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Abstract

Since its introduction by Tuckman and Chang (Nonprofit Volunt Sector Q 20(4):445-460, 1991), the Hirschman-Herfindahl Index (HHI) has been widely adopted into the nonprofit literature as a precise measure of revenue concentration. This widespread adoption has been characterized by diverse composition, with the HHI's calculation being largely determined by the nature of the available data and the degree to which it contained disaggregated measures of revenue. Using the NCCS 990 Digitized Data, we perform an acid test on whether different HHI measures yield significantly different results. Four measures of revenue concentration--an aggregated measure based on three revenue streams, an aggregated measure separating government grants from other contributions, a more nuanced measure based on seven revenue streams, and a fully disaggregated measure based on thirteen revenue streams--are used to predict two dominant nonprofit financial health dimensions: financial volatility and financial capacity. Overall, our results show that aggregation in HHI measurement matters; aggregation often downplays relationships by influencing the significance levels and magnitudes of estimates in a non-trivial way.

Keywords

Revenue concentration, Hirschman-Herndahl Index, Nonprofit financial capacity, Financial volatility, Measurement

Introduction

Researchers have captured revenue diversification by calculating a Hirschman Herndahl Index (HHI). Its calculation has largely been determined by the nature of the available data and the degree to which it contained disaggregated measures of revenue. To that effect, the HHI calculation has included varying counts of revenue streams ranging from three, four, five, eleven, and thirteen, to as many as nineteen. Given its high degree of adoption and use in nonprofit research, this paper seeks to perform an acid test on whether the way the revenue diversification is calculated, that is, whether one uses more aggregated measures (three or four revenue streams) or more disaggregated measures (seven or thirteen revenue streams), influences the results in important ways. In other words, how sensitive is the Hirschman Herndahl Index when it is calculated using different counts of revenue aggregations? The concern here is that with aggregation, important information is lost -- information that can potentially alter estimations and predictions in non-trivial ways.

Hirschman-Herndahl Index: Paternity and Adoption

Independently posited by both Hirschman (1945, 1964) and Herndahl (1950) as a measure of trade and industry concentration or inequality, the HHI has been used in the calculation of concentration across various contexts, ranging from household wealth or income, merger analysis, rm outputs (Rhoades 1993), to revenue concentration in both the public (e.g., Suyderhoud 1994) and nonprofit sectors (e.g., Calabrese 2011; Carroll and Stater 2009; Chang and Tuckman 1994; Chikoto and Neely 2014; Mayer et al. 2012; Tuckman and Chang 1991; Yan et al. 2009). The HHI is therefore regarded as a precise measure of concentration that takes into account the number of revenue streams and the distribution amongst them.

Since its introduction into the nonprofit literature by Tuckman and Chang (1991), there has been a widespread adoption of the HHI. For instance, a basic google scholar search of the words revenue diversification AND nonprofit yields about 17,100 records where the words revenue, diversification, and nonprofit have been used or referenced within a single record. Alternatively, the word search of revenue concentration AND nonprofit yields 27,500 records. Bottom line; the topic of revenue diversification or its inverse, revenue concentration, has been and continues to be of keen interest to the study of nonprofit organizations financial environments (Chang and Tuckman 2010). Generally, the strategy of revenue diversification has been positively associated with financial stability (Carroll and Stater 2009; Greenlee and Trussel 2000; Hager 2001; Keating et al. 2005; Thomas and Trafford 2013; Trussel 2002; Tuckman and Chang 1991), and negatively associated with financial capacity building (Chikoto and Neely 2014; Faulk 2010; Foster and Fine 2007). As a result, various recommendations to nonprofit organizations have ensued surrounding revenue diversification and concentration.

The HHIs widespread adoption as a measure of revenue diversification has also been characterized by wide composition. As a function of data availability (e.g., National Center for Charitable Statistic (NCCS) Core 990 Data versus NCCS Digitized Data), U.S.-based nonprofit researchers have tended to rely on three aggregated revenue sources - donative, earned, and investment income to calculate the HHI (e.g., Carroll and Stater 2009; Keating et al. 2005; Frumkin and Keating 2002). Others have used four revenue streams - donative income, earned income, government grants, and investment income (e.g., Yan et al. 2009); with some using five revenue sources very different from those used in Tuckman and Chang (1991) public support, program service revenues, dues and assessments, net fundraising income, and profits from the sale of inventory (e.g., Hager 2001).

Where more comprehensive data was available, a handful of researchers have measured revenue diversification using more disaggregated revenue streams, ranging from as many as eleven (Calabrese 2011), thirteen streams (Chikoto and Neely 2014), to nineteen revenue streams (Wicker and Breuer 2013). Piquing our interest is that, although not the centerpiece of Chikoto and Neelys (2014) research, in their review of whether revenue concentration promoted nonprofit financial capacity growth, the authors observed that as the HHI became more comprehensive (calculated using three, four, or thirteen revenue streams), the coefficients on their financial capacity growth measures increasingly became more positive.

Bear in mind that, grounded in Markowitzs (1952) financial portfolio theory, revenue diversification is a risk reduction strategy that is based on the differential levels of volatility associated with each revenue stream. Furthermore, each funding stream generally requires different solicitation and fundraising competencies. In light of all of the above, this research uses the NCCS 990 Digitized Data to test whether different HHI measures significantly predict different levels of financial volatility (a measure of stability) and financial capacity (a measure of growth) two thematic areas that have dominated nonprofit research (Bowman 2011).

Aggregation and Information Loss

Nonprofit financing can be classified into varying macro and micro categories such as donations or contributions (as represented in the 990 form), which when disaggregated, may include donations from individual and from institutions like foundations, as well as government grants. Hence, the

contributions variable would represent a reduced funding stream at the macro-level. In the same vein, government funding, includes funding from federal, state, and local government, which in turn can be disaggregated into grants, contracts, and cooperative agreements (Kerlin 2006), among other forms - all of which behave differently (Young 2006) and may generate different behaviors from nonprofit recipients of such funding (Chikoto 2015; Chikoto 2007; Kelman 2002; Kerlin 2006; Salamon 2002).

