Empirical Comparisons of Rival Theories

Han, Jang-Hui*

≪Contents≫

There is hardly a discipline where an important theory reigns undisputed or where no alternative theories are conceivable. The more important a theory, the more rivals it is likely to have. Also it is not rare that more than one fields of science inquire into the same, similar, or interrelated problems. Consequently, scientists have naturally had a great interest in the systematic investigation of intertheoretic relations within and/or between disciplines.

How should we classify intertheoretic relations? Can we rationally compare the cognitive contents of interrelated theories? If so, by what criteria of rationality? What will be the results of such comparisons? How should we evaluate the outcomes? The proper answers to these questions will be crucial for the scientific progress if science advances through theac cumulation of knowledge at least in part. They will be especially important in such a discipline as marketing where interdisciplinary approaches are strongly recommended.

The purpose of this essay is to search for some plausible answers to the questions raised above. Beginning with a discussion about some types of intertheoretic relations of scientific interest, it will go on through the topics: of the rational comparability of theories; of the comparison procedures for various types of intertheory relations; and of

* Assistant Professor of Marketing, College of Business Administration, Chonnam National University

empirical evaluations of the results of those comparisons.

Ⅰ. Intertheoretic Relations of Interest

Because theories evolve from scientific problems, the basic problems of theories would be good starting points for analyzing intertheoretic relations. According to Bunge[6], three kinds of ideas are involved in every problem: the background, the generator, and the solution it in case exists. Every problem is posed against a certain background constituted by the antecedent knowledge and, in particular, by the specific presuppositions of the problem. The presuppositions of the problem are the statements that are somehow involved but not questioned in the statement of the problem and in the inquiry prompted by it. Further, every problem may be regarded as being generated by a definite set of formulas. The generator of the problem is the propositional function which yields the problem upon application of the operator "?" one or more times. Finally, every problem induces a set of formulas called the solution to the problem which, when inserted into the problem's generator, convert the latter into a set of statements with a definite truth value.

We can list not all but three kinds of binary interrelations of problems of interest in terms of their respective generators: (1) If any two problems (Q1 and Q2) have equivalent respective generators (G1 and G2, respectively), we can say that they are equivalent; (2) If G1 implies G2, we can say Q1 implies Q2; and (3) If G1 entails G2, we can say that Q1 is more general than or as general as Q2. In the first two cases, Both G1 and G2 have the same variables or G2 has the same subset of variables G1 has. This holds between their solutions, too. In the third case, the solutions of Q2 are derivable from those of Q1.

Two scientific theories will be regarded as rivals if they deal with roughly the same problem system differently. Thus, if two theories deal with the problems with any of the relationships discussed above, they can be regarded as rivals. If the problems of two theories are grounded upon the same presuppositions, it may be easy to classify their interproblem relation into one of these types. It would be relatively easy in such cases to find out the correspondence between the theories even when there are some ontological and/or conceptual discrepancies. But if the two problems are noticed with different broader term, paradigms), it will not be so simple at least in some cases. This difficulty has raised some debates on comparability of different paradigms or theories.

Now, let us further investigate the types of intertheory relations between two rival theories. Philosophy of scientists have generally put emphasis on the differences between rival theories in their syntactic and semantic nature, that is, the structure, of a theory [2]. But the structural differences are not sufficient bases of the classification in some cases, especially in policy-oriented disciplines like marketing, where researchers have strong interest in the solution of a specific problem.

Because theories are usually imperfect, it is not rare that a theory gives empirical predictions to a probelm which are inconsistent with those of its rival theories. Thus, we should also pay attention to any differences in the deduced consequences of rival theories with respect to the problem under consideration. If the theories yield much the same empirically testable consequences or projections to a given problem, we can say that they are empirically equivalent, however structurally different they may be. Empirically equivalent theories need not be mutually compatible as are the various cartographic representations of the globe: if they were, they would be just different formulations of the same theory, i.e., they would be structurally equivalent, too.

