AStA Adv Stat Anal (2010) 94: 113–116
DOI 10.1007/s10182-010-0133-2

EDITORIAL

Advances in structural equation modeling—the 2009 meeting of the working group SEM

Jörg Betzin · Dirk Temme

Abstract This editorial introduces the Special Issue "Advances in Structural Equation Modeling" which provides a snapshot of the different research activities performed by members of the working group "Structural Equation Modeling". More specifically, this issue contains a selection of papers presented at the 2009 annual meeting in Berlin at Humboldt University.

Keywords Structural equation modeling · Covariance structure analysis · Partial least-squares

1 Introduction

The working group "Structural Equation Modeling" was founded in 1986 and had its first meeting at ZUMA (Center for Survey Design and Methodology) in Mannheim, Germany. The idea was to provide a platform for in-depth discussions among researchers interested in the most recent developments in the then emerging field of structural equation modeling (SEM). Only a few years later SEM became a widely used approach to analyze complex systems of interdependent relationships between variables in the social and behavioral sciences.

After a short period of interruption the working group started its annual meetings again a couple of years ago, offering academics an opportunity to present their most

J. Betzin (✉)
GKV-Spitzenverband, Mittelstr. 51, 10179 Berlin, Germany
e-mail: joerg.betzin@gkv-spitzenverband.de
url: http://www.gkv-spitzenverband.de

D. Temme
Chair of Methods of Economic and Social Research, University of Wuppertal, Gaußstr. 20, 42097 Wuppertal, Germany
e-mail: Temme@wiwi.uni-wuppertal.de
url: http://kappelhoff.wiwi.uni-wuppertal.de

recent research findings. This Special Issue collects extended versions of selected papers presented at the 2009 meeting of the working group held in Berlin on February 26 and 27 at Humboldt University. The workshop was organized by the two authors of this editorial who also invited the presenters to submit a paper for this Special Issue. The papers published in this issue underwent a peer review process and subsequent revisions.

2 Special Issue of the 2009 meeting

Besides providing room for papers presenting methodological as well as applied research in the tradition of covariance structure analysis (e.g., Bollen 1989), a major aim of the 2009 meeting of the working group was to achieve a higher integration of the PLS ("partial least-squares") community and the users from business administration and economics. The PLS path modeling approach has recently gained renewed interest especially among academics in the marketing and management field (see, for example, the Handbook of Partial Least Squares edited by Esposito Vinzi et al. (2010)). Measured by this goal the meeting was quite successful. Out of the thirteen papers presented in Berlin, four focused on applications of PLS or dealt with specific methodological issues of this approach. Below we will briefly introduce the seven papers collected in this Special Issue and give a short overview of those papers presented at the meeting which are not included in this issue.

The papers in this issue all contribute to the methodological advancement of SEM and can be assigned to one of the following three research topics. The first topic addresses the problem of detecting measurement bias based on the factor analytic model. The second topic deals with the issue of how to uncover and handle nonlinear relationships in structural equation modeling. The third topic covers models which try to describe intra-individual change over time.

In the first paper on measurement bias, Barendse, Oort, and Garst extend restricted factor analysis (RFA) by latent moderated structural equations to allow for both the detection of uniform and nonuniform bias. In comparison with multi-group factor analysis (MGFA), a multitude of variables can be more easily checked for causing measurement bias simultaneously by this approach. A simulation study shows that the extended RFA compares favorably with MGFA in detecting measurement bias.

A second paper by Jak, Oort, and Dolan examines the role of measurement model misspecification in detecting measurement bias and shows that measurement bias and multidimensionality are closely related. The authors demonstrate that erroneously assuming a unidimensional factor model (instead of a multidimensional two-factor model) may lead to a spurious detection of measurement bias. On the other hand, measurement bias may disappear in a multidimensional model which includes the potentially distorting variable as an additional factor.

In a final paper devoted to measurement bias, King-Kallimanis, Oort, and Garst propose a three-step procedure to detect measurement bias and response shift (a special case of measurement bias caused by a change in the meaning of response categories and/or item wordings in a questionnaire) in the case of multiple measurement occasions. The approach is illustrated by a longitudinal study on health-related quality-of-life data of HIV/AIDS patients.

