UNCERTAINTY IN THE TRANSACTION ENVIRONMENT: AN EMPIRICAL TEST

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Previous studies examining the relationship between uncertainty and vertical integration have produced a conflicting set of results. To clarify this puzzle we drew on the literature to conceptualize three distinct forms of uncertainty—primary, competitive, and supplier—and hypothesized that each had a different effect on vertical integration. The hypotheses were tested using experimental data collected from 308 managers. Consistent with our prediction of differential effects, we found that primary and competitive uncertainty were negatively associated with the decision to vertically integrate, but supplier uncertainty was positively related to the vertical integration decision. No interaction effects were found. Implications for theory and research are suggested. © 1998 John Wiley & Sons, Ltd.

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The concept of uncertainty has long been a central component of a number of theories of organization and strategy. March and Simon (1958) identified uncertainty as a key variable in explaining organizational behavior. Thompson (1967) suggested that an organization's primary task is coping with the uncertain contingencies of the environment, particularly those of the task environment (Dill, 1962). Pfeffer and Salancik's (1978) resource dependency theory suggests that organizations structure their external relationships in response to the uncertainty resulting from dependence on elements of the environment. Other organizational researchers have argued that organizations structure themselves internally in response to environmental uncertainty (Burns and Stalker, 1961; Lawrence and Lorsch, 1967).

Researchers in strategic management also have considered uncertainty to be a major factor affecting key strategic decisions (Porter, 1980). A considerable stream of research drawing on transaction cost theory emphasizes the influence of uncertainty on decisions concerning the scope of the firm, specifically the decision to vertically integrate (e.g., Williamson, 1975; Walker and Weber, 1984, 1987).

Notwithstanding this interest, however, the nature of the relationship between uncertainty and vertical integration has proved to be somewhat of a theoretical and empirical puzzle. Specifically, findings from studies examining the effects of uncertainty on vertical integration appear to contradict one another. For example, studies grounded in transaction cost theory by John and Weitz (1988), Anderson (1985), and Walker and Weber (1984, 1987) provide empirical support for the proposition that vertical integration is an efficient response to environmental uncertainty. In contrast, empirical work grounded in strategic management theory (e.g., Porter, 1980) suggests that firms facing uncertainty require greater flexibility and has shown that uncertainty results in a *lowered* rather

than an increased degree of vertical integration (Harrigan, 1985). Scholarly understanding of the relationship between uncertainty and firm scope is complicated further by other empirical findings. For example, Balakrishnan and Wernerfelt (1986) found that the degree of vertical integration decreased with increased *technological* uncertainty, thereby relating a specific component of uncertainty to the decision about firm scope.

One plausible explanation to account for the contradictory findings noted above may hinge on the source or the type of uncertainty being examined. More specifically, given that uncertainty may arise from a number of sources or may be characterized along a number of dimensions, it is possible that *different* sources or dimensions of uncertainty have *different* implications for vertical integration. In fact, some theoretical work has emphasized the pitfalls of viewing uncertainty as a unidimensional construct (e.g., Milliken, 1987; Yasai-Ardekani, 1986) rather than one that is complex, multidimensional, and differentiated. However, the implications of this line of thinking have not been explored fully. Taken together, there are indications that we need to consider the multidimensionality of the uncertainty construct and the *simultaneous effects of its component parts on vertical integration* in order to resolve contradictory empirical results regarding the nature of this relationship.

Given the prominence of the uncertainty construct to theory and research in strategic management, organization economics, and organizational theory generally, these are important theoretical and empirical tasks. Therefore, the main objective of this study is to empirically differentiate between uncertainty arising from three sources—which we label primary, competitive, and supplier uncertainty—and examine their simultaneous influence on the vertical integration decision. Further, the study also takes a preliminary step toward understanding the governance decision process by examining the extent to which decisions about vertical scope are affected by the uncertainty-related information managers take into account. Hypotheses are tested on 308 managers using a randomized experimental design. The results support the basic thesis of this research that different sources of uncertainty have distinct effects on the decision to vertically integrate.

The rest of this paper is organized as follows. The next section discusses the theory and prior research pertaining to the construct of uncertainty and its relationship with vertical integration, the second section more fully develops the hypotheses, and the third section discusses the experimental method utilized in the study. In the penultimate section, we present the results of the research. The final section presents a discussion and includes the limitations and implications of the findings for theory and research.

PRIOR RESEARCH AND THEORY

Environmental uncertainty

Uncertainty has been an important construct in a number of fields, including organization theory, marketing, and strategic management. In the organization theory literature, Thompson postulated that '[u]ncertainty appears as the fundamental problem for complex organizations' (1967: 159) and that organizations respond to uncertainty in the environment by 'buffering' their 'technical core' from its effects. A number of studies have shown that perceived environmental uncertainty exerts a considerable influence on organizational structures and processes (Huber, O'Connell, and Cummings, 1975; Huber and Daft, 1987). Further, while some of the previous empirical research examining perceived environmental uncertainty has operationalized uncertainty as a unidimensional construct, increasingly researchers question this assumption (Milliken, 1987; Tosi and Slocum, 1984; Yasai-Ardekani, 1986). Milliken (1987), for example, suggests that uncertainty is multidimensional and develops a typology of uncertainty dimensions as follows: *state* uncertainty, the inability to assign probabilities to states of nature; *effect* uncertainty, a lack of knowledge about cause–effect relationships, in particular about how states of nature will affect the organization; and *response* uncertainty, an inability to predict the outcomes of decisions. While these distinctions are useful, our study has another focus—that of capturing the uncertainty about *different aspects* of the environment (see Tosi and Slocum, 1984).

A considerable body of work in the marketing literature also has examined uncertainty and its consequences related to the structural properties of organizations. Much of this work, grounded in transaction cost analysis, explores uncertainty and its influence on vertical integration in distribution

channels. Most notable are studies by John and Weitz (1988), Heide and John (1990), and Heide and Stump (1995) who include volume and behavioral uncertainty in their studies and find that both types of uncertainty invariably exhibit a positive relationship with forward integration into distribution. Heide and John (1990) also investigate technological uncertainty and find a negative relationship with relationship continuity.

Questions related to uncertainty and its effects on firm scope have long intrigued scholars in strategic management as well. As noted earlier, studies in strategic management have examined the link between uncertainty and vertical integration—although findings in this regard are contradictory. In addition, researchers in strategic management have begun to expand research in this area by examining how changes in firm scope subsequently affect different types of uncertainty. For example, Helfat and Teece (1987) examine the proposition that one outcome of vertical integration is a reduction in both secondary and behavioral uncertainty. Using a sample of firms which have undergone vertical mergers, they compare the pre- and postmerger measures of systematic risk (betas) for each of the firms with those of a control group of firms which have *not* experienced vertical mergers. As expected, Helfat and Teece indeed find that firms exhibit lowered risk after a vertical merger.

In contrast to the work of Helfat and Teece, the study presented here takes a different approach to the question of uncertainty and vertical integration. First, we conceptualize and measure uncertainty in perceptual terms rather than as systematic risk (beta). Second, and more importantly, we consider uncertainty as an *antecedent* to the decision to vertically integrate, rather than examining the *post facto* reduction in risk *as a consequence of vertical integration*. Moreover, we explicitly consider the additional effect of *primary* uncertainty on the decision to vertically integrate. In the following paragraphs we consolidate the conceptualization of uncertainty in the strategic management and transaction cost literatures to arrive at a clearer definition of the different dimensions of uncertainty.

Toward a clearer definition and operationalization of uncertainty types

Early transaction cost literature (Williamson, 1975) did not distinguish between different forms of uncertainty. In more recent transaction cost and strategic management literature, however, the construct of uncertainty has been disaggregated (Williamson, 1985: 56–59), a trend consistent with recent developments in organizational theory. In the present study, we draw on Williamson (1985) to develop a typology of three forms of uncertainty (primary, competitive, and supplier). Williamson himself builds on Koopmans (1957) who distinguished between primary and secondary uncertainty as follows: *primary* uncertainty reflects a lack of knowledge about states of nature, such as the uncertainty regarding natural events, whereas secondary uncertainty reflects a lack of knowledge about the actions of other economic actors. Koopmans argues that both forms of uncertainty affect a firm's investment decisions. Thus, in contrast to Milliken's (1987) conceptualization which focuses on ignorance about three stages of a cause–effect chain, primary and secondary uncertainty specifically refer to the uncertainty arising from different *sectors* of the environment that have a bearing on firms' decisions regarding their boundaries.