Empirical equivalence is relatively easy to detect and to test when the shared problem is properly formed. But it is not unusual for us to face difficulties in finding out structural equivalence between competing theories even in such a well formalized discipline as physics. A simultaneous examination of both structural and empirical equivalences between theories in a general context has been called 'reduction of theories' in philosophy of science [19]. Because of the difficulties in making competing theories rationally comparable, this reduction is never a simple task. Given a specific probelm of focus, however, we can more easily study the reducibility of a theory into another. Before reviewing the details of the difficulties in theory reduction in the following section, we should talk about various types of intertheory relations of a reductive sort here. Pearce [21] proposes a not exhaustive but, at least at present, broadest set of intertheory relations (ITR) of this kind: ITR = $\{\alpha, \delta, \rho, \gamma, \beta, \sigma, \varepsilon, \sigma', \varepsilon'\}$.

Let T and T′ denote the two theories of interest and L and L′ adequate logics to T and

T', respectively. Then $T\alpha T'$ represents a correspondence of T to T': There are both a mapping or semantic correlation F of some models in T' onto some models in T and a syntactic translation I of some sentences in T into some sentences in T' which keep the same syntactic and semantic nature in the relevant logic. In $T\delta T'$, T is said to be interpretable in T': $T\alpha T'$ and both F and I hold for all the models in T'. In $T\rho T'$, T is said to be embeddable in T': $T\alpha T'$ and both F and I hold for all the models in T. In $T\gamma T'$, T is said to be in limiting case correspondence with T': $T\alpha T'$ and the mapping F of a model in T', which applicable to not all but some of the models in T', can result in just a standard approximation of the model. When a correspondence is both an interpretation and embedding of T in T', Pearce calls it a faithful interpretation and writes $T\beta T'$.

The reductive relations defined so far place no special restrictions on the vocabularies of T and T'. Embeddings and interpretations, for example, may hold between theories that possess quite different sets of primitive terms, as well as between theories that share a good deal of logical and nonlogical vocabulary. In the event that one of the theories contains all the primitives of the other, one can distinguish important special cases of embedding and interpretation.

In general, when one speaks informally of a theory T 'extending' another theory T', this may mean that T contains additional laws, or that it has additional concepts (or both). In the former case, the class of the models of T' is narrowed down; in the latter case, the similarity type of the models of T' is expanded. Moreover, T may, in the first sense, 'extend' T', even if it contains only a part of the vocabulary of T'; and T may, in the second sense, 'expand' T' in a quite inessential way; for instance, if the extra primitives of T turn out to be 'definable' in the language of T'. Under the assumption that the involved logic L and L' are the same, Pearce adds these two special types of theory extension in his ITR set. For embedding cases, $T\sigma T'$ denotes that T is an extension of T'; while $T\varepsilon T'$ designates that T is an expansion of T'. For interpretation cases, the former type is expressed by σ' and the latter by ε', because a duality holds between the two cases.

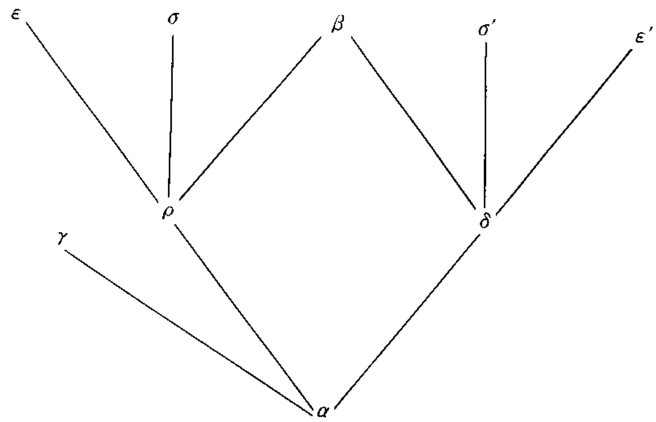
Among binary intertheoretic relations, we say that ϕ is stronger than ψ, if T ψ T' whenever T ϕ T' for any two theories T and T'. Pearce partially orders the members of according to logical strength as in <Figure 1>, where the stronger relations appear above the weaker.

