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Virginia Franke Kleist
West Virginia University

Irene Frieze
University of Pittsburgh

William King
University of Pittsburgh

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INFORMATION TECHNOLOGY AND INFORMATION GOODS PRODUCING FIRMS: VERTICAL AND HORIZONTAL BOUNDARY CHANGE¹

Virginia Franke Kleist
West Virginia University
U.S.A.

Irene Hanson Frieze
William R. King
University of Pittsburgh
U.S.A.

Abstract

The electronic markets hypothesis holds that information technology use influences the dismantling of vertical firm boundaries because of reductions in the cost of transactions between firms. Anecdotal evidence of merger and alliance activity for information goods producing firms seems to be at odds with these predictions of an IT-driven rise in vertical market coordination structures. An intersection of transactions cost economics with information economics yields a research model that may more thoroughly explain and predict vertical and horizontal boundary change behavior for information goods producing firms. The model separates the economic effects of a firm's use of information technology on the internal governance of the production and distribution sequence (vertical organizational boundaries), from the economic effects of the degree of information in the firm's product line on internal governance and external market structures (horizontal organizational boundaries). The research reported here tests if firms that produce higher levels of information goods have different vertical and horizontal organizational boundaries when compared to non-information goods firms, even when these firms have similar levels of IT deployment. Preliminary data from 49 publicly traded firms indicate that the model and some of the research hypotheses are supported. If additional research finds further support for the model, then it may be that information goods firm structures are driven more by the unique scale, scope, and transactional economics of producing, distributing, and marketing information products, rather than the transactional effects of using information technology in the production value chain.

1. INTRODUCTION

The information technology (IT) contribution to changing organizational boundaries is subject to much debate and discussion in the IS literature (Bakos and Brynjolfsson 1997; Brynjolfsson and Hitt 1998). Transactions cost economics (TCE) has been the major theoretical underpinning of predictions of IT-driven changes in the nature of the boundaries of the firm, but there is no definitive evidence confirming this theory in that context. Further, the Electronic Markets Hypothesis (EMH), which specifically argues that information technology will cause the dissolution of formal corporate vertical coordination structures in favor of electronic intermediaries, has also had little empirical verification in the IS literature (Bakos and Brynjolfsson 1997; Brynjolfsson and Hitt 1998).

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The focus of this preliminary research is to investigate possible differences in the organizational boundaries of a subset of firms that are characterized as being information goods producers, while at the same time examining the impact of information technology on the organizational structures of firms. Here, an information economics (IE) perspective, based on the distinctive economics of information goods, may serve to complement the TCE approach and settle discrepancies in the predictions of real world firm behavior.

An information goods firm markets information in some form as its primary source of revenue. The information good may be used for decision making (legal case archive, newspaper), entertainment (songs on CD, tape or radio, movies on videocassette or cable), or as inputs to further production (software, marketing database). The information good may be a service that delivers a digital bit stream of information (radio or TV network signals, telecommunications transmission), although it is not the hardware which enables the information delivery. The vehicle of conveyance is less significant than the information good itself. The research relies on the newly defined "Information Sector" North American Industry Classification System (NAICS) taxonomy as the underlying structure for variable operationalization (Census Bureau 1998; Margherio et al. 1998).

2. RESEARCH OBJECTIVES AND QUESTIONS ADDRESSED

This initial research develops and explores two major hypotheses and two secondary issues. First, the intersection of transactional theory and information economics suggests the proposition that information goods producing firms may have higher between-firm transactions costs than do non-information goods firms. If so, higher transactions costs would theoretically argue for more vertically integrated firm structures for these kinds of companies. Vertical integration refers to the depth of firm ownership of the production value chain, from raw inputs to final distribution and service. The second proposition is that information goods producers are more likely to be horizontally integrated than non-information goods firms for reasons of differences in economies to scale and scope, and network externality effects. Horizontal integration refers to firm ownership of the product market channel, both in terms of width of firm product line offerings within a single market, and also in terms of breadth of product coverage by a firm across geographic markets.

The study includes a test designed to reaffirm classic transactions cost predictions regarding reductions in formal vertical organizational boundaries in response to applications of information technology (the Electronic Markets Hypothesis). Finally, the study incorporates an analysis of the interaction effects of information technology and the degree of information goods production on vertical organizational boundaries.

