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QUANTITATIVE METHODS IN ACCOUNTING RESEARCH

Marek Gruszczyński
Instytut Ekonometrii, SGH
e-mail: marek.gruszczynski@sgh.waw.pl

Abstract: Quantitative methods are in frequent use in modern accounting research. The evidence may be found e.g. in the journals like "Journal of Accounting Research", "European Accounting Review", "Review of Quantitative Finance and Accounting" or in the *Accounting Research Network* in SSRN base. Paper presents a brief survey of research areas and statistical-econometric approaches in accounting research. Particular reference goes to research on corporate disclosure. Methodological component of the paper includes remarks on the use of binary response models with choice-based and matched samples as well as comments on the sample selection approaches.

Keywords: accounting research, corporate disclosure, binary response, choice-based samples, matched samples, sample selection.

INTRODUCTION

Paper presents the brief survey as well as some methodological remarks on quantitative methods used in accounting research. Let us begin with the question of "how probable is probable in accounting?". Documents and practice of accounting principles like IAS (International Accounting Standards) or IFRS (International Financial Reporting Standards)[1] quite distinctly call for the use of probability in delivering statements like e.g. the auditors' opinion on some possible outcomes of company's activities.

Table 1 lists the various uses of the language of probability in accounting. There are 27 shades of probability listed here: from "virtually certain" to "not genuine". How do we decide which of the 27 categories should be used in the statement? It is evident that some quantitative advice on how to find the relevant

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[1] IAS are set by International Accounting Standards Board while IFRS – by Financial Accounting Standards Board. In Poland IAS are known as MSR (Międzynarodowe Standardy Rachunkowości) and IFRS – as MSSF (Międzynarodowe Standardy Sprawozdawczości Finansowej).

probability level in a given situation might be in order. This is the example of how the accounting research may help the practitioners. One could imagine that, given a large number of situation of a kind, the researcher could be in the position to estimate such probability with some degree of confidence.

Table 1. Various categories of probability in accounting

Description of the probability level of business event	In accounting standards
Virtually certain	IAS 37.33
No realistic alternative	IAS 37.10
Highly probable	IFRS 5 BC82
Reasonably certain	IAS 17.4
Substantially all	IAS 17.8
Substantially enacted	IAS 12.46
Highly effective	IAS 39.88
Principally	IFRS 5.6
Significant	IAS 18.14 (a)
Major part	IAS 17.10 (c)
Probable - more likely than not	IAS 37.14 (b)
More likely	IAS 39.22
Likely	IAS 39 AG 40
May, but probably will not	IAS 37 app. A
Reasonably possible	IAS 32.92
Possible	IAS 37.10
Unlikely	IAS 39 AG 44
Highly unlikely	IAS 40.31
Extremely unlikely	IFRS 4 app. B 23
Minimal probability	IFRS 4 app. B 25
Sufficiently lower	IAS 17.10 B
Insignificant	IAS 39.9
Remote	IAS 37.28
Extremely rare	IAS 1.17
Virtually none	IAS 34 IN 6
Not genuine	IAS 32.25

Source: Aktualności MSSF, No. 44/2006, PriceWaterhouseCoopers

So far the "real" accounting research does not necessarily follow this path of reasoning. The question of how to estimate the level of probability is skipped in accounting research to more general situations like audit failure or company's bankruptcy. As of now, answering questions posed by Table 1 remains the challenge for the future.

Section 2 presents the scope of accounting research as evident from the literature. In Section 3 tackles on research methods. As the example of research area Section 4 presents the subject of corporate disclosure. In Section 5 some methodological questions are raised, following a few recent papers on the use of qualitative variables on accounting research. Section 6 concludes.

SCOPE OF ACCOUNTING RESEARCH

Countless papers and books on accounting research make impossible to reasonably survey the entire area. In this section we begin with indicating the major journals covering modern accounting research. These are:
- Journal of Accounting Research
- European Accounting Review
- Review of Quantitative Finance and Accounting
- The Accounting Review
- Journal of Accounting and Economics
- Journal of Applied Corporate Finance
- Accounting, Auditing & Accountability Journal
- Accounting and Finance
- Accounting, Organizations and Society
- Journal of Management Accounting Research

The journals serve as the dissemination tool of new research findings and as the guide for the research directions.

As the representatives of the books on the topic let us mention just three items:
- Handbook of Management Accounting Research (2007),
- Methodological Issues in Accounting Research (2006),
- Advances of Quantitative Analysis of Finance and Accounting (in 6 volumes, 2004-2006).