If a theory can be reducible to another theory, the former can be regarded as either the same as or a part of the latter. If two theories have equivalent structures but inequivalent empirical projections, there must be some logical defects in both or either of them. If two theories are structurally inequivalent to one another, we can either select the better one in both empirical and nonempirical senses or devise another theory through an integration of the two. But the criteria and/or procedures of selection and of integration would differ depending on their empirical equivalence or inequivalence. All of these methods will be discussed in detail in the section following the next.

Ⅱ. Comparability and Connectability of Theories

The so-called incommensurability thesis has emerged as undoubtedly the single most controversial and questioned feature of Thomas Kuhn [14]. Kuhn used the word "incommensurable' to describe the situation where pairs of apparently conflicting scientific theories, conceptual frameworks, or Weltanschauungen are conceptually too distant from one another to be strictly rationally comparable. This was a radical claim which caught the mood of the sixties. Targeted on the dominant empiricist and critical rationalist epistemology of science, it resulted in a polarization in the philosophical community. These days the virulence of the commensurability debate has faded. But it has left its mark on the shape of scientific philosophy and on science itself. And though Kuhn has clarified, modified and even abandoned some of his earlier views, he remains today as staunchly as ever committed to the thesis of incommensurability [15].

The logical thesis of incommensurability has come in for rough treatment in the past. There have, of course, been more positive efforts to resolve the problem of incommensurability, too. Most remarkable ones among them are: (1) the structuralist conception of 'theory reduction' represented by Stegmuller's [27] thesis that reduction, thus rational comparability, does not require commensurability; (2) Laudan's [16] idea of "research tradition" in which rival theories can be compared for their cognitive contents,



<Fig. 1> An ITR Arrangement Along Logical Strenth

tent' is construed not in terms of truth and truthlikeness but in terms of problem-solving effectiveness; and (3) Pearce's [21] generalization of the structuralist framework of theory reduction. Each of them tries to establish the rational comparability of scientific theories while accepting the existence of some sorts of difficulties in making theories rationally comparable. We will adopt Pearce's view here because it may suggest most plausible ways to overcome the incommensurability problem.

To establish the rational comparability of theories, Pearce[21] tries to generalize the structuralist fixed model-theoretic theory reduction framework by using abstract logic. In the framework of abstract logic, one may treat logic as a variable of the system, and recognize that different types of logic and semantics may be appropriate in different contexts and for different theories.

Pearce maintains that the problem of incommensurability is just not the kind of problem that can be felled in a single blow, and therefore it is senseless to proffer instant remedies for it. But he suggests two possible routes to commensurability. The first way is a piecemeal local analysis of primitive terms and basic sentences. The aim of a local analysis is to find common conceptual and ontological ground for intertheory comparison by digging deep enough into the conceptual soil of each theory so that eventually a layer of shared terms is unearthed.

The second route Pearce proposes hunts commensurability at the surface. It makes a more global inspection of the terrain, and aims to set up a lexical and semantic correspondence between the languages of rival theories considered in their entirety. Unlike the first type approach, here translation does not even have a limited theory neutrality. The point of reference is the target language itself as interpreted by a given theory, typically by a supplanting theory to which an earlier theory corresponds or reduces. The translation here can be seen as the natural outcome of a three-stage process. The first stage is characterized by the recognition of a physically meaningful and intuitively acceptable correspondence relation between the theories concerned. At the second stage, there is an informal, syntactical representation of this relation which is open to the charge of being purely mathematical and of failing to reproduce such features as meaning variance and the deductive explanation of one theory by the other. The third stage consists in turning the informal correspondence relation into a formally precise conceptual link which gels with the physical interpretation of the relation and at the same time provides a coherent account of meaning change and explanation.