More specifically, primary uncertainty reflects the uncertainty arising from exogenous sources, such as natural events, from changes in preferences, as well as from regulatory changes, such as those involving standards or tariffs. Thus, primary uncertainty appears to subsume technological uncertainty, or the uncertainty arising from changes in technology due to new inventions or discoveries. Primary uncertainty also corresponds closely to *state* uncertainty as described by Milliken (1987), in that both refer to the lack of knowledge about various states of nature. As noted earlier, secondary uncertainty refers to the uncertainty about the actions of other economic actors generally.

Williamson (1985) describes both primary and secondary uncertainty as 'innocent' and 'nonstrategic' forms of uncertainty and distinguishes them from *behavioral* uncertainty, the deliberate nondisclosure of information or the strategic misrepresentation of information by economic agents. Williamson contends that the behavioral type of uncertainty is the key form of uncertainty relevant to the transaction context. Behavioral uncertainty arises from the difficulty in predicting the actions of other relevant actors, particularly in view of the potential for opportunistic behavior.

Since our focus in this study is on distinguishing between different forms of uncertainty

which arise from the different *sources* that are relevant to decisions about firm scope, we believe that uncertainty can be usefully classified as *primary*, *competitive*, and *supplier* uncertainty. We take this approach to classifying forms of uncertainty because we believe that strategic decisions about firm scope are critically affected both by exogenous events and by the actions of competitors, suppliers, and buyers. This approach accords well with a strategic management perspective which views the actions of these groups, as well as the macroenvironment, as important for strategic analysis (Porter, 1980). Further, we believe that it is useful to make these distinctions because the effects on vertical scope from the uncertainty arising from these different sources are not likely to be identical, as previous research has indicated.

In defining primary uncertainty, we follow Koopmans (1957) and Williamson (1985), and consider this form of uncertainty as relating to exogenous sources, as discussed earlier. Competitive and supplier uncertainty require explanation. We define *competitive uncertainty* as the uncertainty arising from the actions of potential or actual competitors, which may be either 'innocent' or 'strategic'. Competitive uncertainty derives from moves or signals by economic actors in current or future competition with the focal firm, which may be 'noisy' and difficult to grasp precisely (Porter, 1980). Moves by potential new entrants, or of firms making substitutes, in addition to those of existing competitors in an industry, may have a major influence on a focal firm's vertical scope decisions. The uncertainty engendered by the actions of potential or actual competitors may be deliberate, stemming from strategic motivations, such as the uncertainty created from product preannouncements (Farrell and Saloner, 1986). On the other hand, competitive uncertainty may arise innocently from a lack of competitor intelligence or awareness about the prospective actions of competitor firms.

Supplier uncertainty is the behavioral uncertainty arising from the (strategic) actions of the exchange partner firm. Behavioral uncertainty arises from the possibility of *ex ante* or *ex post* opportunism on the part of the exchange partner firm. Williamson (1975) refers to behavioral uncertainty as 'self-interest seeking with guile' and includes in the concept the use of self-disbelieved statements and misinformation with the intention of profiting at the expense of the

exchange partner. In sum, we propose that supplier uncertainty is 'strategic' in Williamson's (1985) terms and therefore of a behavioral nature. Further, this form of uncertainty relates specifically to possible opportunism by either the upstream or the downstream exchange partner.[1]

Figure 1 shows the relationship between primary, competitive, and supplier uncertainty and their effects on an organization.

Uncertainty and vertical integration

The transaction cost literature (Williamson, 1975, 1985) suggests that governance structures evolve out of the uncertain consequences of investments in transaction-specific assets. Uncertainty is theorized to increase the likelihood that opportunistic appropriation of quasi-rents from transaction-specific assets may take place (Klein, Crawford, and Alchian, 1978), thereby increasing transaction costs of exchange. In order to limit the extent of potential opportunism, firms are likely to integrate the transaction into a hierarchy, where opportunism is controlled by fiat (Williamson, 1975). Consequently, vertical integration is a solution to the problem of high uncertainty.

An opposing line of argument flows from the empirical work of other scholars in the field. Balakrishnan and Wernerfelt (1986), for example, argue that environmental uncertainty, more specifically the uncertainty in technological conditions, is likely to *discourage* vertical integration due to the lowered profits in such industries. Profits are argued to be lower since innovations occur more rapidly, and capital losses are greater. Presumably, it is the unanticipated nature of the innovations that results in lower profits for firms. With lower profits, there is a reduction in the incentives to bargain, and fewer transaction costs to save. As a result, there are reduced incentives to integrate. Balakrishnan and Wernerfelt's empirical findings support the proposition that vertical integration is lower when technological change is high, particularly when the degree of competition is also high. Balakrishnan and Wer-

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[1] Strictly, we should label this form of supply chain uncertainty 'supplier–customer uncertainty,' but we prefer to use the term 'supplier uncertainty' both for reasons of simplicity and because the discussion in Williamson's work, for example (1975) and (1985), typically focuses on the supplier.
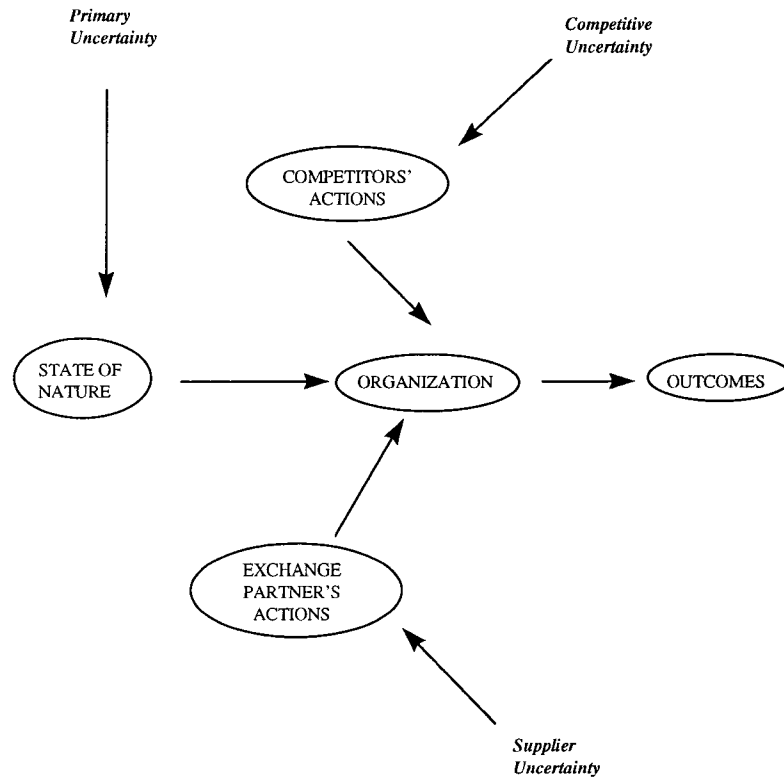
Figure 1.   Sources of uncertainty

nerfelt also briefly note the distinction between demand uncertainty and technological uncertainty.

Harrigan (1985) and Porter (1980) relate environmental uncertainty to vertical integration using a somewhat different logic. Their arguments rest on the notion that environmental uncertainty, more specifically the uncertainty in demand and technological conditions, is likely to *discourage* vertical integration due to the strategic inflexibility that may accompany vertical integration. In particular, as changes take place in technological conditions, a firm's strategy, for example with respect to sources of supply, may also need to change in response. Vertical integration may constrain the ability of a firm to alter strategy in such conditions due to the firm's commitment to a now-obsolete technology.

Uncertainty and asset specificity

Although uncertainty is a key variable affecting strategic decisions about firm boundaries, other factors may moderate its effects. Specifically, transaction cost theory and research have empha-

sized that asset specificity will conditionally affect vertical integration decisions (Walker and Weber, 1984; Williamson, 1985). Under conditions of high asset specificity, uncertainty will be a more significant determinant of vertical integration because both the cost and the possibilities of hold-up from opportunistic behavior are higher. Without asset specificity, the rationale for vertical integration would simply not exist, as there would be no assets at risk and therefore in need of protection (by means of vertical integration) from possible opportunism. In the next section, we develop hypotheses linking forms of uncertainty to vertical integration assuming a *background condition of asset specificity*; in other words, by manipulating experimental conditions to *keep asset specificity moderate, but constant*. Given the importance of asset specificity to the vertical integration decision, a question may well be raised about the appropriateness of empirically examining the relationship between uncertainty and vertical integration without explicitly including asset specificity in the analysis. Before proposing hypotheses, we elaborate briefly on our

rationale for dealing with asset specificity in this way.

