COGNITIVE FRAMES AS CO-DETERMINANTS OF PERSISTENT PERFORMANCE DIFFERENTIALS

by

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ABSTRACT

The present study extends the competence-based view by appealing to cognitive frames as co-determinants of persistent performance differentials. It is suggested that financial performance is influenced by a causal chain running from cognitive frames through constrained information processing and perceived uncertainty. The empirical test provides evidence from survey data and archival data supporting this assertion. We are aware of no previous work that explicitly states or tests this causal chain. Furthermore, we introduce a novel method to estimate path models when the usual approach is infeasible.

Key words: Cognitive frames, Information processing, Uncertainty.

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Both theory and empirical evidence suggest that decision makers faced with problems in an uncertain and complex world need a set of guiding principles in order to structure and coordinate actions (Kellaris et al., 1996, Levinthal & March, 1993; Rabin, 1998). The core of this argument is well-established (see e.g., Rabin, 1998), and founded on the idea that cognitive frames provide a simplifying heuristic used to manage the unlimited detail of everyday life. In consequence, accomplishing simplification entails ignorance of some detail and thus loss of information. However, what specific information gets lost depends on the particular frame used.

By tracing how firm-specific cognitive frames influence financial performance, the present work adds to the strategy literature by extending the general suggestion that information not relevant for a particular cognitive frame will tend to be ignored. The contribution may be summed up in the general proposition that firm-specific cognitive frames are important co-determinants of persistent performance differentials. This proposition, to be justified in the following, lends support to the emerging capabilities- or competence-based view of the firm (for an overview, see Teece et al., 1997) and suggests that the literature on cognitive frames may enrich the understanding of the, arguably, central question in strategy: why do firms differ? The suggested connection between cognitive frames and performance is established in a two step argument.

First, ignoring information not relevant for a particular cognitive frame will tend to increase perceived uncertainty (Kiesler and Sproull 1982). Always at the potential cost of increased uncertainty, cognitive frames enable a more clear conceptualization of one part of the world when other parts are ignored (Levinthal & March, 1993). Second, it is commonly accepted that both perceived uncertainty and information processing may influence financial

performance, i.e., perceived uncertainty should decrease performance whereas information processing should increase performance (see e.g. Pfeffer, 1997).

This two-step argument establishes a causal chain in which cognitive frames are sources of ignorance. In turn, ignorance is a potential cause of uncertainty, and, uncertainty influences performance. Now, since cognitive frames may be conceived as rather stable firm-specific frames of reference containing unquestioned assumptions (Shrivastava & Schneider, 1984), we have then established that cognitive frames may have an important role as co-determinants of persistent performance differentials. Thus, the present paper adds to previous capabilities- or competence-based theory by identifying an explicit chain of causality between cognitive frames and performance, and, on this basis, suggesting how cognitive frames may be a source of persistent performance differentials among firms which otherwise share similar industrial conditions. Note that the usual argument in the competence-based literature hinges upon resource immobility, demand- or supply-side uncertainty and resource heterogenity (see e.g. Peteraf, 1993). The present argument extends this line of reasoning by suggesting how specific causes for immobility and uncertainty (i.e. ignorance entailing the use of cognitive frames) by way of an explicit and testable causal chain may translate into performance differentials. Although the theoretical argument is general, the empirical test is limited to two cognitive frames (a strategic frame and a cost frame) and scoped within the context of issues related to the natural environment. This choice is motivated in the ensuing section.

Linking Cognitive Frames and Financial Performance

The general argument linking cognitive frames and financial performance hinges on the commonly accepted idea that performance decreases in uncertainty. In the process of using cognitive frames, some information is lost and when it is important information, uncertainty increases. Not all ignored information is important for financial performance but some is.

Therefore, the use of some particular cognitive frame which ignore information important for financial performance will increase uncertainty. Whether the relationship between cognitive frames and performance is a direct one or involves mediation by uncertainty is spelled out in the ensuing. Before doing this, however, it is necessary to define the boundaries within which the argument can be tested empirically. We proceed as follows.

First, all cognitive frames involve simplification, loss of information, and so forth. But only some cognitive frames may influence financial performance. Therefore, we first identify a specific set of cognitive frames which according to the literature are likely to have this property. Second, since our test involves the need to operationalize uncertainty and information processing, we also need to select a particular empirical context within which these constructs are salient and may be defined in a meaningful way. Third, having selected a specific set of cognitive frames and narrowed the scope of the empirical test to a case where uncertainty is a persistent feature of the context for the firm's decision making, we proceed to formulate hypotheses limited within these bounds.

That is, the specific nature of any construct which may be chosen to test our argument forces us to formulate specific rather than general hypotheses. Evaluating whether the conclusions extend to other cognitive frames and empirical settings involves assessment of external validity in the sense originally defined by Campbell & Stanley (1966), i.e., the formulation of a new set of hypotheses consistent with the argument that cognitive frames may be co-determinants of persistent performance differentials. In this case, we predict that is always possible to find relatively stable cognitive frames which influence financial performance through uncertainty and information processing in any region, industry or strategic group within which persistent performance differentials are observed.

Selecting cognitive frames for the empirical test. In this section, we motivate our

choice of the particular cognitive frames to be used for the empirical test and establish their link to uncertainty and information processing. We start by characterizing the two broad and mutually exclusive cognitive frames, strategic focus and cost focus, chosen for the empirical test due to their ubiquity in theory and practice (see e.g. Porter, 1980; Rumelt et al., 1995). The relation between these two cognitive frames and allocative and adaptive efficiency suggest they capture fundamental ideas of what business is about. Thus, if allocative efficiency is emphasized, managers will increase exploitation of the existing alternatives whereas emphasizing adaptive efficiency will increase the exploration for new alternatives. This also implies a difference in time-horizon and scope for the two cognitive frames.

Allocative efficiency is usually associated with a short-term cost frame whereas adaptive efficiency is associated with a long-term strategic frame (Levinthal & March, 1993). Moreover, the scope of search is broad when a strategic frame directs decision making and it is narrow when guided by a cost frame (Levinthal & March, 1993). Given the competence in evaluating alternatives, differences in framing will influence the scope of search. A cost frame will tend to ignore effects distant from immediate antecedents of efficiency (Levinthal & March, 1993). Therefore, a cost frame economizes on sample size of relevant alternatives but will increase the number of potential surprises due to a narrow sample of possible futures (Levinthal & March, 1993). By contrast, a strategic frame will, at the cost of large samples of alternatives, tend to include distant effects and thus reduce potential surprises (Ibid.). Observations within the context of utilization of information technology lend support to this conjecture. Thus Fletcher & Wright (1995) found that a general reliance on traditional cost-benefit appraisal methods for integration of new information technology indicates a short-term, rather than a long-term strategic, focus for information systems use.

Hence, the use of the particular cognitive frames, “strategic focus” and “cost focus”

entails two effects. First, there is a hypothesized effect on information processing intensity, i.e., gathering more or less information on a particular outcome related to a subject matter. Second, there is an effect on sample size, i.e., gathering information on a more or less broad collection of possible outcomes. In the following paragrahps, we shall develop separate hypotheses concerning these effects. Before doing this, however, it is necessary to specify the bounds placed on the hypotheses due to considerations regarding the appropriate focus and sample of the empirical test.

