

Formative versus reflective measurement models: Two applications of formative measurement[☆]

Tim Coltman^{a,*}, Timothy M. Devinney^{b,1}, David F. Midgley^{c,2}, Sunil Venaik^{d,3}

^a Centre for Business Services Science, University of Wollongong, Wollongong 2522, Australia

^b Australian School of Business, The University of New South Wales, Sydney 2052, Australia

^c Marketing Area, INSEAD, Boulevard de Constance, 77305 Fontainebleau, France

^d UQ Business School, The University of Queensland, Brisbane 4072, Australia

Received 1 May 2007; received in revised form 1 November 2007; accepted 1 January 2008

Abstract

This paper presents a framework that helps researchers to design and validate both formative and reflective measurement models. The framework draws from the existing literature and includes both theoretical and empirical considerations. Two important examples, one from international business and one from marketing, illustrate the use of the framework. Both examples concern constructs that are fundamental to theory-building in these disciplines, and constructs that most scholars measure reflectively. In contrast, applying the framework suggests that a formative measurement model may be more appropriate. These results reinforce the need for all researchers to justify, both theoretically and empirically, their choice of measurement model. Use of an incorrect measurement model undermines the content validity of constructs, misrepresents the structural relationships between them, and ultimately lowers the usefulness of management theories for business researchers and practitioners. The main contribution of this paper is to question the unthinking assumption of reflective measurement seen in much of the business literature.

© 2008 Elsevier Inc. All rights reserved.

Keywords: Formative; Reflective; International business; Integration-responsiveness; Marketing; Market orientation

1. Introduction

Management scholars often identify structural relationships among latent, unobserved constructs by statistically relating covariation between the latent constructs and the observed variables or indicators of these latent constructs (Borsboom et al., 2003, 2004). This statistical covariation allows scholars to argue that if variation in an indicator X is associated with

variation in a latent construct Y, then exogenous interventions that change Y can be detected in the indicator X. Most scholars assume that this relationship between construct and indicator is reflective. In other words, the change in X reflects the change in the latent construct Y. With reflective (or effect) measurement models, causality flows from the latent construct to the indicator.

However, not all latent constructs are entities that are measurable with a battery of positively correlated items (Bollen and Lennox, 1991; Edwards and Bagozzi, 2000; Fornell, 1982). A less common, but equally plausible approach is to combine a number of indicators to form a construct without any assumptions as to the patterns of intercorrelation between these items. A formative or causal index results (Blalock, 1964; Diamantopoulos and Winklhofer, 2001; Edwards and Bagozzi, 2000) where causality flows in the opposite direction, from the indicator to the construct. Although the reflective view dominates the psychological and management sciences, the formative view is common in economics and sociology.

[☆] The views here are solely those of the authors, who appear in alphabetical order. The authors thank the anonymous reviewers and the editor of the special issue for their many helpful comments.

* Corresponding author. Tel.: +61 2 4221 3912; fax: +61 2 4221 4055.

E-mail addresses: coltman@uow.edu.au (T. Coltman), T.Devinney@agsm.edu.au (T.M. Devinney), david.midgley@insead.edu (D.F. Midgley), svenaik@business.uq.edu.au (S. Venaik).

¹ Tel.: +61 2 9385 5671; fax: +61 2 9385 5722.

² Tel.: +33 1 60 72 49 77; fax: +33 1 60 74 55 00.

³ Tel.: +61 7 3365 6841; fax: +61 7 3365 6988.

The distinction between formative and reflective measures is important because proper specification of a measurement model is necessary to assign meaningful relationships in the structural model (Anderson and Gerbing, 1988). Theoretical work in construct validity (Blalock, 1982; DeVellis, 1991; Edwards and Bagozzi, 2000) and structural equation modeling (Baumgartner and Homburg, 1996; Chin and Todd, 1995; Shook, Ketchen, Hult, and Kacmar, 2004) enhances our understanding, however, considerable debate still exists regarding the procedures a working researcher should follow to achieve construct validity (e.g., Diamantopoulos, 2005; Finn and Kayande, 2005; Rossiter, 2005). This paper is not to repeat or continue this debate. Rather, the authors take the middle ground, building on the work of both those who stress theoretical justifications for constructs and those who argue for empirical validation as part of measure development.

The paper presents an organizing framework for construct measurement that begins with theoretical justification to define the nature of the focal constructs, and then employs a series of empirical tests to support the causal direction between constructs and their measures. The framework builds on the work of Jarvis et al. (2003) who provide a set of decision rules for deciding whether the measurement model should be formative or reflective. However, the framework here differs from Jarvis et al.'s decision rules in several respects, most importantly in the specific procedures and the attention to measurement error.

The major contribution of this paper is to question the common assumption of a reflective measurement model seen in much of the business literature. Applying the framework to two widely used constructs in this literature is the vehicle for questioning this assumption. The two constructs are integration-responsiveness (from the discipline of international business) and market orientation (from the discipline of marketing). This choice of examples is important because of: (1) the predominance of the reflective modeling approach for these constructs, even though a formative model may be theoretically more appropriate, and (2) the criticality of the underlying phenomena to the development of the two disciplines.

In the case of the integration-responsiveness framework, the diverse measures of each of the integration and responsiveness pressures are unlikely to intercorrelate highly as a reflective model requires. A priori, a formative approach to measurement would seem worthy of consideration, yet most of the work in this area takes the reflective stance, often without any consideration of alternatives (Venaik et al., 2004). Similarly, most research on market orientation defines it as a one-dimensional construct which the researcher measures through a multi-item reflective scale. Yet, the main scales that measure market orientation—MARKOR (Kohli and Jaworski, 1990) and MORTN (Deshpande and Farley, 1998)—are conceptualized as a set of activities that make up the attribute (see Narver and Slater, 1990, p. 21), implying a formative model. Further, the substantive inconsistencies in the market orientation literature (Langerak, 2003) raise many questions about the dimensionality (Sigauw and Diamantopoulos, 1995) and measurement (Narver et al., 2004) of the market orientation

construct. These examples serve to illustrate a problem in the international business and marketing literature, which pay insufficient attention to measuring constructs.

The organization of the paper is as follows. Section 2 presents the framework for designing and validating reflective and formative models using both theoretical and empirical considerations. Sections 3 and 4 then apply this framework to the two illustrative and important examples taken, respectively, from international business and marketing. The purpose here is to examine whether reflective or formative measurement models are more or less appropriate, not to debate the content validity of the measures that various scholars adopt. Finally, Section 5 provides discussion and conclusions.

2. An organizing framework for designing and validating reflective and formative models

In recent years, scholars have begun to challenge the blind adherence to Churchill's (1979) procedure with its strict emphasis on exploratory factor analysis (Spearman, 1904), internal consistency (Cronbach, 1951) and the domain sampling model (Nunnally and Bernstein, 1994). In psychology, Borsboom et al. (2003, 2004) use basic logic and measurement theory to argue that the choice of model is dependent upon the ontology the latent construct invokes. In marketing, Rossiter (2002) provides a general procedure for scale development which extends "accepted" practice by reemphasizing the importance of theoretical considerations. Borsboom and Rossiter both argue that scholars should focus only on theoretical considerations and resist the temptation to conduct empirical tests.

