AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

*The World's Largest Open Access Agricultural & Applied Economics Digital Library*

**This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.**

**Help ensure our sustainability.**

Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

# Factors Affecting Outsourcing for Information Technology Services in Rural Hospitals: Theory and Evidence

Brian E. Whitacre
Department of Agricultural Economics
Oklahoma State University
brian.whitacre@okstate.edu

J. Matthew Fannin
Department of Agricultural Economics
Louisiana State University
mfannin@agcenter.lsu.edu

James N. Barnes
Department of Agricultural Economics
Louisiana State University
jbarnes@agcenter.lsu.edu

***Working paper prepared for Southern Agricultural Economics Association Annual Meeting in Dallas, Texas Feb 2 – 5, 2008.***

*Copyright 2008 by Brian E. Whitacre, J. Matthew Fannin, and James N. Barnes. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice and this statement appear on all such copies.*

**Abstract**
As health information technology becomes more prevalent for most healthcare facilities, hospitals across the nation are choosing between performing this service in-house and outsourcing to a technology firm in the health industry. This paper examines factors affecting the information technology (IT) outsource decision for various hospitals. Using 2004 data from the American Hospital Association, logistic regression models find that governmental ownership and a proxy variable for hospitals that treat more severe injuries positively impact the probability of outsourcing for IT services.

*Key Words:* Health Information Technology, Outsourcing, Hospital
JEL Classifications: I12, C140

## 1. Introduction

Organization of services at rural hospitals is an important aspect of hospital performance and largely affects the quality of patient care. For example, the cost of administering medical billing, patient records, and health care safety and regulatory compliance continues to be a significant burden to rural hospitals in the U.S. While numerous studies have documented the potential benefits from the use of information technology (IT) in a hospital environment (Brooks et al, 2005; Bates et al, 2001; Haux, Winter, Ammenwerth, Briggel, 2004), very little research has looked into how hospitals should go about implementing this technology. Changes in rural health based programs usually increase relevant administrative costs, compelling rural hospital administrators to evaluate several business strategies for managing digital information. These strategies consist of either hiring IT staff as salaried employees or outsourcing for such services to a technology firm in the health industry. Because future legislation may set the stage for data management in all hospitals, understanding the characteristics that lead to outsourcing should help hospital administrators determine which factors are most influential to their own decision process.

We examine the outsource decision in the rural hospital setting and evaluate the factors that affect the use of outsourcing for IT by rural hospital administrators instead of employing an internal IT staff. The examination of rural health services from an economic organization perspective has received little attention historically. However, a few studies have begun to apply transaction cost theory to understand the procurement of

services, including recruitment of physicians to rural communities (Fannin and Barnes, 2007). To our knowledge, this paper represents one of the first empirical applications of the conceptual model of transaction cost theory to understand the organization of IT services in rural hospitals in the U.S. This approach represents a new way of thinking about the IT adoption decision in that it documents and empirically estimates the importance of transaction costs for the various IT options available.

**Objective and Background**

This paper focuses on the factors that affect whether or not rural hospitals outsource their IT work. Specific objectives include: (1) to develop a conceptual model of transaction cost theory that explains the outsource decision by rural hospital administrators when procuring information technology services; (2) to identify transaction cost theory hypotheses to be tested; (3) to identify the key drivers of outsourcing for IT services in rural hospitals in the U.S.; and (4) to discuss the policy implications associated with enhancing the adoption of IT assets within rural hospitals. Additionally, as telemedicine services such as teleradiology and telepsychiatry become more common for many rural hospitals, this paper looks into some of the issues associated with combining these applications into the existing IT structure – and whether that work should be outsourced or done internally.

