FORMATIVE AND REFLECTIVE MODELS IN MARKETING RESEARCH

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ABSTRACT

Not all constructs can be measured with a battery of items positively correlated as it is assumed in the general reflective model [5]. A construct can be determined or formed by a number of indicators without correlation between them - formative model. This paper will present both models, the differences between them and some methods that can determine their reliability and validity.

Keywords
Formative model, reflective model, validity, reliability.

1. INTRODUCTION

Marketing researchers interest towards the conceptualisation and operationalization of the theoretic reflective and formative constructs (or a combination between them) began to grow after the publication of [12] and [22] articles.

Formative scales are used when a construct is seen as an explicative combination of its indicators [16]. In this case, the construct is defined as a total score of all its indicators, regardless of the values of other indicators, and the final score of the construct is the sum of all items scores. A good/correct formative scale is the one that captures all the relevant aspects of the construct. In the beginning almost all researchers used in the case of formative constructs, almost exclusively, the covariance structure analysis (CSA). In the last years a lot more researchers are using partial least squares analysis.

In the case of reflective scales all observed indicators are considered to be caused by a common dimension or by a construct. This construct represents the common reference factor of all the items, so an increase in its value produces an increase of all reflective construct factors value.

2. REFLECTIVE MEASUREMENT MODEL

As it was demonstrated also by Jarvis, MacKenzie and Podsakoff [19], the reflective measurement model (Fig.1) is most widely used in marketing research. It is based on classic testing theory according to which changes that affect one of the indicators cause effects on the latent construct [5]. This way the causality starts from the construct to the items. In other words, the latent variable η is the common cause of all construct items xi, and each item corresponds to a linear function at which adds the measurement error.

\[ x = \lambda \eta + \varepsilon \quad (1) \]

where:

- \( x \): ith indicator of the latent variable \( \eta \)
- \( \varepsilon \): measurement error for the ith indicator
- \( \lambda \): coefficient (loading) capturing the effect of \( \eta \) on \( x_i \)

Measurement errors are independent by assumption \( (\text{cov}(\varepsilon_i, \varepsilon_j) = 0, \text{for } i \neq j) \), so they are not influencing the latent variable \( (\text{cov}(\eta, \varepsilon) = 0, \text{for all } i) \).

Equation (1) is the simple regression equation where the observed value is the dependent variable and the latent construct is the independent or exploratory variable. As it was mentioned, a fundamental characteristic of this model is that a change in the latent construct will cause a simultaneous variation of all indicators. Moreover, a basic condition is that all reflective scale indicators should be positively intercorrelated. Equation (1) for the reflective model corresponds to the graphical representation in Figure 1.
3. FORMATIVE MEASUREMENT MODEL

Curtis & Jackson proposed for the first time the formative model in 1962 [14]. They contested the necessary condition of items positive correlation, based on the fact that sometimes they can have negative or null values even when measuring the same concept. Later, Blalock [2],[3],[4] discussed the alternative measurement from the items perspective that determine the construct more than their effects. This perspective is presented in Figure 2. In other words, the indicators determine the latent variable which is taking over their significance. Some classic examples of such variables: social status, quality of life or career success. The equation for this model is the following:

\[ \eta = \sum_{i=1}^{n} \gamma_i x_i + \zeta \]

where:
- \( \gamma_i \) = coefficient capturing the effect of indicator \( x_i \) on the latent variable \( \eta \)
- \( \zeta \) = disturbance term - this summarizes all remaining causes of the construct which are not represented in the indicators and are not correlated to the construct.

Thus, following the assumption that \( \text{cov}(x_i, \zeta) = 0 \), equation (2) is a multiple regression equation, where the latent variable is dependent variable and the indicators are explicatory variables.

Following, there are presented some formative model characteristics that emphasize clear differences versus reflective model:
1. Indicators characterizing a set of different causes that cannot be interchangeable because each indicator presents a specific aspect of the construct [19]
2. There are no specific expectations regarding the type and extent of the indicators intercorrelation.
3. Formative indicators don’t have individual error terms, so conventional they have no error [15]. The error \( \zeta \) is explained at construct level and is not a measurable error.
4. For an isolated formative model not all parameters can be estimated [6]
4. CHOOSING THE MODEL: FORMATIVE VERSUS REFLECTIVE

There are three theoretical considerations and three empirical considerations that need to be taken into consideration when choosing one of the two models [10].