The NCCS is a key source of data for studying nonprofits in the United States. Unless digitized, its datasets generally aggregate funding from individuals (from charitable donations, bequests, and other fundraising initiatives), foundations (independent and corporate), and government grants under one category of contributions. But in reality, each of these funding sources requires different fundraising and grant making techniques to acquire as they are influenced by diverse motivations and factors and hence, may impose diverse opportunities, demands, and restrictions on nonprofit organizations (see Chikoto 2015; Cordes and Sansing 2006; Rooney 2006; Rushton and Brooks 2006). In addition, each one of these sources might be subjected to unique volatility (Foster and Fine 2007; Froelich 1999; Mayer et al. 2012).

The same is equally true about earned income and investment income. In fact, investment income has often been aggregated under the umbrella of earned income, and more recently, the NCCS classifies membership dues as a type of earned income. Again, the fact is that, earned income includes income earned from the sale of mission and non-mission-related goods and services (in the form of fees and funding from government contracts), as well as income generated from various other commercial ventures and corporate partnerships (see James and Young 2006). On the other hand, investment income includes interest, dividends, and capital gains generated from endowments and quasi-endowments and the sale of assets (see Bowman et al. 2006). According to Mayer et al. (2012), investment income is a uniquely independent resource, (p. 15), one whose generation is not dependent on a nonprofits ability to market its goods and services while it is generated via different channels. Aggregation therefore, masks these differences by discarding information (Fan and Zhang 2012; Orcutt et al. 1968).

This raises questions about the types and number of funding streams that are included in the calculation of the revenue concentration index and whether the indices generated from such calculations influence results. Studies of biological, ecological, and population systems recognize that aggregation reduces the number of variables, which according to Sanz and Bravo de la Parra (1998), ignores the internal structure of phenomenon under scrutiny. Such simplification overlooks the possibility that the internal structure may have implications for everything else (Sanz and Bravo de la Parra 1998), especially since variables aggregation reduces the dimensionality necessary for predicting system dynamics (Shpak, Stadler, Wagner, and Hermisson 2004, 61). In the same logic, by aggregating a nonprofits revenue stream that is, relying on three or four compared to eleven, thirteen, or nineteen revenue streams in the construction of the revenue concentration index, the assumption one makes is that the internal structure provides no additional information. Our simple demonstration below does not support this assumption.

For example, organization A has three revenue streams, $R1 = \$1$, $R2 = \$49$, and $R3 = \$50$, and total revenue $TR = \$100$. If we aggregate the first two revenue streams and then calculate a HHI measure as the sum of the squared portion of total revenue, we would have $\mathrm{HHI} =$

$((\$1 ? \$49)/\$100)2 ? (\$50/\$100)2 = 0.50$. Organization B also has three revenue streams, $R1 = \$25$, $R2 = \$25$, and $R3 = \$50$, and total revenue $TR = \$100$. Using the aggregated approach to calculate the HHI, we will have $\text{HHI} = ((\$25 ? \$25)/\$100)2 ? (\$50/\$100)2 = 0.50$. We would conclude that the two organizations are the same in terms of revenue concentration. Now let us use the disaggregated approach to calculate the HHI. For organization A, the $\text{HHI} = (\$1/\$100)2 ? (\$49/\$100)2 ? (\$50/\$100)2 = 0.490$. For organization B, the $\text{HHI} = (\$25/\$100)2 ? (\$25/\$100)2 ? (\$50/\$100)2 = 0.375$. The disaggregated measure helps us to see that organization B has a more diversified revenue strategy than organization A (where an HHI approaching 1 signifies concentration). This example illustrates that information is lost during the aggregation process.

Apart from data limitations, revenue concentration indices have been calculated using five or fewer funding streams, without necessarily providing much justification or argument for the aggregation. This is where this research comes in, to test this assumption, in an effort to understand whether different aggregated and disaggregated measures of revenue concentration result in significantly different results. As Tuckman and Chang (1991) noted above, the HHI is designed to capture not only the number of revenue sources, but also the level of dispersion amongst them. As Orcutt et al. (1968) noted, aggregation can result in extreme loss of effective estimation and testing power, (773) giving us reason to be concerned.

The current study also addresses which type of revenue sources may lead to more or less loss of information when aggregated. To address this, we focus on three categories of revenue: contributions, earned income, and investment income, primarily because these categories represent dominant fundraising structures or models in the nonprofit sector (Carroll and Stater 2009; Hansmann 1980).

In addition, diversification in one's revenue mixes and hence, resource dependence has been closely linked to one's mission. For example, testing Youngs (2006) normative theory of nonprofit finance, Fischer et al. (2011) found that the more public a nonprofits services are, that is, services that are more collective in nature and hence, exhibit nonrivalry and nonexclubility qualities, the more likely the organization is to rely on donative income. The authors also found that nonprofits that generate a high proportion of their revenue from earned income are those that produce private benefits, that is, goods and services that can feasibly be sold on the marketplace without undermining nonprofit mission. Furthermore, commercial nonprofits have been found to display more concentrated revenue streams than donative nonprofits (Chang and Tuckman 1994). And compared to donative and earned income categories, investment income is by far the most volatile (Mayer et al. 2012, 15).

Considering the relatively distinct nature of the three broad categories of revenue (contributions, earned income, and investment income), it becomes an empirical question whether revenue sources within each category are relatively more or less homogenous and whether this level of homogeneity leads to relatively more or less information loss and thus measurement error within the HHI.

Data and Methods

As noted earlier, in researching whether revenue concentration promotes growth in nonprofits financial capacity, Chikoto and Neely (2014) found discrepancies in the direction and magnitude of the results across the three revenue concentration measures they employed (based on whether three, four, or thirteen revenue sources were used). The authors inadvertently observed that the coefficients

on their measures of financial capacity increasingly became more positive as the HHI became more comprehensive, suggesting that how one measures revenue concentration may alter the results.