Alternatively, Diamantopoulos (2005) and Finn and Kayande (2005) argue that both theoretical and empirical criteria are necessary to design and validate measurement models. Empirical analyses provide an important foundation for content validity, especially to detect errors and misspecifications or wrongly conceived theories. For example, finding a negative relationship when theory and common sense suggest a positive relationship should be a concern for researchers.

This paper follows the stance of Diamantopoulos, and Finn and Kayande but takes a different perspective on empirical measurement and the role that measures play in the choice of a formative or reflective measurement model. To comprehensively capture the necessary theoretical and empirical aspects, the paper presents an organizing framework for designing and validating formative and reflective models (see Table 1). As shown in the table, three theoretical considerations and three empirical considerations distinguish formative models from reflective ones. The following sections briefly discuss each of these considerations.

2.1. Theoretical considerations

Three broad theoretical considerations are important in deciding whether the measurement model is formative or reflective. These considerations include: (1) the nature of the construct, (2) the direction of causality between the indicators

Table 1
A framework for assessing reflective and formative models: theoretical and empirical considerations

Considerations	Reflective model	Formative model	Relevant literature
<i>Theoretical considerations</i>			
1. Nature of construct	Latent construct exists > Latent construct exists independent of the measures used	Latent construct is formed > Latent constructs is a combination of its indicators	Borsboom et al. (2003, 2004)
2. Direction of causality between items and latent construct	Causality from construct to items > Variation in the construct causes variation in the item measures > Variation in item measures does not cause variation in the construct	Causality from items to construct > Variation in the construct does not cause variation in the item measures > Variation in item measures causes variation in the construct	Bollen and Lennox (1991); Edwards and Bagozzi (2000); Rossiter (2002); Jarvis et al. (2003)
3. Characteristics of items used to measure the construct	Items are manifested by the construct > Items share a common theme > Items are interchangeable > Adding or dropping an item does not change the conceptual domain of the construct	Items define the construct > Items need not share a common theme > Items are not interchangeable > Adding or dropping an item may change the conceptual domain of the construct	Rossiter (2002); Jarvis et al. (2003)
<i>Empirical considerations</i>			
4. Item intercorrelation	Items should have high positive intercorrelations > Empirical tests: assessing internal consistency and reliability by Cronbach alpha, average variance extracted, and factor loadings (e.g., from common or confirmatory factor analysis)	Items can have any pattern of intercorrelation but should possess the same directional relationship > Empirical test: no empirical assessment of indicator reliability possible; various preliminary analyses are useful to check directionality between items and construct	Cronbach (1951); Nunnally and Bernstein (1994); Churchill (1979); Diamantopoulos and Siguaw (2006)
5. Item relationships with construct antecedents and consequences	Items have similar sign and significance of relationships with the antecedents/consequences as the construct > Empirical tests: establishing content validity by theoretical considerations, assessing convergent and discriminant validity empirically	Items may not have similar significance of relationships with the antecedents/consequences as the construct > Empirical tests: assessing nomological validity by using a MIMIC model, and/or structural linkage with another criterion variable	Bollen and Lennox (1991); Diamantopoulos and Winklhofer (2001); Diamantopoulos and Siguaw (2006)
6. Measurement error and collinearity	Identifying the error term in items is possible > Empirical test: identifying and extracting measurement error by common factor analysis	Identifying the error term is not possible if the formative measurement model is estimated in isolation > Empirical test: using the vanishing tetrad test to determine if the formative items behave as predicted > Collinearity should be ruled out by standard diagnostics such as the condition index	Bollen and Ting (2000); Diamantopoulos (2006)

and the latent construct, and (3) the characteristics of the indicators used to measure the construct [numbering relates to the rows in Table 1].

Consideration 1: The nature of the construct. In a reflective model, the latent construct exists (in an absolute sense) independent of the measures (Borsboom et al., 2004; Rossiter, 2002). Typical examples of reflective scenarios include measures of attitudes and personality. Practically all scales in business and related methodological texts on scale development (Bearden and Netmeyer, 1999; Bruner et al., 2001; Netmeyer, Bearden, and Sharma, 2003; Spector, 1992) use a reflective approach to measurement. For example, examining papers in the Journal of International Business Studies and the Journal of Marketing for 2006 reveals that nearly 95% of constructs with multiple items assume reflectivity without apparent consideration of an alternative formulation.

In contrast, in a formative model, the latent construct depends on a constructivist, operationalist or instrumentalist interpretation by the scholar (Borsboom et al., 2003). For example, the human development index (HDI) does not exist as an independent entity. Rather, it is a composite measure of human development that includes: health, education and

income (UNDP, 2006). Any change in one or more of these components is likely to cause a change in a country's HDI score. In contrast to the reflective model, few examples of formative models are seen in the business literature.

Consideration 2: Direction of causality. The second key theoretical consideration in deciding whether the measurement model is reflective or formative is the direction of causality between the construct and the indicators. As shown in Fig. 1, reflective models assume that causality flows from the construct to the indicators. In the case of formative models, the reverse is the case, causality flows from the indicators to the construct. Hence, in reflective models, a change in the construct causes a change in the indicators. In the case of formative models, it is the other way around; a change in the indicators results in a change in the construct under study. Thus, the two models in Fig. 1 are different, both psychometrically and conceptually (Bollen and Lennox, 1991). The difference in causal direction has profound implications both for measurement error (Diamantopoulos, 2006) and model estimation; topics for Section 2.2.

Consideration 3: Characteristics of indicators. Significant differences are present in the characteristics of the indicators

that measure the latent constructs under reflective and formative scenarios. In a reflective model, change in the latent variable must precede variation in the indicator(s). Thus, the indicators all share a common theme and are interchangeable. This interchangeability enables researchers to measure the construct by sampling a few relevant indicators underlying the domain of the construct (Churchill, 1979; Nunnally and Bernstein, 1994). Inclusion or exclusion of one or more indicators from the domain does not materially alter the content validity of the construct.

However, the situation is different in the case of formative models. Since the indicators define the construct, the domain of the construct is sensitive to the number and types of indicators the researcher selects. Adding or removing an indicator can change the conceptual domain of the construct significantly. However, as Rossiter (2002) points out, this does not mean that researchers need a census of indicators as Bollen and Lennox (1991) suggest. As long as the indicators conceptually represent the domain of interest, they may be considered adequate from the standpoint of empirical prediction.

2.2. Empirical considerations

Paralleling the three theoretical considerations above, are three empirical considerations that inform understanding of the measurement model: (4) indicator intercorrelation, (5) indicator relationships with construct antecedents and consequences, and (6) measurement error and collinearity [numbering relates to the rows in Table 1].

Consideration 4: Indicator intercorrelation. In a reflective model, the underlying construct drives the indicators, which have positive and, desirably, high intercorrelations. In a formative model, the indicators do not necessarily share the same theme and hence have no preconceived pattern of intercorrelation. Indicators in a formative model can theoretically possess no intercorrelation or high or low intercorrelation.