Theoretical considerations: construct type, the causality direction between indicators and the latent construct, and the characteristics of indicators used to measure the construct

1. The nature of the construct. In a reflective model, the independent latent construct, regardless of the indicators used [22], for example for measuring attitude or personality. These are personality traits measured by causing individuals responses to indicators of such constructs. In contrast, in the formative model, the latent construct is determined by the combination of its component factors. A research on published studies in International Business Studies and Journal of Marketing in 2006 showed that almost 95% from multiple item constructs used the reflective model without having into consideration a different alternative [1],[20].

2. Direction of causality between the construct and its factors. In reflective models causality runs from the construct to its indicators, contrary in formative models where causality goes from indicators to construct. This way it is considered that a construct change in the reflective model will determine an indicators change, and vice versa in the formative model. These differences of direction causality determine deep implications at measurable errors evaluation [1],[20].

3. Indicators characteristics used for construct measurement. There are significantly differences between indicators characteristics used to measure latent constructs in the case of both models. In the reflective model, a change in the latent variable needs to be followed by a indicators variation, although indicators share the same theme and are interchangeable with other indicators that are likely to be caused by the same construct. Because of this interchangeable dimensions is recommended to measure the construct by using several key indicators that highlight the construct

Empirical considerations: Intercorrelation between indicators, the antecedents and consequences indicator’s relations with construct error measurement and collinearity.

1. Intercorrelation between indicators. In a reflective construct, indicators are highlighted by the base construct, having positive intercorrelations preferably with high values. In contrast, in the formative model, where indicators share the same them, at the theoretical level, it doesn’t meters the correlation type [10].

Therefore the researchers need to make sure that the correlation between the indicators is at their expected level. These verifications can be realized in the preliminary stage of the analysis which is necessary in order to use the questionnaire as a research instrument.

The preliminary analysis includes:

- Verification of outlier presence,
- Verification of construction dimension in comparison with the one proposed initially (by using common factor models or main components analysis)
- The test of correlation between items and construct – if it is the same with the expected one as direction and power (by bi-variate correlation analysis, factor analysis or regression)
- The test of statistical confidence (in the case of reflective model).

A part of these preliminary methods of analysis and their results can offer important information about the inter-correlations and inferences between indicators, suggesting which one of the two methods is preferred. Nevertheless, there are necessary supplementary tests in order to confirm or infirm the choice of one of the two models. If it is expected to have positive correlations in the case of the reflective indicators, then they can be evaluated empirically by using Cronbach Alpha, mean of variances and internal consistency [24]. Taking into consideration that confidence measurement is based on testing the internal consistency (strong inter-correlations between items), for the reflective model. For the formative model, this is not suitable because there is no theoretical hypothesis regarding the inter-item correlation. It is one of the key operational aspects in using formative indicators: there are no simple criteria, easy and universally accepted for confidence evaluation in the case of formative indicators.

1. The relations of the indicator with the antecedents and the consequences of the construct. In the case of the reflective model it is necessary for the indicators to have similar relations with the antecedents and the consequences of the construct (positive/negative, significant /insignificant). This is not the case of the positive indicators because they are not necessarily part of the same theme and therefore the condition from the case of the formative model does not apply. This is an important aspect concerning formative models because it has implications regarding the proper aggregation level of the formative indicators. By aggregating the indicators with the purpose of creating a construct with the objective of minimum economic there is the possibility of losing reach, diverse and unique information integrated in indicators underlying the theoretical model.

2. In the case of the formative model, Diamantopoulos and Winkloher [14] suggest three possible approaches. The first connects the indicators to a global simple variable as the overall score. The second approach applies the MIMIC model (multi-indicator and multi-cause), in which the construct is measured both by formative and reflective indicators. The third approach assumes a structural model through which a formatively measured constructed is connected to another construct, with which form the theoretical point of view, it is expected to be related, the last being measured through a reflective model.