Hence, this research is mainly concerned with how the HHI is measured and whether different measurements yield significantly different results for predicting or estimating nonprofit financial health[1]. Such an examination is crucial given the widespread acceptance and use of the HHI in nonprofit research. As noted in the literature, nonprofit financial health is a two-dimensional concept which includes financial stability and capacity (Bowman 2011; Miller 2001, 2003). With this distinction in mind, this research explicitly tests whether different HHI measures produce significantly different financial volatility and financial capacity growth estimates.

Using NCCS digitized 990 data (19982003), we employ Ordinary Least Squares (OLS) to test whether using aggregated measures (i.e., the three- or four-item revenue diversification measures) compared to more comprehensive measures (i.e., the seven- or thirteen-item revenue diversification measures), yield significantly different financial volatility and financial growth results. While the overall dataset included 1,388,480 observations, we deleted 94,962 returns led for special conditions such as termination, as well as dropped 34,183 group affiliated returns. We also deleted 14,755 observations because they had a scal year-end change. We thus limited observations to have all variables necessary to run the regressions.

Finally, we made sure that the sample was the same for both our financial volatility and financial capacity tests, which limited the sample to 1 year of data (2003) due to the capacity growth measure requiring five (5) years of data. As a result, our final sample had 103,701 observations representing every National Taxonomy of Exempt Entities (NTEE) major code (A through Z).

Table 1 shows the distribution of nonprofits by the count of revenue sources for the year 2003. Approximately, half of our sample collects income from more than four sources. And based on Table 2, the three most common revenue sources for our sample are direct public support (75 %), interest on investments (70 %), and program service revenue (65 %), which, respectively, reflects the three commonly used nonprofit revenue classifications of donative, investment, and earned income. Together, the results in Table 2 indicate that close to half of the organizations have some diversification within the three revenue categories.

Although not surprising that many nonprofits have revenue diversification across these three revenue streams, the majority of the nonprofits in our sample demonstrated a tendency to diversify within one or more of these three streams. This provided us with an opportunity to test whether how we measure revenue diversification has different implications for nonprofits dependent on different types of funding models. Specifically, we performed the acid test using four scenarios. The first scenario includes an acid test of whether diversification measurement yields different results across our full sample of 103,701 nonprofits.

As noted in the literature, nonprofits are particularly subject to resource dependency (Carroll and Stater 2009 p. 950), and reliance on any one revenue stream greatly influences its organizational structure and financial health (Brooks 2002; Hodge and Piccolo 2005; Weisbrod 1998). As such, the next three acid tests

Table 1 Number of nonprofits by the count of revenue streams

Number of revenue streams	Number of nonprofits	Percent of total	Cumulative percent
1	5080	4.90	4.90
2	13,209	12.74	17.64
3	19,239	18.55	36.19
4	20,942	20.19	56.38
5	18,349	17.69	74.08
6	13,082	12.62	86.69
7	7790	7.51	94.20
8	3807	3.67	97.88
9	1548	1.49	99.37
10	510	0.49	99.86
11	115	0.11	99.97
12	28	0.03	100.00
13	2	0.00	100.00
Total	103,701	100.00	

Table 2 Percentage of nonprofits by the type of revenue stream

Revenue stream	Percentage of nonprofits with source (%)
Direct public support	75
Indirect public support	20
Government grants	35
Program service revenue	65
Membership dues	24
Interest on investments	70
Dividends from securities	29
Other investment income	6
Net rental income‘	13
Net gain on sale of assets	12
net income from special events	31
Gross profit from sale of inventory	14
Other revenue	40

are based on three scenarios that reflect the nature of a nonprofit organizations resource-dependence, that is, whether its funding sources are predominantly diversified within donative, earned, or investment income.

First, Donative-dependent reflects nonprofits with at least two of the following sources: direct public support, indirect public support, government grants, and/or net income from special events. In addition, donative-dependent nonprofits must have fewer than two earned income revenue streams and fewer than two investment income revenue streams. Second, Earned Income-dependent denotes a subgroup of nonprofits with at least two of the following sources: program revenue, membership dues, and/or other revenue. In addition, earned income-dependent nonprofits must have fewer than

two donative income revenue streams and fewer than two investment income revenue streams. And finally, Investment Income-dependent contains a subgroup of nonprofits with at least two of the following sources: interest and savings, other investment income, and/or net gain from sale of assets. In addition, investment income-dependent nonprofits must have fewer than two donative income revenue streams and fewer than two earned income revenue streams.

Dependent Variables

Our first dependent variable is a measure of revenue volatility consistent with Carroll and Stater (2009). This is measured as the percentage of actual revenues deviated from predicted values. Specifically the following fixed effects model is first run:

$$R_{it} = \beta_i + \beta_t + \varepsilon_{it},$$

where R_{it} is the log of total revenue, β_i represents a series of dummy variables for each organization, and β_t represents a series of time dummy variables. The residual from the model ε_{it}, represents the deviation of actual revenue from expected revenue. The predicted values from the model are then obtained and divided by the absolute residuals to generate the measure for revenue volatility. We run the model over all years of data in the dataset (1998-2003) and then use the results to obtain the revenue volatility measure in 2003 and the prior revenue volatility measure (in 2002) for our final sample.

Carroll and Staters (2009) iteration of financial volatility is therefore calculated on the basis of the extent of the deviation between actual and expected revenue. Specifically, based on a revenue growth trend regression model, volatility is estimated as the percent deviation of the actual gross revenue from the expected revenue. According to the authors, this measure includes controls for fiscal years to account for potential prior revenue volatility, in addition to accounting for the unique total revenue growth trends for each organization. Our second dependent variable is similar to Chikoto and Neely (2014) and is measured as the five-year percentage growth in total revenues from 1998 to 2003 (line 12 on the IRS 990 form).