The central hypothesis of the study is that information goods producers are more likely to be shifting to deeply integrated vertical hierarchies, along with increased horizontal monopoly and conglomerate boundary expansion activity, as compared to non-information goods producers with similar levels of IT deployment.

3. THEORETICAL FOUNDATIONS OF THE STUDY

Firm boundaries can be characterized in terms of either vertical integration or horizontal organizational forms (Scherer and Ross 1990; Tirole 1997; Williamson 1975). A vertically integrated firm has increased the reach of its within-firm ownership of the production sequence boundaries, becoming hierarchically structured in order to govern the management of this process (Williamson 1975, 1991). The backward or forward chaining of production through vertical integration implies that a firm uses market transactions less and internal firm management (i.e., hierarchy) more in acquiring upstream inputs or downstream outputs for the production and distribution of goods. The vertical integration of firms is theorized to occur due to high transactions costs between firms, which may arise for reasons such as high agency costs or high asset specificity (Coase 1937; Williamson 1975, 1991).

Horizontal integration describes firm organizational boundaries in terms of competitive market relationships within an industry, ranging from pure markets to conglomerates and monopolies (Richardson 1972; Scherer and Ross 1990). Firm horizontal boundaries may expand due to economies to scale (a larger firm can more efficiently produce more of the same product) and economies to scope (a larger firm can more efficiently produce and distribute different products, either in similar markets or even in completely unrelated markets) (Tirole 1997). Some argue that information goods production may yield increasing returns to scale, which causes horizontal boundary expansion (Arthur 1996; Romer 1986). Increasing returns to scale is an unusual

economic phenomenon where an increase in product quantity leads to even more increases in product quantity, without the normal growth limitations of an eventually rising marginal production cost. This behavior might occur in the software market, for example, where additional production costs only pennies per item.

The research contributes to an understanding of firm boundary choice, by separating vertical boundary expansion drivers (transactions costs) from horizontal boundary expansion drivers (economies to scale and scope and network externality effects) within the same model. In general, TCE forecasts a move to smaller, more market-oriented firms as a result of increases in the utilization of information technology enabling hierarchically organized firms to shift to market coordination by allowing less expensive and improved electronic integration of information between and within entities (Malone, Yates and Benjamin 1987). However, information goods firms often have high fixed costs of production and low marginal costs (Lee 1999; Jones and Mendelson 1997; Shapiro and Varian 1999), which is a scenario often leading to economies of scale and scope in a horizontal sense. The transactions cost literature is theoretically limited in explaining the dependent variable of organizational boundary choice because it confuses organizational contracting with organizational structure (Hennart 1993). Information economics may explain why some kinds of firms choose to merge and ally, while other kinds of firms do not. This study is based on the premise that an IE and TCE based model will better describe the complexities of vertical and horizontal organizational boundary choice.

4. METHODOLOGY

There are two independent variables in the study as shown in the research model in Figure 1. One independent variable is the relative quantity of information products in a firm's total product line, based on percentage of revenues earned by product type. High information goods producing firms are companies where the dominant production goods are units of information. The information goods level of a firm is reliably measured in this study by four MIS professors or Ph.D. candidate experts, who were provided with firm revenue data by product type, and a set of theoretically developed and NAICS based guidelines for making firm assessments on a five-point scale.