Selecting the context for the empirical test. Even if the theoretical argument is general, the empirical test is limited to the two cognitive frames "strategic focus" and "cost focus" and bounded within the context of environmental issues. That is, the hypotheses are bounded within a sample of firms that are influenced by environmental issues, and, cognitive frames, information processing and uncertainty all concern the firm's consideration, or ignorance, of such issues. Since our hypotheses are limited by these considerations, it is necessary to motivate the scope of the empirical test before turning to the formulation of hypotheses. The discussion whether the hypotheses may be generalized to other samples and situations is postponed to the concluding section.

In order to test the hypotheses drawn on the above argument, we were looking for a case where some uncertainty should be a persistent feature of the context for the firm's decision making. Although many settings were possible, we focussed upon firms which produced high amounts of hazardous waste, and, therefore, were prone to influence by stakeholders promoting various different issues related to the natural environment. In light of the last twenty years public focus on firms' behavior towards the natural environment, it is increasingly important for managers to consider non-market stakeholders such as government agencies, pressure groups and media. According to the literature on this subject (see e.g. the material contained in

Harrison & Freeman, 1999 and Fischer & Schot, 1993), issues related to the natural environment thus introduce the turbulence necessary to test the argument suggested in the present study.

Linking cognitive frames and performance within the bounds of the empirical test. We now turn to formulating hypotheses which stipulate a possible relation between strategic frames, cost frames, information processing, perceived uncertainty and financial performance. Since the effects of environmental issues are usually distant from immediate efficiency concerns, but relevant for strategic reasons (Fischer and Schot, 1993), a strategic frame and a cost frame have assymetric effects on information processing. Since non-market stakeholders associated with environmental issues are irrelevant in terms of narrowly focussed cost and efficiency considerations, a cost frame should lead to an absence of information processing related to environmental issues. By contrast, a strategic frame should lead to high information processing intensity related to environmental issues since non-market stakeholders often raise new issues, some of which may potentially hurt the firm financially.

H1.1 *A strategic frame leads to high information processing intensity related to environmental issues.*

H1.2 *A cost frame leads to an absence of information processing related to environmental issues.*

Furthermore, there is a direct effect of cognitive frames on sample size. Decision makers with a strategic frame will consider large samples of possible outcomes whereas a cost frame implies narrow samples. Therefore, the number of situations to which point probabilities are assigned to outcomes of actions will tend to be larger when decision makers are characterized by a strategic frame. In other words, the number of potential surprises will decrease. When a cost frame applies, the logic is reversed. Defining uncertainty as the situations in which point

probabilities are not assigned to outcomes of actions (Runde, 1998) leads to an inverse relation between cost and strategic frame regarding the uncertainty of non-market influences such as stakeholder claims related to environmental issues.

H1.3 *A strategic frame reduces uncertainty related to environmental issues.*

H1.4 *A cost frame increases uncertainty related to environmental issues.*

Considering environmental issues, it is suggested that a strategic frame has two distinct effects. The sample size of alternatives considered will be larger and the evaluation of alternatives will improve due to increased information processing intensity. Understanding search for alternatives as an activity of mutual engagement with the firm's stakeholders suggests that representations may be formed, and not merely updated, when information processing intensity is increased. Hence, the effect of a strategic frame on uncertainty related to environmental issues may be mediated by information processing. A cost frame entails no mediation due to the absence of information processing directed towards environmental issues.

H1.5 *The relation between a strategic frame and uncertainty related to environmental issues is mediated by information processing.*

H1.6 *The relation between a cost frame and uncertainty related to environmental issues is* not *mediated by information processing.*

We next consider the relation between decision making and outcomes. First, there is a straightforward relation between uncertainty and performance. Increased uncertainty will tend to reduce performance because uncertainty entails a weak causal link between actions and outcomes as well as costly adjustments following surprises. Second, information processing improves alternative evaluation because it increases the correspondance between the subjective and objective aspects of decision making, i.e., between cognitive frames and social regularities.

Specifically, information processing increases the correspondance between the actual

and perceived importance of non-market factors such as stakeholder claims. Given the reasonable assumption of costly information processing, a threshold will exist beyond which the marginal effect of a further increase in information processing is negative. Clearly, uncertainty and instability raises this threshold and the amount of information processing needed to reach it will increase. By contrast, in a simple and stable world information processing will become too costly very fast. Since our argument and empirical test concerns a context characterized by a relatively high degree of uncertainty and instability, we represent our argument without this qualification in order to retain parsimony.

H2.1 *Increased* uncertainty *related to environmental issues reduces financial performance.*

H2.2 *Increased* information processing *related to environmental issues increases financial performance.*

As aforementioned, information processing is understood as an active search process where representations may be formed, and not merely updated. Hence, increased information processing intensity entails cognitive frames that better correspond to actual events. Cognitive frames that better correspond to actual events will be more accurate and perhaps cover a larger portion of reality. Uncertainty has a double role. As stated in H2.1, the direct effect of uncertainty will decrease performance. Moreover, since uncertainty implies that the necessary conceptual frames for information processing to take place are not present, this indirect effect will also decrease performance. This implies that information processing will have a negative mediating effect on the relation between uncertainty and performance.

H2.3 *Information processing has a negative mediating effect on the relation between uncertainty related to environmental issues and financial performance.*

It should be noted that a decrease in performance well beyond the aspired level will tend

to increase information processing (March, 1988). However, the argument concerning the relation between uncertainty, information processing and performance suggests that the success in uncovering and adopting useful alternatives critically depends on the cognitive frame that directs information processing. That is, a cost frame might well lead to an ignorance-trap where an increase in information processing or search uncovers the wrong alternatives.

We have suggested that cognitive frames might influence information processing and uncertainty but do not find it plausible to suggest a general causal link between framing effects and financial performance. Avoiding the prediction of null effects, this leads to the following hypotheses.

H3.1 *The relation between a strategic frame and financial performance is completely mediated by information processing and uncertainty.*

H3.2 *The relation between a cost frame and financial performance is completely mediated by uncertainty.*

The hypothesized relations are summarized in the path-diagram shown in Figure 1. As can be seen, the three sets of hypotheses imply that a cost frame will tend to decrease financial performance due to an increase in uncertainty and an absence of information processing. By contrast, a strategic frame entails a positive effect on performance. In sum, the hypotheses establish a causal chain where cognitive frames are co-determinants of financial performance.

Figure 1 about here

It is important to note that the relations shown in Figure 1 are hypothesized to hold only in a context characterised by turbulence. It is quite possible that a cost frame may be appropriate in some contexts, for example when stability is high and non-market effects absent.

As noted, the present study is scoped within the context of issues related to the natural environment. Since firms which are affected by such issues are likely to experience turbulence and unexpected stakeholder demands, this context is one in which the relations shown in Figure 1 can be assumed to hold. There is, however, one further snag associated with the model shown in Figure 1. Since it is impossible to identify the model without imposing further constraints, it cannot be estimated by a simultaneous equation approach to path-analysis. The solution to this problem is presented in the following section.

METHODS

Estimation procedure

The hypothesized causal relations were summarised in the path diagram shown in Figure 1. As previously noted, a structural equations approach to path-analysis is infeasible for estimation of this model since it cannot be identified. Moreover, because the independent variables are correlated, the assumptions for such an approach are violated. In consequence, we devised a novel estimation procedure in order to handle this problem. Figure 2 shows the general procedure. Note that the diamond, in compressed form, captures the relations shown in Figure 1.