Independent Variables

As indicated above, we model revenue diversification at four levels of aggregation; first, following Carroll and Stater (2009), the most aggregated measure $\left(\mathrm{RD}_{\mathrm{Aggregated}}\right)$ is based on three revenue streams: contributions, investment income, and program revenue. Our second measure separates out government grants and includes four revenue streams following Yan et al. (2009): contributions, government grants, investment income, and program revenue $(\mathrm{RD}_{\mathrm{FourSource}})$. Our third measure is based on seven revenue streams $(\mathrm{RD}_{\mathrm{SevenSource}})$ identified as the streams most common in our sample: direct public support, government grants, program service revenue, interest on investments, dividends from securities, net income from special events, and other revenues (see Table 2). For our fourth measure, similar to Chikoto and Neely (2014), we include a comprehensive or disaggregated measure $\left(\mathrm{RD}_{\mathrm{comprehensive}}\right)$ which includes thirteen revenue streams.

These revenue streams are the break-down of the first line item and the other ten line items of the revenues on the Form 9902 This comprehensive measure takes advantage of the richness of the digitized data. The general form of the four measures is

$$\mathrm{RD} = \left(1 - \sum_{i=1}^{n} \mathrm{Ri}^2\right) / \left[(n-1)/n\right],$$

where R_i is the ratio of the revenue stream to total revenue; and n is the number of revenue streams, which is 3, 4, 7, or 13 depending on the measure. This RD measure, a variation of HHI (i.e., $\mathrm{RD} = (1 - \mathrm{HHI})/[(n-1)/n)]$), is widely used in nonprofit studies (e.g., Carroll and Stater 2009; Yan et al. 2009). It is interpreted as follows: the higher the value of RD, the greater the level of revenue diversification[3]

Table 3 provides descriptive statistics for our four HHI measures, as well as our two dependent variables; financial volatility and financial capacity growth. We observe differences in means across the four revenue diversification indices, with a greater dispersion across the medians. Consistent with expectations, the mean and median values of the indices are higher for the level of disaggregation ($\mathrm{RD}_{\mathrm{Aggregated}}$ is the smallest with the largest value observed in $\mathrm{RD}_{\mathrm{Comprehensive}}$). In addition, the revenue volatility mean percentage of 2.1 % is similar to the 2.49 % reported in Carroll and Stater (2009).

Table 3 also demonstrates that 24 % of the nonprofits had revenue diversity only within donative streams, 16 % of the nonprofits had revenue diversity only within earned revenue streams, with 4 % of the sample having revenue diversity only within investment-based revenue sources. This suggests that inferences derived from using the three source aggregation measure will provide less value to approximately 44 % of the organizations. A significant number of organizations could gain more insights when a revenue diversification measure looks into the details of the revenue sources.

Control Variables

In all financial volatility models, we control for similar variables utilized in the literature, in particular, Carroll and Stater (2009). These include prior financial volatility, organizational size (measured by total expenses), administrative and fundraising efficiency (measured as the ratio of administrative expenses to total expenses and fundraising expenses to total expenses, respectively), debt margin (total year-end liabilities divided by total year-end assets), total margin (net surplus or deficit divided by total revenue), retained earnings (measured by net assets), age, and whether an organization was donative or not (whether the ratio of donations to total revenue is greater than 50 % or not). The controls for prior financial volatility and size are both found by Carroll and Stater (2009) to be significant and are therefore included in our model.

Administrative and fundraising efficiency are included as it is expected that organizations that are less efficient are more financially troubled and are therefore more likely to experience greater financial volatility (Keating et al. 2005). Debt and total margins are included to control for the level of financial flexibility. Organizations that are more financially flexible are expected to be less financially volatile. Retained earnings are also included in the model since organizations with more retained earnings are expected to be financially healthier and thus experience less revenue volatility. In addition, we control for the age of the organization as we expect older organizations to be more revenue stable and thus less volatile. Recognizing that different revenue types behave differently and that organizations' missions and geography often drive choices in revenue types, we also control for organizational sector or field, location, and whether an organization is primarily donative.

Table 3 Summary statistics for variables of interest

Variable	Mean	Median	Sd	Min	Max	*N*
$\mathrm{RD}_{\mathrm{Aggregated}}$	0.31	0.23	0.29	0.00	0.99	103,701
$\mathrm{RD}_{\mathrm{FourSource}}$	0.33	0.29	0.28	0.00	0.99	103,701
$\mathrm{RD}_{\mathrm{SevenSource}}$	0.35	0.35	0.26	0.00	0.97	103,701
$\mathrm{RD}_{\mathrm{Comprehensive}}$	0.35	0.36	0.26	0.00	0.93	103,701
Voltperc	0.02	0.01	0.03	0.00	0.65	103,701
fiveyrg_totalrev	0.82	0.25	22.5	-0.99	5,573	103,701
Donative-dependent	0.24	0.00	0.43	0	1	103,701
Earned income-dependent	0.16	0.00	0.36	0	1	103,701
Investment Income- dependent	0.04	0.00	0.18	0	1	103,701

Paired T tests reveal that the differences between *RDaggregated* and *RDComprehensive* are statistically different at $p < 0.001$. *Donative-dependent* is defined as ''1'' if the organization has at least two of the following sources: direct public support, indirect public support, government grants, and/or net income from special events. In addition the organization has one or zero earned income sources and one or zero investment income source. *Earned Income-dependent* is defined as ''1'' if the organization has at least two of the following sources: program revenue, membership dues, and/or other revenue. In addition the organization has one or zero donative income sources and one or zero investment income source. *Investment Income-dependent* is defined as ''1'' if the organization has at least two of the following sources: interest and savings, other investment income, and/or net gain from sale of assets. In addition the organization has one or zero donative sources and one or zero earned income sources

For the financial capacity models, consistent with Chikoto and Neely (2014), we control for total revenue, fundraising and administrative efficiency, the age of the organization, the ratio of executive compensation to total compensation, whether an organization is primarily donative, as well as include controls for organization type and location. All independent variables for the financial capacity models are measured for the year 1998, since this is the base year for our dependent variable. Total revenue is included as a control in recognition that revenue growth rates are dependent in part on starting levels of revenue. Fundraising and administrative efficiency are included as we expect more efficient organizations to experience higher growth rates. Age is included in the model as we expect more mature organizations to have a slower rate of growth. We also control for the relative amount of the budget spent on executive compensation as we expect that organizations run by a relatively more professional executive team will experience higher growth rates. Finally, in recognition that revenue types can be expected to have different growth rates, and that mission and location often drive the choice of revenues, we also include controls for whether an organization is primarily donative, the organizations sector, and the organizations state of location.