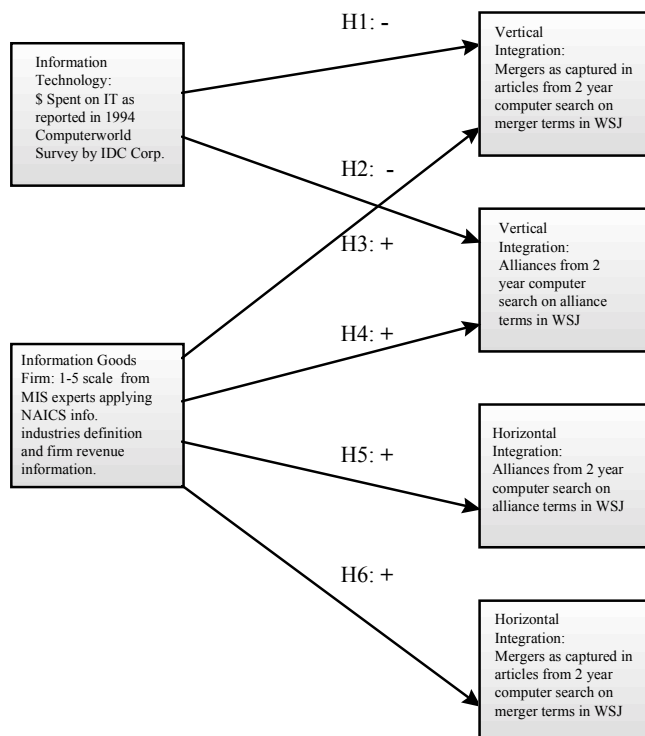


Figure 1. Research Model: The Predicted Effects of IT and Information Goods Firms on Horizontal and Vertical Boundary Changes

The second independent variable is the level of information technology deployed at a firm. This is usually measured in terms of dollar expenditures on IT, albeit accurate measures of IT expenditures are difficult for researchers to find (Brynjolfsson and Hitt 1998). Here, firm IT expenditure data were obtained from 10,000 responses to questionnaires administered by the IDC Corporation to information systems professionals working in firms with 100 employees or larger. These data should also allow us to conduct an analysis of the EMH, i.e., that IT deployment will cause vertical internal governance changes of a move away from hierarchies and toward markets.

The dependent variables for the study are measures of each firm's horizontal and vertical boundary expansion as shown in the research model in Figure 1. The dependent variable constructs are measured using event announcement data, captured from a structured, two-year computerized search of the *Wall Street Journal*, using theoretically derived alliance and merger terms. Horizontal and vertical boundary change behaviors are either mergers (e.g., mergers, acquisitions, purchases) or alliances (e.g. marketing agreements, joint ventures, linkages, coalitions and partnering or licensing agreements). Mergers and alliances are positioned as the theoretical outcome variables for both the governance (TCE, vertical view) and market dominance motivations (information economics, horizontal view). The horizontal and vertical nature of the events are reliably coded using a three stage procedure based on Department of Justice firm legal merger guidelines.

The previously discussed transactions cost and information economics literature leads to the development of the following hypotheses:

Hypothesis 1. Information technology will have a negative relationship with vertical mergers.

Hypothesis 2. Information technology will have a negative relationship with vertical alliances.

Hypotheses 1 and 2 are a test of the Electronic Markets Hypothesis, which says that IT will cause the dissolution of extensive vertical firm boundaries.

Hypothesis 3. High information goods producing firms are expected to have a positive relationship with high vertical mergers.

Hypothesis 4. High information goods producing firms are expected to have a positive relationship with high vertical alliances.

Information goods producing firms may have higher transaction costs than non-information producing firms. Higher transaction costs lead to hierarchies rather than to markets (Coase 1937, 1988; Williamson 1967). Several aspects of the nature of information production are likely to cause higher between-firm transactions costs, as compared to using within-firm inputs. Because the value of information varies by user, it is more difficult to establish the value of goods in process if obtained in the market vs. manufactured in-house. Information goods may cost more to market, sell, and maintain ownership of in the value chain due to perpetual intellectual property costs over the life of the product, making forward vertical integration less expensive than markets. Information products are produced with the highly asset specific input of tacit human knowledge, often in a dynamic, team oriented and interactive environment (Nonaka and Takeuchi 1995), and high asset specificity is linked to higher transaction costs (Williamson 1975). Information products have a higher degree of design connectedness and may be complex to separate in the steps of vertical production (Jensen and Meckling 1976; Milgrom and Roberts 1992). Information goods firms add value at the juncture of the output end of the information production chain and the customer, by acting as information intermediaries which distill, vet and guarantee the quality and trustworthiness of the produced information goods (Lee 1999; Rose 1998). Information goods have a short shelf life due to the rapid explosion of technological advance and the next version of the product must be developed almost in parallel with the current version of the product (Shapiro and Varian 1999), leading to blurring of the distinct contribution of goods in process inputs to the production sequence.

Hypothesis 5. High information goods producing firms are expected to have a positive relationship with high horizontal alliances.

Hypothesis 6. High information goods producing firms are expected to have a positive relationship with high horizontal mergers.