Regardless, researchers should check that indicator inter-correlations are as they expect. Such checks are a necessary part of the various preliminary analyses for questionnaire items which samples of respondents provide. These preliminary analyses include checking for the presence of outliers (e.g., using distances in factor spaces for reflective measurement models or regression influence diagnostics for formative models); checking that the dimensionality of the construct is consistent with a researcher’s hypothesis (e.g., using common factor models or principal components analysis); establishing that the correlations between items and constructs have the expected directionality and strength (e.g., through bivariate correlations, factor or regression analysis); reliability statistics (only in the case of the reflective measurement model); and, where several constructs are part of a theoretical structure, showing that common method bias is not an issue (e.g., by the absence of one common factor). Some of these preliminary analyses (and the diagnostics that go with them) shed useful light on issues of indicator intercorrelation and inferentially suggest whether the researcher should prefer one measurement model or another. However, in themselves, they cannot either support or disconfirm theoretical expectations as to the nature of the measurement model. For that, researchers require stronger tests.

Since reflective indicators have positive intercorrelations, researchers can use statistics such as factor loading and communality, Cronbach alpha, average variance extracted and internal consistency to empirically assess the individual and composite reliabilities of their indicators (Trochim, 2007). However, as these measures of reliability assume internal consistency—that is, high intercorrelations among the indicators in question—they are inappropriate for formative indicators, where no theoretical assumption is made about inter-item correlation. One of the key operational issues in the use of formative indicators is that no simple, easy and universally accepted criteria exist for assessing their reliability.

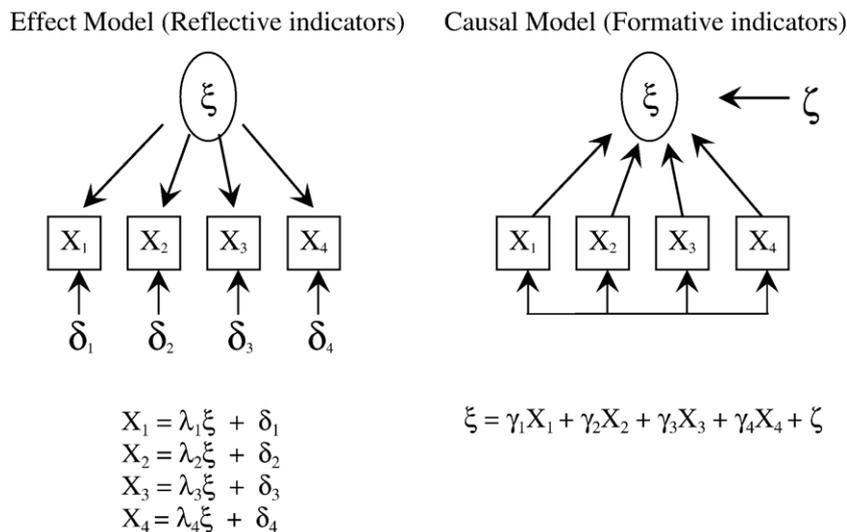


Fig. 1. Reflective and formative measures.

Consideration 5: Indicator relationships with construct antecedents and consequences. In the case of reflective models, the indicators have a similar (positive/negative, significant/non-significant) relationship with the antecedents and consequences of the construct. The requirement for interrelated indicators is not the case for formative indicators as they do not necessarily share a common theme and, therefore, do not have the same types of linkages with the antecedents and consequences of the construct. This lack of a common theme is a significant issue when using formative models, particularly as it has implications for the appropriate level of aggregation of formative indicators. While aggregating indicators to create a construct achieves the objective of model parsimony, it may come at a significant cost in terms of the loss of the rich, diverse and unique information the individual indicators provide. Edwards (2001) makes a similar point for second and higher order dimensions.

In the case of formative measurement, Diamantopoulos and Winklhofer (2001) suggest three possible approaches. First, the researcher can relate the indicators to some simple overall index variable, such as a summary or overall rating—this is the approach the second example in this paper takes (market orientation). Second, the researcher can apply a Multiple Indicators and Multiple Causes (MIMIC) model, where both formative and reflective indicators measure the construct. Third, the researcher applies a structural model linking the formatively measured construct with another reflectively measured construct to which it relates theoretically. This approach establishes criterion and nomological validity, and is the approach the first example in this paper takes (integration-responsiveness pressures).

Consideration 6: Measurement error and collinearity. A key difference between formative and reflective measurement models is the treatment of measurement error. As Fig. 1 shows, an important assumption underlying the reflective measurement model is that all the error terms (δ_i of Fig. 1) associate with the observed scores (x_i) and, therefore, represent measurement error in the latent variable. The formative measurement model does not assume such a correlational structure. For the formative case the disturbance term (ζ) neither associates with the individual indicator, nor the set of indicators as a whole. This term therefore does not represent measurement error (Diamantopoulos, 2006).

In the case of reflective measurement models, researchers can identify and eliminate measurement error for each indicator using common factor analysis. This elimination occurs because the factor score contains only that part of the indicator that is shared with other indicators, and excludes the errors in the underlying items (Spearman, 1904). However, in the case of formative models, the only way to overcome measurement error is to design it out of the study before collecting the data. Diamantopoulos (2006) suggests two possible ways to eliminate the error term: (1) capture all possible causes of the construct, and (2) specify the focal construct in such a way as to capture the full set of indicators. Both approaches legitimately exclude the error term ($\zeta=0$). In the light of the above, it is clear that unlike the reflective model, no simple way exists to empirically assess the impact of measurement error in a formative model.

However, Bollen and Ting (2000) suggest that the tetrad test can provide some assistance in assessing measurement error. A tetrad refers to the difference between the products of two pairs of error covariances (Spearman and Holzinger, 1924). The tetrad test involves examining the nested vanishing tetrads that a comparison of the two different measurement models implies. In the case of a reflective model, the null hypothesis is that the set of non-overlapping tetrads vanishes. In simpler terms, when comparing the intercorrelations between pairs of errors, they should tend to zero. Referring back to Fig. 1, the assumption underlying the reflective model is that the correlations between the δ_i are zero. The tetrad test confirms whether or not this is true. If not, the researcher may wish to consider a formative measurement model.

The tetrad test is a confirmatory procedure and not for use as a stand-alone criterion for distinguishing formative from reflective models. Specifically, if the test rejects the hypothesis that the errors are uncorrelated, it can be for one of two alternative reasons. One is that the construct is better measured formatively, not reflectively. The other is that reflective measurement is more appropriate but the error structure is contaminated. One possible source of contamination is common method error. Similarly, if the researcher accepts the hypothesis that the errors are uncorrelated, this could still be a mistake. A possibility, although unlikely in practice, is that a formative model is correct but that the indicator error structures are uncorrelated. Thus, while serving as an important pointer, the results from the tetrad test do not provide definitive proof as to the correct measurement model.

Another measurement issue that researchers need to check in formative models is collinearity. The presence of highly correlated indicators will make estimation of their weights in the formative model difficult and result in imprecise values for these weights. Given a criterion variable, as above, an estimate of the impact of collinearity can be made by regressing the indicators on this variable and computing standard diagnostics such as the condition index.

The next two sections apply the three sets of theoretical criteria and three sets of empirical criteria to two key constructs in international business and marketing, integration-responsiveness and marketing orientation.

3. Application one: measuring international business pressures

The international business literature makes extensive use of the Integration Responsiveness (IR) framework of Prahalad and Doz (1987) to characterize the environmental pressures confronting firms as they expand worldwide. According to this framework, firms come under countervailing pressures to simultaneously coordinate the activities and strategies of their local business units to attain global competitive advantage (global integration) while adapting these activities and strategies to the unique circumstances of the countries in which they operate (local responsiveness).