OLS Regression Results

Table 4 provides a summary of our regression results, and Tables 5, 6, 7, 8, 9, 10, 11 and 12 in the Appendix provide results for the detailed regression models.

First, our models using the full sample - in predicting financial stability - show statistically insignificant results which are inconsistent with Carroll and Staters (2009) general findings that increasing ones level of revenue diversification reduces financial volatility and hence contributes to the financial stability of the organization. Our results show that the level of revenue diversification is not associated with the

level of financial volatility. However, when assessing whether revenue concentration is associated with nonprofit financial growth, our results fully demonstrate the impact of information loss through aggregation. In this case, only the disaggregated measures (seven or thirteen sources) of revenue diversification yield statistically significant results4 compared to relying on the aggregated (three or four sources) HHI measure.

Pertinent to our research, the results in Table 4 demonstrate the impact of information content between our diversification measures, with the disaggregated measures ($\mathrm{RD}_{\mathrm{SevenSource}}$ or $\mathrm{RD}_{\mathrm{Comprehensive}}$) capturing more detailed diversification information than the aggregated measures ($\mathrm{RD}_{\mathrm{Aggregated}}$ or $\mathrm{RD}_{\mathrm{FourSource}}$). Restricting our analysis to the three subsamples of nonprofits dependent on donative, earned, and investment income, respectively, yields revealing results on the impact of information loss due to aggregation. Recall that donative income-dependent nonprofits denote a subgroup of nonprofits dependent on at least two or more of the following sources: direct public support, indirect public support, government grants, and/or net income from special events, with fewer than two earned or investment income sources. In the same vein, earned income-dependent nonprofits predominantly rely on at least two of the following sources: program revenue, membership dues, and/or other revenue, with the investment income-dependent subgroup relying on at least two or more of the following sources: interest and savings, other investment income, and/or net gain from sale of assets, and less on the others streams.

Impact on Financial Volatility

First, when dealing with predominantly donative income-dependent nonprofits, the comprehensive measure does not support a diversification strategy when trying to reduce financial volatility. The results in Table 4 show that while using the most aggregated diversification measure yields statistically significant results, using four, seven, or thirteen sources results in statistically insignificant findings. (For additional detail, also see Table 7). This suggests that using an aggregated measure overstates results, leading one to conclude that there is a relationship between revenue diversification and financial volatility when no relationship exists.

Second, isolating the analysis only to earned income-dependent and investment income-dependent nonprofits, respectively, seem to confirm the first point above. The magnitude of the relationship is demonstrably understated (0.061 compared to 0.179 and -0.064 compared to 0.258, respectively, between the least and most aggregated HHI measures). In the case of investment income-dependent nonprofits, the direction of the relationship between revenue diversification and financial volatility not only changes, the results also become statistically significant. In fact, our comprehensive measure results suggest that increasing diversification within earned income or investment income increases financial volatility (For additional detail, also see Tables 8, 9). Our results are different from - Mayer et al.'s finding which focuses on the diversification cross the donative, earned, and investment income; instead, our results show the additional insights gained from looking into the details of the three income categories.

Impact on Financial Capacity

A similar story is also observed when assessing the impact of revenue concentration on nonprofit financial growth. As demonstrated in Table 4 (For additional detail, also see Tables 10, 11, 12), using an

aggregated revenue diversification measure would lead us to conclude that there is no relationship between revenue concentration and financial capacity growth (as shown in the full model and when isolating the analysis only to investment income-dependent nonprofits). However, the results from the more disaggregated measures ($RD_{SevenSource}$ or $RD_{Comprehensive}$) tell a different story, one that is consistent with Chikoto and Neelys (2014) findings.

In addition, focusing on the subsample of donative- and earned income-dependent nonprofits, we also observe noteworthy differences in the magnitude of the coefficients, thus further displaying the impact of information loss through aggregation. In two scenarios we observe that the aggregated revenue diversification measure understates

Table 4 Summary OLS results predicting financial volatility & financial capacity growth

$RD_{Aggregated}$	-0.009	0.063*	0.061*	-0.064
$RD_{FourSource}$	0.006	-0.023	0.217***	0.057
$RD_{SevenSource}$	0.026	-0.006	0.146***	0.230**
$RD_{Comprehensive}$	0.015	-0.050	0.179***	0.258**
Dependent variable: 5-year revenue growth				
$RD_{Aggregated}$	0.004	-0.066***	-0.104***	0.030
$RD_{FourSource}$	-0.006	-0.096***	-0.167***	-0.050
$RD_{SevenSource}$	-0.077***	-0.149***	-0.168***	-0.399***
$RD_{Comprehensive}$	-0.074***	-0.159***	-0.201***	-0.450***

All models include robust standard errors
* p\0.05, ** p\0.01, *** p\0.001

the magnitude of financial growth when nonprofits concentrate their revenues streams (6.6 % compared to 15.9 % growth for donative-dependent nonprofits, and 10.4 % compared to 20.1 % growth for earned income-dependent nonprofits).