Figure 2 about here

As shown, estimation of the model can be decomposed into a four-step estimation procedure. The first and the second step in the procedure tests whether the two partial mediator effects are present. The third step is necessary to test whether mediation between the independent(s) and the dependent is complete or partial. Finally, the fourth step is needed to

establish whether the effect between the independent(s) and the dependent is in fact mediated by the two intermediate variables. An obvious alternative explanation is that significant mediator effects established in step one and two just represent variance which is "shuffled" around. To reject this alternative, a significant effect in step four has to be shown. Furthermore, the sign of the independent variable should approximately reflect the net effect on the dependent variable according to the estimates obtained in step one and two.

In sum, on basis of the above four steps, models of the type shown in Figure 2 can be estimated. Since yet larger models can be broken down into models of the type shown in Figure 2, the method is general and lends itself readily to empirical tests in a number of situations where structural modelling cannot be pursued. Obviously, there is a trade-off between the requirements of theory and parsimony in the choice of estimation method. Clearly, a structural equations approach should be used when applicable. However, there might be cases, as in the present study, where theoretical considerations should override the constraints of a particular estimation method. Having provided an overview of the estimation procedure, a brief account of the estimation method is in order.

Estimation: step one and two. To establish mediation, estimation in step one is carried out by three linear regression-equations (OLS-estimation) following Baron and Kenny's (1986) suggestions for differentiation of moderator and mediator effects of third variables. Estimation in step two follows an identical procedure.

It is important to notice that mediation does not concern interaction (moderation). It is an intermediate mechanism that accounts for the relation between the independent and the dependent variable. For example, mediators may explain *how* external events are endogenized, i.e. take on psychological significance. By contrast, a moderator, in the form of an external event, may explain when the effect of another external event takes on psychological

significance. That is, the term "moderator effect" is equivalent to the commonly used term "interaction effect," however mediation is different. To test for mediation we estimate a series of regression analyses where the path from the independent to the dependent variable is controlled. When the effect of the independent variable and the mediator variable are both significant, mediation holds if, further, the independent variable has less effect when the mediator is controlled. In step one, this involves estimation of three regression equations: (1) regressing the mediator on the independent variable, (2) regressing the dependent variable on the independent variable, and (3) regressing the dependent variable in both the independent variable and on the mediator (Baron and Kenny, 1986). Mediation is established when: (1) the effect of the indendent variable is significant in the two first equations, (2) the effect of the mediator is significant in the third equation, and (3) the effect of the independent variable is less in the third equation. There is perfect mediation when the independent variable has no effect when the mediator is controlled.

Estimation: step three. Estimated by linear regression (OLS-estimation).

Estimation: step four. Step four includes the model's mediator variables (Z-variables in Figure1) as instrumental variables (IV) in a two-stage least-squares estimation. The method and the associated test-statistics are described in appendix A. The purpose of the estimation is to test for the relation between the model's independent and dependent variable given the instrumental variables. In two-stage least-squares regression, estimates are obtained through two regressions (appendix A). The first stage estimates values of the problematic predictor(s) and the second stage regresses the dependent variable on those values to obtain valid estimates of the model. Since asymptotic efficiency is not guaranteed, it is important to apply statistical tests for model-misspecification. This is done by estimating Sargan's (1964) general test of misspecification. Moreover, R^2 is not a valid measure of the goodness of fit in two-stage least-

square models. Instead we propose that Pesaran & Smith's (1994) generalized R^2 (GR^2) be used. Since they are not widely used (or included in soft-ware packages), the computation of Sargan's test and GR^2 are shown in appendix A.

Data

The data in this study originate from a survey conducted during the winter of 1995 supplemented by financial data subsequently acquired from an independent publicly available source. The survey was conducted by Kommunekemi, a state-owned Danish firm that processes hazardous waste. For most types of hazardous waste, Kommunekemi is the *mandatory* alternative for Danish firms. It is important to note that all companies in our survey are customers of Kommunekemi and that the relationship between Kommunekemi and their customers reflects a high degree of mutual trust. For example, Kommunekemi has helped with expertise in a number of incidents, such as explosions and chemical spills. Information about such incidents is very sensitive and, clearly, mutual trust is important. All respondents were told that their questionnaire would be used by Kommunekemi on a confidential basis and that dissemination of information to other parties would be in anonymous form. Subsequently, we were allowed to use the questionnaire for research purposes subject to the condition that results are reported in anonymous form only.

The population was defined as all Danish firms that produce hazardous waste as a by-product of their primary activities (approximately 10,000 firms). Examples of such firms include paint producers, the medical industry, and electroplating firms. After exclusion of the smallest waste producers (less than 5 tonnes per year), and state or municipality owned companies, the target population totalled 858 firms that each produce more than 5 tonnes of hazardous waste each year (90% of the total volume of hazardous waste produced in Denmark). Clearly, these companies are likely to be among the firms most influenced by stakeholder claims related to the

natural environment.

A disproportionate sample with two strata was drawn. One stratum included the 36 major producers, defined as the companies in the sample which produce 50% of the total volume of hazardous waste. The second stratum included the remaining 822 producers, 50% of these producers were randomly selected and mailed a self-administered questionnaire. The response rate was 40%. Among the 36 largest producers of hazardous waste qualitative interviews of one to two hours duration were conducted. As only five firms refused to participate, a total of 31 firms were interviewed. In the large firms the respondents were typically the person in charge of the Environment, Health and Safety (EH&S) function. In firms without an EH&S function the respondent was typically the CEO of the company. In both instances there is no doubt that the respondent possessed adequate knowledge. Extensive non-response analyses were conducted among the medium-sized non-respondents; these analyses indicate no substantial discrepancy between respondents and non-respondents (a summary of these analyses are available from the first author). Consequently, with a high degree of confidence, the findings can be generalized to the population.

Measuring financial performance. The financial data used to measure performance were obtained from a publicly accessible electronic database (CD-Direct, published by Købmandstandens Oplysningsbureau, Denmark). Financial performance is measured as the return on assets (ROA) calculated as the net income of primary activities after depreciation, but before net financial gains, extraordinary earnings, and taxes. The base is the end of the fiscal year.

Our financial data span the years 1991 to 1995. It was only possible to obtain valid ROA for 141 firms as the rest of the sample were business units in larger firms, and therefore independent, external data were not available. Of these, one firm was excluded because of an

extreme low ROA (-425%) in the most recent year (1995) strongly suggesting the firm as an outlier. We measure both short-term and long-term financial performance. Short-term financial performance is calculated as the ROA in 1995. Long-term financial performance is measured as the cumulated ROA in the period 1991-95 calculated as:

$$roa_i = (1+roa_{91}/100)\times(1+roa_{92}/100)\times(1+roa_{93}/100)\times(1+roa_{94}/100)\times(1+roa_{95}/100).$$

Since the measure was obtained through a publicly available data source independent of the survey-data and since all analyses were validated with financial performance as dependent variable, we can rule out common methods bias. Finally, it is worth noticing that the bias sometimes associated with accountancy data is minimized because it will tend to even out over a longer period, e.g. over five years.