As the first step of theory comparison, both of the routes to commensurability suggested by Pearce require an analysis of syntactic and semantic nature of the theories concerned. This process is usually called a formalization of theory. A full formalization of a theory includes both syntactical axiomatization and semantical interpretation [12, 152-59]. But it is not rare especially in social science that the systematic interconnections among the concepts of a theory are insufficiently specified to enable fruitful axiomatization[29, 110-15] and/or that the logic of and/or the observations for the theory is imperfect to endow complete interpretation[20]. Even for those theories, however, we can practice a partial formalization[29]. Bagozzi's[2] 'holistic construal' may be one of the most plausible frameworks for partial but still comprehensive formalization, especially for the purpose under consideration here. Partly because the holistic construal framework has to do rather with theory construction than with overall evaluation, it does not involve axiomatization of theories. Consequently, it focuses on the clarification of syntactic and semantic nature of theories by considering all of the three types of meanings the focal concept of a theory has: (1) conceptual, (2) empirical, and (3) spurious meanings.

The conceptual meaning of the focal concept of a theory is obtained both by its definitions and by its links, either causal or associative or correlative, to the other concepts in the same theory, or sometimes in other related theories[20]. The empirical meaning of a concept refers to its observational content, that is, semantic nature, which is accomplished through interpretation or correspondence rules. As the conceptual meaning of a concept is obtained through the whole network of the theory which contains the concept, its empirical meaning should be achieved under consideration of the network, too. This requirement is expressed as the structural form of correspondence rules by Bagozzi[2].

Either theoretical or observational limits contaminate (or make imperfect) our clarification of the syntactic and semantic nature of a theory. Spurious meaning refers to this imperfection in clarification. In terms of an analysis of intertheory relations, one may have more interest in spurious meaning arising from theoretical limits than in that caused by observational limits. In some processes of making theories commensurable, for example, in reduction in limiting case correspondence, we can not help increasing the portion of spurious meaning. Because this would result in a shrinkage in the quality of theory comparison, we should be cautious about any increase in spurious meaning. On the contrary, theory integration must decrease the portion of spurious meaning due to theoretical limits. If the degree of decrease is not significant, we should select parsimony over the increment of determination or of the portion of explained (i.e., of nonspurious).

Ⅲ. Comparison, Integration, and Synthesis of Theories

Along with the two dimensions of empirical equivalence and structural equivalence, we should apply different comparison/connection strategies to an analysis of rival intertheory relations. <Table 1> describes appropriate strategies for each of the types. For cell (a) in <Table 1>, where a theory is reducible to another theory, the reducing theory can be said to be either the same as or more general than the reduced theory. Reduction, i.e., selection of the reducing theory, may be the most appropriate theory comparison strategy here [See, section 1 for details].

<Table 1> Strategies for Comparing Rival Theories

		Empirically	
		equivalent	inequivalent
Structurally	equivalent	(a) reduction	(b) logical defection check
	ineqivalent	(c) selection or Kantian integration	(d) selection or Hegelian integration

lent but empirically inequivalent: either some parts of the logical structure (i.e., concepts, links, and/or reasoning) are missing in both of the theories or the problem of concern is understood at different levels of analysis from one another [See 26 for the possibility of the latter]. Hence, either logical scrutiny or a level-congruity test is required for the cases in cell (b). Because these topics have been well dealt with in logic [See, for example, 9 for the types of valid inference and 24 for the topics of unit of analysis], this essay will not discuss about them any further.

The intertheoretic relations fallen in cell (c) are found where two structurally different theories give the same solution set to the problem of concern. This type of relation can not hold for all the cases of the problem; otherwise, there must be a possible way of theory reduction. The cases of this type may involve two theories which include different subsets of the whole set of relevant concepts. Therefore, integration is advisable for the intertheory relations of this type. But selection is also plausible here, if our interest is limited to a subset of the cases of the problem. For example, think about a simple 'which' problem like "Which will be the property, say, high temperature, of tomorrow's weather in Kwangju?". One can say that it will be near 27° C because today's high was 27° C. Another can give the same answer but with different reason: The average high temperature of the date during the last fifty years has been 27° C. These two types of reasoning or theories will never give the same answers to all the 365 days of a year. Given these two types of reasoning, however, one would try to select the one which seems to be the better for one's purpose at hand; while another would consider both of them in combination. Which ria should be used to select the better theory here? Is there any rational procedure of integration? If so, what is that? These questions hardly seem to be simple.