3. Error and co-linearity measurement. An essential point of discriminating between the reflective and formative
model is the error measuring method. At it was mentioned previously, in the case of the reflective model, the errors are associated to the observed scores (xi) and therefore represent the measuring error of the latent variable (δi). In the case of the formative model, the disturbance factor (ζ) is not associated with the individual indicator or with the set of indicators and for this reason it is not considered error of measurement [13]. For the reflective model, measuring error for each indicator can be identified using factorial analysis. For the formative model, the only way to exclude the measuring error is to realize the model before collecting the data. [7] suggest that the tetravalent can help in the process of evaluating the measuring error in the formative model. Inspired from [23], the test is based upon tetravalent serial intervals included by comparing the two theoretical models of measuring. More accurate, a tetravalent refers to the difference between the products of two pairs of error covariance.

Table 1. Table for model evaluation: Formative and reflective – Theoretical and empirical considerations [10]

<table>
<thead>
<tr>
<th>Theoretical Considerations</th>
<th>Reflective model</th>
<th>Formative model</th>
<th>Relevant literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Nature of construct</td>
<td>Latest construct is existing</td>
<td>Latest construct is formed</td>
<td>Dubousset et al. (2005, 2004)</td>
</tr>
<tr>
<td></td>
<td>Latest construct exists independent of the measures used</td>
<td>Latest constructs is determined as a combination of its indicators</td>
<td></td>
</tr>
<tr>
<td>2. Direction of causality between items and latent construct</td>
<td>Correlate from construct to items</td>
<td>Correlation from items to construct</td>
<td>Bellan and Lemon (1991); Edwards and Roger (2000); Reuter (2002); Jarvis et al. (2003)</td>
</tr>
<tr>
<td></td>
<td>Variation in the construct causes variation in the items measured</td>
<td>Variation in the construct does not cause variation in the items measured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Variation in item measures does not cause variation in the construct</td>
<td>Variation in item measures causes variation in the construct</td>
<td></td>
</tr>
<tr>
<td>3. Characteristics of items used to measure the construct</td>
<td>Items are manifested by the construct</td>
<td>Items define the construct</td>
<td>Reuter (2002); Jarvis et al. (2003)</td>
</tr>
<tr>
<td></td>
<td>Items share a common theme</td>
<td>Items not share a common theme</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Items are interchangeable</td>
<td>Items are not interchangeable</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adding or dropping an item does not change the conceptual domain of the construct</td>
<td>Adding or dropping an item may change the conceptual domain of the construct</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Empirical Considerations</th>
<th>Reflective model</th>
<th>Formative model</th>
<th>Relevant literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Item intercorrelation</td>
<td>Items should have high positive intercorrelations</td>
<td>Items can have any pattern of intercorrelation but should possess the same directional relationship</td>
<td>Cronbach (1951); Nunnally and Bernstein (1994); Churchill (1979); Diamantopoulos and Siguaw (2006)</td>
</tr>
<tr>
<td></td>
<td>Empirical test: internal consistency and reliability assessed via Cronbach’s alpha, average variance extracted, and factor loadings (e.g. from common or confirmatory factor analysis)</td>
<td>Empirical test: indicator reliability cannot be assessed empirically; various preliminary analyses are useful to check directionality between items and construct</td>
<td></td>
</tr>
<tr>
<td>5. Item relationships with construct antecedents and consequences</td>
<td>Items have similar sign and significance of relationships with the intermediate/consequences in the construct</td>
<td>Items may not have similar significance of relationships with the antecedents/consequences in the construct</td>
<td>Bellan and Lemon (1991); Diamantopoulos and Winklhofer (2001); Diamantopoulos and Siguaw (2006)</td>
</tr>
<tr>
<td></td>
<td>Empirical test: construct validity is established based on theoretical considerations, and assessed empirically via convergent and discriminant validity</td>
<td>Empirical test: construct validity can be assessed empirically using a BMDIC model, and structural linkages with another criterion variable</td>
<td></td>
</tr>
<tr>
<td>6. Measurement error and collinearity</td>
<td>Error term in items can be identified</td>
<td>Error term cannot be identified if the formative measurement model is estimated in isolation</td>
<td>Bellan and Ting (2000); Diamantopoulos (2008)</td>
</tr>
<tr>
<td></td>
<td>Empirical test: vanishing tetrat test can be used to determine if the formative items behave as predicted</td>
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</table>

4.1 TESTING THE VALIDITY OF FORMATIVE AND REFLECTIVE SCALES

Testing the validity of the reflective scales is realized through a series of scale construction and measurement evaluation techniques which includes factorial analysis, classical testing theory, parametric item responses theory as Rasch and of nonparametric items by Mokken analysis. Nevertheless, even if the reflective scales are unidimensional tested, these can be also implied in the case of the formative scales.