Discussion and Conclusion

Generally, the nature of nonprofit financial data has inadvertently predisposed nonprofit researchers to how to construct the revenue concentration index. Limited data on revenue streams meant the adoption of more aggregated measures of revenue concentration. However, the degree to which this impacted the results remained hitherto an unexplored or unquestioned issue. Building on Chikoto and Neelys (2014) suspicions, our results suggest that a loss of information occurs through aggregation and this in turn affects estimation results in important ways. Researchers and nonprofits are thus encouraged to evaluate the importance of the additional information disaggregated measures provide, in order to capture a more accurate picture of revenue diversification (concentration) and its potency as a strategy for financial health (growth).

Overall, the preceding results demonstrate a number of issues that have implications for research utilizing the revenue concentration index. First, based on the results from the full sample, how the revenue diversification index is constructed not only might result in divergent results, it may also influence whether results are significant or not, as demonstrated in our test for financial growth.

Hence, merely relying on the aggregated measure would result in a verdict of no relationship between revenue concentration and financial capacity growth.

Second, if the theory of information loss due to aggregation is correct, then our results suggest that using aggregated measures of revenue diversification may misstate the magnitude and/or statistical significance of the findings as scenarios changes. While utilizing, our full sample demonstrates a modest impact of information loss, especially in the financial volatility model; breaking up our sample of nonprofits by their resource-dependence yielded results that allowed us a better understanding of the impact of information loss through aggregation. Hence, it becomes important for researchers to be well-acquainted with their data and the character of their sample of study. An ancillary benefit here may be the need to also be cognizant of the nature of revenue diversification among different nonprofit organizations as suggested by Young (2006) and others.

With respect to the primary objective of this research, our results demonstrate that, revenue diversification measurement matters, that is, how one aggregates revenue streams in the calculation of the HHI, influences the direction and significance levels of ones estimates. In all, we believe there are important lessons here for nonprofit researchers, which brings us to our third observation; where magnitudes are important, caution should be exercised when interpreting results when using aggregated measures of revenue.

Granted, due to cost restrictions, researchers have to choose between existing datasets with aggregated revenues or having to spend money to purchase more disaggregated data, or spend substantial number of hours hand collecting data. In light of the nature of the data available to researchers, work still needs to be done in establishing greater data specificity and in reclassifying data to capturing all, new, and different forms of revenue (Chang and Tuckman 2010). Finally, researchers and nonprofits need to be cautious when advocating a revenue diversification strategy. As shown above, when a nonprofit goes after diversification within a revenue stream (e.g., donative versus investment income), it may not get the normally believed results of lower revenue volatility.

In general, aggregation forces otherwise nuanced revenue sources into a few revenue streams, thus resulting in important information loss, which in turn impacts results in regression analyses of variables of interest. Overall, this research supports the observation in the literature that different funding streams behave differently and they generate different consequences on nonprofits behavior. We nd that disaggregated measures respect this internal structure.

Appendix

Variable Denitions

laglnvoltperc	Lag of the natural log of volatility percentage
laglnexpenses	Lag of the natural log of total expenses
$\mathrm{lRD}_{\mathrm{Aggregated}}$	Lag of the HHI measure with three aggregated sources
$\mathrm{lRD}_{\mathrm{FourSource}}$	Lag of the HHI measure with four aggregated sources
$\mathrm{lRD}_{\mathrm{SevenSource}}$	Lag of the HHI measure with seven aggregated sources
$\mathrm{lRD}_{\mathrm{Comprehensive}}$	Lag of the HHI measure with thirteen sources
ladmineff	Lag of the ratio of administrative expenses to total expenses
lage	Lag of age defined as the current fiscal year minus the ruling year

lfundeff	Lag of the ratio of fundraising expenses to total expenses
laglnnetassets	Lag of the natural log of total net assets
ltotalmargin	Lag of the ratio of excess(deficit) income divided by total revenue
ldebtmargin	Lag of the ratio of total liabilities to total assets
donative	1 if the ratio of donations to total revenue is greater than 50 %
donative98	1 if the ratio of donations to total revenue is greater than 50 % in 1998
revenue98	Total revenues in 1998
adminexpratio98	Ratio of administrative expenses to total expenses in 1998
age98	1998 Age (fiscal year–ruling year)
frexpratio98	Ratio of fundraising expenses to total expenses in 1998
compratio98	=Ratio of officer compensation to total expenses in 1998
$\mathrm{RD}_{\mathrm{Aggregated-98}}$	1998 HHI measure with three aggregated sources
$\mathrm{RD}_{\mathrm{FourSource-98}}$	1998 HHI measure with four aggregated sources
$\mathrm{RD}_{\mathrm{SevenSource-98}}$	1998 HHI measure with seven aggregated sources
$\mathrm{RD}_{\mathrm{Comprehensive-98}}$	1998 HHI measure with thirteen sources
Additional controls	dummy variables for state of location and NTEE Major GroupCode (A to Z)

See Tables 5, 6, 7, 8, 9, 10, 11, and 12.

Table 5 Regression model with the natural log of volatility percentage

	(1)	(2)	(3)	(4)
laglnvoltperc	0.350***	0.350***	0.350***	0.350***
laglnexpenses	−0.134***	−0.133***	−0.133***	−0.133***
ladmineff	0.057**	0.057**	0.054**	0.055**
lage	−0.005***	−0.005***	−0.005***	−0.005***
lfundeff	0.153***	0.152***	0.150***	0.151***
laglnnetassets	0.060***	0.060***	0.059***	0.059***
ltotalmargin	−0.000	−0.000	−0.000	−0.000
ldebtmargin	0.107***	0.107***	0.106***	0.107***
donative	0.110***	0.109***	0.108***	0.109***
$\mathrm{lRD}_{\mathrm{Aggregated}}$	−0.009			
$\mathrm{lRD}_{\mathrm{FourSource}}$		0.006		
$\mathrm{lRD}_{\mathrm{SevenSource}}$			0.026	
$\mathrm{lRD}_{\mathrm{Comprehensive}}$				0.015
Additional controls	Yes	Yes	Yes	Yes
_cons	−1.793***	−1.797***	−1.805***	−1.801***
N	103,701	103,701	103,701	103,701
adj. R^2	0.243	0.243	0.243	0.243