Numerous criteria have been proposed to evaluate the adequacy of theoretical constructions and they can also be applied to a comparison of rival theories. Among the criteria, the one suggested by Bunge[7, 351-56] might have been accepted most broadly in marketing [33; 28]. Bunge classifies tests for testing factual truth of theories into empirical and nonempirical ones. He also proposes twenty nonempirical tests. In order to estimate the degree of truth of factual theories, according to Bunge[7, 356], we have to use all the nonempirical criteria in conjunction with multiple and tough empirical tests. But empirical tests stand supreme over all the nonempirical ones[12, 166-7], because there is not a single test, let alone an empirical one, of factual truth.

For the theories classified into cell (c), the key criterion of an empirical test to select one theory over the other should be relative efficiency or generalizability. A theory is more efficient than its rivals either if it can explain more findings (or give correct predictions for more cases of the problem) with the same number of constructs as invoked by competitive theories; or if it requires fewer constructs than its rivals to explain a set of findings [28, 21]. Generalizability can be regarded as a weak form efficiency emphasizing the degree of empirical confirmation: A theory is more generalizable than its rivals if it can explains more findings. Hence, comparative approach is preferable to comfirmatory approach here [28].

When integrating two or more theories, we must specify a rule of integration. Such a rule is a kind of Churchman's[8] 'executive' of an inquiring system. The executive is, according to Churchman[8, 27], the component of an inquiring system that: (1) determines the functions of the other parts; (2) determines which part should be used in a given circumstances; and (3) judges the adequacy of a part's performance. There are two types of theory integration systems: 'Kantian' and

'Hegelian' inquiring systems in Churchman[8]. If the rival theories are consistent or compatible with each other, a Kantian system is appropriate; while a Hegelian (dialectic) system is appropriate if they are inconsistent. In other words, the former should be applied to the cases in cell (c), while the latter to those in cell (d).

Sirgy's[26] Integration Strategy I gives a concrete example of a Kantian system. But the cases in cell (d) are the most familiar type of intertheory relations to most scientists: Different theories give different explanations and predictions to the same phenomenon or problem. Let alone the fact that more than one competing theories are explicitly compared at the same time, the theory evaluation criteria for these cases are exactly the same as the traditional ones for an evaluation of a single theory. But the difference emphasizes comparative approaches over confirmatory ones. Also, it requires us to consider the possibility of an Hegelian integration for some of the cases.

For an empirical comparison of the cases, we have to apply an inference procedure of Platt's[22] 'strong inference' in generating hypotheses and/or choosing research settings. If strong inference is done through the Popperian 'refutation' process, we can select the most 'corroborated' one among the theories compared. But it is not always possible to derive purely refutable hypotheses for comparing rival theories. In consequence, even this procedure usually ends with indeterminacy. Therefore, we should keep in mind that a theory selection here is usually not absolute but relative and contingent and that an on-going comparison process should be installed.

If a set of premisses is inconsistent, those premisses will validly yield any conclusion. As a result, the subject of inference from inconsistent premisses has not been seriously dealt with in logic. When considering our limits in theory construction, however, we must face more often than not with a situation where two theories use the same presupposition but derive contrary conclusions. Besides, through the use of Bayesian probability theory and Communication theory, Mitroff, Betz, and Mason[18] prove that a Churchmanian dialectic inquiry system would result in a better decision through an integration than ignoring the contradictions. The point is how to preserve logical consistency while combining two theories containing one or more contradictory propositions. Now one can always preserve logical consistency by throwing out those parts of the integrated theory that conflict, but this seriously begs the questions: Which parts should one throw out?; How does one insure oneself that one is throwing out the 'right' parts?; What does 'right' mean?; Is it possible to proceed without throwing out any of the parts?[17, 270.]