Our approach was driven by two basic ideas. First, asset specificity has been successfully studied and its effects on vertical integration are well documented in the literature. Second, a number of empirical treatments in the transaction cost tradition, including studies by Balakrishnan and Wernerfelt (1986), John and Weitz (1988), and Heide and John (1990), have shown that uncertainty exerts an effect on vertical integration, or on its surrogates, quite independent of asset specificity. Given this, we believed a fruitful area of inquiry was to focus on *uncertainty while controlling for asset specificity* because the effects of asset specificity have been well established in the empirical literature, and because uncertainty is likely to have independent effects on vertical integration. As is normal scientific practice, we undertake to study a piece of the puzzle and extend research by concentrating on resolving the ambiguity in the literature by explicitly recognizing different types of uncertainty and examining their simultaneous effects on the vertical scope decision.

HYPOTHESES

As noted earlier, primary uncertainty arises from a profound lack of knowledge of the states of nature. Primary uncertainty includes the uncertain outcomes of natural events, changes in consumers' tastes and preferences, technological shifts, and other exogenous changes in the broader environment. Firms have to adapt to changes in the environment. However, as the number of possible changes increases, the number of possible unforeseen contingencies that may affect contracts between firms increases too. Bounded rationality precludes the writing of completely contingent contracts (Williamson, 1985), and contracts will tend to become less complete in more uncertain environments. Due to 'nonconvergent expectations' (Malmgren, 1961), firms will read and react to the same information in the broader environment differently, giving rise to the possibility of suboptimized outcomes through the lack of coordination.

Moreover, incomplete contracts create increased costs because negotiation and bargaining are required to resolve the disputes that arise as unforeseen contingencies increase. These disputes concern the distribution of the appropriable quasi-rents (Klein *et al*., 1978), that are generated by the transaction-specific assets the exchange partners have dedicated to the relationship. Under such conditions hierarchical coordination through vertical integration is suggested because unified ownership within a hierarchy allows superior coordination. Further, fiat and related incentive structures may limit the extent of costly bargaining over the rents (Williamson, 1985, 1993). Thus, firms will tend to vertically integrate transactions around which high primary uncertainty exists. Accordingly,

> *Hypothesis 1: Primary uncertainty will be positively associated with decisions to vertically integrate.*

In contrast to the above reasoning, an alternative argument consistent with strategic management research (Balakrishnan and Wernerfelt, 1986) suggests that high levels of primary uncertainty— which includes exogenous technological uncertainty—may act in the *opposite* direction with regard to vertical integration. As discussed earlier, changing technological conditions imply a high rate of obsolescence. Under uncertain technological conditions, the costs of frequent obsolescence may result in lower profits, reducing the potential savings in transaction costs from vertical integration. This line of reasoning suggests that firms will opt against vertical integration when technological conditions are perceived to be changing rapidly. Thus, a plausible alternative hypothesis is:

> *Hypothesis 1a: Primary uncertainty will be negatively associated with decisions to vertically integrate.*

The notion of competitive uncertainty, as discussed earlier, refers to the actions of other competitors which have a bearing on the vertical scope decisions of a focal firm. These actions may be either 'innocent' or 'strategic' (deliberately deceitful or misrepresented). Notwithstanding this distinction, competitive uncertainty is likely to lead to an increase in the contingencies of the competitive marketplace, thereby increasing the transaction costs of exchange in vertical contractual relationships

between firms. As discussed above, for both coordination and bargaining reasons vertical integration may be the efficient governance choice under such conditions because it economizes on transaction costs (Williamson, 1975). More specifically, as the possibility of strategic action by competitors increases, so does the likelihood of vertical integration. Consequently we suggest:

Hypothesis 2:   Competitive uncertainty will be positively associated with decisions to vertically integrate.

The rationale linking supplier uncertainty to vertical integration differs from the logic presented above for primary and competitive uncertainty. Supplier uncertainty arises from the uncertainty about the behaviors of the vertical partner in the transaction. Williamson views behavioral uncertainty as 'strategic non-disclosure, disguise, or distortion of information' (1985: 57), and such opportunistic behavior may occur both *ex ante* and *ex post*. Further, while behavioral uncertainty may be salient depending on the 'particulars of the contract... [e]ven knowledge of the particulars . . . does not preclude surprises' (1985: 58). In effect behavioral uncertainty can be viewed independently of the unspecified contingencies in the contract. Behavioral uncertainty is likely to be higher or lower when dealing with 'trader[s] . . . from one part of the opportunism distribution' than the other (1985: 58), but even 'screening for trustworthiness' does not eliminate uncertainty regarding the behavior of an exchange partner.

Supplier uncertainty profoundly affects the governance efficiency of the relationship. In particular, uncertainty regarding the partner's possible opportunism will lower incentives to invest in transaction-specific assets that may be committed to the relationship. In order to ensure the optimal level of investment in such assets, vertical integration of the transaction is suggested. Alternatively, vertical integration implies the use of fiat and unified governance to reduce incentives for the appropriation of quasi-rents (Klein *et al.*, 1978) that are generated by transaction-specific assets, making such a governance form the efficient choice. Accordingly, we propose:

Hypothesis 3: Supplier uncertainty will be positively associated with decisions to vertically integrate.

While supplier uncertainty relates to the behavioral uncertainty about the actions of vertical partners and its effects on vertical integration, a case may also be made for the *moderating* effects of primary and competitive uncertainty with supplier uncertainty on vertical integration. The reasoning behind these predictions is as follows. Supplier uncertainty exists due to the possibility of opportunistic behavior on the part of the supplier. However, given incomplete contracts, the opportunities for nondisclosure of information and other strategic misrepresentation (Williamson, 1985) increase with the number and degree of contingencies in the exchange relationship. Such contingencies may arise due to exogenous events taking place in the external environment (primary uncertainty) or due to more proximate events such as changes in supply due to competitive actions (competitive uncertainty). When primary and competitive uncertainty are higher, the number of contingencies rises too. Accordingly, we propose that the effects of supplier uncertainty on vertical integration are even stronger when supplier uncertainty operates in conjunction with primary and competitive uncertainty. Further, competitive uncertainty is likely to be exacerbated in the face of primary uncertainty. The following hypotheses capture the two-way and three-way interaction effects implied in the foregoing:

Hypothesis 4a: Primary uncertainty will moderate the relationship between supplier uncertainty and the decision to vertically integrate.

Hypothesis 4b: Primary uncertainty will moderate the relationship between competitive uncertainty and the decision to vertically integrate.

Hypothesis 4c: Competitive uncertainty will moderate the relationship between supplier uncertainty and the decision to vertically integrate.

Hypothesis 4d: Primary uncertainty and competitive uncertainty will moderate the relationship between supplier uncertainty and the decision to vertically integrate.

Information use

The literature on strategic decision-making suggests that strategic decision effectiveness is shaped by both environmental factors and decision processes. Although some scholars argue that environmental constraints determine choices and lessen the importance of choice processes (e.g., Pfeffer and Salancik, 1978), other scholars argue that managers retain a substantial degree of control over strategic choices even in the context of constraints (e.g., Child, 1972). The latter position is strengthened by the observation that 'some managers make very poor strategic choices, with devastating consequences for their firms, while others in very similar circumstances make much better choices' (Dean and Sharfman, 1996: 369). The collection of information relevant to the decision and reliance upon analysis of this information in making the choice is central to effective decision processes (Dean and Sharfman, 1993). Yet, studies employing the transaction cost paradigm have paid relatively little attention to the kinds of environmental information decision-makers use in making vertical integration decisions.