Measuring cognitive frames. In the present study we use the broad frames cost focus and strategic focus as a proxy for cognitive frames. Furthermore, the scope is limited to integration of issues related to the natural environment. According to this operationalization, a strategic frame and a cost frame related to environmental issues are broad cognitive frames that act to direct managerial attention. As evidenced in the large literature on the role of strategic versus cost focus, these constructs provide excellent illustration of cognitive frames since they are commonly reported to serve as prototypes for concept driven information processing (see e.g. Fletcher & Wright, 1996). As previously noted, the empirical literature on the firm's environmental (green) strategy (e.g. Klassen & Whybark, 1999 and Fischer & Schot, 1993) further suggest their importance.

A five-point semantic scale was used (1: "disagree strongly" to 5: "agree strongly") to measure the two constructs. A strategic frame was measured by the two items: (1) an environmental certification is a source of competitive advantage, and (2) to be environmentally conscious gives strategic advantage. Also, a cost frame was measured by two items: (1)

environmental initiatives make our products more costly, and (2) our competitiveness decreases if we initiate environmental initiatives. Additive conjunctive scales were formed including the two sets of items. The assessment of scale-reliability through estimation of Cronbach's Alpha supported the notion that the two items in each scale capture different dimensions of a common construct (Table 1). It should be noted that the Alpha obtained on the two-item construct "strategic frame" is 0.57, a rather low value even if it is above the acceptable limit (0.50). However, this value should be interpreted in view of the item-dependent nature of Cronbach's Alpha. It is recommendable to assess the item-dependent improvement in Alpha by the general Spearman-Brown formula (Peter, 1979). Such an estimation shows that the value 0.57 obtained on the two-item construct "strategic frame" would increase to 0.80 in an equivalent five-item (and 0.87 in a seven-item) construct. Therefore, we conclude this construct to be acceptable in terms of scale-reliability.

Measuring the degree of contextualized information processing. In the present study we measure the firm's processing of information within the specific context related to environmental issues. We refer to this construct as contextualized information processing. Since the actual processing of information is not easily measured, we developed a construct which is supposed to correlate highly with information processing activity within the particular context measured in the present study.

This construct captures contextualized information processing as company-wide discussions of environmental issues and items regarding environmental policy (policy formulation, distribution of knowledge about policy, top management involvement in policy formation and employee involvement in policy implementation). The measure includes both process (discussion and involvement) and state variables (presence of a clear environmental policy and the distribution of knowledge about such policy).

Contextualized information processing was measured with five items, chosen according to their importance in the empirical literature (see e.g. the material contained in Harrison & Freeman, 1999), that capture alternative dimensions of this activity in the context of the natural environment. A five-point semantic scale was used (1: "disagree strongly" to 5: "agree strongly"). The measurement of environmental information processing was anchored by using four dimensions related to environmental policies: (1) formulation of clear environmental policy, (2) knowledge of the firm's environmental policy among employees, (3) top management involvement in policy formation, and (4) employee involvement in the implementation of environmental practices in the firm. A fifth item captures the extent to which environmental issues are discussed in the firm. An additive conjunctive scale was formed including all five items. The assessment of scale-reliability through estimation of Cronbach's Alpha (0.87) supported the notion that the five items capture different dimensions of the common construct, information processing in relation to the natural environment.

The 31 qualitative interviews conducted in the present study were used to assess face validity of the construct used to measure information processing. Consider the following rather typical excerpt from the interview transcripts as illustration:

> Large chemical producer: "The environmental policy implies that we *discuss* and look through things regularly. ... you talk to people out there..."

In numerous instances, the 31 interviews clearly showed that actual information processing activity is highly related to internal discussions of environmental problems, the presence of an environmental policy, distribution of knowledge about such policy and involvement in its implementation (further interview transcripts in English and full transcripts in Danish are available from the author). Since these dimensions are captured in our measure of information processing (regarding environmental issues) we have a high degree of confidence in the face

validity of the construct used to measure the intensity of contextualised information processing.

Measuring uncertainty. We constrain measurement of uncertainty within the scope of the present study. Uncertainy regarding environmental issues was measured as: (1) uncertainty leading to delays in handling environmental problems, and (2) general uncertainty related to integration of environmental considerations in the operation and management of the firm. A five-point semantic scale was used (1: "disagree strongly" to 5: "agree strongly"). An additive conjunctive scale was formed including these two items. The assessment of scale-reliability through estimation of Cronbach's Alpha supported the notion that the two items capture different dimensions of the common construct, uncertainty in relation to the natural environment (Table 1). Since the concept of uncertainty has many meanings it should be noted that this construct captures the perceived difficulties in representing considerations related to the natural environment in terms of operations and management. This use of the concept of uncertainty corresponds well to the notion of Knightian or Keynesian uncertainty as situations in which point probabilities are not assigned to outcomes of actions (Runde, 1998). As aforementioned, the item-dependent nature of Cronbach's Alpha has to be taken into consideration when interpreting scale-reliability. Estimation using the general Spearman-brown formula shows that a two-item Alpha of 0.60 would increase to 0.82 in an equivalent five-item (and 0.88 in a seven-item) construct.

Controls. Measures were included to control for the firm's size, age and the total amount of dangerous waste produced. This is motivated by the following considerations. It is possible that the amount of the firm's resources and thus size will influence both performance and the firm's general level of information processing positively. Likewise, the age of the firm could influence the firm's performance and general level of information processing negatively due to either inertia associated with old age or limited experience associated with newness

(Hannan & Freeman, 1989). Since we measure contextualized information processing related to environmental issues, we also need to consider if the level of information processing is merely influenced by the amount of hazardous waste produced.

The firm's size is measured by the number of employees on basis of publicly available archival data. The same source was used to obtain data on the firm's age. The total amount of dangerous waste was obtained through the questionnaire. Kommunekemi a/s holds archival data of the total amount of dangerous waste produced by each firm in the present survey and the firms were aware of this fact. Therefore, we expect this information to be reliable.

Table 1 about here

RESULTS

The ensuing analysis follows the four-step procedure for estimation of difficult path-models described in the above.

Estimation: step one. Estimation in step one (and two) involves three sets of linear regression-equations (OLS-estimation) following Baron and Kenny's (1986) suggestions for estimation of mediator effects. Table 2 shows the first set of analyses. In model 1.0, a strategic frame and a cost frame related to environmental issues has assymetric effects on information processing. Supporting H1.1 and H1.2, the relation between a cost frame and information processing is absent whereas the relation between a strategic frame and information processing is positive and significant. As model 1.1 shows, the controls only have a minor effect.

Table 2 about here

Furthermore, the results show an inverse relation between a cost and a strategic frame regarding the perceived uncertainty related to issues of the natural environment. In model 2.0, a strategic frame reduces uncertainty related to environmental issues whereas a cost frame increases uncertainty, lending support to H1.3 and H1.4. Note that when the variable "information processing" is included in model 3.0, the effect of the independent variable "strategic frame" is no longer significant. These results lend strong support to the idea that information processing mediates the effect between a strategic frame and uncertainty, thus supporting H1.5.

First, model 1.0 shows that the effect of information processing regressed on a strategic frame is significant and model 2.0 shows that the effect of uncertainty regressed on a strategic frame is significant. Second, the effect of information processing is significant in model 3.0. Third, the effect of a strategic frame is *not* significant in model 3.0. Note further, that the effect of "cost frame" is stable across the estimations in model 2.0 and 3.0 suggesting that the estimated effects are robust. Inspection of model 1.1 shows that the control variable "employees" has a positive but insignificant influence on information processing. Models 2.1 and 3.1 shows that "employees" has a significant and positive influence on uncertainty. In other words, as the firm increases in size the perceived uncertainty regarding environmental issues also increases. Since the controls add to the explained variance without confounding the estimates, we conclude that the estimates in model 1.0, 2.0 and 3.0. are robust.