Rescher and Manor[23] propose a plausible executive by which we can construct a better theory through an integration of the logical contradictions between two rival theories. Its core concept is the maximal consistent subsets (MCS's) of a set of propositions or a theory. A MCS is the largest subset of propositions that can be formally conjoined (i.e., linked together through the logical operator 'and') such that the subset is logically consistent. Let S denote a set of propositions whose elements are p, W, and R where W = {p→q} (i.e., If p, then q), and R = {p→ q′ (not q)}. Then S is inconsistent because p and W and R can not be true. For S, there are two MCS's: {p, W} and {p, R}. Each of the MCS's is internally consistent because (p and W) == (p and q) and (p and R) == (p and q′). The concept of MCS thus allows one to preserve all the information contained in the entire original set of propositions. To handle contradictions we merely form all the possible MCS's of a whole set of propositions. Each MCS represents a different logically consistent conclusion that can be formed from the original set.

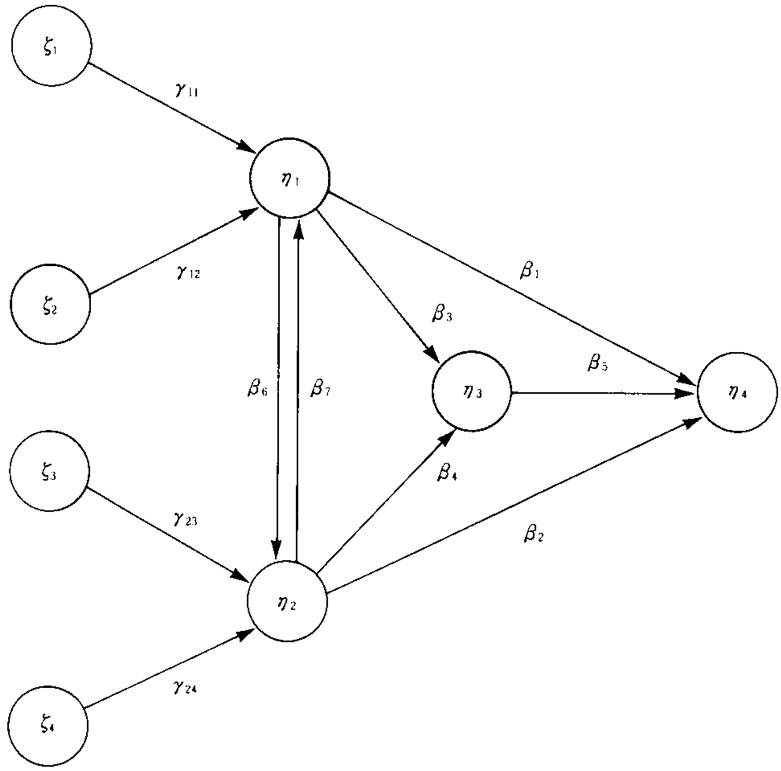
Rescher and Manor distinguish three types of logical consequences of S: (1) C is an inevitable consequence if it is a consequence of every MCS of S; (2) C is a weak consequence if it is a consequence of at least one of the MCS's; (3) C is a plausible or preferred consequence if it is always a weak consequence but not always an inevitable consequence. Because we try to get a broader or more powerful theory through an integration of conflicting theories, we would not want to restrict ourselves to the inevitable consequences of S. Nor would we want to extend our interest to all the weak consequences since they again form an inconsistent set. Thus, one would want to find some intermediate way of establishing certain consequences of S as 'preferred.' If we have a basis for selecting as preferred certain ones among the maximal consistent subsets of an inconsistent set of propositions, we can confine our interest to a subset of its weak consequences preferable to others. This is where Rescher and Manor introduce the concept of 'plausibility indexing' for the set S [See 23 for details].

Ⅳ. Empirical Evaluation of Theory Integrations

Not all the types of rationing rely upon causation. But causal thinking always brings about better understanding and predictions[11; 1]. Reconstruction of a theory in a system of causality is thus always worthwhile the effort. Structural equation modeling has been appraised as a highly valuable tool for this process[1, 2]. This method has also been assessed to yield more reliable empirical test results than such a traditional statistical procedure as regression. These are especially the cases when we evaluate outputs of theory integration, because the evaluation does not have to do with comparisons of simple hypotheses but with those of models, either between an integrated theory and each of its original component theories or between integrated theories themselves.