The following subject of nonlinear relationships in SEM starts with a paper by Klein and Schermelleh-Engel. In their paper the authors introduce a new measure alleged to be able to detect model misspecification due to omitted nonlinear relationships (e.g., quadratic terms) more reliable than the conventional chi-square test. Although conceptualized as a formal test based on the comparison of the likelihood under the assumption of heteroscedastic residual scores with the likelihood under the assumption of homoscedastic residuals, it is recommended to use it as a descriptive measure. First simulation results lend convincing support for the measure's soundness although further Monte Carlo studies should explore this issue in more depth.

In a second paper, Schermelleh-Engel, Werner, Klein and Moosbrugger compare the partial least-squares product-indicator approach (PLS-PI) to modeling latent interaction effects, as a kind of nonlinearity, with two alternative methods: (1) constrained product-indicator approach using the LISREL program (LISREL-PI) and (2) latent moderated structural equations approach (LMS) using the Mplus software. The corresponding Monte Carlo simulation study supposedly favored the PLS approach in that it assumed a small sample size ($N = 100$) and a rather large number of indicators ($p =$ six) assigned to each latent variable. However, the simulation results clearly reveal that (at least under the normality assumption) PLS-PI has a considerably lower power to detect nonlinear relationships than LISREL-PI and LMS. Furthermore, as could be expected, linear and interaction parameter estimates are downward biased under the PLS approach.

The first paper covering the final topic, intra-individual change over time, is by Geiser, Eid, Nussbeck, Courvoisier and Cole, who present a new model for the analysis of multitrait-multimethod-multioccasion data (MMM). Compared to conventional single-occasion multitrait-multimethod data (i.e., MTMM data), stability of convergent and discriminant validity over time can be assessed by using MMM designs. The authors extend the Correlated State-Correlated Method Minus One [CS-C(M-1)] model by introducing change in state as well as in method effects as latent difference variables. This approach requires that one method can be designated as reference method against which all remaining methods are contrasted. An important feature of the CS-C(M-1) change model is that by including covariates it allows to investigate why different methods diverge in the assessment of states and latent change.

The final paper in this Special Issue by Oud first reviews the autoregressive latent trajectory (ALT) model as well as its recent extension, the continuous-time autoregressive latent trajectory (CALT) model. In a nutshell, ALT models combine autoregressive cross-lagged models and multivariate latent curve models, which incorporate intercepts and slopes as latent variables. The paper shows that the inclusion of a linear component (i.e., a latent slope variable) causes serious problems with this hybrid model. First, the model becomes unstable by definition. Second, because the slope variables characterize individuals but are not connected to specific time-points, a causal interpretation is highly questionable. Third, the linear component makes the model time-varying and relationships between intercept and slope variables dependent on the choice of the zero time point. In order to avoid the aforementioned shortcomings, a second-order stochastic differential equation model is proposed. The new approach is illustrated by longitudinal data on marital satisfaction.

In addition to the papers mentioned above, six papers were presented at the working group's meeting not included in this Special Issue for various reasons.

Two of them were concerned with the analysis of longitudinal data. Harry Garst's presentation ("A general longitudinal model") had a very strong methodological flavor, whereas Daniel Seddig ("Modeling longitudinal self-reported delinquency data") presented empirical results of different models applied to a five-wave panel data set on self-reported delinquency data including several covariates.

Two further papers discussed specific problems raised by incorporating formative measurement models into structural equation models. Guidelines for identifying formative measurement models in LISREL-type models as well as specification issues regarding truly endogenous formative constructs were discussed by Dirk Temme ("Formatively measured constructs: How to incorporate them into covariance-based structural equation models"). Jörg Betzin ("Formative and reflective modeling in PLS path models") discussed the properties of formative and reflective measurement models used in the PLS approach.

A further group of papers comprised applications of the PLS approach. Markus Ruge and Hans-Gerhard Strohe ("Sentiments and Expectations in the German Economy") applied dynamic PLS on a longitudinal data set covering various explanatory variables of sentiments in product as well as capital markets. Barbara Hanfstingl and her coauthors ("PLS applied in educational psychology: Do motivated teachers have motivated students?") presented both a PLS and a covariance structure model exploring the role of teachers' perceived self-determination in the motivation of students.

Slides of all speeches from the meeting can be found at the working group's website http://www.uni-bielefeld.de/soz/personen/reinecke/agsem/meetings.html.

We hope that readers will enjoy this Special Issue and become more interested in the further development of the SEM field.

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