In sum, the results in model 1.0 to 3.1 support the idea that the relation between a strategic frame and uncertainty related to environmental issues is mediated by information processing. Finally, models 1.0 to 3.1 support H1.6. A cost frame related to environmental

issues has a direct positive effect on uncertainty related to such issues and information processing does *not* mediate the effect between a cost frame and uncertainty. This result suggests that a cost frame related to environmental issues, as a general cognitive frame, leads managers to overlook the very problems that cause uncertainty, and, to maintain an absence of information processing that could otherwise change the state of ignorance.

Table 3 about here

Estimation: step two. The results in model 5.0 show that uncertainty related to environmental issues has a negative effect on long-term financial performance (supporting H2.1). Model 6.0 establishes the expected positive effect of information processing on financial performance (supporting H2.2). Model 4.0 shows that uncertainty has a significant negative effect on information processing. Since the effect of uncertainty disappears in model 7.0, all three conditions are fulfilled for establishing information processing as mediator between uncertainty related to environmental issues and long-term financial performance (supporting H2.3).

Including the controls in model 6.1 and 7.1 does not effect the results. By contrast, the inclusion of controls in model 4.1 has a significant effect. Explanatory power increases due to a significant negative age-effect and a positive size-effect (employees) on information processing. These are spurious effects due to the multicollinearity introduced by the positive correlation among the controls. The same effects cause the reduction of explanatory power in model 5.1. Although the inclusion of controls lead to some misspecification of explained variance in the models where they are included, the notable feature is that throughout models 1.0 to 7.1, the signs of the estimated regression coefficients are unaltered and their size is remarkably stable.

That is, age and size effects are minor and do not in any way change the conclusion of step one and two.

Table 4 about here

Estimation: step three. The results in Table 4 show that there is no direct effect of a strategic frame or a cost frame on financial performance (model 8.0). Again we can discard the marginal increase in explanatory power in model 8.1 due to the multicollinearity introduced by the controls. The results support the idea that cognitive frames providing broad managerial orientation effect uncertainty through information processing. This is not sufficient to support H3.1 and H3.2. Since the necessary condition to support H3.1 and H3.2 was established in step three, we further need step four to provide the *sufficient* test for a relation between cognitive frames and financial performance.

Estimation: step four. Model 9.1 establishes that the effect of a cost frame on financial performance is negative and significant when the insturmental variable (IV) uncertainty is included. Given the results in step three, this confirms H3.2. Model 9.0 and model 9.3 are not significant and thus rejected. Moreover, model 9.2 and 9.3 are rejected due to misspecification (p-value for Sargan's Chsq < 0.05).

Model 10.0 and 10.1 establish that a strategic frame has a positive effect on financial performance when the instrumental variables information processing and uncertainty, respectively, are included. This confirms H3.1. The increase in explanatory power in model 10.2, compared with model 10.0 and 10.1, further shows that both instrumental variables contribute to better explanation. The inclusion of controls in model 10.3 results in the previously observed marginal increase in explanatory power without altering the sign or

changing the size of the coefficient much. Note further that neither model 10.2 (p-value for Sargan's Chsq = 0.966) or model 10.3 (p-value for Sargan's Chsq = 0.723) can be rejected due to misspecification but model 10.2 provides the better fit.

An issue of concern is that the validity of our results may be compromised by response bias, social desirability or common methods bias. Note that the issue of common methods bias only concerns analyses where financial performance was not used as independent variable. When financial performance was used, the dependent variable (archival data) and independent variables (questionnaire) differed in methods. Consequently, there is no concern of common methods bias regarding these results.

We shall first address the issue of social desirability bias which refers to the respondent's tendency to choose response that reflects societally approved behaviours (see e.g. Zerbe and Paulhaus, 1987). One way to deal with this issue is to include scales of social desirability and subsequently correlate measures with such a scale. Although appealing in terms of tractability there are a number of problems related to this approach (Zerbe and Paulhaus, 1987) which motivate assessment of social desireability on basis of the rather unique context of our survey (referred to in the above). We shall consider problems related to frankness, adequate knowledge, and response adjustment (see e.g. Nunnally and Bernstein 1994: ch 9).

According to the stated purpose of the questionnaire and the relationship between the respondents and Kommunekemi, conscious deviations from frank response are unlikely. There was simply no gain or loss, whatsoever, for the respondents to over- or underemphasize the uncertainty related to environmental issues such as the importance of various different stakeholders, since: (1) Kommunekemi is the mandatory waste treatment alternative for the firms, (2) there is a proven trust-relationship between the firms and Kommunekemi (evidenced in the transcripts of the 31 interviews), and (3) Kommunekemi is simply indifferent about the

level of uncertainty regarding environmental issues such as what stakeholders the firm considers Therefore, we have a high degree of confidence that the results reported in the present study do not reflect social desirability response due to deviation from frank response.

As aforementioned, the respondents were either the CEO or the executive EH&S officer. In both instances there is no doubt that the respondent possessed adequate knowledge.

Clearly, we cannot rule out the possibility of response adjustment. The problem would be most severe if the questions were not priorly considered or the respondents possessed inadequate knowledge. Since we can positively rule out both possibilities it is likely that the situational adjustment was limited. A triangulation with the transcipts of the qualitative interviews lends support to this assessment. The clear impression reflected in the transcripts is that there is stability in response across the two situations. The evidence contained in the questionnaires and the interviews largely converge. For the above reasons we have confidence that our results do not reflect severe bias due to socially desirable response.

The possibility of common methods bias only concerns results where information processing and uncertainty were used as independent variable. However, due to the results obtained in step four, all estimates involving these two variables were validated by their inclusion as instrumental variables in analyses with financial performance as the dependent variable. Therefore, we can effectively rule out common methods bias.

DISCUSSION AND CONCLUSION

The present study extends the capabilities- or competence-based theory by appealing to cognitive frames as co-determinants of persistent performance differentials. The empirical test provides evidence from survey data and archival data (ROA) that support the suggested causal chain between cognitive frames and financial performance through information processing and

perceived uncertainty. We are aware of no previous theoretical work that explicitly states this causal relation or any empirical survey that tests this relation. Furthermore, the present paper introduced a novel method to estimate path models when the usual approach is infeasible. In the following we shall focus on the theoretical implications of our results.

The *general* theoretical basis underlying our argument is Simon's (1987) work on bounded rationality and the derived idea of imperfect environmental matching. Further and massive empirical and theoretical support for the assumption of imperfect environmental matching can be found in recent studies of error in decision making (Reason, 1990). Thus, according to Reason (1990), the imperfect correspondance between cognitive frames and social regularities is a result of the simplification involved in elimination of differences among occurences perceived as similar. The implication is that occurences not frequently encountered tend to be ignored (Kiesler and Sproull, 1982; Reason, 1990). We base our view that cognitive frames generally direct information processing on this simplification hypothesis, combined with the assumption of a relatively persistent cognitive rigidity. Both assumptions have been challenged, however.