Although this framework has been in use for two decades, the issue of relevance here is whether the formative or reflective

measurement model is appropriate for these pressures. Venaik et al. (2004) review of the literature demonstrates that nearly all researchers who use the IR framework take the reflective route and only a handful the formative. More critically, this review shows little discussion or analysis that justifies the route that each researcher takes. Hence, it is important to apply the theoretical and empirical considerations of Table 1.

3.1. Theoretical considerations

Consideration 1: nature of the construct. The environmental pressures facing a multinational enterprise cover a domain of enormous breadth and diversity. Researchers in international business characterize these as global integration pressures—global competition, the need to reduce costs, and the pressures of technological change, etc.—and local responsiveness pressures—diversity of market infrastructure, country based regulation, local customer heterogeneity, etc. It is difficult to think of these pressures as being innate or latent characteristics of the business environment that cause overall global integration or local responsiveness pressures on the firm.

Consideration 2: direction of causality. A more logical approach is to view the diverse facets of the environment as forming IR pressures rather than the other way around. Indeed, the very word “pressures” implies this view (from the Latin *pressura*—the action of pressing, Webster’s Dictionary). Thus, the direction of causality is from the various aspects of the international business environment to what the researcher

defines as the pressures through choosing specific measures. A formative model is likely to be a more appropriate approach for testing the IR framework.

Consideration 3: characteristics of indicators. Additionally, it is not clear that the individual items in this domain—be they questionnaire items or variables from economic databases—share a common theme in the way the reflective approach requires. For example, any number of integration pressures may underlie the firm’s need to integrate activities worldwide—these could include “the importance of multinational customers”, “investment intensity”, etc. (Prahalad and Doz, 1987; pp. 18–19). There is little reason to believe that all these pressures are sampled from a common domain and are interchangeable, as is required when applying a reflective approach. Why, for example, would an item measuring the “importance of multinational customers” necessarily relate to one measuring “investment intensity.” Similarly, country infrastructure is a different aspect of local responsiveness pressures than say, subsidiary country regulations, even though both force firms to design their strategies on a country-by-county basis. Indeed, the diversity of phenomena that falls under the heading of IR pressures suggests at least considering the formative viewpoint as a possibility.

The three theoretical considerations in the proposed framework—the nature of the construct, the direction of causality, and the characteristics of the items representing the construct—indicate that it is better to conceptualize and measure the IR framework by a formative model. Next follow the three

Table 2
IR pressures: dimensionality and association between constructs and indicators from the preliminary analyses

No.	Indicators	Constructs				
		Government influence	Quality of local infrastructure	Global competition	Technological change	Resource sharing
1	Product decisions influenced by government	√				
2	Price decisions influenced by government	√				
3	Advertising decisions influenced by government	√				
4	Promotion decisions influenced by government	√				
5	Sourcing decisions influenced by government	√				
6	R&D decisions influenced by government	√				
7	Quality of local infrastructure: logistics		√			
8	Quality of local infrastructure: channels		√			
9	Quality of local infrastructure: advertising		√			
10	Quality of local infrastructure: personnel		√			
11	Quality of local infrastructure: suppliers		√			
12	Competitors are mostly global			√		
13	Competitors sell globally standardized products			√		
14	The nature of competition is global			√		
15	Co-ordination of production is global			√		
16	Co-ordination of procurement is global			√		
17	Rate of product innovation				√	
18	Rate of process innovation				√	
19	Technological complexity				√	
20	Rate of technological change				√	
21	Sharing of production resources					√
22	Sharing of R&D resources					√
23	Sharing of management services					√

Source: adapted from Venaik et al. (2004).

empirical considerations which can corroborate or refute the suitability of this model to the data.

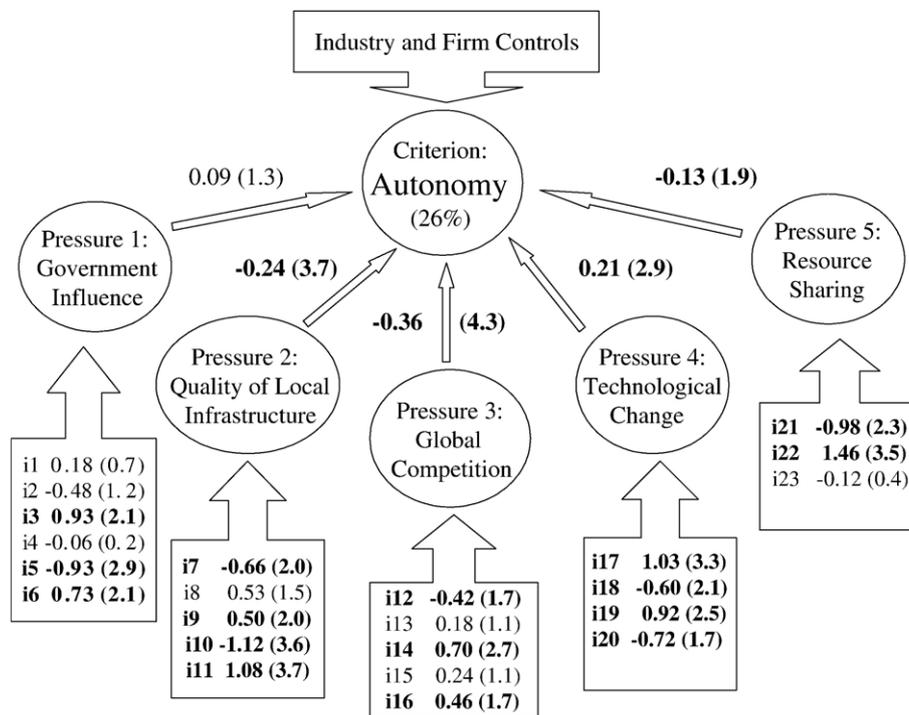
3.2. Empirical considerations

Venaik et al. (2004) administer 23 indicators of IR pressures drawn from the literature to a sample of 163 managers from the subsidiaries of multinational firms in 35 countries. These data form the basis for the empirical tests below.

Consideration 4: indicator intercorrelation. Venaik et al. conduct a range of preliminary analyses on these data (including outlier detection, bivariate correlation analysis, principal component analysis and common factor analysis). The major conclusion from these analyses that is relevant here is that representing this domain needs more than two integration-responsiveness pressures. At least for these data, five pressures represent what much of the literature forces into two. Table 2 shows the association between the 23 items and these five pressures of government influence, quality of local infrastructure, global competition, technological change and resource sharing. Low intercorrelations in oblique rotations demonstrate that these five pressures are largely independent of one another. Given these five pressures, the directionality and strength of the indicators also fit expectations. However, diagnostics for the common factor model are poor, raising concerns as to whether

the reflective model is appropriate. Overall, these initial analyses support the theoretical considerations above by tentatively suggesting five formatively measured pressures rather than two reflectively measured ones.