Structural equation modeling procedures and statistical evaluation criteria have been relatively well developed for the cases of various research settings[1] or of single or nested model evaluations[3, 5]. But theory integration generates different types of relations between models to be compared. First of all, different executives will produce different integration outputs in any kind of integration strategies, i.e., in either Kantian or Hegelian or synthetic integration. For example, different mediating variables make respective Kantian integrations of the same component theories different from each other. Also, even the relation between an output of synthesis and its original component theories may not be a nested sort if the synthesis includes significant structural changes of the components. Thus, we could not apply the existing procedures and statistical criteria to all the possible cases of integration evaluations. In the following, we will propose some plausible evaluation criteria just for the example executives mentioned in the preceding section.

Case 1: Mediating Variable When one adopts one (or more) mediating variable as the executive for a Kantian integration, one should evaluate its utility against any other mediating plausibilities including no mediator case. <Fig. 2> describes an integrated model with one mediator (i.e., η_4). For this integration to be valuable, β_6 and β_7 must be insignificant. No or low correlations among ξ' s are necessary conditions for this requirement. Thus the estimates of γ' s may not differ in an integrated model from in component models. And either β_1 and β_2 (supporting no mediator model) or β_3, β_4, and β_5 (supporting one mediator model) must be significant. If both of the coefficient sets are significant, we need other criteria for a selection between no mediator model and the one mediator case. If the mediator works as in Sirgy's [26] Strategy I, β_4 and β_5 must have opposite signs.



⟨Fig. 2⟩ A Kantian Integration Example with One Mediator

These criteria can sometimes, but not always, screen out the most plausible integration. If none of the integrations under consideration satisfy all of these criteria, we should go back to comparison between the initial component theories or search for another type of executive [See 10 for an example]

If more than one possible integrations pass the screening process above, we should compare them in terms of the coefficient of determination for the dependent variable of our very concern. Because available estimation programs such as LISREL[13] and EQS[4] require a big data size, χ_2 tests may not be applicable to a comparison between integration with different moderators.

Case 2: Preferred MCS's Rescher and Manor [23] leave the selection of preferred MCS sets at one's discretion. If the MCS's in the selected preferred set are consistent with each other, the integrations from any of its subset MCS's will be nested in the integration from all of the MCS's; otherwise, the integrations from some of the subset MCS's are not nested in it. In either case of consistency, not both of the initial component theories will be nested in that integration, because the latter does not include both of the conflicting propositions.

For the evaluation of nested models, all the criteria summarized in Bagozzi and Yi[3] can be applied. But for the comparison of unnested models, we have to check the size of estimates for all the parameters in their structural models, i.e., the strength of their hypothetical relations between constructs as well as the coefficient of determination for the very intrinsic or dependent variable(s) of our interest. All the parameter estimates should be significant in size and have the same direction as expected. The larger the coefficient of determination, the more preferred the model will be.

REFERENCE

[1] Bagozzi, R. P. (1980), *Causal Models in Marketing*, New York: John Wiley & Sons.

[2] __________ (1984), "A Prospectus for Theory Construction in Marketing," *Journal of Marketing*, Vol. 48 (Winter), 11-29.

[3] __________ and Y. Yi (1988), "On the Evaluation of Structural Equation Models," *Journal of Academy of Marketing Science*, Vol. 16 (Spring), 74-94.

[4] Bentler, P. M. (1985), *Theory and Implementation of EQS: A Structural Equations Program*, Los Angeles: BMDP Statistical Software.

[5] __________ and D. G. Bonett (1980), "Significance Tests and Goodness of Fit in Analysis of Covariance Structures," *Psychological Bulletin*, Vol. 88, 588-606.

[6] Bunge, M. (1967), *Scientific Research I: The Search for System*, New York: Springer-Verlag.