Research has shown that information is likely to have an instrumental effect on actual decisions (Bourgeois, 1985; Sabatier, 1978). Presumably, better decisions are a consequence of more extensive information collection which leads to more accurate perceptions of environmental conditions (Sutcliffe, 1994) and better firm performance (Bourgeois, 1985). Of course, assessing the context to determine how best to adapt the organization to meet contextual demands or constraints is not easy. Managers have to wade into a sea of ambiguous, conflicting, and contradictory information and decide what to pay attention to and what to ignore. An important implication of this research stream of relevance to the present study is that the extent to which managers take *relevant* contextual information into account may moderate the relationship between the level of uncertainty and the vertical integration decision. This leads to the following hypotheses:

Hypothesis 5a: The association between primary uncertainty and decision to vertically integrate is moderated by the extent to which decision-makers take primary uncertainty information into account.

Hypothesis 5b: The association between competitive uncertainty and decision to vertically integrate is moderated by the extent to which decision-makers take competitive uncertainty information into account.

Hypothesis 5c: The association between supplier uncertainty and decision to vertically integrate is moderated by the extent to which decision-makers take supplier uncertainty information into account.

METHOD

Overview

The nature of the research questions in this study dictated that we use a methodology that would allow us to control the information-processing context. Thus, data was gathered through the use of written decision scenarios using an experimental methodology. Although some scholars argue against experimental research in strategic management, the usefulness of an experimental decision-based perspective has been demonstrated by a number of strategic process investigators (Bower, 1970; Fredrickson, 1984; Mintzberg, 1978; Thomas and McDaniel, 1990) and is considered a promising method for enhancing understanding of competitive strategic decision-making (Schwenk, 1995: 489). In our study, participants read a decision scenario that depicted a hypothetical situation in which a firm must decide whether to vertically integrate or outsource part of its operations. The scenario included information in regard to the three forms of uncertainty. Informants then were asked to give an assessment whether the firm should vertically integrate or outsource. In addition, participants were asked to respond to Likert-type questions to describe the extent to which they used nine information items contained in the case scenario in making their decision. The research materials contained detailed instructions in the self-administration of the research instruments.

Instruments

The scenarios provided detailed information about a hypothetical firm in the printing industry. One criterion for industry selection was an industry

with a large number of firms—since we wished to create realistic scenarios while not wanting respondents to make comparisons with real-life firms. The printing industry met this criterion well. Further, we were looking for a manufacturing industry in which the customization of physical equipment to meet customers' needs (asset specificity) was a plausible condition. As explained earlier, the level of asset specificity was held constant in all the decision scenarios and was designed to be moderately high.

Before developing the scenarios, we conducted an extensive search for information about the printing industry to identify specific industry characteristics and to identify typical problems faced by firms within the printing industry. Industry issues were worked into scenarios, each four pages long, which included information about the firm, its background and performance history, the current decision situation, and information about the three types of uncertainty under investigation in this study (see Appendix 1 for a sample scenario).

The independent variables were manipulated by inserting in the cases one set of alternative paragraphs describing primary uncertainty (either high or low), one of two alternative paragraphs describing competitive uncertainty (either high or low), and one set of alternative paragraphs describing supplier uncertainty (either high or low) (see Appendix 2). Therefore, eight combinations of conditions were possible, resulting in eight different decision scenarios.

In order to refine the decision scenarios and to ensure that the manipulations were successful, an extensive pilot test of the instruments was conducted. Evening graduate business students in a large Midwestern university were asked to participate in the pilot study. Pilot study participants were also asked to evaluate the length of the instrument, the clarity of the questions, and to provide feedback in regard to the meaningfulness of the language used. Changes were made to strengthen the manipulations based on the participants' feedback and analysis of the pretest data.

Measures

After participants read a case that contained one of the eight possible combinations of the three types of uncertainty, they responded to a series of 7-point Likert-type scaled questions. The questions were used to create the vertical integration dependent measure and the uncertainty information use independent measures.

Dependent measure

The decision to *vertically integrate* was measured with a two-item scale (alpha = 0.94) that asked participants to indicate the extent to which they agreed or disagreed with the two following statements: 'Vegas Press should outsource its finishing operations' (reverse coded), and 'Vegas Press should expand its in-house finishing operations.' Items were averaged to create a variable score since there was no theoretical grounding for using weighted averages in the calculation.

Independent measures

Dummy variables were created to reflect the experimental levels of *primary*, *competitive*, *and supplier uncertainty* (1 = low, 2 = high). The nine information items used to construct each of the case scenarios were presented to the participants, who were asked to indicate the extent to which they would use each piece of information in making their decision. Information items in the case scenario provided the basis for three measures of *information usage*. The extent to which participants took *primary uncertainty information* into account in making their decision was measured with five items that were averaged to create a variable score (Cronbach alpha = 0.71). The degree to which participants used *information about competitive uncertainty* in making their decision was assessed with one item. The extent to which participants took *supplier uncertainty information* into account in making their decision was measured with three items that were averaged to create a variable score (Cronbach alpha = 0.68).

Control variables

Several variables were used as controls in the analyses, including: the age of the participants, the gender of the participants, and total years of work experience. Individual characteristics were included in the models consonant with research suggesting that perceived environmental uncertainty is related to personal characteristics (Downey, Hellriegel, and Slocum, 1977).

Manipulation checks

The final questions were manipulation checks. Subjects were asked to complete the manipulation questions after they had completed the other study questions and sealed the case and questions in an envelope. There were six questions covering manipulation checks. For example, the first question stated that '[t]he certainty of economic recovery is . . .' and provided a response continuum from 1 (highly certain) to 7 (highly uncertain). Each of the eight case scenarios contained the same questions.

Subjects and procedures

Subjects in this study were 308 students enrolled in graduate-level business administration classes, specifically core strategic management and organizational theory/behavior courses. All subjects were executives or managers working full time. Many were enrolled with the express intention of maintaining or enhancing current business knowledge and management competencies; some were enrolled at night to complete a long-term course of study for the MBA degree. Further, many were senior-level executives. For example, our sample included the chief financial officer of a large agricultural trading company, the senior vice president for human resources for a large institutional investment firm, a high-level executive in a U.S. government lending institution, and the chief financial officer of a large manufacturing firm. Consequently, the average subject profile in our sample did not match the typical profile of an MBA student both in terms of age and experience levels. All subjects had undergraduate degrees; half of the subjects were older than 28.9 years of age, half of the subjects had more than 6.13 years of work experience (3.04 years work experience in their current firm); 36 percent were women, 64 percent men.

The use of laboratory research in strategic management is often criticized on the grounds that subjects (often undergraduate college students) differ greatly from the managers and other professionals to whom the results may be generalized. Although speculative (we have no data regarding the population to which the results might be generalized), the average profile of the subjects in the study reported here may be more representative of the population to which the results will be generalized than is typical of most lab studies. Further, we believe that the sample is sufficient to test the theory for the following reasons. First, the subjects in the sample have considerable work experience and many of them are making high-level decisions. While they single-handedly may not be making vertical integration decisions, it is likely that they are involved in such decision-making processes. This consideration is especially valid since it is likely that decisions of the type studied here would be made by a team of decision-makers rather than a single decision-maker. Second, we suggest that the issue is not so much one of whether the sample includes individuals who specifically make vertical integration decisions (provided such a population could be identified), but that the sample include knowledgeable and experienced subjects who can apply their knowledge and expertise to the choice situation at hand. Since over half of our subjects exceeded 6 years of work experience, we consider them to have sufficient experience to address the issues at hand.

The study took place during a 3-week period during the winter quarter. In all cases, students were given at least an hour (sometimes more) to complete the experiment. Our pilot test indicated that the average time to complete the study materials was about 30–40 minutes. Case conditions were randomly distributed across individuals. An effort was made to ensure that within each section there were equal numbers of the eight case-and-condition combinations. We also tried to ensure, to the extent possible, that the total number of participants in each case condition cell was equal. Final cell sizes ranged between 36 and 42.

Analyses

Preliminary analyses were conducted: manipulation checks and tests to determine whether the respondents' age, total years experience, and gender varied across the eight experimental conditions. We carried out manipulation checks on the three uncertainty conditions using ANOVA. The results indicated that participants correctly understood the level of each of the three types of uncertainty (primary uncertainty, $F = 7.82$, $p < 0.0001$; competitive uncertainty, $F = 1.92$, $p < 0.06$; supplier uncertainty, $F = 10.51$, $p < 0.0001$). We also used ANOVA to test for differences in the respondents' ages across conditions and no significant differences were found

($F = 1.41$, n.s.). No systematic differences were found across experimental conditions for total experience ($F = 1.37$, n.s.) or gender ($F = 0.71$, n.s.).