Consideration 5: indicator relationships with construct antecedents and consequences. Conceptualizing and measuring the five pressures by the formative model yield five predictors of the independent reflective construct of subsidiary Autonomy. The latter is a one-dimensional construct with composite reliability of 0.90 and average variance extracted of 61%. This additional construct of Autonomy is the criterion construct which identifies the formative model (Diamantopoulos and Winklhofer, 2001). The IR literature regards Autonomy as one of the most important consequences of global pressures on firms and so this criterion is of theoretical relevance. The predictive analysis includes control variables to provide greater confidence that effects are not spurious results of industry and firm heterogeneity. Here the analysis uses partial least squares (PLS) for the structural modeling (Chin, 1998). Fig. 2 shows the results. These results add further support to the formative model as the five pressures predict Autonomy well and the majority of outer item coefficients and inner path coefficients have the right signs and adequate t-statistics. The exception is government influence, which, although the formative model seems appropriate from the theoretical perspective, does not predict Autonomy.



Note: Boxes contain outer indicator coefficients; inner path coefficients are next to arrows (with the absolute values of the bootstrap t-statistic in parentheses). All significant values are in bold type (p<0.05). The percentage under the independent, reflective construct of Autonomy is the R². The indicator numbers i1, i2, etc. refer to the measures in Table 2.

Source: Adapted from Venaik et al. (2004).

Fig. 2. Test of criterion validity for IR pressures measured formatively.

However, it is difficult to judge a structural equation model in isolation. So the PLS analysis is rerun measuring the five pressures with a reflective model instead of the formative (i.e., reversing indicator directionality). This additional analysis provides a clear comparison between reflective and formative measurement models (Diamantopoulos and Siguaw, 2006).

Although noting that reflective models always explain less variance than formative models (which maximize prediction), the reflective measurement model performs much worse than the formative one. The reflective pressures explain 17% of the variance in Autonomy compared with 23% for the formative model. (With the additional variance due to firm and industry controls these numbers rise to 22% and 26%, respectively). Examination of the item coefficients shows that this difference in performance is not due to poor measurement—for the reflective model, all the item loadings and *t*-values are high, and for the formative model all pressures have an adequate number of significant weights. Instead, the difference is attributable to the reflective model not explaining the independent construct as well as the formative model. Indeed, measuring the pressures reflectively results in only one of the five having a significant and meaningful path coefficient with Autonomy (where meaningful is $\beta > 0.20$, Meehl, 1990), namely global competition ($\beta = -0.45$, $p < 0.01$). In contrast, measuring the pressures formatively results in three of the five having significant and meaningful path coefficients (quality of local infrastructure, global competition and technological change, $\beta = -0.24$, -0.36 and 0.21 , respectively; all with $p < 0.01$). For the international business literature, this is an important finding. Most scholars expect IR pressures to impact on the degree of subsidiary autonomy (e.g., Dunning, 1988) and thus, above and beyond the evident empirical superiority, would consider the formative model more theoretically valid.

The other model comparison that is relevant is with the measurement model commonly accepted in the literature: for example, a two-dimensional model measuring the pressures of Global Integration (dimensions 3 through 5 in Fig. 2) and Local Responsiveness (dimensions 1 and 2) reflectively. For these data, this model is neither theoretically nor empirically compelling. Although the *R*-square is adequate at 17% (excluding 4% of variance due to controls), only the path from Global Integration to Autonomy is significant ($\beta = -0.42$, $p < 0.02$). The path from Local Responsiveness to Autonomy is not significant ($\beta = -0.14$, $p > 0.15$). The latter should be of concern to IR theorists. Furthermore, as might be expected when collapsing several dimensions into two, the reflective measurement diagnostics are not strong, especially average variance extracted (which is less than 30% in both cases). Pruning the measures in the traditional manner can improve these diagnostics, but only at the expense of prediction and meaning. The definition of Global Integration becomes solely one of global competition and all the other pressures disappear from the model. For IR pressures, these results support the theoretical arguments that formative measurement may be more appropriate.

Consideration 6: measurement error and collinearity. Applying the vanishing tetrad test to each construct rejects the reflective model for four of the five constructs, lending

Table 3
IR pressures: tetrad test results for formative indicators

Constructs	Number of indicators	$\chi^2(Df)$	Df	Significance	Implication
Government influence	6	22.4	9	<0.01	Formative
Quality of local infrastructure	5	19.9	5	<0.01	Formative
Global competition	5	20.5	5	<0.01	Formative
Technological change	4	9.8	2	<0.01	Formative
Resource sharing	3 ^a	1.0	2	0.59	Reflective

^a The test here includes a fourth—unrelated—indicator. This follows the advice of Bollen and Ting (2000) on what to do when there are only three indicators.

additional support to the formative view. However, with the fifth construct, the pressure of resource sharing, the test does not reject the reflective model (see Table 3). This can be because this construct is truly reflective or because of complete lack of correlation between the indicators of a formative construct. Here the correlations between the sharing of production, R&D and management service resources are modest but not zero. Re-running the PLS analysis and switching resource sharing from a formative to a reflective measurement model result in a non-significant impact of this construct on Autonomy. Although it is not possible to reach a definitive conclusion with these data, it does suggest that resource sharing is also better conceptualized formatively, as theory indicates.

Collinearity is not an issue in these results as the largest condition indices from regressions of the five sets of indicators range from 7.1 to 13.8, all of which are less than 15 (the normal heuristic for the point at which some concerns of collinearity start to emerge) and well below 30 (the heuristic for clear collinearity problems).

To sum up, much of the extant research uncritically assumes a reflective measurement model when empirically representing the integration-responsiveness pressures confronting multinational firms. However, both theoretical and empirical analyses show that this assumption is debatable. The first three theoretical considerations indicate that no obvious rationale exists for the large set of measures that represent the broad and diverse domain of integration-responsiveness pressures to share a common theme. The three empirical considerations and statistical analyses, together with tetrad tests, lend further support to the formative measurement model.

4. Application two: measuring market orientation

The concept of market orientation has long been a cornerstone in marketing strategy. The literature in marketing stipulates that organizations should allocate resources to the systematic gathering and analysis of customer and competitor information and make use of customer knowledge to guide a customer linking strategy (Hunt and Morgan, 1995; p. 11). The emphasis placed on market orientation as a driver of competitive advantage and business performance in marketing

is not surprising. The main tenets of this view—that is, customer-oriented thinking, customer analysis and understanding—are fundamental to the beliefs of the discipline. However, despite the concept’s apparent credibility, the literature suffers from inconsistent measures (Mason and Harris, 2005).

The empirical evidence also indicates that the power of market orientation to predict advantage or performance is still an open question (Langerak, 2003). For example, Agarwal et al. (2003) report no direct relationship, while Grewal and Tansuhaj (2001) show mixed results. These inconsistencies imply that either the theory underpinning market orientation does not hold or that the measurement model used to operationalize the construct is incorrect. This paper aims to demonstrate that the latter is arguably one cause of these inconsistent results.

4.1. Theoretical considerations

Consideration 1: nature of the construct. The conceptualization of market orientation builds from either cultural or behavioral criteria. According to the cultural perspective, market orientation creates a deeply rooted customer value system among all employees and is a potential source of competitive advantage (Hunt and Morgan, 1995). Others suggest that market orientation is a behavioral concept that is largely a matter of choice and resource allocation (Ruekert, 1992). Therefore, from an ontological standpoint, researchers can measure market orientation reflectively (cultural perspective) or formatively (behavioral perspective). The market orientation literature uncritically assumes the reflective view.