As healthcare information systems have become more and more complex, a growing body of research has evolved on this topic. The benefits of moving to such systems have been well-documented, and include error reduction, cost minimization, and more efficient

time management (Bates et al. 2001, Brooks et al 2005, Hauz et Al, 2004). Further studies on the diffusion and adoption of health IT suggests that despite common beliefs that such technology will increase healthcare savings, reduce medical errors, and improve overall health status, little progress has been made in the actual adoption of IT services such as Electronic Medical Records (EMRs) and Clinical Decision Support Tools. In fact, by 2005 only 20 to 30 percent of hospitals have committed to adopting IT services (Fonkych and Tayler, 2005). Some studies have focused on why those hospitals that did adopt health IT services chose to do so. These studies have generally uncovered a positive relationship between the financial status, size, and productivity of the health care facility and its level of IT adoption. Not surprisingly, hospitals that are more "wired" are often more productive and have better control of their financial situation (Solovy, 2001). However, endogeneity problems made inferences about causality difficult – in fact Parente and Dunbar (2001) concluded that health IT had no impact on a hospital's operating margin. Other studies have found several factors that seem to have an impact on IT adoption itself, such as for-profit status (negatively associated), operation in a competitive environment (positively associated), higher caseloads of "sick" patients (positively associated), and time under operation (mixed results) (Parente and Van Horn, 2003; Wang et al, 2002). Further, Borzekowski (2002) found that the implementation of Medicare's prospective payment system increased the rate of IT adoption for hospitals.

Additional studies have questioned which of these services are most likely to be outsourced, and why. Wholey et al (2001) found that the development of an IT system is much more likely to be outsourced than the day-to-day operation of the system. The idea

is a hospital administrator would choose to buy the IT system from an IT company rather than investing its own resources to develop a proprietary IT system. Such a decision to outsource for IT depends on several factors. From a hospital perspective, how can we understand the possibilities? In what follows, we use transaction cost theory as our conceptual framework to understand the economic incentive factors that drive the decision to outsource for IT services in hospitals.

**Conceptual Framework**

Transaction cost theory (TCT) (Coase, 1937; Williamson, 1991) assumes people have limited knowledge of future events and act opportunistically. The transaction cost to avoid in contracting with another firm are those related to what Williamson calls opportunism. Williamson developed a reduced form model that highlights the relative cost of outsourcing versus in-house production of services. For example, the reduced form model uses three economic incentive factors as determinants as to why a hospital would choose to outsource for IT services compared to providing those same services via internal procurement with a set of employees who would be responsible for maintaining IT services. Hence, the hospital faces a make (provide internally via employees) or buy (from an IT firm) decision for IT services.

TCT uses uncertainty, frequency and asset specificity as three primary determinants that explain the make or buy decision for IT. Frequency refers to how often a transaction will take place to provide services. For a hospital, it might represent the number of times IT services would be purchased from an IT based firm for hospital operations. According to

TCT, the higher the frequency, the more likely a hospital would consider hiring employees to provide IT services in-house. Hence, frequency would usually have a negative effect on outsourcing for IT services assuming the cost of outsourcing exceeds that of in-house production. Uncertainty can refer to demand, technological or environmental dimensions that affect outsourcing. For example, a hospital administrator would consider the performance record of an IT firm before deciding to outsource for IT services to avoid poor quality service and cost overruns. High performance uncertainty raises the cost of doing business and a hospital may be better off hiring its own employees and providing IT services in-house. Hence, high performance uncertainty tends to increase the likelihood that a hospital would choose to provide services in-house because the cost of outsourcing exceeds in-house production.

Finally, TCT uses alternative types of what Williamson calls asset specificity to understand the relative cost of using outsourcing compared to in-house production. The two primary types of asset specificity variables used in TCT studies relate to investments made in human and physical assets. High asset specificity means the hospital makes a sizeable investment in an IT system specifically designed for its business operations; hence, switching costs for the hospital to switch to another IT system would be high. The IT firm, knowing such an IT system has been developed for the unique hospital operations, could hold-up the hospital for more value at contract renegotiation. Given switching costs are high, the IT firm would have some opportunity to capture more of a margin. Knowing this type of opportunism by the IT firm exists, the hospital could opt to go with a less specialized IT system to avoid the costs of hold-up. Hence, TCT suggests if

the hospital invests in a highly-specific IT system, more control over that system would be preferred to less and this usually means hiring employees and developing an IT system in-house. Providing in-house IT services would then avoid the added cost of hold-up associated with outsourcing to the IT services firm. One type of direct cost of hold-up could be a higher upgrade price (than otherwise was agreed to) for the software that organizes the IT infrastructure. An indirect cost of hold-up could be the opportunity costs associated with not having the updated IT system, including effects to patient quality of care, hiring and managing day-to-day operations.

