A critical look at the use of SEM in international business research

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For the sake of clear visualization, we did not incorporate references into the presentation.
„The dynamic nature of the IB field and the early stage of theory development more often require a partial least squares (PLS-)SEM approach!“

**Purpose:** Critical review the application of SEM techniques in the field

**Methodology:** Screening articles applying SEM in 6 journals with an international business focus from 1990-2013. Analysis of their research objectives in contrast to methodology choices, plus an assessment of whether best practices in methodology usage were followed.

**Findings:** 379 articles utilized covariance based, and 45 PLS-SEM. Authors did not sufficiently build on the procedure’s benefits that stem from its design for predictive and exploratory purposes. Authors need to fully exploit PLS-SEM’s benefits and better follow best practice to advance the field.

**Value:** Guidelines for selecting and using SEM procedures and for making better choices concerning an appropriate SEM approach.

IB is a field characterized by being in a stage of theorizing and increasingly complex phenomena

- International business studies often build on theory in progress or theorizing (i.e. expanding, modifying, and further developing existing theory).
- To address the changes in the international environment and the ways international business and management are conducted, researchers often make use of a broad spectrum of theoretical explanations and borrow theories from other management disciplines to explain international research problems.

- Furthermore, over the past decades, the fluid and dynamic environment has led to increasingly complex research phenomena and models.
Theorizing requires predictive and exploratory research approaches well reflected in the PLS-SEM methodology

- In covariance-based SEM, strong theory drives model development - all theoretical relationships need to be modeled. Parameters are estimated so that the difference between the empirical covariance matrix and the covariance matrix determined by the theoretical model is minimized.
- Fit statistics are computed to evaluate the extent to which the empirical data fit the theoretical model.
- Thus, the theoretical model’s correctness is the basic assumption that underlies the approach!

- In theorizing, an unambiguous specification of a research model and its structural relationships might not be possible.
- A soft-modeling approach can be useful which focuses on the best prediction of a specific set of structural relationships between the variables of interest using numerous models.
- PLS-SEM proves particularly valuable for such purposes, because the extraction of latent variable scores in conjunction with the explanation of a large percentage of the variance in the indicator variables are useful for accurately predicting scores on the latent variables.
PLS-SEM for theorizing in empirical research

STAGES IN EMPIRICAL RESEARCH
- Problem definition and research goal
- Data collection and preparation
- Data analysis

PROCESS PECULIAR TO THEORIZING
- Generalizing findings to other research areas
- Selecting from different approaches & synthesizing different approaches
- Explaining new relationships
- Relating findings to contextual factors

MIGHT BE SUPPORTED BY THE FOLLOWING CHARACTERISTICS OF PLS-SEM

1. Test for the predictive relevance of hypothesized relationships in different research areas.

   The assessment of predictive power allows one to select from competing models, and points to room for improvement in terms of practical relevance (i.e. 2) test & improve existing models by synthesizing different approaches); PLS-SEM’s ability to test more complex models can help researchers to explore and (3) uncover new causal relationships that had previously been overlooked.

2. Test & improve existing models by synthesizing different approaches

3. Uncover new causal relationships that had previously been overlooked

4. Identify relevant contextual factors defining relevant subgroups

PLS-SEM tools for multigroup analyses or more explorative or prediction-oriented procedures such as FIMIX-PLS or PLS-POS help to identify relevant contextual factors defining relevant subgroups.
PLS-SEM for theorizing in empirical research

Problem definition and research goal

Collecting a variety of data with constructs that are theoretically less clearly defined

(5) The data are nonnormal.

(6) The analysis draws on secondary data.

Data collection and preparation

Analysis of a variety of often complex research models

(7) The causal model comprises many constructs, path relationships, and indicators, advanced elements such as moderator variables or hierarchical components, and formatively measured constructs.

(8) PLS-SEM offers latent variable scores that can be used in subsequent analyses.

PLS-SEM for complex research phenomena

- In CB-SEM, model complexity affects various goodness-of-fit measures, such as the chi-square value. For instance, the chi-square value decreases when parameters (or complexity) are added to the model. Thus, a good model fit (represented by a smaller chi-square value) may result either from a correctly specified model or from high model complexity.

- As a result, an inferior model fit may result either from an incorrectly specified model or from low model complexity.