Although the literature discusses both cultural and behavioral definitions of market orientation, measures of market orientation mainly use behavioral items. For example, Narver and Slater (1990, pp. 20–21) define market orientation as “the business culture that most effectively and efficiently creates superior value for customers.” Yet, they measure market orientation through behavioral items relating to customer orientation, competitor orientation and inter-functional coordination (Langerak, 2003). Arguably, adding or removing any of these components would change the conceptual interpretation of the construct, again implying a formative model is more appropriate.

Consideration 2: direction of causality. Virtually all the empirical literature in marketing on this topic uses three progenitor scales, a synthesis of which became the popular MORTN summary scale (Deshpande and Farley, 1998). Examination of all these scales shows that the items measure the activities or behaviors that make up the construct. Hence, conceptual justification would imply that the direction of causality is from the indicator to the construct and not the other way around.

Consideration 3: characteristics of indicators. The indicators in the MORTN scale look at the expressed needs of customers, implying that the construct is one-dimensional, with researchers conceptualizing the construct as a reaction to these needs. Yet, no attention is given to intelligence-related items that support a proactive market orientation. The lack of emphasis currently given to proactive market orientation is problematic, given the growing evidence that industry and

customer foresight are probably the most important components of market orientation (Hamel and Prahalad, 1994). Indeed, Narver et al. (2004) argue that much of the criticism surrounding market orientation is due to confusion surrounding the meaning of the term. The solution, they argue, is to divide market orientation into reactive and proactive components. Others also express concerns about the measurement of market orientation and recommend examination of the construct’s dimensionality (Siguaw and Diamantopoulos, 1995) or encourage modifications to the existing scales (Rossiter, 2002).

The three theoretical considerations in the proposed framework—the nature of the construct, the direction of causality, and the characteristics of the items representing the construct—indicate that it is better to conceptualize and measure market orientation by a formative model. Next follow the three empirical considerations which can corroborate or refute the suitability of this model to the data.

4.2. Empirical considerations

Here an analysis of responses from a survey of senior executives addresses the issue of whether it is more valid to measure market orientation through formative or reflective models. This sample is different to the first application and comprises 90 respondents. The questionnaire includes eight indicators of market orientation drawn from existing scales in the literature.

Consideration 4: indicator intercorrelation. The starting point is a range of preliminary analyses, as for the first application. These analyses identify two separate dimensions for reactive and proactive market orientation, supporting Narver et al. (2004). Low intercorrelations in oblique rotations demonstrate that these dimensions are largely independent of each other. The association between the indicators and these two dimensions is shown in Table 4. Given two constructs, the directionality and strength of these indicators largely fit

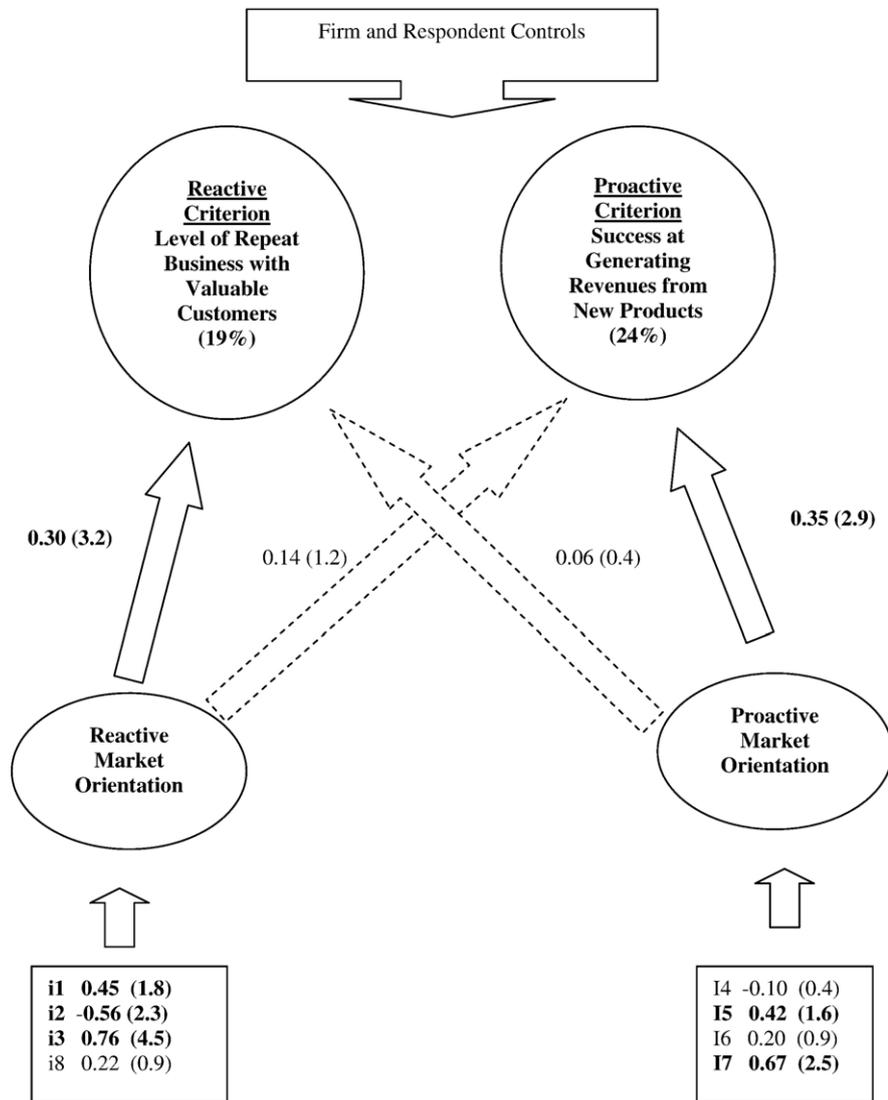
Table 4
Market orientation: dimensionality and association between constructs and indicators from the preliminary analyses

No.	Indicators	Constructs	
		Reactive orientation	Proactive orientation
1	Responsiveness to individual customer needs relative to competitors	✓	
2	Ease to do business with relative to competitors	✓	
3	Share customer experience across business relative to competitors	✓	
4	Business driven by customer satisfaction relative to competitors		✓
5	Predicting new market developments relative to competitors		✓
6	Discovery of latent needs relative to competitors		✓
7	Brainstorm customer usage relative to competitors		✓
8	Work closely with lead users relative to competitors	Unclear	

expectations. However, one indicator from the literature —“working with lead users”—correlates fairly equally with both dimensions in all analyses. Diagnostics for the common factor model, although better than for the first application, are again not high enough to provide support for the reflective model. Overall, these analyses support theoretical considerations by suggesting two constructs measured formatively rather than one measured reflectively.

Consideration 5: indicator relationships with construct antecedents and consequences. As before structural equation modeling using the PLS method can help assess criterion validity against two theoretically relevant and independent single-item constructs (see Fig. 3). First, a high reactive market orientation should correlate significantly with the level of repeat

business with valuable customers. The questionnaire measures this independent criterion by a single item on a 5-point Likert scale: “Compared to the highest performing business in your industry, the level of repeat business with valuable customers is far better to much worse.” This wording ensures that respondents perceive the construct as a concrete, singular object. Hence, a single-item measure is entirely appropriate (Bergvist and Rossiter, 2007; Rossiter, 2002). The analysis uses reverse scoring, where 5 = “far better”. Second, a high proactive market orientation should correlate significantly with success at generating revenue from new products. The questionnaire measures this revenue generating success with a similar question: “Compared to the highest performing business in your industry, the level of success generating revenue from new



Note 1: Boxes contain outer indicator coefficients; inner path coefficients are next to arrows (with the absolute values of the bootstrap t-statistic in parentheses). All significant values are in bold type (p<0.05). The percentage under each of the independent criteria is the R². Indicator numbers, i1, i2, etc. refer to the measures in Table 4.