In this paper, we follow the recent work of Esposto (2004) to identify possible TCT factors that determine the outsource decision by hospitals for IT services for two reasons. First, TCT has become the predominantly used industrial organization theory to understand outsource decisions by firms and Esposto represents a useful application of how TCT explains outsource decisions in hospitals. Second, while Esposto studied the outsource decision related to procuring physician services, we believe the TCT factors considered correspond to other outsource decisions such as IT.

The key TCT factor considered by Esposto was not asset specificity or frequency, but that of complexity. Esposto examined the outsource decision for physician services as determined by the complex nature of the average procedure provided by physicians. The use of a case mix index was used by Esposto for complexity of services rendered by physicians; the case mix index is used by the Centers for Medicare and Medicaid Services in the Medicare Prospective Payment System to compensate hospitals for the

treatment services provided by physicians. Specifically, each time a physician treats a Medicare patient, his or her medical record has to be updated for diagnoses and procedures; approximately 13,000 diagnoses and 5,000 procedures exist all of which are represented by specific codes. Based on treatment, each patient is classified into a group of these codes called Diagnoses Related Group (DRG). The hospital then receives a payment which is called the DRG payment and is calculated by multiplying the weight (associated with a DRG which his set by the Centers for Medicare and Medicaid Services) by the payment rate which is set by federal regulations for different types of hospitals. The case mix index (CMI) represents the average DRG weight for all of a hospital's Medicare volume, can be interpreted as a relative severity measure of a patient population and is directly proportional to DRG payments.

Esposto cited the CMI as understanding the complex nature of managing patients with different sicknesses and medical needs. Esposto found a positive relationship between the CMI and the use of physician contractual arrangements which provided the hospital with more decision rights and control over operations. We believe the same may hold true when considering IT outsourcing and the CMI for at least one reason. The CMI represents an organizational, not transaction specific, measure of complexity of services offered and supported by hospitals. Likewise, IT systems generally support organizational day-to-day operations. We hypothesize that a high CMI (which means the average complexity of services rendered is high), the hospital would prefer to have more control over IT operations and provide them via in-house production, other things equal. Likewise, if the CMI is low then we expect a hospital to outsource for IT services. This

assumes that a high CMI would require the use of a more specialized, unique IT system to manage electronic medical records and other data flows within the hospital. To avoid the possible direct and indirect costs of hold-up using outsourcing, a hospital would prefer more control over IT and that control would be through in-house production (Table 1).

**Data and Descriptive Statistics**

We model the economic incentives affecting the decision to outsource for IT services using 2004 data from the American Hospital Association and the use of binary choice models. This data includes numerous hospital-specific characteristics such as the organizational structure, number of beds, volume of patients, and capital expenses. Also included are estimates for the number of full-time equivalent (FTE) employees in IT-related work, and whether this work was employed internally or outsourced. Unfortunately, data regarding IT employment or outsourcing were treated as confidential and required written permission from individual state hospital associations. For this study, such permission was only obtained from the state of Oklahoma. Thus, the analysis in this paper is limited to a single state.

The data obtained allows for a full host of econometric models to be employed, including logit models looking explicitly at the in-house / outsource decision. Table 2 displays descriptive statistics for several characteristics of hospitals in the study. Approximately 15 percent of all hospitals choose to outsource their IT procedures. Several other variables are also of interest, including the case mix index (which indicates the relative

severity of the patients being served), the total number of in-patient days and out-patient visits, the percentage of all inpatients who were Medicare / Medicaid recipients, the organizational status, and whether or not the hospital resides in a non-metropolitan county. Approximately 49 percent of the hospitals in our study were in non-metropolitan areas, and the two dominant types of hospitals were not-for-profits and those run by the federal government.