To some extent, the simplification hypothesis implies a conjecture of simple-minded decision makers, a view challenged by Walsh (1988). Walsh's (1988) results speak loud and against the hypothesis of simplification biases that direct information processing but the evidence in favour of this hypothesis speaks even louder. Walsh's (1988) assertion on the lack of evidence that managers are actually victims of suboptimal information processing strategies seems to pass over a number of relevant studies too hastily. For example, Hogarth and Makridadis (1981) review 67 empirical studies on biases in acquisition and processing of information. All studies support the idea of simplification biases associated with a principle of similarity and frequency. Reason (1990) reviews the literature on research in human error and

finds massive empirical evidence that pervasive error-forms are associated with frequency- and similarity-gambling related to well-known cognitive biases. Even if we find an impressive amount of evidence supporting the idea of constrained information processing, Walsh's (1988) defence of managerial intelligence is well-taken. Rosman et al.'s (1994) warning that agents are portrayed as either rigid or flexible is in the same spirit. It all depends on the particular talent of the decision maker, the task at hand, the situation, and the context of the decision.

In the present study, we have studied experienced decision makers who processed information associated with environmental issues. All were employees in firms that produce large amounts of hazardous waste and as evidenced in Klassen & Whybark (1999) as well as in 174 studies reviewed by Knudsen (1998), such issues are a source of uncertainty for firms. We have further assumed that general cognitive frames are rigid. 31 interviews conducted with a subset of the respondents support this impression. We find it unlikely that decision makers shift between a cost frame and a strategic frame on a daily basis.

Although our model leaves some room for imaginative, explorative and creative efforts, it was suggested that decision making is framed within broad and relatively persistent categories of what business is about. However, it is not the actual frames *per se* that is of interest in the present study. The theoretical interest is in the effect such frames may have on performance differentials. Indeed, the empirical results support the general idea that the effect of cognitive frames, through perceived uncertainty and information processing, can be traced to performance. This effect may well have general validity when managers face changing, complex and uncertain environments. There is no reason to believe that this effect is specific to environmental issues. The general implication is that specific and relatively stable cognitive frames channel the direction of information processing activities, influence the level of perceived uncertainty and thus influences performance. The results thus support the general proposition

that firm-specific cognitive frames are important co-determinants of persistent performance differentials.

Turning to the specific implications of the present study, the results suggest that the cognitive frame "cost focus" entails a possible ignorance-trap. According to our results, a cost frame related to environmental issues has a positive effect on uncertainty related to such issues and leads to an absence of information processing that could otherwise change the state of ignorance. Even if negative financial performance increases search for alternatives, a cost frame may lead managers to search in the neighbourhood of alternatives that has a direct link to short-term efficiency gains. When the causes of negative performance are located in other neighbourhoods, the firm will increasingly apply the wrong solutions and uncertainty increases. Therefore, an ignorance-trap entails. By contrast, a strategic frame implies that samples from a broader scope of alternatives, including more distant possibilities, may lead to a better diagnosis of the causes of negative financial performance. This raises the question of how to sustain a strategic frame in the face of an increase in search costs and an increase in the number of possible reasons for bad performance.

Levinthal and March (1991) suggest an assymetric relation between a cost frame and a strategic frame. A cost frame will tend to be self-sustaining because a sample limited to the near future provides positive feed-back since immediate pay-offs will tend to be positive. By contrast, the longer into the future alternatives are sampled, the immediate pay-offs will tend to be negative and the expected pay-offs will tend to have higher variance than alternatives associated with a short time horizon. Thus, a cost frame will tend to sustain itself because a shift to a strategic frame provides negative feed-back and a strategic frame must be sustained in spite of negative feed-back in the short term. This points to a key issue implied by the indirect relation between cognitive frames and performance suggested in the present work. If this

relation holds beyond the context of the present study, the time.horizon as a defining characteristic of the scope within which cognitive frames are effective deserves further attention in future research. It further points to the need for critical scrutiny of the limitations of our data.

Apart from the measurement concerns previously raised, there is an obvious limitation in our independent variables which are based on cross-sectional data. Even if the supplementary 31 interviews assured that a strategic- or cost-frame was a relative persistent feature, a future longitudinal study is needed to account for the change in cognitive rigidities. Furthermore, we have taken the approach of using the respondent as a representative individual. Clearly, an important avenue for future research is to examine how differences in experience and professionalization (see e.g. Rosman et al., 1994) influence cognitive frames over longer periods of time. Also, it seems pertinent to explore whether uncertainty and information processing may be a general mediator between cognitive frames and performance. A further but perhaps too ambitious implication of our theoretical argument is the need for studies that track the co-evolution of social regularities in society and cognitive frames in business organisations. Finally, our study is limited to the particular cognitive frames studied and to issues related to the natural environment. Even if the implications may well be general, we need further research in other contexts and on different frames to test this assertion.

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APPENDIX A

Since two-stage least-squares regression is not widely used, this appendix provides the model and the test-statistics associated with the metod. Two-stage least-squares regression involves two regressions of the linear form: the linear regression model and two-stage least squares.

The linear regression model

$$\mathbf{y} = \mathbf{X}\beta + \mathbf{e}$$

y is a n×1 matrix, **X** is a n×k matrix, the coefficient matrix is a k×1 matrix and **e** is a n×1 matrix.

Two-stage least-squares

The first step in two stage least squares estimation involves computation of the fitted values of the independent observations **X** on a the n×s matrix **Z** of instrumental variables (n observations on s instrumental variables and s k) by means of a n×n projection matrix $\mathbf{P}_z$. As shown in the two equations below, the second step then involves computing the IV-coefficients by regressing **y** on **X**-hat. Estimations in the two steps are obtained through OLS-regression.

$$\hat{\mathbf{X}} = \mathbf{P}_z\mathbf{X}$$

$$\mathbf{y} = \hat{\beta}_{IV}\hat{\mathbf{X}} + \mathbf{e}_{2SLS}$$

Test statistics in two-stage least-squares

The appropriate measure for assessing the goodness of fit in models involving instrumental variables (such as the linear two-stage least-squares method) is the generalized R^2 (GR^2) proposed by Pesaran & Smith (1994). Pesaran & Smith (1994) show that GR^2 is a valid discriminator for models that are not mis-specified. It is computed by the following formula where $\mathbf{e}_{2SLS}$ are the residuals from step two in the two-stage least-squares estimation (as shown in the equations in the above). The first formula shows how the GR^2 is computed and the second formula shows how this measure is adjusted for degrees of freedom.

$$GR^2 = 1 - \frac{(\mathbf{e}'_{IVS}\mathbf{e}_{IVS})}{\left(\sum_{t-1}^{n}(yt - \bar{y})^2\right)}$$

$$\overline{GR^2} = 1 - \left(\frac{n-1}{n-k}\right)(1 - GR^2)$$

Misspecification test of two-stage least-squares models

It is well known that regression involving instrumental variables is problematic due to the possibility of misspecification. The test proposed by Sargan (1964) provides the necessary statististics to evaluate if a model is misspecified. The test is based on the following statistics given the null hypothesis that the s (s>k) instrumental variables contained in **Z** are valid instruments:

$$\chi^2_{SM} = \frac{Q(\hat{\beta}_{IV})}{\sigma^2_{IV}}$$

$$Q(\hat{\beta}_{IV}) = (\mathbf{y} - \mathbf{X}\hat{\beta}_{IV})' \mathbf{P}_Z (\mathbf{y} - \mathbf{X}\hat{\beta}_{IV})$$

Under the null-hypothesis, Sargan misspecification (SM) statistics is asymptotically ^{2} distributed with s-k degrees of freedom (s is the number of instrumental variables and k is the number of ’s estimated).