The hypotheses were tested using hierarchical regression analysis. The vertical integration dependent variable was regressed on dummy variables representing the three uncertainty conditions, the four interactions between the levels of uncertainty, the three continuous measures of information usage, the interactions between the levels of uncertainty and the measures of information use, and the three control variables. We tested the increment in R^2 yielded by the addition of each of these blocks of variables. If the increment in R^2 was significant, the coefficients were examined to determine whether the coefficients conformed to the hypotheses.

RESULTS

Table 1 presents descriptive statistics and correlations between all variables included in the study. The hierarchical regression results are presented in Table 2. The percentage of variance explained in the model is 0.33 (adj. $R^2 = 0.30$). Overall, we find main effects for uncertainty statistically significant, though the interactions between them were not. In addition, two of the three interaction effects for the information use and the uncertainty conditions were statistically significant. A discussion of the support, or the lack thereof, for the hypotheses follows.

Hypothesis 1 proposed that primary uncertainty would be significantly and positively related to the decision to vertically integrate, while Hypothesis 1a proposed the opposite. The results presented in Table 2 provide *support* for Hypothesis 1a and indicate that primary uncertainty is associated *negatively* with decisions to vertically integrate. The unstandardized coefficient for the variable is -0.39 ($p < 0.01$).

Hypothesis 2 argued that competitive uncertainty is positively associated with vertical integration decisions. As the data in Table 2 show, competitive uncertainty was *negatively* and significantly related to vertical integration thereby providing *no support* for Hypothesis 2. The unstandardized coefficient for the variable is -0.32 ($p < 0.05$).

Hypothesis 3 suggested that supplier uncer-

tainty is positively associated with vertical integration. The findings *supported* this hypothesis as shown in Table 2. The unstandardized coefficient is 0.53 ($p < 0.01$).

Hypotheses 4a, 4b, 4c and 4d proposed interaction effects between primary, competitive, and supplier uncertainty. Neither the two-way interaction nor the three-way interaction were significant, suggesting that each form of uncertainty acts independently of the others on the decision to vertically integrate.

Hypotheses 5a, 5b and 5c proposed another series of interaction effects, i.e. that the extent to which decision-makers take information about each type of uncertainty into account will *strengthen* the relationships between the form of uncertainty and vertical integration. These hypotheses received mixed support. Whereas Hypotheses 5a and 5c were *supported* ($\beta = -0.47$, $p < 0.01$ and $\beta = 1.09$, $p < 0.01$) respectively, Hypothesis 5b did not receive support ($\beta = -0.09$, n.s.). The results indicate that primary uncertainty information use strengthens the negative relationship between primary uncertainty and vertical integration, and supplier uncertainty information use strengthens the positive relationship between supplier uncertainty and vertical integration.

As Table 2 indicates, none of the control variables were significant predictors of vertical integration at the $p < 0.05$ level.

DISCUSSION

A study of uncertainty and its effects on the scope of the firm is timely in view of the sharply increased environmental uncertainty of the current economic and business context. Heightened business and academic interest in 'outsourcing', or vertical *dis*-integration (Quinn and Hilmer, 1994), is evidence of the criticality of firm boundaries as a means of transforming the organization to deal with the new environment. Thus, as firms seek to respond to the uncertainty in their environments, one of the key decisions they face is determining the degree of vertical scope that best matches their competitive and strategic positions.

The purpose of the study reported here was to empirically demonstrate the relative significance of the different sources or forms of uncertainty in affecting decisions about vertical scope. The

Table 1.   Descriptive statistics and zero-order correlations

Variables	Means	S.D.	1	2	3	4	5	6	7	8	9	10
1. Primary uncertainty	1.51	0.50	–									
2. Competitive uncertainty	1.51	0.50	−0.01	–								
3. Behavioral uncertainty	1.51	0.50	0.01	−0.01	–							
4. Primary uncertainty information use	4.14	1.00	−0.01	0.01	0.02	–						
5. Competitive uncertainty information use	4.29	1.48	0.02	0.12*	0.06	0.12*	–					
6. Supplier uncertainty information use	4.35	1.28	0.00	0.06	0.10	0.22**	0.10	–				
7. Age	28.89	4.97	−0.02	0.04	0.13*	−0.02	−0.06	0.00	–			
8. Sex	1.66	0.48	−0.00	0.03	0.04	−0.02	0.04	−0.11†	0.02	–		
9. Total work experience	6.13	5.12	0.03	0.05	0.16**	0.02	−0.13*	−0.06	0.61**	−0.05	–	
10. Vertical integration	4.02	1.59	−0.16**	−0.19**	0.18**	−0.07	0.03	0.11†	−0.04	0.08	0.00	–

$N = 308$
†$p < 0.10$; *$p < 0.05$; **$p < 0.01$

Table 2. Regression results[a] ($N = 308$): Dependent variable = vertical integration

	Beta	R^2	Change R^2
Step 1 (Uncertainty)		0.09	0.09
Primary uncertainty (P)	−0.39**		
	(0.156)		
Competitive uncertainty (C)	−0.32*		
	(0.158)		
Supplier uncertainty (S)	0.53**		
	(0.158)		
$F = 9.66$**			
Step 2 (Uncertainty interactions)		0.10	0.01
$P \times C$	0.07		
	(0.312)		
$P \times S$	0.13		
	(0.313)		
$C \times S$	0.39		
	(0.320)		
$P \times C \times S$	−0.92		
	(0.628)		
$F = 4.54$**			
Step 3 (Information use)		0.13	0.03
Primary uncertainty information use (PU)	−0.11		
	(0.081)		
Competitive uncertainty information use (CU)	0.05		
	(0.055)		
Supplier uncertainty information use (SU)	0.02		
	(0.068)		
$F = 4.30$**			
Step 4 (Information use/uncertainty interactions)		0.30	0.16
$P \times PU$	−0.47**		
	(0.160)		
$C \times CU$	−0.09		
	(0.109)		
$S \times SU$	1.08**		
	(0.133)		
$F = 10.44$**			
Step 5 (Control variables)		0.33	0.03
Age	−0.01		
	(0.019)		
Sex	0.20		
	(0.166)		
Total years experience	−0.01		
	(0.016)		
$F = 8.80$**			

*$p < 0.05$; **$p < 0.01$
[a]All beta weights are from final step in hierarchical regression. Standard errors are in parentheses.

results suggest not only that managers are able to make distinctions among the three forms of uncertainty proposed here, but also that these three sources of uncertainty are differentially related to the vertical integration decision. In particular, the results may help clarify and resolve some of the ambiguity in previous research about the opposing effects of primary and competitive uncertainty on the one hand, and supplier uncertainty on the other, on the vertical scope of the firm.

Most notably, the three sources of uncertainty

appear to act independently of each other on vertical integration (since we found no statistically significant interaction effects). These results are important as they emphasize the need to treat uncertainty as a distinct set of constructs, rather than as an undifferentiated concept. In addition, the results of this study suggest that decision-makers, when using information about primary and supplier uncertainty in their decisions, act in a way that reinforces the effects of these forms of uncertainty on vertical integration.

An important question to be asked, however, is whether a global measure of uncertainty would produce the same results. In order to provide additional support for our conclusion, we conducted a post hoc analysis to see whether our results would have been different had we used a 'global' uncertainty measure. First, we constructed a 'global' uncertainty measure by collapsing the different uncertainty conditions into a single index. Then we regressed the vertical integration dependent variable on this global variable (without interactions, information use and its interactions, or controls).

The results were significantly different from the results reported in Table 2. First, the overall model was marginally significant ($F = 2.96$, $p < 0.09$) and explained only 1 percent of the variance. Second, the coefficient for the global uncertainty measure was negative and marginally significant ($p < 0.09$). Comparing those results with the results reported in the paper, in which we decomposed uncertainty into its subcomponent parts, we find that the model tested in our study is a significantly better fit to the data.

The finding that the propensity to vertically integrate decreases as *primary uncertainty* increases is at odds with *early* transaction cost work suggesting that environmental uncertainty is positively associated with vertical integration (Williamson, 1975). More recently, however, Williamson (1985) singles out behavioral uncertainty as the main driver of vertical integration, and suggests a positive relationship between *behavioral* uncertainty and vertical integration, a proposition that is consistent with our result regarding supplier uncertainty.