**Methodology**

*A Model for Determining the Outsource Decision*

The decision on whether or not to outsource a hospital's IT services is a discrete adoption choice for the hospital that is dependant on the utility from outsourcing ($U_1$) versus keeping the services in-house ($U_0$). The hospital's utility will, in turn, depend on the relative costs and benefits of the outsourcing versus in-house decision. Therefore, the hospital will invest in outsourcing if $U_1 > U_0$, and will keep the service in-house otherwise.

$$\text{Let } \; y_i^* = U_1 - U_0 = \beta' X_i + \varepsilon_i,$$

where $X_i$ is a vector of hospital and place-based characteristics that influence the utility of outsourcing IT services relative to performing them internally, $\beta'$ is the associated parameter vector, and $\varepsilon_i$ is the associated error term. Although $y_i^*$ is a latent variable, the presence of outsourcing (meaning $y_i = 1$) is observed if $y_i^* > 0$, and $y_i = 0$ otherwise. Hence,

$$\Pr(y_i = 1) = \Pr(\varepsilon_i > -\beta' X_i), \text{ or } \Pr(y_i = 1) = 1 - F(-\beta' X_i)$$

Where $F(\ )$ is the cumulative distribution function for the error term $\varepsilon_i$. Each observed $y_i$ is then a function of a binomial process, with the associated likelihood function expressed as:

$$L = \prod_{yi=0} F(-\beta' X_i) \prod_{yi=1} [1 - F(-\beta' X_i)]$$

If the cumulative distribution of $\varepsilon_i$ is logistic, then

$$F(-\beta' X_i) = \frac{\exp(-\beta' X_i)}{1 + \exp(-\beta' X_i)} = \frac{1}{(1 + \exp(-\beta' X_i))}, \text{ and}$$

$$[1 - F(-\beta' X_i)] = \frac{\exp(\beta' X_i)}{(1 + \exp(\beta' X_i))}$$

The associated statistical model is then estimated by the maximum likelihood method,

$$\log L = \sum_{yi=0} \log\left[\frac{1}{(1 + \exp(\beta' X_i)}\right] + \sum_{yi=1} \log\left[\frac{\exp(\beta' X_i)}{(1 + \beta' X_i)}\right]$$

The explanatory variables in matrix $X_i$ are categorized into two distinct groups, those associated with the hospital and those associated with the county in which the hospital is located.

**Results**

The results from a logistic regression model are displayed in Table 3. Our analysis highlights several key factors affecting the use of internal IT staff versus outsourcing for IT services: (1) the severity of patient illness (serving as a proxy for transactions costs) positively impacting the outsource decision; (2) the counteracting impacts of in-patient days and out-patient visits; (3) positive impacts on outsourcing of governmentally-owned facilities; and (4) the lack of impact from non-metropolitan status.

As Table 3 indicates, the case mix index has a positive impact on the probability of outsourcing. This implies that hospitals facing increased complexity are *more* likely to outsource their IT work, which runs counter to our initial hypothesis that the two would be negatively related. This may indicate that our proxy for complexity is a poor measure for the risk that the hospital faces when it determines whether or not to outsource IT services. Other results suggest that the volume of patients encountered has effects that tend to offset each other: the volume of in-patient days is positively correlated to the probability of outsourcing, while the volume of outpatient visits is negatively related. This may be an indicator that the procedures associated with in-patient days are easier to predict by the hospital staff and are therefore easier to move to an off-site location. Although both of these variables are statistically significant at the 10 percent level, neither has much economic significance as evidenced by their minimal marginal effects. We also see that, relative to the base group of "for-profit" hospitals, an organizational structure that is owned by the federal government (either federal or non-federal) significantly increases the likelihood of outsourcing. This suggests that for-profits are more hesitant to allow IT work to be done externally, perhaps due to privacy concerns or even a perception that this activity is simply not as cost effective. Finally, the metropolitan status of the county in which the hospital is located does not have a significant impact on its decision to outsource, suggesting that physical distance from potential outsourcing sites is not important.

