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Common methods variance detection in business research☆

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ABSTRACT

The issue of common method variance (CMV) has become almost legendary among today's business researchers. In this manuscript, a literature review shows many business researchers take steps to assess potential problems with CMV, or common method bias (CMB), but almost no one reports problematic findings. One widely-criticized procedure assessing CMV levels involves a one-factor test that examines how much common variance might exist in a single dimension. This paper presents a data simulation demonstrating that a relatively high level of CMV must be present to bias true relationships among substantive variables at typically reported reliability levels. The simulation data overall suggests that at levels of CMV typical of multiple item measures with typical reliabilities reporting typical effect sizes, CMV does not represent a grave threat to the validity of research findings.
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1. Introduction

Academic business researchers currently pay tremendous attention to the potential influences of common method variance (CMV) and common method bias (CMB) (Bagozzi, 2011; Lance, Dawson, Birkelbach, & Hoffman, 2010; Malhotra, Kim, & Patil, 2006; Richardson, Simmering, & Sturman, 2009; Sharma, Yetton, Crawford, 2010; Sharma, Yetton, Crawford, 2009; Williams, Hartman, & Cavazotte, 2010). A search of the *Journal of Business Research* (*JBR*) database reveals CMB as the most conventionally used term with 239 articles in the *JBR* referring to "common method bias," dating back to 1985 (Oliver and Bearden, 1985), with mentions increasing dramatically in the past 3 years. A total of 203 articles to date (many overlapping with the 239), refer to "common method(s) variance." In addition to these reports appearing in print, many others potentially address reviewer queries related to CMV in earlier manuscript versions or directly in notes to reviewers or reviewer appendices. The hundreds of papers represent considerable attention, particularly in comparison to other typically reported and absolutely critical issues such as "construct validity," which appears 288 times. Today's survey researchers seem to face a presumption of guilt with respect to CMB.

Business researchers report post-hoc statistical tests for CMV or CMB with increasing frequency in recent years (Richardson et al., 2009; Simmering, Fuller, Richardson, Ocal, & Atinc, 2015). As more reviewers receive exposure to the concepts during review processes or doctoral training, they begin to ask potential authors more questions about CMV. Despite increased reports of tests for CMV and CMB (as demonstrated by the numerous mentions in the *JBR*), however, the vast majority of the diagnostic checks conclude that no concern due to CMB exists. Therefore, as a way of examining whether the presumption of guilt makes sense, the article addresses two research questions. First, just how much common method variance must be present to create bias sufficient to distort interpretations materially? Second, is the so-called Harman's one-factor test, which is fast and easy to apply, capable of detecting CMV at biasing levels? Given the increasingly common view that authors must report on common methods variance in self-report surveys in today's academic business research, this study addresses more widely whether the issue merits such attention, particularly in light of other potential sources of response error.

1.1. CMV and CMB in business research

CMV occurs when responses systematically vary because of the use of a common scaling approach on measures derived from a single data source. CMV biases result when the so-called method, as a causal factor, meaningfully distorts substantively-driven causal effects. However,

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CMV, should it even exist, may not produce changes in effect sizes and significance levels, may change them trivially, or may change them in an amount that is practically meaningless. Therefore, any report only addressing CMV is of limited utility. CMV biases data when it produces significant and nontrivial divergence between true and observed relationships (Ostroff, Kinicki, & Clark, 2002) and CMV itself is just one of the many sources of error that potentially lead to attenuated trustworthiness of reported results (Babin & Zikmund, 2016).

CMV may either artificially inflate or deflate correlations (Conway & Lance, 2010; Williams & Brown, 1994). Researchers place most concern in the possibility that CMV may falsely inflate observed relationships among measures. If so, biased results could cause a researcher to falsely conclude that a relationship exists (enhancing type I error). Researchers debate the nature and influence of CMV, ranging from those who argue that if CMV exists, the degree of CMV does not generally rise to biasing levels, to those who believe that distortion due to common methods is pervasive and rampant (see Brannick, Chan, Conway, Lance, & Spector, 2010; Podsakoff, MacKenzie, Lee, & Podsakoff, 2003; Richardson et al., 2009; Spector, 2006). Further, reviewers and editors may express greater skepticism regarding research that makes use of same-source, self-reported data because they believe that common methods drive effects more than the hypothesized cause (Brannick et al., 2010; Conway & Lance, 2010; Pace, 2010). Interestingly, response error sources that may drive common variance or otherwise distort results, such as low response involvement, acquiescence, or respondent dishonesty, receive relatively little notice.

