

## Association for Information Systems AIS Electronic Library (AISeL)

---

AMCIS 1996 Proceedings

Americas Conference on Information Systems  
(AMCIS)

---

8-16-1996

# The Impact of Information Technology on Vertical Integration : An Empirical Analysis

Namchul Shin

University of California, Irvine, [shinn@uci.edu](mailto:shinn@uci.edu)

Follow this and additional works at: <http://aisel.aisnet.org/amcis1996>

---

### Recommended Citation

Shin, Namchul, "The Impact of Information Technology on Vertical Integration : An Empirical Analysis" (1996). *AMCIS 1996 Proceedings*. 277.

<http://aisel.aisnet.org/amcis1996/277>

This material is brought to you by the Americas Conference on Information Systems (AMCIS) at AIS Electronic Library (AISeL). It has been accepted for inclusion in AMCIS 1996 Proceedings by an authorized administrator of AIS Electronic Library (AISeL). For more information, please contact [elibrary@aisnet.org](mailto:elibrary@aisnet.org).

# **The Impact of Information Technology on Vertical Integration : An Empirical Analysis<sup>1</sup>**

[Namchul Shin](#)

Graduate School of Management

University of California, Irvine

Email : shinn@uci.edu

## **1. Introduction**

Information systems (IS) spending in organizations has grown rapidly in the past decade, and there is some belief that a surge of IS spending has a certain impact on the organization of economic activities such as outsourcing or vertical integration. While the relationship between IS spending and the organization of economic activities has been reviewed in the literature (Malone, Yates and Benjamin, 1987; Gurbaxani and Whang, 1991; Clemons and Reddi, 1992; Bakos and Brynjolfsson, 1993), empirical research on the relationship between the two has been very few.

Brynjolfsson, Malone, Gurbaxani, and Kambil (1993), using the industry level data, have empirically analyzed the relationship between IT and value-added which was used as a supplementary measure of firm size. However, since the industry-level data for value-added are available only for the manufacturing industries, their analysis of the impact of IT value added was not made for the whole industries.

In this paper, we empirically examine the relationship between IT and vertical integration. To examine this question, we make use of firm level IS spending data based on five annual surveys of large US firms which include service firms as well as manufacturing firms. We assess a couple of econometric techniques to study the impact of IT on vertical integration. Using the firm level data, we could make an economy wide analysis on the relationship between IT and vertical integration. Another advantage of firm level analysis, compared to the industry level analysis which uses an industry average, is that we could capture the differences in individual firms' degree of vertical integration.

## **2. Theory and Hypotheses**

Transaction costs economics posits that there are costs of coordinating economic activities in a market, that is market transaction costs. (Coase, 1937). According to Williamson (1975), market transaction costs arise from such factors as bounded rationality and opportunistic behavior of economic agents coupled with uncertainty and asset specificity. Since asset specificity limits the firms' options for transferring their business to alternative suppliers or buyers, transactions supported by investments in durable, transaction-specific assets experience 'lock-in' effects (Williamson, 1975; Klein, Crawford and Alchian, 1978). Such transaction-specific assets cause opportunism and costly haggling. Thus, as market transaction costs increase, the internalization of transactions through vertical integration is likely to be more desirable than market coordination.

IT reduces both market transaction costs and internal coordination costs by providing better means of information gathering and processing, and negotiating, monitoring and enforcing contracts (Ciborra, 1985; Malone et al., 1987; Gurbaxani and Whang, 1991; Clemons and Reddi, 1992). IT reduces market transaction costs and thus transaction previously performed within organizations can be more efficiently performed in markets. IT also can lead firms to coordinate more economic activities internally by greatly reducing internal coordination costs. However, since market transaction costs are relatively higher than internal coordination costs, IT would reduce market transaction costs more than internal coordination costs, and thus decrease the disadvantage of market coordination. Thus, As a result, market coordination becomes more desirable in some situations where internal coordination were previously favored. Moreover, since market coordination has certain production cost advantages over internal coordination, the increasing

adoption of IT makes outsourcing or economic activities coordinated by markets more attractive, and hence vertical integration is less appealing to many firms.

Since IT is not the only factor that affects firms' decision to integrate vertically, we should control for the firm specific factors when we study the impact of IT on vertical integration. Such factors which will be included as control variables in our model are the extent of firms' R&D activities and uncertainty.

### 3. Data and Methodology

Our approach is to use a economy-wide US firm level dataset to directly examine the relationship between IT and vertical integration. For the firm level data on IT, we use a dataset on IS spending by large U.S. firms that was compiled by International Data Corporation (IDC). We use data collected from 1988 to 1992. The total central IS budget is used as a measure of IT spending.

We use a traditional measure for the degree of vertical integration, the ratio of value-added to total sales. The value-added is derived by subtracting the costs of raw materials from the value of production. The value of production is derived by subtracting the beginning inventory from the sum of the ending inventory and total sales. We use Compustat to obtain the data for constructing the measure of vertical integration. Since the data on the costs of raw materials are not available from the data source, we construct a measure for the costs of raw materials by subtracting labor and overhead expenses from the costs of goods sold<sup>2</sup>. We also obtain the data for research expenditure, BETA<sup>3</sup>, and industry classification from Compustat. Research expenditure and BETA are used as measures of the extent of R&D activities and uncertainty respectively.

We use two different techniques for analyzing the combined dataset of cross section and time series data: an ordinary least-squares (OLS) regression and a two stage least-squares (TSLS) regression which include industry and year dummy variables. Since the size of each firm varies significantly in the data, the assumption of constant error variance is violated. We correct such a problem of heteroskedasticity by dividing all the variables by the number of employees for each firm.