Referring to the scope of accounting research we just quote the list of topics summarized in "Journal of Accounting Research". These are:
- Cost allocation
- Capital investment decisions
- Performance measurement
- Transfer pricing
- Auditor changes
- Audit failures
- Auditor independence
- Internal control assessment
- Corporate tax planning
- Impact of changes in tax laws
- Differences across jurisdictions
- Tax vs. financial reporting
- Financial disclosure
- Financial reporting quality
- Impact of accounting standards
- Impact of securities laws
- International financial reporting

- − Financial reporting of bankers
- − Valuation use of accounting
- − Contracting use of accounting

As we see, this is a very comprehensive list. In a sense it covers also most of the issues considered by the research on corporate finance.

Another source showing the scope of accounting research are international congresses of major scientific accounting societies. The evidence from annual congresses of European Accounting Association, as presented in Table 2 shows the topical distributions of papers delivered to those meetings.

Table 2. Papers presented to EAA Annual Congresses (2003-2008)

Subject area	Percentage of papers
Accounting and Capital Markets	4%
Accounting Education and Research	3%
Accounting History	3%
Accounting and Information Systems	2%
Accounting and Strategy	1%
Accounting Theory	3%
Auditing	6%
Critical Perspectives on Accounting	3%
Economic Analytical Accounting	2%
Financial Analysis	3%
Finance/Financial Management	1%
Financial Accounting (capital markets)	8%
Financial Reporting	11%
Corporate Governance	8%
International Accounting	8%
Management Accounting	16%
Behavioural Aspects of Accounting	5%
Public Sector and Non-profit Accounting	7%
Social and Environmental Accounting	5%
Accounting and Taxation	2%

Source: Fülbier and Sellhorn (2008)

The analysis of Table 2 reveals that accounting researchers in Europe major in Management Accounting or in the Financial Reporting areas as well as in Corporate Governance, International Accounting and Financial Accounting. Public Sector and Non-profit Accounting follow the list of most popular subjects.

To summarize – research scope in accounting is broad. It seems that the common questions in accounting research are directed to general problems, ready to tackle as a kind of average of the group of events or companies. What is more difficult remains unresolved. Typical accountant or auditor makes his/her own decision more on legal grounds than on the statistical evidence.

RESEARCH METHODS

Table 2 presents the list of research methods in accounting as compiled by Fülbier and Sellhorn (2008) on the basis of papers presented to the annual congresses of European Accounting Association in 2000 and 2005. It turns out that most popular are research methods classified as "empirical archival methods". About 70% of papers of EAA congress in 2005 were classified into this category.

Table 3. Research methods. Papers presented to EAA Annual Congresses: 2000 and 2005

Methods	2000	2005
1) Empirical archival – database or archive Research based on historical documents, texts, journal articles, corporate annual reports, company disclosures etc. Research mainly applies statistical techniques to data drawn from commercial databases.	51%	70%
2) Empirical experiment The defining feature of an experiment is that the researcher manipulates one or more variables with subjects who are assigned randomly to various groups.	2%	0%
3) Empirical field or case study Field study and case study research is preoccupied with studying the role and function of accounting in its natural context. The term 'case study' usually implies research confined to a single unit of analysis. 'Fieldwork' encompasses more general studies of social activity.	4%	1%
4) Empirical survey Researchers usually ask a random sample of individuals, companies etc. to respond to a set of questions on a given subject.	7%	6%
5) Non-empirical – analytical Analytical research comprises theory construction and evaluation using formalized, mathematical models. This includes financial modelling, formal game theory, agency models etc. in, among others, the areas of auditing, financial reporting, and disclosure.	0%	1%
6) Non-empirical – theory Every form of scientific reasoning which is non-analytical and non-empirical. It is more "a set of tentative explanations", which "provides acceptable answers to interesting questions".	7%	6%
7) Other This category captures authors adopting multiple methods. It also includes research methods not easily assigned to the previous categories, as well as abstracts without any clue about the method.	21%	10%
8) Ambiguous Research method not made clear in the abstract	9%	6%
Total	100%	100%

Source: European Accounting Association, Fülbier and Sellhorn (2008)

The detailed explanation of methods classified in Table 3 is shown inside of the table. Methods relevant to the topic of this paper clearly belong to most popular group 1. These are based on statistical-econometric methodology as applied to the issues covering practically all research areas mentioned above in Section 2.