All models include robust regressions. Utilizing the STATA procedure rreg, observations are dropped that have a Cooks D value greater than 1. The procedure then performs an iterative process down weighing outliers until the median absolute deviation for the residuals is no more than 7 times the median residual value. See StataCorp (2011) for further information on the rreg procedure* p < 0.05, ** p < 0.01, *** p < 0.001

Table 6 Regression model with 5-year revenue growth

	(1)	(2)	(3)	(4)
revenue98	0.000	0.000	0.000	0.000

adminexpratio98	-0.075***	-0.073***	-0.059***	-0.060***
age98	-0.002***	-0.002***	-0.002***	-0.002***
frexpratio98	-0.368***	-0.367***	-0.354***	-0.356***
compratio98	0.122***	0.122***	0.126***	0.126***
donative98	0.015***	0.016***	0.019***	0.019***
$RD_{Aggregated-98}$	0.004			
$RD_{FourSource-98}$		-0.006		
$RD_{SevenSource-98}$			-0.077***	
$RD_{Comprehensive-98}$				-0.078***
Additional controls	Yes	Yes	Yes	Yes
_cons	0.313***	0.316***	0.340***	0.339***
N	103,701	103,701	103,701	103,701
adj. R^2	0.029	0.029	0.030	0.030

All models include robust regressions. Utilizing the STATA procedure rreg, observations are dropped that have a Cooks D value greater than 1. The procedure then performs an iterative process down weighing outliers until the median absolute deviation for the residuals is no more than 7 times the median residual value. See Statacorp (2011) for further information on the rreg procedure* p < 0.05, ** p < 0.01, *** p <0.001

Table 7 Regression model with the natural log of volatility percentage as the dependent variable and organizations with At least 2 donative funding sources and fewer than 2 earned income and investment funding sources

	(1)	(2)	(3)	(4)
laglnvoltperc	0.315***	0.314***	0.315***	0.314***
laglnexpenses	−0.127***	−0.129***	−0.129***	−0.131***
$lRD_{Aggregated}$	0.063*			
$lRD_{FourSource}$		−0.023		
$lRD_{SevenSource}$			−0.006	
$lRD_{Comprehensive}$				−0.050
ladmineff	0.014	0.014	0.012	0.016
lage	−0.007***	−0.006***	−0.006***	−0.006***
lfundeff	0.251**	0.243**	0.249**	0.249**
laglnnetassets	0.050***	0.052***	0.052***	0.053***
ltotalmargin	−0.005	−0.005	−0.005	−0.005
ldebtmargin	0.169***	0.171***	0.171***	0.170***
donative	0.166***	0.153***	0.153***	0.155***
Additional controls	Yes	Yes	Yes	Yes
_cons	−2.047***	−2.013***	−2.020***	−1.993***
N	25,175	25,175	25,175	25,175
adj. R^2	0.202	0.202	0.202	0.202

Donative funding sources include direct public support, indirect public support, government grants, and net income from special events. Earned income funding includes program revenue, membership dues, and other revenue. Investment funding includes interest and savings, other investment income, net gain from sale of assets. All models include robust regressions. Utilizing the STATA procedure rreg, observations are dropped that have a Cooks D value greater than 1. The procedure then performs an iterative process down weighing outliers until the median absolute deviation for the residuals is no more than 7 times the median residual value. See StataCorp (2011) for further information on the rreg procedure* p < 0.05, ** p < 0.01, *** p < 0.001

Table 8 Regression model with the natural log of volatility percentage as the dependent variable and organizations with at least 2 earned funding sources and fewer than 2 donative income and investment funding sources

	(1)	(2)	(3)	(4)
laglnvoltperc	0.372***	0.370***	0.372***	0.371***
laglnexpenses	−0.087***	−0.082***	−0.083***	−0.080***
$\mathrm{lRD}_{\mathrm{Aggregated}}$	0.061*			
$\mathrm{lRD}_{\mathrm{FourSource}}$		0.217***		
$\mathrm{lRD}_{\mathrm{SevenSource}}$			0.146***	
$\mathrm{lRD}_{\mathrm{Comprehensive}}$				0.179***
ladmineff	0.089	0.048	0.063	0.055
lage	−0.004***	−0.005***	−0.005***	−0.005***
lfundeff	0.161	0.116	0.149	0.143
laglnnetassets	0.031***	0.026***	0.030***	0.028***
ltotalmargin	−0.007	−0.008	−0.007	−0.007
ldebtmargin	0.069*	0.061	0.069*	0.067*
donative	0.147***	0.120***	0.149***	0.149***
Additional controls	Yes	Yes	Yes	Yes
_cons	−1.934***	−1.953***	−1.983***	−2.018***
N	16,298	16,298	16,298	16,298
adj. R^2	0.241	0.242	0.241	0.242

Donative funding sources include direct public support, indirect public support, government grants, and net income from special events. Earned income funding includes program revenue, membership dues, and other revenue. Investment funding includes interest and savings, other investment income, net gain from sale of assets. All models include robust regressions. Utilizing the STATA procedure rreg, observations are dropped that have a Cooks D value greater than 1. The procedure then performs an iterative process down weighing outliers until the median absolute deviation for the residuals is no more than 7 times the median residual value. See StataCorp (2011) for further information on the rreg procedure* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9 Regression model with the natural log of volatility percentage as the dependent variable and organizations with at least 2 investment funding sources and fewer than 2 earned income and donative funding sources