#### 3.1 The Model

The model measures the relationship between the level of IT spending and the degree of vertical integration for a given sector in a given year, while controlling for R&D expenditure, BETA, industry specific and year specific effects<sup>4</sup>. The basic model is as follows :

$$VI_{it} = \alpha_0 + \alpha_1 IT_{it} + \alpha_2 R\&D_{it} + \alpha_3 BETA_{it} + \alpha_4 INDUSTRY_{it} + \alpha_5 YEAR_{it} +$$

where

$VI_{it}$  : The degree of vertical integration of the  $i$ th firm in year  $t$

$IT_{it}$  : IT spending per employee for the  $i$ th firm in year  $t$

$R\&D_{it}$  : R&D expenditure per employee for the  $i$ th firm in year  $t$

$BETA_{it}$  : Systematic risk in profits for the  $i$ th firm in year  $t$

$INDUSTRY_{it}$  : A sector or industry dummies

YEARit : A year dummy

: An error term with zero mean

The model is estimated for the full sample both with R&D and without R&D since the R&D variable is not available for most firms in other sectors except the manufacturing sector. The model is also estimated for each sector separately in order to see if the impact of IT is different across sectors. For the individual sector analysis, we do not estimate the model for the sectors of finance and other services since there are so few data points.

According to our hypothesis that IT reduces market transaction costs and thus leads to more outsourcing or less vertical integration, we expect the coefficient on IT spending in all the equations be negative. The coefficients of R&D and BETA should be positive.

#### 4. Results

The estimate of IT spending indicates that IT spending is highly correlated with a decline in vertical integration for the full sample and for each individual sector over the five year period ( $p < .01$ ). R&D has a significant positive relationship with vertical integration in the manufacturing sector as expected ( $p < .01$ ). BETA is also highly correlated with an increase in vertical integration in the analysis of the full sample. The results are shown in Table 1.

In estimating regression equations, one potential problem is that direction of causality may be reversed. Theoretically, the linear regression model assumes that the residuals are purely random variables. But when the residuals are correlated with independent variables, the problem of simultaneity occurs.

The appropriate correction for these potential biases is possible by using the technique of two stage least squares regression (TSLS) using instrumental variables which minimizing the simultaneity problem (Schroeder, Sjoquist, and Stephan, 1986; Berndt, 1991; Brynjolfsson and Hitt, 1993; Brynjolfsson et al, 1993). To derive consistent estimates, we use once-lagged values of IT spending, R&D expenditure, and BETA as instruments. The results using this technique are reported in Table 2. The estimate of IT spending is highly correlated with decreases in the degree of vertical integration for the full sample and for each individual sector over the sample period as for the OLS regressions ( $p < .01$ ). The estimates of R&D and BETA are also comparable to the OLS regression results.

**Table 1 : OLS Regressions**

	Manu	Trans & Util	Trade	Full Sample	Full Sample
IT Spending	-.0163*** (6.518)1	-.0141*** (4.100)	-.0564*** (4.973)	-.0278*** (12.722)	-.0159*** (9.165)
R & D	.0168*** (7.741)	Not Available	Not Available	.0239*** (13.113)	Not Included
BETA	.0067* (1.871)	.0195 (.305)	.0079 (.209)	.0126*** (3.319)	.0174*** (3.767)
Dummy	Industry & Year	Industry & Year	Industry & Year	Sector & Year	Sector & Year
R2	54.0%	25.0%	57.1%	44.2%	26.8%
N(total)	480	166	110	503	794
DW2	1.936	2.399	2.097	1.849	1.497

Key : \*\*\*( $p < .01$ ), \*\*( $p < .05$ ), \*( $p < .1$ )

1 - T Statistics in the parenthesis.

2 - If Durbin Watson (DW) statistic is close to 2, it indicates no serial correlation. If DW is greater than 2

or less than 2, it indicates high serial correlation. This suggests that the point estimates are correctly

estimated but that the standard error estimates may be biased upward or downward.

## **Table 2 : TSLS Regressions<sup>5</sup>**

### **5. Conclusion**

In this paper, we empirically examine the impact of IT on vertical integration for the whole economy, using the firm level data. Our results clearly shows that there is a significant negative relationship between IT spending and the degree of vertical integration for the five years from 1988 to 1992. The results support our hypothesis that IT leads to less vertical integration by reducing market transaction costs.

The results of this study are comparable to the results of Brynjolfsson et al.'s study (1993) which also found a negative relationship between IT investment and value-added per firm. Contrast to the former study which used industry averages of value-added, we use individual firm's degree of vertical integration (value-added divided by sales). Using the individual firm's IT spending and degree of vertical integration, we have found that the negative relationship between IT spending and vertical integration is an economy wide phenomenon.

The findings may provide some implications to corporate practitioners. As IT leads to vertical disintegration or more outsourcing, firm's vertical structure can be greatly changed. Since decision on firms' organizational structure and process is related to performance (Bakos, 1988), the use of IT would enhance firm's performance through vertical disintegration or more outsourcing. It may be no accident that value-adding partnerships and reengineering projects currently become popular.

### **References upon request**

### **Endnotes**

1. An longer version of this paper is available from the author upon request.
2. The costs of goods sold include the costs of raw materials, labor and overhead expenses.
3. BETA represents systematic risk in profits.
4. We do not consider lags because the panel is too short to consider lags and there is a high serial correlation between lag variables.
5. Table 2 is available from the author upon request.