Fig. 3. Test of criterion validity for market orientation measured formatively.

products is far better to much worse.” In contrast, there should be no significant correlation between the reactive construct and the proactive criterion or between the proactive construct and the reactive criterion. This pattern of expected correlations between constructs and criterion questions provides a strong test of the measurement model.

Adding control variables as before, the PLS results—based on a formative measurement model—are shown in Fig. 3. Only one control is significant, that for firm size. Firm size has a negative coefficient and explains 3% of the variance on the reactive criterion and 2% on the proactive criterion. Excluding this control, the market orientations themselves explain 16% of the reactive criterion and 22% of the proactive criterion.

The results match theoretical expectations. The path from the reactive construct to the reactive criterion is both significant and meaningful ($\beta=0.30$; $p<0.01$), as is the path from the proactive construct to the proactive criterion ($\beta=0.35$; $p<0.01$). Also, the crossover paths from each construct to the criteria are not significant. However, three of the eight measurement indicators have insignificant weights. Thus a small number of indicators essentially drive performance on the two criteria.

If the analysis is rerun assuming a reflective measurement model, the loadings on all eight indicators have significant t -statistics. Measurement error is not a problem here but the prediction of the reactive criterion is worse, with an R -square of 10% (excluding the variance due to the single control) and a weaker path ($\beta=0.24$ $p<0.02$). However, the difference between the magnitude of this path coefficient in the reflective and formative models is not statistically significant. For the proactive criterion, the reflective and formative models have a similar performance, with the reflective model having an R -square of 19% and a similar path magnitude to that of the formative model ($\beta=0.33$ $p<0.01$).

The other comparison of relevance is with the one-dimensional, reflective model seen in the literature. This results in a reflective measure with reasonable diagnostics (composite reliability of 0.86 and average variance extracted of 43%) that explains 9% of the reactive criterion and 17% of the proactive criterion (excluding controls). Both path magnitudes are significant ($\beta_{\text{reactive}}=0.23$, $p<0.02$ and $\beta_{\text{proactive}}=0.41$, $p<0.01$). Again, a fall in the predictive power of the reactive criterion is evident when compared with the formative model, but at this sample size, the difference is not significant.

Overall, the empirical results here are inconclusive and point toward the need for additional tests to support or reject the formative model. Unlike the first example of integration-responsiveness pressures, both the formative and reflective models of market orientation are reasonably consistent with theoretical predictions on these tests.

Consideration 6: measurement error and collinearity. The vanishing tetrad test (see Table 5) rejects the reflective model for both dimensions of market orientation (reactive at the 2% and proactive at the 10% level of significance). Further investigation using bootstrapping shows that the 10% level for proactive market orientation is more likely a result of sample size limitations on the chi square test than incorrect rejection of a reflective model. These results imply that a formative model

Table 5

Market orientation: tetrad test results for causal indicators

Constructs	Number of items	$\chi^2(Df)$	Df	Significance	Implication
Reactive orientation	4	8.1	2	<0.02	Formative
Proactive orientation	4	4.7	2	<0.10	Formative

may be a better way of measuring both reactive and proactive market orientation. Again collinearity is not an issue for these results. The largest condition indices, from regressions of the two sets of indicators, are 14.6 and 13.1, respectively.

The weight of evidence (both theoretical and empirical) supports measuring market orientation formatively and by two separate constructs for proactive and reactive orientation. The only qualification to this support is for consideration 5 where the formative and reflective measurement models both fit theoretical predictions. The degree of support for conceptualizing and measuring market orientation formatively as a two-dimensional construct has important intellectual implications. Nearly all the published work in marketing views market orientation as a one-dimensional construct and uses a reflective measurement model. Here theoretical and empirical considerations indicate that the current scales may not be completely valid, and also lend further support to those arguing for two separate constructs.

5. Discussion and conclusions

Most researchers in the management sciences assume that the correct measurement model is a reflective one, whereas there are many instances in which it may be hard to justify this assumption from either theory or empirics. This paper synthesizes previous literature and presents an organizing framework for designing and testing measurement models. The authors agree with Borsboom et al. (2004) and Rossiter (2002) that designing construct measures starts with theoretical considerations. However, the authors also agree with Bollen and Ting (2000), Diamantopoulos and Winklhofer (2001) and others who emphasize the need for empirically analyzing these measures. As this paper shows, after collecting data, it is often useful to know if the assumptions underlying the measurement model hold empirically or not. Of course, it is possible that the reasons for empirical disconfirmation are incorrect instrument design or mistaken responses by the respondents. But another possibility is that the theory underlying the measurement model is incorrect. Since empirical validation is accepted as a norm to validate structural model hypotheses, the same should apply to hypotheses about measurement models.

Next, applying the framework to two important concepts in management—integration-responsiveness pressures and market orientation—illustrates the usefulness of testing theoretical and empirical validity. In both cases, the weight of evidence favors a formative measurement model over a reflective one, which is in stark contrast to what the literature assumes. In some cases, in personality and attitude measurement, for example, a reflective

model is obvious. In other cases, a formative model is understandable, for example, in a human development index or an index of economic freedom for countries. However, it is not uncommon to encounter situations in social sciences where individual interpretation can lead to ambiguous results, especially when the construct definition and/or nomenclature are inconsistent. For example, the construct of marketing mix adaptation is formative when viewed by the researcher as a composite comprising adaptation of the various elements of the marketing mix. However, the construct of propensity to adapt the marketing mix is reflective as it drives the degree to which the firm adapts various elements of the marketing mix. Depending on the interpretation given to “mix adaptation” by the researcher, either measurement model is appropriate. In the case of the two applications in this paper, both theoretical and empirical considerations suggest that formative models are more plausible than reflective ones. This claim is not definitive, but simply offers an alternative lens for conceptualizing and measuring these two important constructs.

Naturally the analyses here may have limitations. In particular, choosing questionnaire items from a literature with a strong reflective tradition may introduce measurement biases. However, a counter-argument is that such items represent a conservative test of the proposition that formative measurement is worth considering. If researchers develop indicators especially for formative measurement these items ought to perform better than the ones here. This suggests one necessary area for further research: namely, better procedures for the design of formative indicators. Another area for development is statistical techniques for assessing the appropriateness of formative versus reflective models. The tetrad test aside, the academic world is split between covariance and partial least squares model testing, each of which has strengths but few complementarities that help researchers to apply the empirical tests suggested here.

The main contribution of this paper is to show the need for researchers to explicitly justify their choice of reflective or formative measurement models by providing the supporting theoretical arguments and empirical corroboration. Uncritical application of a reflective model to oversimplify the measurement of constructs risks reducing the rigor of business theory and its relevance for managerial decision making.