RESEARCH EXAMPLE: CORPORATE DISCLOSURE ISSUES

As an example of research founded on statistical methodology one may take the issues of corporate disclosure. This research field in accounting is strongly connected with corporate governance – currently being readily investigated in various disciplines, including corporate finance, law and economics. Below we introduce two research papers showing how quantitative approach may help in explaining corporate disclosure issues.

COUNTRY-WIDE CORPORATE TRANSPARENCY

Bushman, Piotroski and Smith (2004) in their paper on corporate transparency explore its determinants on the basis of cross-country data. Corporate transparency is understood as availability of firm-specific information to those being outside publicly traded firms. The investigation concentrates on analyzing this transparency on a country level as the system producing, collecting, validating and disseminating information to market participants outside the firm.

For each of 40+ countries examined the range of measures capturing firm-specific information environments i.e. measures of transparency has been collected. Major index taken into account is CIFAR i.e. country-specific index created by means of examining companies' annual reports on the inclusion or omission of 90 items. CIFAR measures intensity of disclosure. Along with CIFAR other variables on corporate reporting were included: DISCL measuring financial disclosures, GOVERN for governance disclosures, MEASURE for accounting principles, TIME for timeliness of disclosure, AUDIT for credibility of disclosures. The private information, acquisition and communication were represented by measures like NANALYST for average number of analysts following large firms, POOL_INV for the average ratio of the value of pooled investment schemes to GDP as well as the dummy variable IT_ENF equal to 1 if the country enforced insider trading laws before 1995. Information dissemination was shown by MEDIA variable representing penetration of media channels in the economy. MEDIA was the average rank of countries' per capita number of newspapers and televisions as reported by World Development Indicators.

This set of variables has been factor analysed for the data on 45 countries. The results reveal that of the two factors isolated the first may be regarded as representing financial transparency since it captures intensity and timeliness of financial disclosures, their interpretation and dissemination. The second factor represents governance transparency, capturing the intensity of governance disclosures used by outside investors to hold management accountable.

Consequent result of the Bushman, Piotroski and Smith (2004) research shows that governance transparency factor is related to country's legal/ judicial regime: this transparency is higher in countries with common law legal origin and high judicial efficiency. Financial transparency factor primarily is related to political regime: this transparency is higher in countries with low state ownership of enterprises, banks and low risk of state expropriation of firms' wealth.

BRAZILIAN CORPORATE DISCLOSURE INDEX

Main issue of paper by Lopes and de Alencar (2008) is the construction of customized Brazilian Corporate Disclosure Index (BCDI) and the investigation of its relevance to the cost of equity. The proposed index measures disclosure across following six dimensions:

(i)   general information about the firm its market and major events over the last year,
(ii)   relations to employees and managers regarding compensation and policies,
(iii)   non-financial information about markets, sales, and products,
(iv)   information about forecasts of sales, cash flows and earnings,
(v)   discussion and analysis of financial data including time series information about performance and explanations of past behavior,
(vi)   other information.

The final score is measured over 47 questions with binary answers being 1 for answers considered to be good disclosure and 0 otherwise. Data is composed by the panel of 50 shares with highest liquidity on Saõ Paulo Stock Exchange (BOVESPA) on December 2005. The panel consists of firm-specific observations from the years 1998, 2000, 2002, 2004 and 2005.

Sample means of BCDI are as follows: 0.24 for 1998, 0.32 for 2000, 0.42 for 2002, 0.46 for 2004 and 0.54 for 2005. Thus, it is worth to note the increase of BCDI over time. Authors state that "firms in Latin America are immersed in a very poor institutional environment (…) Some firms in the region decide to voluntary adopt better corporate governance practices in order to differentiate themselves and access foreign sources of capital. This movement causes governance and disclosure practices to improve on average in the region but with significant dispersion."

In their paper Lopes and de Alencar (2008) look into the relation of BCDI and the cost of equity capital (ks) measured as a function of firm's earnings and the growth in earnings. Panel data regression of ks against BCDI and control variables shows significant negative association between disclosure and cost of equity capital. In addition, this relation is more pronounced for firms which receive less attention from analysts and have dispersed ownership structures.