Our findings are at odds with some studies in the marketing channels literature that reveal a positive link between volume uncertainty and close vertical relationships, but are consistent with other studies in marketing that demonstrate a positive association between behavioral uncertainty and vertical integration. It is possible that volume uncertainty in the context of downstream distributor relationships reflects a narrower scope of uncertainty, or a more controllable phenomenon than ours; whereas our constructs of primary and competitive uncertainty reflect a broader, more uncontrollable set of elements. Further, technological uncertainty forms part of our definition and operationalization of primary uncertainty, and our results are consistent with previous findings in this regard. Although speculative, our results may suggest that firms opt against risky investments in vertical integration capacity when the macroenvironment is perceived as uncertain, but decide *for* vertical integration when the source of uncertainty is more proximate or controllable. While one may argue that the supplier firms could equally pass on the costs of bearing the uncertainty to the focal firms, suppliers are also able to insulate themselves from the negative effects of primary and competitive uncertainty by cumulating the demand from a number of downstream firms.

As far as the research in the strategy field is concerned, our findings broadly support empirical work by Balakrishnan and Wernerfelt (1986) and confirm the weak relationship in Harrigan (1985), who found that firms are less likely to pursue vertical integration as the level of technological uncertainty increases. In addition to the transaction cost argument made by Balakrishnan and Wernerfelt (1986)—that there may be lower profits and therefore less to bargain over and save by integrating in such contexts—other explanations in this stream appear to hinge on maintaining strategic flexibility. In fact, given the current context of greatly increasing environmental uncertainty including rapid changes in technology and in demand conditions more generally, it is possible that the *actual* relationship between primary uncertainty and firm scope has strengthened and that earlier suggestive findings of Harrigan (1985) would be even stronger today. Put differently, it may be that the need to stay flexible and thereby limit the vertical scope of the firm has become a much more compelling necessity in today's business environment, a trend which would be consistent with our results.

The results of the study reported here also show that managers are less likely to decide

to vertically integrate under conditions of high *competitive uncertainty* although we had hypothesized the contrary. Competitive uncertainty in its effects on firm decisions appears to behave in a manner similar to primary uncertainty, at least insofar as the test for our alternative hypothesis, that of a negative relationship between primary uncertainty and vertical integration, indicated. The most straightforward explanation for this finding is that managers prefer to limit vertical scope when they have little information about the potential actions of competitors. Uncertainty about the actions of competitors also may imply that future *supply* conditions will be uncertain. This would be true especially if competitors plan to expand capacity and thereby preempt current and potential competitors (Dixit, 1980). Vertical integration under conditions of competitive uncertainty may restrict a firm's strategic options by escalating commitments to certain investments. Alternatively, managers may consider the possibility that competitors' actions may be strategic (i.e., deceitful) and consequently decide to simplify the boundaries of the firm until their understanding of the situation becomes clearer. While competitive uncertainty has a similar effect on vertical integration as primary uncertainty, the actions of these two forms of uncertainty are, interestingly, independent of each other, as the lack of interaction effects revealed. However, past studies have not considered competitive uncertainty as conceptually or operationally distinct from environmental uncertainty in general.

The finding that vertical integration is more likely when *supplier uncertainty* or supplier behavioral uncertainty is high is consistent with recent transaction cost research (e.g., John and Weitz, 1988) and arguments suggesting that the behavior of the exchange partner is a critical determinant of the boundaries of the firm (Williamson, 1985). While behavioral uncertainty in terms of opportunism by the exchange partner has so far been treated as a 'given' in the theory and literature, some researchers (e.g., Dore, 1983) question the assumption in regard to the opportunistic behavior of economic actors. Dore (1983) argues that trusting behavior between economic actors *can* be identified, which would suggest that supplier (i.e., behavioral) uncertainty can be reduced in a transaction context. Such an argument implies that it is possible to purposefully reduce transaction costs between organizations by

increasing the level of trust, thereby reducing behavioral uncertainty and moving to more efficient governance structures.

Finally, the results of this study shed some light into strategic decision processes and how information affects vertical integration decisions. We found that vertical integration decisions are affected not only by uncertainty type, but also by the extent to which managers take information related to uncertainty into account when making their decision, although the main effects of the extent to which managers pay attention to different types of information were not significant. More interestingly, though, we found that the extent to which managers consider information about primary and supplier uncertainty significantly moderates the relationships between primary and supplier uncertainty and vertical integration. This set of findings suggests that, in general, what managers pay attention to matters to their decision. In other words, paying attention to information about primary and supplier uncertainty influences their decision about vertical integration. Of course, we did not find a significant coefficient for the interaction term between competitive uncertainty and information use about this form of uncertainty, which is an anomalous result.

The transaction cost perspective has been criticized for ignoring the processes by which governance decisions are made. The results presented here provide a preliminary step toward articulating the process by which managers use information about uncertainty in making decisions about firm boundaries.

Limitations

A possible limitation of this research relates to external validity. This study used an experimental design; thus, the external validity of our findings may be questionable. However, we took some precautions to decrease threats to external validity. First, our sample was composed of executives and practising managers who are presumed to be similar to the executives and other professionals to whom the results may be generalized. Second, significant care was taken in developing and testing the decision scenarios in order to make sure they were as realistic as possible. Our findings seem to be consistent with more recent theoretical and empirical treatments, which lends credence to their validity.

Although uncommon, scholars suggest that laboratory research is particularly appropriate for examining strategic phenomena that are not easily accessible in the field. For example, Schwenk (1995: 488) argues that laboratory studies may be an especially effective method for examining the ways environmental and organizational factors affect decision processes because key informant reports in the field are not always reliable (Golden, 1992; Huber and Power, 1985). In the study reported here, lack of control over the environmental and information factors would have seriously inhibited any effort to disentangle the effects attributable to each of the three forms of uncertainty.

It may also be fruitful to question the extent to which it is meaningful to distinguish between different categories of uncertainty, particularly when they are defined in terms of different *sources* of uncertainty. In fact, it could be argued that the different sources of uncertainty are really simply parts of a *continuum* of uncertainty that shade into one another. Such a continuum, as mentioned earlier, would range from a completely exogenous end, where there is little that a firm can do to influence the course of events, to increasingly endogenous parts. For example, while regulatory change has been viewed as part of primary uncertainty and the exogenous end of the uncertainty continuum, the role of firms in influencing the direction and scope of regulation through lobbying and other efforts is not to be underestimated (Hirsch, 1975; Lenway and Rehbein, 1991). Thus, competitive actions can lead to regulatory change, blurring the distinction between primary and competitive uncertainty. Similarly, actions of competitive firms can influence the pace and direction of technological change. On the other hand, it makes sense to theoretically and empirically make a distinction between these types of uncertainty and supplier uncertainty, whose effects on vertical scope tend to be the opposite from those of primary and competitive uncertainty.

Another possible limitation concerns the directionality of the uncertainty items used in the decision scenarios. Some studies have shown that decision processes and outcomes differ depending on whether managers perceive they are responding to problems or threats or responding to opportunities (Fredrickson, 1985; Jackson and Dutton, 1988). In fact, Jackson and Dutton (1988)

found that managers are more sensitive to information that suggests the presence of a threat and have a tendency to interpret ambiguous information in threat terms. In order to prevent the confounding of our results related to the framing of environmental contingencies, it was important to develop certainty–uncertainty items that simply reflected the level of certainty–uncertainty and were free of positive or negative connotations. Surprisingly, this task was much more difficult than we had imagined. Nonetheless, careful attention to the issue of directionality resulted in uncertainty passages that are relatively free from any positive–negative directionality (see Appendix 2). Thus, we are reasonably confident that we have avoided any confounding of our results related to directionality or framing.

The results reported in this study raise other questions. Organizational environments are becoming increasingly complex, qualitatively more demanding, ill defined, contradictory, and dynamic. It is possible that the results reflect a recognition of this change in organizational environments and a tendency to favor flexibility and the implied reduction in firm scope. In other words, it may be that subjects emphatically indicated their preferences for smaller firms in the face of the uncertainty of the general environment.