TABLE 1

Means, Standard Deviations and Correlations

Economic Performance	mean	s.d.	1	2	3	4	5
ROA 1995	1.08	.09					
ROA 1994	1.08	.09	.73***				
ROA 1993	1.07	.08	.59***	.67***			
ROA 1992	1.07	.08	.47***	.46***	.62***		
ROA 1991	1.07	.07	.37***	.43***	.52***	.64***	
Cumulative ROA 1991-95	1.46	.47	.79***	.83***	.84***	.77***	.72***
Cost frame related to environmental issues							
Environmental intiatives make products costly	3.46	1.21					
Environmental initiatives decrease competitiveness	2.74	1.30	.63***				
Scale: (1) Disagree completely, (2), (3), (4), (5) Agree completely. Cronbachs Alpha for additive scale: .77							
Strategic frame related to environmental issues							
Environmental awareness is a strategic advantage	3.46	1.29					
Environmental certification gives competitive advantage	4.14	.87	.43***				
Scale: (1) Disagree completely, (2), (3), (4), (5) Agree completely. Cronbachs Alpha for additive scale: .57							
Degree of Information Processing Related to the Natural Environment							
We often discuss env. problems in our firm	4.08	1.00					
Our firm has formulated a clear env. policy	3.75	1.24	.44***				
All employees know our environmental policy	3.45	1.19	.48***	.73***			
Top management is strongly involved with the firm's environmental policy	3.92	1.18	.48***	.73***	.64***		
All employees take actively part in the implementation of the firm's env. policy	3.46	1.10	.36***	.56***	.56***	.66***	
Scale: (1) Disagree completely, (2), (3), (4), (5) Agree completely. Cronbachs Alpha for additive scale: .87							
Uncertainty related to environmental issues							
Uncertainty leads to delays in handling environmental problems	2.02	1.05					
We are generally uncertain how to integrate environmental issues in management and operations	2.03	1.10	.44***				
Scale: (1) Disagree completely, (2), (3), (4), (5) Agree completely. Cronbachs Alpha for additive scale: .60							
Controls							
Age of the firm (years)	52	39					
Number of employees	471	1451	0.174*				
Total amount of dangerous waste (tonnes)	156	379	0.091	0.172†			

† <0.10, *p<0.05, **p<0.01, ***p<0.001.

TABLE 2
Regression Results

Variable	Model 1.0	Model 1.1	Model 2.0	Model 2.1	Model 3.0	Model 3.1
(Constant)	(0,400)	(0,459)	(0,423)	-0.484	-0.453	(0,512)
Info. Proc.					-0,292**	-0,285**
					-0.095	(0,099)
Cost frame	-0.022	-0.007	0,248**	0,275**	0,235**	0,258**
	-0.079	-0.07	-0.068	-0.075	-0.067	-0.073
Strat. frame	0,494***	0,509***	-0,264**	-0,309***	-0.109	-0,156
	-0.064	(0,081)	(0,084)	-0.086	-0.096	(0,098)
Controls						
Age		-0.087		-0.066		-0,094
		-0.002		-0.002		-0.002
Employees		0.112		0,183*		0,215*
		0		0		(0,000)
Waste		0.062		-0.088		-0,096
		(0,000)		0		0
R-Square	0,237	0,267	0.143	0.183	0.194	0.229

Dependent model 1.0-1.1: *Degree of information processing*

Dependent model 2.0-3.1: Uncertainty

Standard errors are in parenthesis.

All models significant, p<0,001

† <0.10, *p<0.05, **p<0.01, ***p<0.001

TABLE 3
Regression Results

Variable	Model 4.0	Model 4.1	Model 5.0	Model 5.1	Model 6.0	Model 6.1	Model 7.0	Model 7.1
(Constant)	(0,324)	(0,230)	(0,097)	(0,113)	(0,167)	(0,173)	(0,235)	(0,247)
Info. Proc.					0,257**	0,281**	0,213*	0,262*
					(0,043)	(0,042)	(0,047)	(0,047)
Uncertainty	-0,381***	-0,397***	-0,223*	-0,199*			-0,13	-0,077
	(0,084)	(0,087)	(0,043)	(0,043)			(0,047)	(0,046)
Controls								
Age		-0,190*		-0,087		-0,04		-0,023
		(0,002)		(0,001)		(0,001)		(0,001)
Employees		0,205*		-0,045		-0,112		-0,103
		(0,000)		(0,000)		(0,000)		(0,000)
Waste		-0,037		-0,007		-0,053		0,016
		0		0		0		(0,000)
R-Square	0.138	0.172	0,042	0,016	0,058	0,058	0.068	0.055

Dependent model 4.0-4.1: *Degree of information processing*

Dependent model 5.0-7.1: Economic performance, long-term

Adjusted R-square and standardized coefficients reported.

All models significant, $p<0,001$

† <0.10, *p<0.05, **p<0.01, ***p<0.001

TABLE 4
Regression Results

Variable	Model 8.0	Model 8.1
(Constant)	(0,226)	(0,244)
Cost frame	0,034	0,097
	(0,36)	(0,037)
Strat. frame	0,115	0,161†
	(0,045)	(0,043)
Controls		
Age		-0,060
		(0,001)
Employees		-0,054
		(0,000)
Waste		0,076
		(0,000)
R-Square	0,000	0,001

Dependent, 8.0-8.1: Economic performance
Standard errors are in parenthesis.
Models not significant at p<0,10.
† <0.10, *p<0.05, **p<0.01, ***p<0.001

TABLE 5

IV-Regression Results (two-stage least-squares)

Variable	Model 9.0	Model 9.1	Model 9.2	Model 9.3	Model 10.0	Model 10.1	Model 10.2	Model 10.3
(Constant)	(1,777)	(0,461)	(0,464)	(0,224)	(0,377)	(0,625)	(0,365)	(0,315)
Cost frame	-0,754	-0,743*	-0,734†	-0,130				
	(0,539)	(0,149)	(0,150)	(0,072)				
Strat. frame					0,527*	0,705*	0,550**	0,519**
					(0,099)	(0,163)	(0,095)	(0,082)
IV								
Info. Proc.	X		X	X	X		X	X
Uncertainty		X	X	X		X	X	X
Age				X				X
Employees				X				X
Waste				X				X
R-Square	0,003	0,023	0,022	0,000	0,045	0,029	0,057	0,062
GR-Square	0,069	0,029	0,032	0,003	0,069	0,029	0,076	0,082

Dependent model 9.0: Economic performance, long-term, p-value for model: 0,245

Dependent model 9.1: Economic performance, long-term, p-value for model: 0,049

Dependent model 9.2: Economic performance, long-term, p-value for model: 0,052; Sargan's CHSQ(1df): 3,885 (p=0,049)

Dependent model 9.3: Economic performance, long-term, p-value for model: 0,508; Sargan's CHSQ(4df): 12,016 (p=0,017)

Dependent model 10.0: Economic performance, long-term, p-value for model: 0,032

Dependent model 10.1: Economic performance, long-term, p-value for model: 0,010

Dependent model 10.2: Economic performance, long-term, p-value for model: 0,005; Sargan's CHSQ(1df): 0,002 (p=0,966)

Dependent model 10.3: Economic performance, long-term, p-value for model: 0,004; Sargan's CHSQ(4df): 2,067 (p=0,723)

Dependent model 11.1: Economic performance, long-term, p-value for model: 0,015; Sargan's CHSQ(3df): 1,069 (p=0,.785)

Standard errors are in parenthesis.