- In PLS-SEM, complexity is not problematic, as long as the sample is of sufficient size. PLS-SEM’s superiority in terms of prediction and exploratory research has been validated in simulation studies that confirm that PLS is preferable to maximum-likelihood-based CB-SEM if the research objective is to identify relationships (i.e. prediction and theory development) instead of confirming relationships.
Hence, authors are advised to make use of the benefits offered by PLS-SEM in research in situations characterized by *theorizing and prediction-oriented goals* rather than by strong theory as well as by complexity!
This is the case for many of the research situations in international business. Do authors tap the full potential of PLS-SEM?
The use of SEM in past international business research

<table>
<thead>
<tr>
<th>Journals</th>
<th>CB-SEM (of which 144 focus on factor analyses)</th>
<th>PLS-SEM (of which two focus on factor analyses)</th>
</tr>
</thead>
<tbody>
<tr>
<td>International Business Review</td>
<td>70</td>
<td>15</td>
</tr>
<tr>
<td>International Marketing Review</td>
<td>99</td>
<td>4</td>
</tr>
<tr>
<td>Journal of International Business Studies</td>
<td>108</td>
<td>7</td>
</tr>
<tr>
<td>Journal of International Management</td>
<td>24</td>
<td>4</td>
</tr>
<tr>
<td>Journal of World Business</td>
<td>52</td>
<td>8</td>
</tr>
<tr>
<td>Management International Review</td>
<td>26</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>424</td>
<td>379</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Years</th>
<th>CB-SEM</th>
<th>PLS-SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990 to 1994</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>1995 to 1999</td>
<td>28</td>
<td>2</td>
</tr>
<tr>
<td>2000 to 2004</td>
<td>70</td>
<td>3</td>
</tr>
<tr>
<td>2005 to 2009</td>
<td>131</td>
<td>8</td>
</tr>
<tr>
<td>2010 to 2013</td>
<td>148</td>
<td>31</td>
</tr>
</tbody>
</table>

For a relevant number of studies PLS-SEM might have been a better methodological choice

- Reasons given for choosing PLS-SEM: small sample size (56%), data distribution (47%), exploratory investigation and theory development (40%), use of formative indicators (35%), explanatory power and predictive performance (30%), model complexity (28%), measurement scale (16%), assessment of reliability and validity (5%), and assessment of relationships between constructs (5%).

- International business researchers’ PLS-SEM usage is largely determined by the characteristics of the data and the measures utilized and, to a lesser degree, by research objectives that champion the characteristics of the PLS-SEM approach.

- Reasons given for choosing CB-SEM: no reason for this methodological choice given (64%), useful tool for testing theory (13%), simultaneous testing of various relationships (11%), measurement errors (8%), use of latent constructs with multiple indicators (7%), a complex model (5%), testing of mediation (4%), comparison of different groups (6%), and simultaneous assessment of the measurement model (3%).

- Thus, only a few studies explicitly justified CB-SEM usage by its ability to test theory-based hypotheses.
## Compliance to guidelines to tap PLS-SEM’s full potential

<table>
<thead>
<tr>
<th>GUIDELINE</th>
<th>COMPLIANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prediction</strong></td>
<td></td>
</tr>
<tr>
<td>(1) Report results of predictions conducted in one or more samples.</td>
<td>(1) No study.</td>
</tr>
<tr>
<td>(2) Report blindfolding: $Q^2 &gt; 0$ is indicative of predictive relevance;</td>
<td>(2) 11 out of 40 studies reported blindfolding results; on average, they</td>
</tr>
<tr>
<td>$q^2$: 0.02, 0.15, 0.35 for weak, moderate, strong degrees of predictive</td>
<td>were indicative of predictive relevance (mean $Q^2 = 0.163$).</td>
</tr>
<tr>
<td>relevance (only applicable to endogenous latent constructs with</td>
<td></td>
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<tr>
<td>reflective measurement models).</td>
<td></td>
</tr>
<tr>
<td><strong>Improve existing models</strong></td>
<td></td>
</tr>
<tr>
<td>(1) Respecify models (by adding or removing paths to or from an</td>
<td>(1) 5 studies respecified their models;</td>
</tr>
<tr>
<td>originally proposed model);</td>
<td>(2) only two authors provided theoretical reasoning for their</td>
</tr>
<tr>
<td>(2) base respecifications on theoretical justifications;</td>
<td>respecifications;</td>
</tr>
<tr>
<td>(3) cross-validate a respecified model.</td>
<td>(3) authors did not cross-validate the respecified models.</td>
</tr>
<tr>
<td></td>
<td>[Instead, 13 out of 43 studies tested competing models; of these, 2</td>
</tr>
<tr>
<td></td>
<td>studies referred to a naïve or control estimation.]</td>
</tr>
</tbody>
</table>
## Compliance to guidelines to tap PLS-SEM’s full potential