Future directions

This study highlights several areas for extending and enhancing current research. One important avenue for future research concerns the relationships among environmental uncertainty, managerial perceptions, and objectively measured attributes of the environment (e.g., Sutcliffe, 1994), and assessing the effects of objective vs. perceptually measured uncertainty on vertical scope and other strategic decisions. Field researchers studying the link between environmental uncertainty and organizational adaptations have adopted one of two approaches (Yasai-Ardekani, 1986). Some researchers have focused their efforts on examining the link between *objective* environmental uncertainty and organizational responses or structural adaptations (e.g., Balakrishnan and Werner-felt, 1986; Child, 1972; Keats and Hitt, 1988). Other researchers have focused their efforts on examining the link between *perceived* environmental uncertainty and organizational adaptations

(e.g., Duncan, 1972; Miles and Snow, 1978). Given that top managers' perceptions of the environment are a significant determinant of an organization's strategy and design (Pfeffer and Salancik, 1978), it seems reasonable to argue that vertical integration decisions are likely to be based upon top managers' *perceptions* of uncertainty. While the transaction cost literature has not directly addressed the issue of which environmental construct—objective or perceived—underlies vertical integration decisions, the theory seems to imply that it is perceptual, rather than objective uncertainty that drives the decision about firm boundaries. Specifically, it is not so much that firms' environments are uncertain, but, more importantly, that *managers view the environment as uncertain* and act on their perceptions. Of course, organizational outcomes (performance) may be influenced by parts of the environment not considered or ignored by decision-makers.

In order to better understand vertical integration decision processes it may be necessary to employ richer methods and longitudinal designs. For example, studies linking the cognitive maps of dominant coalitions in the same industry over time with descriptive data on the environmental context also may provide fruitful insights into how managers operationally think of their environments and act on them (Fahey and Narayanan, 1989). Research in this vein also may provide additional insights into the environmental information that is relevant for organizational success and may be useful for understanding why some important environmental information is rejected, considered irrelevant, or unimportant, or why unimportant information is considered meaningful, relevant, and important (Sutcliffe, 1997).

The findings reported here—especially the link between supplier uncertainty and the decision about firm boundaries—raise other questions. In particular, on the surface, supplier uncertainty (i.e., behavioral) appears to have a close relationship with trust. Thus, the absence of behavioral uncertainty can be quite easily equated with the existence of trust between the partners in a relationship. In fact, reliability and predictability are two commonly accepted dimensions of the trust construct (Rempel, Holmes, and Zanna, 1985). These are clearly the obverse of 'behavioral uncertainty' on the part of the exchange partner. In fact, recent theoretical treatments have questioned the assumption of opportunism in transaction cost theory (Bromiley and Cummings, 1995) which suggests new directions in the structuring of organizations and of interorganizational relationships. However the role, antecedents, and outcomes of the absence of opportunism—trust—in interorganizational ties have yet to be explored in depth, although some empirical beginnings have been made (Zaheer and Venkatraman, 1995). Further empirical research into these questions will serve to sharpen our conceptions about the related constructs of uncertainty and trust.

In summary, the combined results suggest that more work needs to be done in a number of related areas. Specifically, we need to conduct research that more accurately reflects how decision-makers select the type of information they use in making strategic decisions about organizational boundaries, the relationship of this information with objective reality and with decisions regarding firm scope, and a better understanding of the links between supplier uncertainty and trust and their antecedents.

Concluding remarks

The relationship between uncertainty and vertical firm scope has been ambiguous in empirical and theoretical treatments. This study tries to resolve the ambiguity by explicitly considering the different sources of uncertainty and their simultaneous effects on decisions regarding vertical scope. Hypotheses are tested in an experimental setting on practicing managers with different decision scenarios. The findings suggest that, contrary to theory, two major types of uncertainty tend to reduce rather than increase decisions about firm vertical scope, whereas supplier uncertainty, as hypothesized, indeed results in decisions to increase firm scope. The findings also shed some light on the process of decision-making about firm governance and highlight the instrumental effects of information in affecting decisions. Field tests of the ideas presented here will undoubtedly enhance our understanding of uncertainty, its forms, and its differential effects on strategic decisions.

ACKNOWLEDGMENTS

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APPENDIX 1: Decision Scenario #1 (High Primary, Competitive, Supplier Uncertainty)

Vegas Press

You are the President of Vegas Press, a company in the book publishing industry. You have been at Vegas Press for 22 years, working your way up through the ranks to the presidency which you assumed three years ago. You are well respected by your colleagues in the firm and in the industry.

The management at Vegas Press is faced with a decision on how to improve the company's finishing operations. The Vice President (VP) of Manufacturing has recently submitted a proposal supporting the outsourcing of finishing operations. At the same time, you have received a report from the VP of Finishing Operations proposing cost effective improvements in current hard binding and folding operations.

As President of Vegas Press, you must decide which plan to adopt. Below is some information about the company, the industry, and the economy in general.

The company

Vegas Press, located in Las Vegas, is a medium-sized company specializing in computer manuals. The company was founded in 1947 by Sterling Rule. At that time Sterling was a furniture retailer in Naperville, about 25 miles south of downtown Chicago. As the recession of 1940s took a toll on his business, he liquidated what was left,

looked for a change of scene, and moved the family to Las Vegas on April Fool's Day.

The move did not solve Rule's problem of what to do with the rest of his life. While considering his alternatives, he completed a six-week course in card-dealing and went to work in a casino. He quickly decided that working as an employee in the gambling halls was not for him. His entrepreneurial spirit was rekindled after a chance meeting with a businessman running a printing outfit. When Sterling realized that there was quite a demand for certain specializing binding operations, he used the proceeds from the sale of his furniture store to purchase binding machines, and established a small binding company he called Vegas Press in honor of his new home.

Tom Rule, Sterling's son, joined the company in 1962 after graduating in Printing Technology. After working for several years in various departments of the company, Tom assumed the Presidency of Vegas Press in 1972, while Sterling became Chairman of the Board. When Sterling retired three years ago, Tom succeeded him as Chairman and you moved up to the Presidency.

The business grew slowly during the early years. With the advent of the baby boom and the economic expansion of the 1950s, the firm began to grow more rapidly to keep up with the demand. In the late Sixties, the company expanded its operations by purchasing two small but well established printing presses and acquired their extensive prepress and press operations. The firm steadily grew through the Seventies. As the demand for computers burgeoned in the Eighties, Tom focused the company's operations on the accompanying manuals for the machines and the software.

The book publishing and printing industry

Publishers serve an array of business, consumer, educational, and institutional markets. Shipments of U.S. books to these markets totaled $14.7 billion in 1991. While the U.S. has about 20,000 firms that publish sporadically, a core group of about 2,000 companies consistently publish four or more book titles annually. Marketing and administrative costs are high in this industry. Therefore, despite a high gross profit margin, the operating profit is, on average, low.

There are three distinct operations in the book publishing and printing business—prepress, press, and finishing. Prepress and press operations involve editing, composing, proof reading, and printing. Finishing operations involve diecutting, foil stamping, stitching, trimming, and more. All three sets of operations have to be coordinated in order to run efficiently.

The demand for books depends on a number of factors. During economic downturns, customers sometimes cancel or cut back their existing orders. This leaves publishers in the difficult position of having to make painful cutbacks to their operations. Conversely, in boom times, orders tend to pour in and quick adjustments have to be made to meet the increased demand. Flexibility and customer responsiveness are the key determinants of competitive advantage in the industry.

Since there are as many as 2,000 companies forming the core group of publishing activities, there is intense competition in this industry. Due to the relatively low capital requirements however, there are neither significant barriers to the entry of firms nor to their exit.

The economy

Although the industry declined in 1991 due to the general recession, some analysts project that a recovered U.S. economy should raise book publishing shipments in 1994. On the other hand, other industry observers suggest that there will be continued weakness in the economy which could negatively affect demand in the book publishing industry. In spite of the increased growth rate in GDP, economists are not certain about future interest rates, inflation, and levels of unemployment. Thus, all in all, analysts seem very uncertain about an economic recovery.

The public's hopes for economic recovery also have remained unchanged even after the new administration announced its economic program.

Analysts are also unsure how the new administration might change industry regulations. Some speculate that an environment-conscious administration may impose new restrictions on the paper used by the industry and mandate a minimum recycled portion. In contrast, other industry lobbyists predict that the new government may impose regulations to protect the printing and publishing industries from imported books, which although limited in overall volume, represent a significant proportion of the market in certain specialized

areas. However, no one really knows how regulatory changes will affect the industry.