[7] __________ (1967), *Scientific Research I: The Search for Truth*, New York: Springer-Verlag.

[8] Churchman, C. W. (1971), *The Design of Inquiring Systems: Basic Concepts of Systems and Organization*, New York: Basic Books.

[9] Copi, I. M. (1982), *Introduction to Logic*, 6th ed., New York: Macmillan.

[10] Day, G. S. and S. Klein (1987), "Cooperative Behavior in Vertical Markets: The

Influence of Transaction Costs and Competitive Strategies,"in M. J. Houston, ed., *Review of Marketing,* Chicago: American Marketing Association, 39-66.

[11] Einhorn, H. J. and R. M. Hogarth (1982), "Prediction, Diagnosis, and Causal Thinking in Forecasting," *Journal of Forecasting*, Vol. 1, 23-36.

[12] Hunt, S. D. (1990), *Modern Marketing Theory: Critical Issues in the Philosophy of Marketing Science*, Cincinnati, OH: South-Western Publishing Co.

[13] Jöreskog, K. G. and D. Sörbom (1984), *LISREL: Analysis of Linear Structure Relationships by the Method of Maximum Likelihood*, Mooresville, IN: Scientific Software.

[14] Kuhn, T. S. (1962), *The Structure of Scientific Revolutions*, Chicago: University of Chicago Press.

[15] __________ (1983), "Commensurability, Comparability, Communicability," in *PSA 1982*, Vol. 2, East Lansing: Philosophy of Science Association, 669-688.

[16] Laudan, L. (1977), *Progress and Its Problems*, Berkeley: University of California Press.

[17] Mitroff, I. I. (1982), "The Philosophy of Modeling and Future Research," *Technological Forecasting and Social Change,* Vol. 21, 267-280.

[18] __________, F. Betz, and R. O. Mason (1970), "A Mathematical Model of Churmanian Inquiring Systems with Special Reference to Popper's Measures for 'The Severity of Tests'," *Theory and Decision*, Vol. 1, 155-178.

[19] Nagel, E. (1961), *The Structure of Science: Problems in the Logic of Scientific Explanation,* New York: Harcourt, Brace and World.

[20] Oliva, T. A. and R. E. Reidenbach (1987), "Extensions of Bagozzi's Holistic Construal," in A. F. Firat, N. Dholakia, and R. P. Bagozzi, eds., *Philosophical and Radical Thought in Marketing,* Lexington: D. C. Heath, chap. 8.

[21] Pearce, D. (1987), *Roads to Commensurability,* Dordrecht: D. Reidel.

[22] Platt, J. R. (1964), "Strong Inference," *Science*, Vol. 146 (October 16), 347-353.

[23] Rescher, N. and R. Manor (1970), "On Inference from Inconsistent Premisses," *Theory and Decision*, Vol. 1, 179-217.

[24] Shapere, D. (1984), *Reason and the Search for Knowledge,* Dordrecht: D. Reidel.

[25] Sheth, J. N., D. M. Gardner, and D. E. Garrett (1988), *Marketing Theory: Evolution and Evaluation*, New York: John Wiley and Sons.

[26] Sirgy, M. J. "Strategies for Constructing Marketing Theories Having Greater Unifying Power," in R. W. Belk et al., eds., *1987 AMA Winter Educators' Proceedings: Marketing* Theory, Chicago: AMA, 270-274.

[27] Stegmuller, W. (1975), "Structures and Dynamics of Theories: Some Reflections on J. D. Sneed and T. S. Kuhn," *Erkenntnis*, Vol. 9, 75-100.

[28] Sternthal, B., A. M. Tybout, and B. J. Calder (1987), "Confirmatory Versus Comparative Approaches to Judging Theory Tests," *Journal of Consumer Research*, Vol. 14 (June), 114-125.

[29] Suppe, F. (1977), *The Structure of Scientific Theories*, 2nd ed., Chicago: University of Illinois Press.

[30] Zaltman, G., C. R. A. Pinson, and R. Angelmar (1973), M*etatheory and Consumer Research,* New York: Holt, Rinehart, and Winston.