	(1)	(2)	(3)	(4)
laglnvoltperc	0.306***	0.307***	0.307***	0.306***
laglnexpenses	−0.153***	−0.151***	−0.141***	−0.140***
$\mathrm{lRD}_{\mathrm{Aggregated}}$	0.064			
$\mathrm{lRD}_{\mathrm{FourSource}}$		0.057		
$\mathrm{lRD}_{\mathrm{SevenSource}}$			0.230**	
$\mathrm{lRD}_{\mathrm{Comprehensive}}$				0.258**
laglnnetassets	0.074***	0.071***	0.061***	0.060***
ltotalmargin	0.002	0.002	0.002	0.002
ldebtmargin	−0.049	−0.047	−0.039	−0.043
donative	0.041	0.032	0.037	0.040
Additional Controls	Yes	Yes	Yes	Yes
_cons	−1.967***	−1.995***	−2.086***	−2.097***
N	3,603	3,603	3,603	3,603

adj. R^2	0.261	0.261	0.263	0.263

Donative funding sources include direct public support, indirect public support, government grants, and net income from special events. Earned income funding includes program revenue, membership dues, and other revenue. Investment funding includes interest and savings, other investment income, net gain from sale of assets. All models include robust regressions. Utilizing the STATA procedure rreg, observations are dropped that have a Cooks D value greater than 1. The procedure then performs an iterative process down weighing outliers until the median absolute deviation for the residuals is no more than 7 times the median residual value. See StataCorp (2011) for further information on the rreg procedure* p < 0.05, ** p < 0.01, *** p < 0.001

Table 10 Regression model with 5-year revenue growth as the dependent variable and organizations with at least 2 donative funding sources and fewer than 2 earned income and investment funding sources

	(1)	(2)	(3)	(4)
revenue98	0.000	0.000	0.000	0.000
adminexpratio98	−0.103***	−0.092***	−0.083***	−0.083***
age98	−0.004***	−0.004***	−0.004***	−0.004***
frexpratio98	−0.502****	−0.511***	−0.483***	−0.486***
compratio98	0.255***	0.262***	0.262***	0.268***
donative98	−0.009	0.006	0.012	0.013
$\mathrm{RD}_{\mathrm{Aggregated-98}}$	−0.066***			
$\mathrm{RD}_{\mathrm{FourSource-98}}$		−0.096***		
$\mathrm{RD}_{\mathrm{SevenSource-98}}$			−0.149***	
$\mathrm{RD}_{\mathrm{Comprehensive-98}}$				−0.159***
Additional controls	Yes	Yes	Yes	Yes
_cons	0.430***	0.434***	0.445***	0.448***
N	25,175	25,175	25,175	25,175
adj. R^2	0.034	0.035	0.037	0.037

Donative funding sources include direct public support, indirect public support, government grants, and net income from special events. Earned income funding includes program revenue, membership dues, and other revenue. Investment funding includes interest and savings, other investment income, net gain from sale of assets. All models include robust regressions. Utilizing the STATA procedure rreg, observations are dropped that have a Cooks D value greater than 1. The procedure then performs an iterative process down weighing outliers until the median absolute deviation for the residuals is no more than 7 times the median residual value. See StataCorp (2011) for further information on the rreg procedure* p < 0.05, ** p < 0.01, *** p < 0.001

Table 11 Regression model with 5-year revenue growth as the dependent variable and organizations with at least 2 earned funding sources and fewer than 2 donative income and investment funding sources

	(1)	(2)	(3)	(4)
revenue98	0.000	0.000	0.000	0.000
adminexpratio98	−0.034	−0.003	−0.008	−0.001
age98	−0.002***	−0.002***	−0.002***	−0.002***
frexpratio98	−0.452***	−0.422***	−0.441***	−0.436***
compratio98	0.108*	0.124**	0.112*	0.108*
donative98	−0.045***	−0.028**	−0.048***	−0.048***

$RD_{Aggregated-98}$	−0.104***			
$RD_{FourSource-98}$		−0.167***		
$RD_{SevenSource-98}$			−0.168***	
$RD_{Comprehensive-98}$				−0.201***
Additional controls	Yes	Yes	Yes	Yes
_cons	0.203**	0.195**	0.222***	0.234***
N	16,298	16,298	16,298	16,298
adj. R^2	0.028	0.031	0.031	0.032

Donative funding sources include direct public support, indirect public support, government grants, and net income from special events. Earned income funding includes program revenue, membership dues, and other revenue. Investment funding includes interest and savings, other investment income, net gain from sale of assets. All models include robust regressions. Utilizing the STATA procedure rreg, observations are dropped that have a Cooks D value greater than 1. The procedure then performs an iterative process down weighing outliers until the median absolute deviation for the residuals is no more than 7 times the median residual value. See StataCorp (2011) for further information on the rreg procedure* p < 0.05, ** p < 0.01, *** p < 0.001

Table 12 Regression model with 5-year revenue growth as the dependent variable and organizations with at least 2 investment funding sources and fewer than 2 earned income and donative funding sources

	(1)	(2)	(3)	(4)
revenue98	0.000	0.000	0.000	0.000
adminexpratio98	-0.095*	-0.094*	-0.089*	-0.086*
age98	-0.000	-0.000	0.001	0.001
frexpratio98	0.100	0.109	0.137	0.139
compratio98	-0.123	-0.142	-0.129	-0.127
donative98	0.078**	0.083***	0.044	0.035
$RD_{Aggregated-98}$	0.030			
$RD_{FourSource-98}$		-0.050		
$RD_{SevenSource-98}$			-0.399***	
$RD_{Comprehensive-98}$				-0.450***
Additional controls	Yes	Yes	Yes	Yes
_cons	0.225	0.264	0.413	0.437
N	3,603	3,603	3,603	3,603
adj. R^2	0.036	0.037	0.058	0.061

Donative funding sources include direct public support, indirect public support, government grants, and net income from special events. Earned income funding includes program revenue, membership dues, and other revenue. Investment funding includes interest and savings, other investment income, net gain from sale of assets. All models include robust regressions. Utilizing the STATA procedure rreg, observations are dropped that have a Cooks D value greater than 1. The procedure then performs an iterative process down weighing outliers until the median absolute deviation for the residuals is no more than 7 times the median residual value. See StataCorp (2011) for further information on the rreg procedure* p < 0.05, ** p < 0.01, *** p < 0.001

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