Table 4 displays the correlation matrix of all independent variables used in the regression analysis. Among all the variables, only one relationship is above 60 percent correlation, which, perhaps expectedly, is the measure for patient volume: in-patient days and outpatient visits. However, this correlation of 0.734 is not sufficiently high enough to warrant dropping one of the variables from the analysis, particularly in light of the differing impacts these two variables have on the outsource decision.

**Discussion**

This paper has provided a methodology for analyzing the IT outsource decision by hospitals by turning to transaction cost theory. Applying this theory suggests that hospitals with more complicated treatments (proxied in this study by the case mix index) should have a decreased probability for outsourcing, since the increased complexity may be more problematic for an external firm to handle. Hence, we hypothesized that increased complexity and in-house production are positively related. Our results show the opposite - that the case mix is positively related to outsourcing. From the standpoint of transaction cost theory, this implies that the case mix index may not accurately capture the IT related opportunistic risk faced by a hospital when procuring IT services. Instead, other measures such as human and asset specificity variables may do a better job explaining outsourcing. Further analysis on this topic is needed to break out the individual roles played by these other variables, suggesting an avenue for further research.

Our analysis does turn up several other interesting results; specifically the positive relationships between governmental organizational structures and outsourcing, and the lack of significance of a non-metropolitan dummy variable. These results may suggest that hospitals operating for profit still perceive the outsourcing strategy as too risky or not cost effective, or may indicate that hospitals that are owned by the government have more incentive to look to outsourcing as a management strategy. The question of how rural hospitals view outsourcing is left unanswered by our analysis, but should be further explored given the increasing role of IT in the health sector and global flattening taking place in today's world.

**References**


Bates, D., M. Cohen, L. Leape, J. Overhage, M. Shabot, and T. Sheridan. 2001. "Reducing the Frequency of Errors in Medicine Using Information Technology." *Journal of the American Medical Informatics Association.* 8, 299-308.

Borzekowski, R. 2002. "Health Care Finance and the Early Adoption of Hospital Information Systems." Washington, D.C. Discussion Paper No 2002-41. Finance and Economics Discussion Series from the Board of Governors of the Federal Reserve System.

Brooks, R., N. Menachemi, D. Burke, and A. Clawson. 2005. "Patient Safety-Related Information Technology Utilization in Urban and Rural Hospitals." *Journal of Medical Systems* 29(2), 103-109.

Coase, RH. 1937. The Nature of the Firm. in idem, *The Firm, the Market and the Law*. Chicago, IL: University of Chicago Press.

Esposto, A.G. 2004. Contractual integration of physician and hospital services in the U.S. *Journal of Management and Governance*. 8: 49-69.

Fannin, M. and J. Barnes. 2007. "Recruitment of Physicians To Rural America: A View Through the Lens of Transaction Cost Theory." *The Journal of Rural Health* 23(2), 141-149.

Fonkyck, K. and R. Taylor. 2005. "The State and Pattern of Health Information Technology Adoption." RAND Corporation, Santa Monica, CA.

Haux, R., A. Winter, E. Ammenwerth, and B. Brigl. 2004. Strategic Information Management in Hospitals: An Introduction to Hospital Information Systems. Springer: Health Informatics Series.

Parente, S. and J. Dunbar. 2001. "Is Health Information Technology Investment Related to Financial Performance of US Hospitals? An Exploratory Analysis." *International Journal of Healthcare Technology and Management*. 3 (1), 48-58.

Parente, S. and L. Van Horn. 2003. "Hospital Investment in Information Technology: Does Governance Make a Difference?" Available from http://misrc.csom.umn.edu/workshops/2003/fall/Parente_111403.pdf (accessed December 2007).

Solovy, A. 2001. "The Big Payback: 2001 Survey Shows a Healthy Return on Investment for Information Technology. *Hospitals and Health Networks*. July, 40 – 50.

