	4
3	1	2	.069	0	1	6
4	4	6	.157	2	0	6
5	9	12	.295	0	0	9
6	1	4	.312	3	4	10
7	7	8	.780	0	0	10
8	10	11	1.012	0	0	9
9	9	10	1.795	5	8	11
10	1	7	2.063	6	7	11
11	1	9	11.207	10	9	0

Panel B: Dendrogram

Figure 2: Form 990

Panel (A): Agglomeration

Agglomeration Schedule

Stage	Cluster Combined Cluster 1	Cluster 2	Coefficients	Stage Cluster First Appears Cluster 1	Cluster 2	Next Stage
1	2	3	.026	0	0	3
2	4	5	.060	0	0	4
3	1	2	.068	0	1	6
4	4	6	.153	2	0	6
5	9	12	.230	0	0	9
6	1	4	.314	3	4	10
7	7	8	.857	0	0	10
8	10	11	1.159	0	0	9
9	9	10	1.666	5	8	11
10	1	7	2.209	6	7	11
11	1	9	11.163	10	9	0

Panel B: Dendrogram

Figure 3: Restated Data

Panel (A): Agglomeration						

Agglomeration Schedule

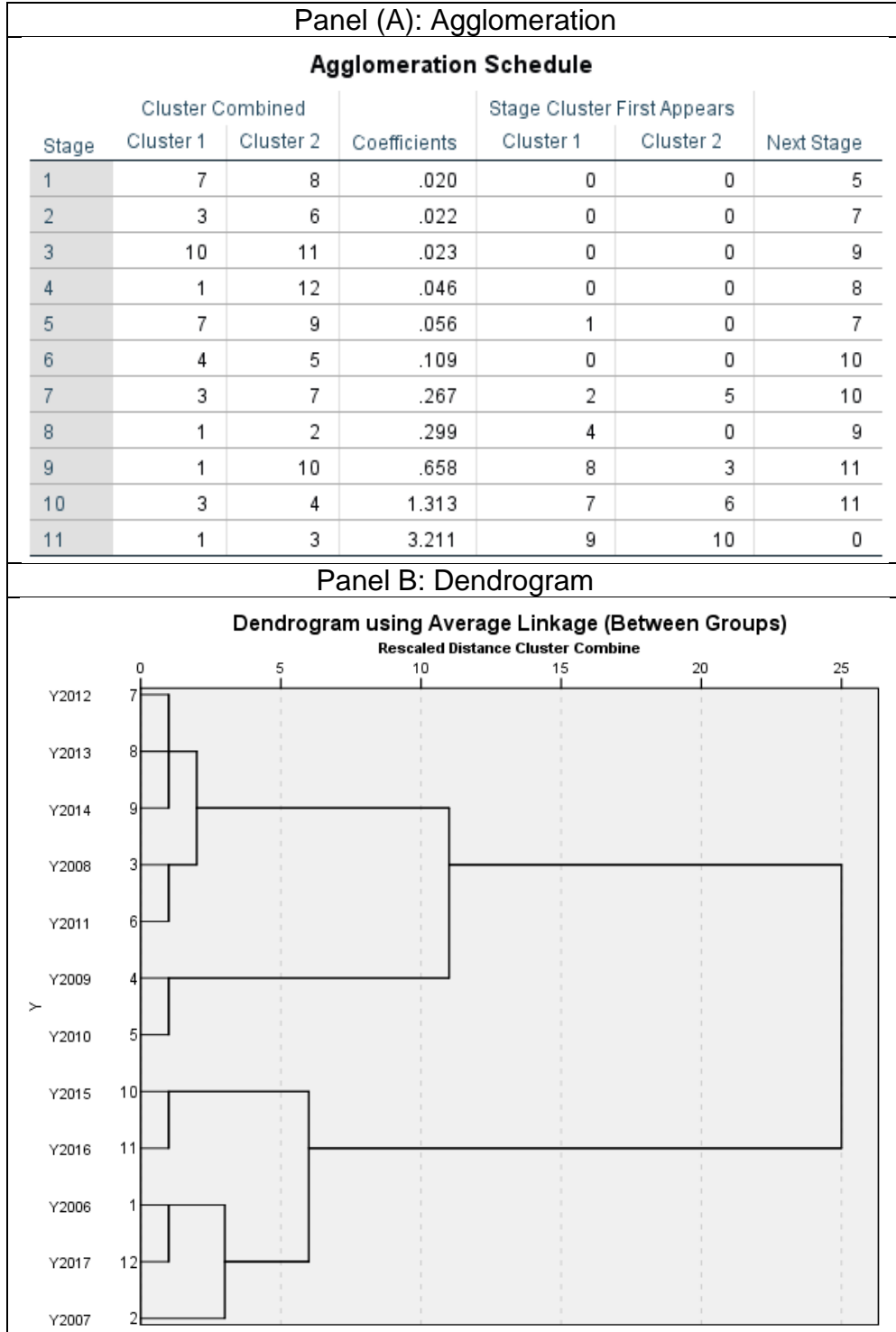| Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	7	8	.020	0	0	5
2	3	6	.022	0	0	7
3	10	11	.023	0	0	9
4	1	12	.046	0	0	8
5	7	9	.056	1	0	7
6	4	5	.109	0	0	10
7	3	7	.267	2	5	10
8	1	2	.299	4	0	9
9	1	10	.658	8	3	11
10	3	4	1.313	7	6	11
11	1	3	3.211	9	10	0

Panel B: Dendrogram

Figure 4: Program ratio Difference (Audited vs Restated)

7. Conclusions

Using a data science approach to investigate joint cost anomalies in not-for-profit organizations, this article attempt to apply cluster analysis to identify whether a NPO has used joint cost allocation schemes to disclose high program to expense ratios with a view to encourage donors and resource providers to increase their contributions to the NPO. In our example of NPO-X, the hierarchical cluster analysis indicate that the organization had very high program to expense ratios in 2009 and 2010 but in recent years 2015 through 2017, it has gone back to the low program to expense ratio levels as in the early years when the NGO just started, which are more reasonable. The proposed approach uses hierarchical linkage clustering since it is a small data set because linkage clustering allows using domain specific similarity measures. Cluster analysis is an exploratory analysis method which attempts to identify homogenous groups of cases when the groupings are not known. As the case example illustrates, it can be used as a tool to detect joint cost allocation anomalies in the non-profit sector.

There are however several limitations of using the hierarchical cluster analysis method. Although cluster analysis groups cases into homogeneous clusters, the choice of algorithms and methods will influence the outcome and hence the results can be easily misinterpreted. In hierarchical cluster analysis, the cases are combined by merging them sequentially. However, the user has to decide whether to use an agglomerative or divisive cluster which will also influence the outcome. In addition, the results may also be affected by the choice of the distance measure which is used as the concept of similarity. The most commonly used distance measure for continuous variables is the squared Euclidean distance. In addition, there is also the choice of linkage measures such as single linkage, complete linkage and average linkage to choose from that may affect the outcome. More to the point, the exact number of clusters is difficult to determine and can be subjective since the underlying cluster solution can change based on the linkage measure selected. There can also be issues such as non-optimal performance in hierarchical cluster analysis if the data set is large due to the sequential approach it utilizes. Despite these potential limitations which is inherent, it is a flexible method and a useful statistical tool for analyzing anomalies in the field of accounting practice. The best approach is for the user is to employ difference cluster techniques and compare results.

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