RESEARCH ON CD INDEX FOR POLAND

Research on corporate disclosure index for Poland is being conducted in Warsaw School of Economics (Chair of Managerial Accounting and the Institute of Econometrics). We aim at constructing the index covering country-specific disclosure issues pertinent to current accounting standards and principles in Poland. Major dimensions of the disclosure index are rooted in annual financial statement, in the company report and in the report on external relations. These are the following 9 areas of reporting:

– Financial statement: (1) Non-material assets, (2) Financial risk, (3) Fair value, (4) Accounting for derivatives, (5) Leasing, (6) Segments of activity, (7) Reserves
– (8) Company report
– (9) Report on external relations.

In each area the disclosures concerned the following issues are examined:

– Accounting policy
– Additional information and explanations – mandatory disclosure
– Additional information and explanations – voluntary disclosure.

The index has been constructed for a sample of 48 companies listed on Warsaw Stock Exchange, a panel covering companies' reports for 2005, 2006 and 2007. Major elaboration went into the detailed investigation of numerous items covered in reports. We believe that the Polish Corporate Disclosure Index (PCDI) constructed in our research correctly grasps the quality of disclosure by Polish companies.

At current stage the research is directed into quantitative analysis of associations between PCDI and the variables representing companies' performance and investors' protection.

METHODOLOGICAL ISSUES: BINARY RESPONSE MODELS AND SAMPLE SELECTION

Quantitative research issues in accounting are customarily connected with sampling problems as well as with questions pertaining to modelling qualitative variables. As in other fields, also in accounting researchers frequently do not bother to apply all the necessary methodological rigour. Some problems pertaining to methodology are described below.

BINARY RESPONSE MODELS

Since the seminal article by Maddala (1991) on limited-dependent and qualitative variables models in accounting research there have been numerous attempts to use such models in accounting. In terms of research quality the results are mixed.

Ge and Whitmore (2009) reviewed more than 30 articles published in accounting journals. The classic Maddala's (1991) paper on dangers in modelling qualitative variables in accounting research is still valid. Most of the articles researched by Ge and Whitmore (2009) have ambiguities and errors in the presentation of the logistic regression model. As they point out, incorrect presentations of the model, even in conjunction with a correct analysis, may lead to a serious misinterpretation of research findings.

CHOICE-BASED AND MATCHED SAMPLES

In their paper entitled "Three threats to validity of choice-based and matched sample studies in accounting research" Cram, Karan and Stuart (2007) discuss the dangers connected with the use of some popular non-random sampling schemes. The authors have reviewed 73 audit research papers and pointed out that most of them suffer from one or more errors mentioned in the article's title.

The choice-based samples occur when groups making different choices are sampled at different rates. In binary choice models it is typical to oversample units with Y=1 (e.g. bankrupt companies) as opposed to those with Y=0 (non-bankrupt).

The matched samples are two samples in which the members are clearly paired or are matched explicitly by the researcher. Another scheme is named semi-matched – in this case there does not need to be an equal number of each outcome collected in each stratum (e.g. industry). In accounting research we may also encounter the scheme called within-subjects design, e.g. study of firms' audit fees compared before and after some event.

Cram, Karan and Stuart (2007) indicate that since choice-based and matched samples are not random samples, it is obvious that the statistical analyses based on them shall not be the same as for the random samples. The three threats to validity of the research based on choice-based and matched samples are (1,2 and 3 below contain excerpts from the article):

1) *Use of unconditional analysis, when analysis conditional upon effects of matching variables is needed.* Researchers believe that the selection of a matched sample already controls for the matching variables. An unconditional analysis is performed, rather than the conditional one that is justified. Failure to account for industry, size, and other matching variables may have driven incorrect findings in many research studies. The authors' guidance to researchers is to either avoid use of matching, or to take the matching into account when analyzing the data. If matching is not taken into account, by either evaluating pairwise differences, or by including dummy variables for each matched set, then the research should not be accepted.

2) *Failure to control for effect of imperfectly matched variables.* Where matching is by "closest" size or other continuous measure, the matching is imperfect, and there remains the possibility that case vs. control differences in this matching variable could be the cause of differences in outcome, so researchers must evaluate that

possibility and perhaps control for it. The authors advise researchers either to avoid imperfect matching, or to perform and report sensitivity analyses on how imperfection in the matching might have influenced outcomes. A closest-matched variable such as size can still have influence. It might be controlled for by including a linear term. But, as size or another variable's contribution might be non-linear, in general, there is no fully satisfactory resolution. The researcher must make some effort to examine the possibility that all results are driven by the omitted effect. Sensitivity analyses including linear and quadratic terms, for example, might be performed and discussed. Otherwise, the researcher has not established that other reported effects are not merely the result of an omitted variable problem.