1. *Information producing firms may have positive network externality effects as compared to non-information intense producing firms. Positive network externalities lead to market failure (monopolies) (Katz and Shapiro 1985).* The value of the product increases as more users share in the installed base, such as e-mail (Brynjolfsson and Kemerer 1996). Customers like a known interface such as Microsoft, because there are high switching costs to learning how new information products work (Arthur 1996).
2. *Information producing firms may have economies to scale in large deployments. Economies to scale in capital financing lead to increases in market share in terms of horizontal and conglomerate mergers (Gort 1963).* Some kinds of information products such as drug research, banking, newspapers, or software production have high barriers to entry due to the significant amount of capital required to operate in these arenas (Arthur 1996). Once the capital is invested, huge market shares are necessary to recoup these large investments (Thurow 1997). Further, customers want the guidance of a well-known, name brand for information good purchases across similar product lines, such as Disney or Microsoft, to assure that a certain expectation level will be met, because information cannot be evaluated until after it is consumed.
3. *Information producing firms may tend to have increasing returns to scale, unlike non-information producing firms. Increasing returns to scale leads to market dominance by a firm (Arthur 1996), and a “winner takes all equilibria” (Jones and Mendelson 1997).* Information is not used up when it is consumed, and can be sold again and again, much like a public good (Arthur 1996; Boulding 1966). Once created, a piece of information can be remarketed with low to zero marginal production costs, as long as the information can be patented or kept secure with intellectual property rights (Romer 1986). An information product has negligible marginal production and distribution costs, leading to the potential for near complete market dominance by the firm that obtains the early market leadership position (Jones and Mendelson 1997; Lee 1999).

5. CURRENT STATUS OF THE PROJECT

Preliminary results, based on a combined stratified and random sample of 49 publicly held firms from the Dunn’s largest 1,000 in the U.S. for 1994 for which we had IT expenditure data, found support for four of six of the hypotheses in the research model. Because of the existence of two independent variables and four dependent variables, as well as an expected multicollinearity among the dependent variables, a MANCOVA, using firm size as the covariate, was done. A summary of the major findings can be seen in Table 1. Overall, the multivariate main effects were significant for a negative relationship between IT and vertical alliances, which seems to support to the Electronic Markets Hypothesis. Further, information goods firms were found to have significant multivariate main effects for positive relationships to both vertical and horizontal integrative activity. This indicates that the model is valid and worthy of analysis with a larger sample size, following the same techniques as were used with the pilot data. Steps are underway to have additional data collected, including controls for market exuberance, and analyzed by December, 1999.

Table 1. Information Goods Pilot Study Raw Data

	Horizontal Alliances	Vertical Alliances	Horizontal Mergers	Vertical Mergers	IT Dollars Mean (\$10 M)	Information Goods Firm Ranking
N	49	49	49	49	49	49
Mean	2.67	2.04	2.41	.41	5.05	1.96
Median	1.00	.00	2.00	.00	1.62	2.00
Variance	13.93	22.96	6.79	1.20	63.44	1.62
Range	19	21	12	6	31.28	4
Minimum	0	0	0	0	.04	1
Maximum	19	21	12	6	31.33	5

6. EXPECTED CONTRIBUTIONS

This research is expected to explain and predict the likely vertical and horizontal boundaries for information goods producing firms, as distinct from “information technology-using” kinds of firms. Information goods production may lead to hierarchical

monopolies. Information technology may lead to vertical disintegration. Information goods production with high use of IT may still lead to hierarchical monopolies, despite the countering effect of reduced interfirm transactions costs.

The research is also designed to facilitate the testing of the Electronic Markets Hypothesis using a new and improved set of data. If IT and the information content of product lines are found to have different and opposite directionality effects on organizational boundary formation, then such results would provide useful knowledge about appropriate organizational forms in the new era of electronic commerce. Since the electronic markets hypothesis has not been definitively verified, if the data analyses establish that non-information goods firms are dissolving vertical boundaries while information goods producers are increasingly coalescing, the research may explain earlier equivocal EMH research results.

To the degree that electronic commerce is conducted with what we define as information goods producers, the research should enable a better understanding of the dynamics of this new business form. It may be that some electronic commerce firms are fundamentally no different than traditional applications of information technology in the value chain. Electronic commerce is made up of firms that are information goods producers and that are not information goods producers, with both firm types using IT creatively in the form of Internet applications in the value chain. The incorporation of degree of information goods product type into electronic commerce analyses may be important in terms of understanding optimal firm governance and market structures.

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