References

- Agarwal Sanjeev, Erramilli M Kirshna, Dev Chekitan S. Market orientation and performance in service firms: role of innovation. *J Serv Mark* 2003;17(1): 68–82.
- Anderson James C, Gerbing David W. Structural equation modeling in practice: a review and recommended two-step approach. *Psychol Bull* 1988;103(3): 411–23.
- Baumgartner Hans, Homburg Christian. Applications of structural equation modeling in marketing and consumer research: a review. *Int J Res Mark* 1996;13(2):139–61.
- Bearden William O, Netmeyer Richard G. *Handbook of marketing scales*. Thousand Oaks: Sage; 1999.
- Bergvist Lars, Rossiter John R. The predictive validity of multi-item versus single-item measures of the same constructs. *J Mark Res* 2007;44(22):175–84.
- Blalock Hubert M. *Causal inferences in nonexperimental research*. Chapel Hill, NC: University of North Carolina Press; 1964.
- Blalock Hubert M. *Conceptualization and measurement in the social sciences*. Beverly Hills, California: Sage; 1982.
- Bollen Kenneth A, Lennox Richard. Conventional wisdom in measurement: a structural equation perspective. *Psychol Bull* 1991;110(2):305–14.
- Bollen Kenneth A, Ting Kwok-Fai. A tetrad test for causal indicators. *Psychol Methods* 2000;5(1):3–22.
- Borsboom Denny, Mellenbergh Gideon J, Heerden Jaap van. The theoretical status of latent variables. *Psychol Rev* 2003;110(2):203–19.
- Borsboom Denny, Mellenbergh Gideon J, Heerden Jaap van. The concept of validity. *Psychol Rev* 2004;111(4):1061–71.
- Bruner Gordon CB II, James Karen E, Hensel Paul J. *Marketing scales handbook*. Chicago: American Marketing Association; 2001.
- Chin Wynne W. Issues and opinion on structural equation modeling. *MIS Quarterly* 1998;22(1):vii–xvi.
- Chin Wynne W, Todd Peter A. On the use, usefulness, and ease of use of structural equation modeling in MIS research: a note of caution. *MIS Quarterly* 1995;26(2/4):237–46.
- Churchill Gilbert A. A paradigm for developing better measures of marketing constructs. *J Mark Res* 1979;16(1):64–73.
- Cronbach Lee J. Coefficient alpha and the internal structure of tests. *Psychometrika* 1951;16(3):297–334.
- Deshpande Rohit, Farley John. Measuring market orientation: generalization and synthesis. *J Market-Focused Manage* 1998;2(3):213–32.
- DeVellis Robert F. *Scale development: theories and applications*. Newbury Park, California: Sage; 1991.
- Diamantopoulos Adamantios. The C-OAR-SE procedure for scale development in marketing: a comment. *Int J Res Mark* 2005;22(1):1–9.
- Diamantopoulos Adamantios. The error term in formative measurement models: interpretation and modeling implications. *J Model Manage* 2006;1(1):7–17.
- Diamantopoulos Adamantios, Siguaw Judy A. Formative versus reflective indicators in organizational measure development: a comparison and empirical illustration. *Br J Manage* 2006;17(4):263–82.
- Diamantopoulos Adamantios, Winklhofer Heidi M. Index construction with formative indicators: an alternative to scale development. *J Mark Res* 2001;38(5):269–77.
- Dunning John H. *Explaining international production*. London: Unwin Hyman; 1988.
- Edwards Jeffrey R. Multidimensional constructs in organizational behavior research: an integrative analytical framework. *Organ Res Methods* 2001;4(2): 144–92.
- Edwards Jeffrey R, Bagozzi Richard P. On the nature and direction of relationships between constructs and measures. *Psychol Methods* 2000;5(2): 155–74.
- Finn Adam, Kayande Ujwal. How fine is C-OAR-SE? A generalizability theory perspective on Rossiter’s procedure. *Int J Res Mark* 2005;22(1):11–21.
- Fornell Claes G. *A second generation of multivariate analysis*. New York: Praeger; 1982.
- Grewal Rajdeep, Tansuhaj Patriya. Building organizational capabilities for managing economic crisis: the role of market orientation and strategic flexibility. *J Mark* 2001;65(4):67–80.
- Hamel Gary, Prahalad CK. *Competing for the future*. Boston, MA: Harvard Business School; 1994.
- Hunt Shelby D, Morgan Robert M. The comparative advantage theory of competition. *J Mark* 1995;59(2):1–15.
- Jarvis Cheryl B, Mackenzie Scott B, Podsakoff Philip M. A critical review of construct indicators and measurement model misspecification in marketing and consumer research. *J Consum Res* 2003;30(3):199–218.
- Kohli Ajay K, Jaworski Bernard J. Market orientation: the construct, research propositions, and managerial implications. *J Mark* 1990;54(4):1–8.
- Langerak Fred. An appraisal of research on the predictive power of market orientation. *Eur Manage J* 2003;21(4):447–64.
- Mason Katy, Harris Lloyd C. Pitfalls in evaluating market orientation: an exploration of executives’ interpretations. *Long Range Plan* 2005;38(4): 373–91.
- Meehl Paul E. Why summaries of research on psychological theories are often uninterpretable. *Psychol Reports* 1990;66:195–244.
- Narver John C, Slater Stanley F. The effect of a market orientation on business profitability. *J Mark* 1990;54(10):20–35.

- Narver John C, Slater Stanley F, MacLachlan Douglas L. Responsive and proactive market orientation and new product success. *J Prod Innov Manag* 2004;21(5):334–47.
- Netmeyer Richard G, Bearden William O, Sharma Subhash. *Scaling procedures: issues and applications*. Thousand Oaks: Sage; 2003.
- Nunnally Jum C, Bernstein Ira H. *Psychometric theory*. New York: McGraw-Hill; 1994.
- Prahalad CK, Doz Yves. *The multinational mission: balancing local demand and global vision*. New York: Free Press; 1987.
- Rossiter John R. The C-OAR-SE procedure for scale development in marketing. *Int J Res Mark* 2002;19(4):1–31.
- Rossiter John R. Reminder: a horse is a horse. *Int J Res Mark* 2005;22(1):23–5.
- Ruekert Robert W. Developing a market orientation: an organizational strategy perspective. *Int J Res Mark* 1992;9(3):225–45.
- Shook Christopher L, Ketchen Jr David J, Hult GThomas M, Kacmar Michelle K. An assessment of the use of structural equation modeling in strategic management research. *Strat Manage J* 2004;25(4):397–404.
- Siguaw Judy A, Diamantopoulos Adamantios. Measuring market orientation: some evidence on Narver and Slater's three-component scale. *J Strat Mark* 1995;3:77–88.
- Spearman Charles. General intelligence objectively determined and measured. *Am J Psychol* 1904;15(2):201–92.
- Spearman Charles, Holzinger Karl J. The sampling error in the theory of two factors. *Br J Psychol* 1924;15:17–9.
- Spector Paul E. *Summated rating scale construction*. Newbury Park: Sage; 1992.
- Trochim, William MK. <http://www.socialresearchmethods.net/kb/index.php>. Visited on 19th July 2007.
- Human development report. New York: Palgrave; 2006.
- Venaik Sunil, Midgley David F, Devinney Timothy M. A new perspective on the integration-responsiveness pressures confronting multinational firms. *Manage Int Rev* 2004;44(1, Special Issue):15–48.