3) *Failure to re-weight observations according to differing sampling rates.* The disproportionate sampling for different population strata (implicit in the choice-based and matched sample selection) would usually necessitate weighting data by the sampling rates in each strata, but re-weighting or other appropriate adjustment to the analysis is often not implemented. Authors suggest that choice-based and matched sampling should be avoided unless explicit sampling rate information can be obtained (allowing for explicit reweighting) or unless logit regression will suffice to analyze the research questions (taking advantage of the logit exemption to the need for reweighting).

SAMPLE SELECTION APPROACHES

Final example of methods readily applied in accounting studies are selection models. The following is based on the paper by Francis and Lennox (2008). *Selectivity* occurs whenever observations self-select into discrete groups, resulting in potential coefficient bias. Estimation procedures such as OLS ignore the nonrandomness of the sample (Maddala 1991). The traditional approach to controlling for self-selection bias is the two-step procedure developed by Heckman (1979). In the first step the *selection equation* is estimated with the use of "instruments" and used to predict inverse Mills' ratios (IMRs) for each observation. In the second step the IMRs are included in the *outcome equation* (primary model of interest) as a control for the effects of selection.

Francis and Lennox (2008) have identified 30 papers that use selection models out of 545 empirical papers published from 2000 through 2007 in *The Accounting Review*, *Journal Accounting and Economics* and *Journal of Accounting Research*.

To successfully identify selectivity, the researcher should include in the first stage choice model at least one exogenous independent variable that has no direct effect on the dependent variable in the second stage regression (can be validly excluded from it). Francis and Lennox (2008) point out that these "exclusion restrictions" are rarely recognized in the accounting literature. An absence of exclusion restrictions can cause: (a) severe multicollinearity problems and (b) provide infer-

ences that are extremely fragile. The economics literature argues that researchers need to find credible and convincing exclusion restrictions.

Selection model is very sensitive to small changes in model specification whereas OLS models are robust. Moreover, the selection model is fragile even if the researcher imposes ad hoc exclusion restrictions that substantially reduce multicollinearity. In addition, the selection model is very sensitive to minor changes in sample composition with results that easily flip signs across individual sample years, whereas the OLS models are robust to such perturbations.

The empirical analysis by Francis and Lennox (2008) demonstrates how easy it is for the selection model to provide different sets of results, all of which lack robustness. Robustness is an attractive characteristic of an estimation procedure because, in practice, empirical researchers do not typically know the correct model specification (e.g., researchers may lack a theory for whether company size should be controlled for using assets, sales, or both). Not only are the main results of the selection model fragile to minor changes in specification, the signs and levels of significance for the IMR coefficients are also highly sensitive. This is important because researchers often use the significance of the IMR coefficients to judge whether or not it is necessary to control for selectivity bias. Results illustrate the dangers of relying on the IMR coefficients to infer whether it is necessary to estimate a selection model instead of OLS.

SUMMARY

Accounting research is still to be fully discovered in the countries like Poland. This paper shows the topical possibilities of the accounting research. We have indicated the research areas in accounting as well as some dangers of using statistical and econometric methodology in the studies founded on large samples.

In terms of quantitative methodology the accounting field is suitable to applying the methods of multivariate statistical analysis and microeconometrics. Paper points out several questions pertaining to correct application of qualitative and limited dependent variables models for accounting research problems.

It should be noted that accounting research is in many instances common with the research in corporate finance. Empirical corporate finance and empirical accounting research have joint roots. Both areas make use of financial reports, both produce results being pertinent to accounting as well as to corporate finance.

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Metody ilościowe w badaniach w zakresie rachunkowości

Streszczenie: Współczesne badania naukowe w rachunkowości często ko-rzystają z podejścia ilościowego, co można potwierdzić w wiodących czaso-pismach, takich jak "Journal of Accounting Research", "European Accoun-ting Review", "Review of Quantitative Finance and Accounting" lub w bazie *Accounting Research Network* w serwisie SSRN. Artykuł przedstawia krótki przegląd dziedzin zastosowań metod ilościowych w badaniach dotyczących rachunkowości. W szczególności omówione są przykłady dotyczące tematyki ujawnień. Uwagi natury metodycznej dotyczą wykorzystania modeli zmien-nych dwumianowych przy użyciu prób dobieranych a także modeli doboru próby (*sample selection*).

Słowa kluczowe: rachunkowość, ujawnienia korporacyjne, zmienne dwu-mianowe, próby dobierane, modele doboru próby.