† <0.10, *p<0.05, **p<0.01, ***p<0.001

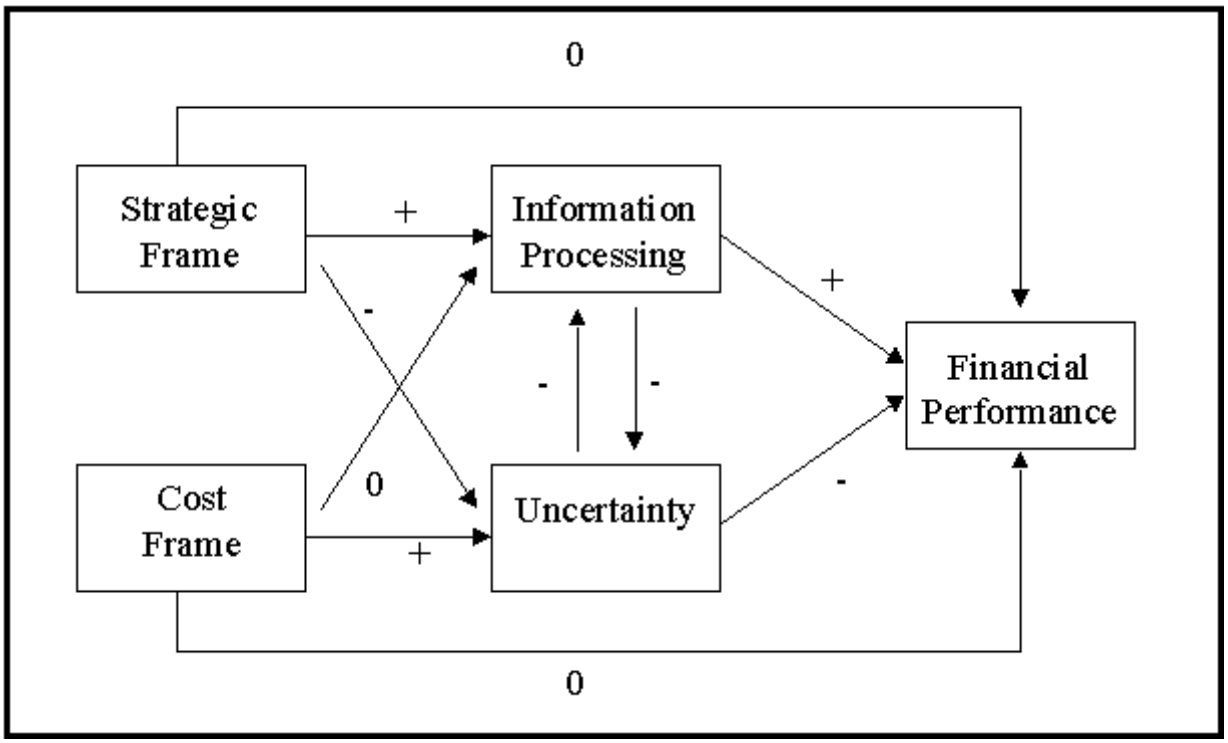

Figure 1: Paths and hypothesized relations. Since the model cannot be identified (and the constructs cost frame and strategic frame are correlated), the estimation follows the four-step "diamond-procedure" outlined below.

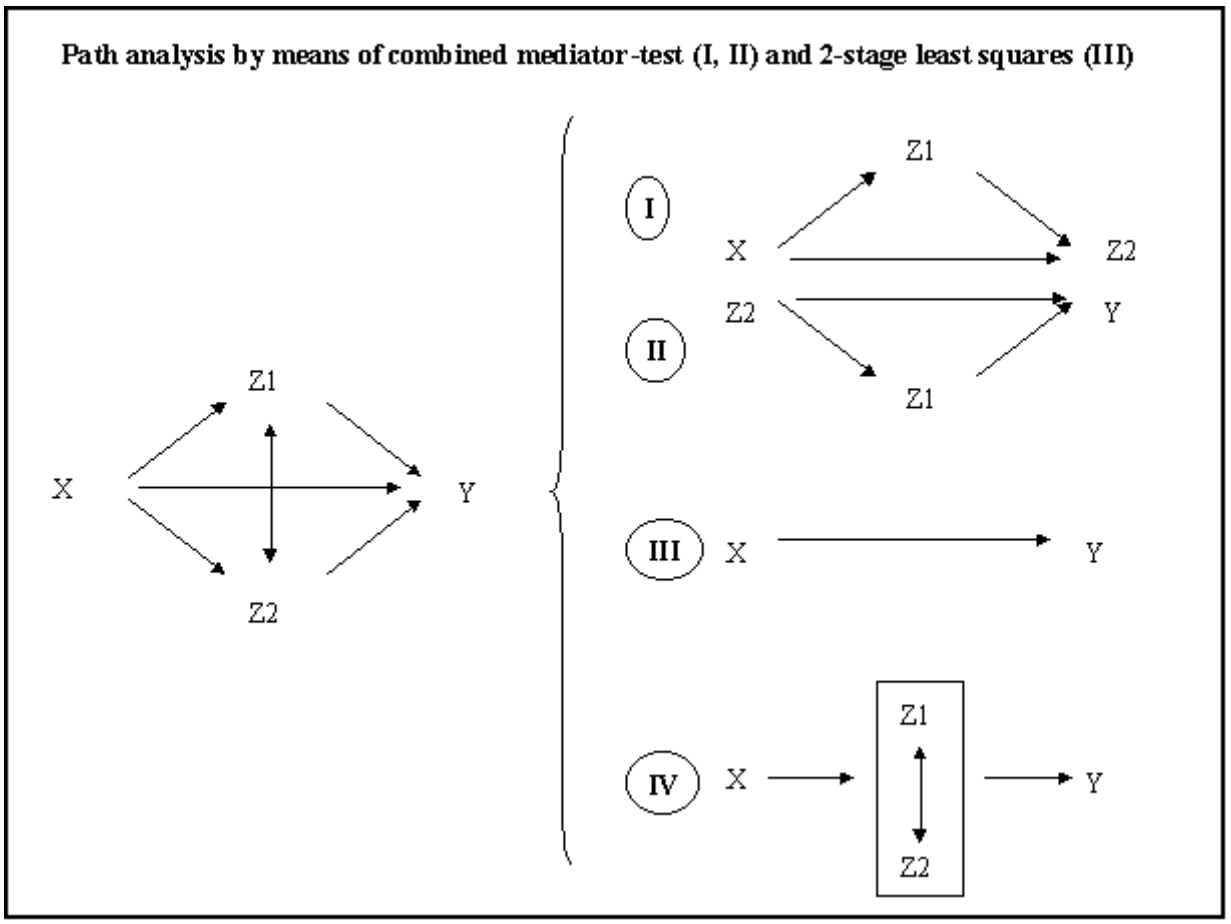

Figure 2: Estimating an over-identified model by decomposition into four estimation steps. X: cognitive frame, Z1: information processing, Z2. uncertainty, Y: financial performance.