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<tr>
<th>GUIDELINE</th>
<th>COMPLIANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uncover new relationships</strong></td>
<td>(1) Make use of PLS-SEM’s capacity to estimate more complex models.</td>
</tr>
<tr>
<td><strong>Uncover heterogeneity</strong></td>
<td>(1) Model complexity was found to be much higher in the PLS-SEM studies than in the CB-SEM studies; the PLS-SEM papers involved, on average, models with 7 latent constructs, 8 paths, and 25 indicator variables.</td>
</tr>
<tr>
<td></td>
<td>(1) 14 studies conducted multigroup analyses based on theoretical group separators;</td>
</tr>
<tr>
<td></td>
<td>(2) only one study utilized FIMIX-PLS;</td>
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<tr>
<td></td>
<td>(3) none of the studies reviewed referred to the POS procedure.</td>
</tr>
</tbody>
</table>

The dominance of CB-SEM in the field is surprising and seems to stem from the procedure’s longer history

- The majority of studies (89%) that apply SEM in this field apply CB-SEM.
- This is surprising, given the character of the international research context. Because the decision to go with CB-SEM was in most cases (in 64 percent of the studies) not further commented on, or not specific to CB-SEM as opposed to PLS-SEM (e.g. the use of latent constructs, a complex model), we can only speculate that this might be due to the stronger distribution and longer history of CB-SEM’s application in the social sciences.
- The studies referring to PLS-SEM provided better reasons for their methodological choices, and the justifications largely referred to sampling – although we did find that sample size was often not the limiting factor in international business research; instead, data and measurement issues were (e.g. data distribution, formative constructs, and measurement scales).
- Our review showed that PLS-SEM usage is to a smaller degree driven by research objectives championing the characteristics of the PLS-SEM approach, stemming from PLS-SEM’s focus on prediction and soft-modeling characteristics.
The full potential of PLS-SEM for theorizing purposes is not tapped by the field

- While a large number of international business themes are related to prediction-oriented research questions, very few of the sample studies used the approach specifically for prediction purposes.

- Except for the application of more complex models, the benefits of PLS-SEM do not appear to be sufficiently exploited by researchers in the field: The models’ predictive relevance were mostly not assessed, few studies used the opportunity to respecify the model in the course of their analysis.

- While international business and marketing research is often interested in the similarities and differences between groups, none of the sample studies referred to explorative PLS-SEM procedures for uncovering unobserved heterogeneity so as to create substantively meaningful subgroups.
We advise researchers to more critically assess whether their analytical approach fits to the research agenda and to make use of the full (exploratory) toolbox of the research method

- A study’s research purpose and the related theoretical and empirical basis should be the primary criteria in selecting either PLS-SEM or CB-SEM: If the primary objective is theory development, then the PLS-SEM approach is preferable. Sample and measurement characteristics should be secondary selection criteria. Researchers are advised to better justify their methodological choices in light of their research problems.

- We encourage researchers to be more open to more explorative techniques and designs, and to make use of the full power of PLS-SEM in the process of theorizing.

- We encourage journal editors and reviewers to indicate this to authors, and to enforce justification of the chosen analytical approach. Journal editors and reviewers should see exploratory research as a way to avoid theoretical stagnation. Therefore, in research areas where the theoretical and empirical basis is fairly weak, they should allow authors to ask and explore research questions, instead of positing and testing hypotheses that are embedded in fairly weak theory. Authors of an exploratory study should not be forced, in the review process, to treat their study as if it were confirmatory.
We advise researchers to more strictly follow best practice of methodology application

Although not part of this presentation, we reviewed the compliance to best practice of methodology usage.

Here are the key recommendations from this analysis:

- More carefully discuss the chosen measurement modes; especially if applying formative measurements, models need to cover a construct’s full theoretical meaning so as to offer valid results. Concerning the application of reflective measurements, considering multiple items is a fruitful route that taps SEM’s full potential (compared to multiple regression analyses).

- In sampling, anticipate the use of holdout samples in order to test their results’ robustness.

- In analyzing the collected data, improve the evaluation of the results and/or the reporting of evaluation criteria. Formative measurement model evaluation, in particular, requires improvement, but the more common reflective measurements will also benefit from referral to the outlined assessment standards.

- Finally, the reporting of the inner model’s quality can be increased in terms of the reporting of effect sizes.

The above recommendations are valid for both explanatory and exploratory research; however, in exploratory research designs, following the guidelines outlined is even more important, so that we can truly advance theory building based on empirical data.