1.1.1. Post-hoc tests

Business researchers typically apply one of four post-hoc statistical techniques to check for CMV and/or CMB. Traditionally, *Harman's One-Factor Test* indicates problematic CMV if an exploratory factor analysis (EFA) with all study variables produces eigenvalues suggesting the first factor accounts for more than 50% of the variance among variables (Podsakoff & Organ, 1986). The *Correlational Marker Technique* (Lindell & Whitney, 2001) provides a correction factor through use of a marker variable (one theoretically unrelated to other items in the survey) of the same scale type. The *Confirmatory Factor Analysis* (*CFA*) *Marker Technique* (Williams et al., 2010) uses a marker variable in a CFA model to detect CMV. Finally, the *Unmeasured Latent Method Construct* (*ULMC*) *test* specifies a latent construct with no uniquely observed indicators to represent shared variance between a method and the substantive constructs (Williams, Cote and Buckley, 1989).

1.1.2. Results of a review

The current review examines how recent survey-based business research addresses CMV and CMB across all articles published in *JBR* during 2011 and 2012. Of the 445 total articles in these issues, 137 articles are single-source, cross-sectional survey-based studies, which are believed to be most susceptible to bias from CMV. The first and second author independently coded whether or not each of 137 papers addressed CMV or CMB and in what way (i.e., mentioned, addressed procedurally, or addressed with a post-hoc technique). The post-hoc statistical techniques involved a consistent set of codes ("0" if the test was not used, "1" if the test was used and that study's authors concluded that CMV did not bias the data, and "2" if the test was used and that study's authors concluded that CMV biased the data). The mean inter-rater agreement between the coders across all coding was 95% (range: 86.9–98.5%). Discrepancies in coding were resolved through discussion.

Results indicate that 54 of the 137 (39.4%) papers mention CMV or CMB and that 42 of 137 (30.7%) same-source survey articles use some post-hoc statistical CMV detection technique. In these 42 papers, authors inconsistently indicate searching for CMV versus CMB. Most articles (59.5%) refer to any diagnosis or conclusion made with the term "common method bias," and fewer (35.7%) describe "common method variance."

This review suggests that researchers employ Harman's one-factor test most frequently (32 times; 76.2%) in these 42 papers, followed by the ULMC (7 times; 16.7%), the correlational marker technique (5 times; 11.9%) and the CFA marker technique (1 time; 2.4%). Two papers state no evidence of CMV without specifying a specific test. Most notably, *none* of these 42 (0.0%) studies draws a conclusion that CMV biases the data. This finding could have several explanations:

(1) CMV may be present, but CMB is not present;
(2) CMB is present, but the tests used do not detect the bias;
(3) A perceived publication bias prevents authors who do find evidence of CMB from submitting papers or when submitted, reviewers vote to reject these papers (Simmering, et al., 2015).

Both options 1 and 2 present possible challenges to the conventional thinking that CMV presents a grave and present danger perhaps over and above other potential sources of response error. That is, researchers use common methods analysis because the use appeases reviewers more than as a way of presenting results in a straightforward manner.

1.2. Use of Harman's one-factor test in prior research

Empirical studies address the efficacy of other post-hoc tests (see Richardson et al., 2009), yet Harman's one-factor test, although widely applied, remains understudied. Harman's one-factor test (also called Harman's single-factor test) uses concepts from Harman's (1967; 1976) texts on factor analysis and researchers apply the test to detect CMV. While this test bears Harman's name, whose work is often cited as the primary source of the test, the application of exploratory factor analysis (EFA) specifically to the detection of common method variance does not appear in Harman's texts (1967, 1976), and thus, the test's name originates from other sources. Researchers apply concepts regarding EFA from Harman (1967) to determine whether a third variable problem or a sizable method factor exists. Schriesheim (1979) illustrates such an early application of Harman's text to the common method issue (Schriesheim, personal communication, Feb. 21, 2011) and Podsakoff and Organ (1986) give the application the label "Harman's single-factor test."

As argued above, while CMB is truly more meaningful in terms of research findings, the earliest descriptions of Harman's one-factor test position the test as appropriate to identify common method *variance* (Podsakoff & Organ, 1986). Yet, articles summarizing techniques such as Harman's assume that any detection of CMV with the test is equivalent to the detection of bias (see Podsakoff & Organ, 1986 and Podsakoff et al., 2003). Such authors give little attention to the notion that post-hoc statistical tests may identify CMV that is not at biasing levels, and this lack of distinction continues in research. While no empirical evidence exists regarding the efficacy of Harman's one-factor test, numerous authors have warned against the use of the test. Podsakoff et al. (2003), who are frequently cited in support of the use of this technique, actually comment that for the technique to be effective, "… common method variance would have to completely account for the covariances among the items for it to be regarded as a problem in a particular study" (p. 889). Authors generally believe Harman's one-factor test to be not sensitive enough to detect CMB (Podsakoff et al., 2003).

2. Simulation

The first question in the current paper aims at determining whether or not the increased attention to common methods effects in business research creates a heresy. More specifically, does CMV equal CMB in data, or at what level does the presence of CMV create bias? Some authors have produced compelling evidence that CMV does not often occur at biasing levels (e.g., Crampton & Wagner, 1994; Lance et al.,

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