The most important problem in the case of missing testing indicators for the formative scales is attributed to the lack of construct specifications. Reason for which, even though there are situations in which the use of formative scales would be suitable for the objectives of various studies, most of the researchers are using reflective scales.

[19] realized a literature review regarding the use of formative and reflective scales, in marketing, in the last 24 years. The results demonstrate that 91% of the research papers used correctly specified measuring methods and of these, 68% used reflective scales and 31% formative scales. The measuring specifications of the models have been lately a highly discussed topic in the specialized articles. [12], [19] In general, the direction of the relation the causality between the indicators is either an effect (reflective scale) or a cause (formative scale) [6]. Formative models must be moderate in a linear combination of the indicators at which the disturbance factor is added. The use of formative models for SEM leads to a few implications for the researchers, namely: if the measurement of an indicator is omitted the final result is totally modified because the construct formed from unique indicators will be different [12]. That is why, in the case of the formative approach, construct realization assumes the identification of all the indicators that are determining it. Most of the times the formative model does not follow a normal distribution curve and has different degrees of symmetry and courtesies, which can
influence strongly the choice of the SEM estimator. Thus, are used two main approaches in estimating SEM formative measurement models PLS (partial least squares method) and CBSEM (covariance based method). Nevertheless, there has been given too little attention to the conditions in which formative models and their estimation method lead to precise coefficients.

4.2 EXAMPLE FOR THE ANALYSIS OF DESTINATION IMAGE

There will be analyzed: overall destination image and its components - cognitive and affective, overall image and intention of visiting. The affective component will be measured using a four bipolar items construct (boring-challenging, irritating-relaxing, trivial - captivating, unpleasant-pleasant). The cognitive component will be measured through 17 bipolar adjectives adapted after Ong and Horbunluekit [21] These are: clean/dirty; accessible/isolated; friendly/unfriendly; harmonious/hostile; innocent/immoral; interesting/boring; dynamic/inert; natural/artificial; crowded/spread; beautiful/ugly; quiet/noisy; sophisticated/simple; old/new; underdeveloped/overdeveloped; expensive/cheap; protected/unprotected (safety); reserved for tourists/ not reserved for tourists.

The 21 items measuring the image will be evaluated using a differential semantic scale of 7. The overall image will be evaluated through the following questions:

- Which is your impression about the overall image of the destinations? The answers will be evaluated on a Likert scale of 3 where: -3 (very bad) / +3 (very good)
- How would you describe your feeling about the destination? The answers will be evaluated on a Likert scale of 3 where: -3 (I dislike it very much) / +3 (I like it very much).

4.3 VERIFICATION OF VALIDITY AND CONFIDENCE

Verifying the validity of the touristic destination image construct will be realized using factorial analysis. To start, there will be made the following preliminary tests in order to check the opportunity of using factorial analysis.

- Kaiser-Meyer-Olkin (KMO) test will be used to verify convergence (there are accepted values higher than 0,5; 0,5-0,7 medium; 0,7-0,8-good, 0,8-0,9-good/0,9-very good)
- Barlet test to test the null hypothesis: the original correlation matrix is identity matrix. For factorial analysis to be possible, there must be relations between the (a Sig. value <0,05 allows the factorial analysis).

The next step is the extraction of the main components from the 21 items of the questionnaire. The criterion for significance will be set at 0,45 [17] for a sample of 150. After the factorial analysis the number of factors to be used further in the evaluation will be set. There will be tested and verified the explanation degree of the chosen factors in the total variance and the significance coefficients (Cronbach Alpha) – with values preferable higher than 0.7. These tests set the validity of the destination image construct. The validity of the destination image criteria will be tested using the regression analysis (OSL). Resulted factors will be considered independent variables, and the overall image, dependent variable. The multicollinearity of the regression models will be tested using VIF factors, for which we are expecting at values <10, according to [17], which indicates the absence of multicollinearity.

REFERENCES