The performance of Vegas Press

Vegas Press is a medium-sized company with annual sales of $5 million. Over its 46 years the company has generally been able to maintain its profitability level at the industry average. Sales have been growing at around 4% per year, again about average for the industry.

Over time, the company has invested in modernizing its prepress and press equipment to keep up with technological advances in these areas. Although many technological strides have been made in the bindery end of the industry in the past few years, there is much uncertainty as to whether the rate and direction of technological change will continue.

The decision facing Vegas Press

Vegas Press is faced with a decision either to outsource its finishing operations to Flamingo Binders—a local binding company that specializes in binding computer manuals—or to purchase and install new, state-of-the-art binding machinery in-house.

The binding equipment currently in use at Vegas Press consists of hard binding and folding machines, which are aging and run at full capacity. This constrains the prepress and press machines which have to be kept idle in order to adjust to the speed of production of the binding equipment; otherwise, large in-process inventories build up.

Investing in binding machinery may improve finishing operations by increasing throughput as the VP of Finishing suggests. However, the Manufacturing VP has been holding discussions with local binders, and has proposed that the finishing operations be completely outsourced to Flamingo. Flamingo has recently installed specialized polyurethane adhesive (PUR) technology and therefore can meet the strict quality standards for the computer manuals required by Vegas Press' customers. Flamingo, however, has made it clear that they will be unable to offer such attractive rates unless they are given responsibility for the entire finishing operation. While in the past Flamingo has generally been able to meet its contractual obligations with Vegas, once about three

years ago when Flamingo was overwhelmed with orders, it let Vegas down badly.

In case operations are outsourced, some modification of Vegas' processes and equipment will be required to assure that the output from printing is compatible with the requirements of Flamingo's finishing operations. The investment required would be moderate.

It is estimated that the total investment required for the new binding machinery is approximately $800,000. If the growth rate of Vegas can be maintained at the existing level of 4% for the next 7 years, the investment will produce a positive return. The future demand for Vegas' products is highly uncertain. If low demand projections become a reality, then outsourcing will become advantageous since production can be cut without worrying about carrying excess capacity in finishing operations. However, if instead actual demand is closer to high estimates, in-house finishing operations will become more attractive due to economies of scale, assuming that other factors remain unchanged.

Jerry Fernandez, the proprietor of Flamingo, was a good friend of Sterling Rule, and maintains a close relationship with Tom. However, Jerry is expected to retire in six months and will give full charge of the company to his son Matthew. People close to Matthew are very unsure about Matthew's plans for Flamingo's business relationships.

There are strong rumors in the marketplace that a major competitor has firmed up plans to add more binding capacity to its finishing line. Some competitors may be considering upgrading their binding equipment. Similar rumors have proved false in the past. However, if true, there may be excess binding capacity in the market, which could lead to price wars and losses for some publishers.

While some companies in the industry do everything in-house, others are known to outsource as much as possible. Industry observers are divided as to whether publishers should concentrate on prepress and press activities and outsource the binding operations or should build in-house finishing capacity to achieve economic efficiencies.

You have been asked by Tom Rule to evaluate the pros and cons of the two alternatives for improving the finishing operations. As the President of Vegas Press, you know that you should

look beyond the financial attractiveness of the alternatives before making a decision.

APPENDIX 2: Scenario passages reflecting the three types of uncertainty and items used to assess information use

Primary uncertainty

Low

Although the industry declined in 1991 due to the general recession, new projections suggest that a recovered U.S. economy should raise book publishing shipments in 1994. In fact, analysts are very certain about economic recovery. Since the unemployment rate is down and personal income has grown slightly with the increased growth rate in GDP, economists generally agree that inflation and levels of unemployment will be controlled.

Analysts also predict that the new administration may impose industry regulations. There is a broad consensus among political observers, however, that the book publishing industry will be one of the few industries to come out even from the actions of the new government.

Over time, the company has invested in modernizing its prepress and press equipment to keep up with technological advances in these areas. It is expected that only minor technological changes will occur steadily in the coming years, and these changes are not expected to materially affect plant efficiency.

The Manufacturing VP is quite certain that future demand will match or exceed current levels.

High

Although the industry declined in 1991 due to the general recession, some analysts project that a recovered U.S. economy should raise book publishing shipments in 1994. On the other hand, other industry observers suggest that there will be continued weakness in the economy which could negatively affect demand in the book publishing industry. In spite of the increased growth rate in GDP, economists are not certain about future interest rates, inflation, and levels of unemployment. Thus, all in all, analysts seem very uncertain about an economic recovery.

Analysts are also unsure how the new administration might change industry regulations. Some speculate that an environment-conscious administration may impose new restrictions on the paper used by the industry and mandate a minimum recycled portion. In contrast, other industry lobbyists predict that the new government may impose regulations to protect the printing and publishing industries from imported books, which although limited in overall volume, represent a significant proportion of the market in certain specialized areas. However, no one really knows how regulatory changes will affect the industry.

Over time, the company has invested in modernizing its prepress and press equipment to keep up with technological advances in these areas. Although many technological strides have been made in the bindery end of the industry in the past few years, there is much uncertainty as to whether the rate and direction of technological change will continue.

The future demand for Vegas' products is highly uncertain.

Competitive uncertainty

Low

You meet frequently with your counterparts from other publishing companies and are certain they will not add to their capacity in any significant way. Further, no one expects any new firms to enter the computer manual niche.

High

There are strong rumors in the marketplace that a major competitor has firmed up plans to add more binding capacity to its finishing line. Some competitors may be considering upgrading their binding equipment. Similar rumors have proved false in the past. However, if true, there may be excess binding capacity in the market, which could lead to price wars for some publishers.

Supplier uncertainty

Low

In the past, Vegas Press has outsourced some of its binding operations during peak demand to Flamingo and has been quite satisfied with the quality of the job and the timeliness of delivery.

Jerry Fernandez, the proprietor of Flamingo, was a good friend of Sterling Rule, and maintains a close relationship with Tom. However, Jerry is expected to retire in six months and will give full charge of the company to his son Matthew. Everyone close to Matthew concurs that he will continue to deal fairly with Vegas Press, like his father.

High

While in the past Flamingo has generally been able to meets its contractual obligations with Vegas, once about three years ago when Flamingo was overwhelmed with orders, it let Vegas down badly.

Jerry Fernandez, the proprietor of Flamingo, was a good friend of Sterling Rule, and maintains a close relationship with Tom. However, Jerry is expected to retire in six months and will give full charge of the company to his son Matthew. People close to Matthew are very unsure about Matthew's plans for Flamingo's business relationships.

Specific items used to measure the extent of information use are listed below.

Low uncertainty information items

1. New projections suggest that a recovered U.S. economy should raise book publishing shipments in 1994.
2. Analysts are very certain about economic recovery.
3. There is a broad consensus among political observers that the book publishing industry will be one of the few industries to come out even from the actions of the new government.
4. The pace of technological change is expected to continue, but changes are not expected to materially affect plant efficiency.
5. Future demand will match or exceed current levels.

6. You meet frequently with your counterparts from other publishing companies and are certain they will not add to their capacity in any significant way. Further, no one expects any new firms to enter the computer manual niche.
7. In the past, Vegas Press has outsourced some of its binding operations during peak demand to Flamingo and has been quite satisfied with the quality of the job and the timeliness of delivery.

High uncertainty information items

1. Some analysts project that a recovered U.S. economy should raise book publishing shipments in 1994. On the other hand, other industry observers suggest that there will be continued weakness in the economy which could negatively affect demand in the book publishing industry.
2. Economists are not certain about future interest rates, inflation, and levels of unemployment.
3. No one really knows how regulatory changes will affect the industry.
4. The future demand for Vegas' products is highly uncertain.
5. Many technological strides have been made in the bindery end of the industry in the past few years, there is much uncertainty as to whether the rate and direction of technological change will continue.
6. There are strong rumors in the marketplace that a major competitor has firmed up plans to add more binding capacity to its finishing line. Some competitors may be considering upgrading their binding equipment. Similar rumors have proved false in the past.
7. While in the past Flamingo has generally been able to meet its contractual obligations with Vegas, once about three years ago when Flamingo was overwhelmed with orders, it let Vegas down badly.