Wang, B., D. Burke, and T. Wan. 2002. "Factors Influencing Hospital Strategy in Adopting Health Information Technology." Paper presented at 2002 Annual Research Meeting, Health Services Research: From Knowledge to Action. Washington, D.C.

Williamson, O. 1991. Comparative economic organization: The analysis of discrete structural alternatives. *Administrative Science Quarterly.* 36: 269-96.

**Table 1. Transaction Cost Theory Hypothesis for IT Outsourcing**

| Complexity of Services Rendered (CMI) | Costs of Outsourcing | Costs of Employment | Predicted IT Arrangement |
|---|---|---|---|
| L | L | H | Outsource |
| H | H | L | Employment |

H - high
L - low

**Table 2. Descriptive Statistics**

| Description | Variable Name | Mean | S.D. |
|---|---|---|---|
| Case Mix Index | casemixindex | 1.268 | 0.3678 |
| Volume of Patients | | | |
| In-patient days total | ipdtot | 29,099 | 39794 |
| Total outpatient visits | vtot | 70,367 | 101852 |
| Medicare / Medicaid Patients | | | |
| % Medicare inpatient | medicarepercent | 0.512 | 0.227 |
| % Medicaid inpatient | medicaidpercent | 0.125 | 0.118 |
| Organizational Status | | | |
| Government - federal | govfed | 0.025 | 0.158 |
| Government - nonfederal | govnonfed | 0.304 | 0.462 |
| Nongovernmental, not for profit | notforprof | 0.430 | 0.498 |
| For Profit | | 0.241 | 0.378 |
| Rural Status | | | |
| Nonmetro | nonmetro | 0.494 | 0.503 |
| Outsource | outsource | 0.152 | 0.3612 |
| Number of Observations | | 79 | |

**Table 3. Logistic Regression Results**

Dependent Variable: outsource (0,1)

| Description | Variable Name | Coeff | S.E. | | Marginal Effects |
|---|---|---|---|---|---|
| Case Mix Index | casemixindex | 4.00080 | 1.38980 | *** | 0.17630 |
| Volume of Patients | | | | | |
| In-patient days total | ipdtot | 0.00003 | 0.00001 | * | 0.00000 |
| Total outpatient visits | vtot | -0.00001 | 0.00001 | * | 0.00000 |
| Medicare / Medicaid Patients | | | | | |
| % Medicare inpatient | medicarepercent | -3.59200 | 2.59650 | | -0.15830 |
| % Medicaid inpatient | medicaidpercent | 6.30220 | 2.87800 | *** | 0.27780 |
| Organizational Status | | | | | |
| Government - federal | govfed | 7.49384 | 2.89900 | *** | 0.94770 |
| Government - nonfederal | govnonfed | 4.30027 | 1.48550 | *** | 0.47870 |
| Nongovernmental, not for profit | notforprof | 1.87413 | 1.63320 | | 0.10230 |
| Rural Status | | | | | |
| Nonmetro | nonmetro | 0.31100 | 0.99060 | | 0.01370 |
| Constant | | -9.57207 | 2.62320 | *** | |
| | | | | | |
| Pseudo R2 | | 0.39210 | | | |

Note: *, **, and *** indicate statistical differences from 0 at the p = .10, .05, and .01 levels, respectively

**Table 4. Correlation Matrix**

| | outsource | casemixindex | ipdtot | vtot | medicarepercent | medicaidpercent | govfed | govnonfed | notforprof | nonmetro |
|---|---|---|---|---|---|---|---|---|---|---|
| outsource | 1 | | | | | | | | | |
| casemixindex | 0.197 | 1 | | | | | | | | |
| ipdtot | 0.258 | 0.446 | 1 | | | | | | | |
| vtot | 0.093 | 0.267 | 0.734 | 1 | | | | | | |
| medicarepercent | -0.282 | -0.096 | -0.133 | -0.203 | 1 | | | | | |
| medicaidpercent | 0.363 | 0.055 | 0.339 | 0.080 | -0.247 | 1 | | | | |
| govfed | 0.156 | -0.089 | -0.082 | 0.288 | -0.365 | -0.171 | 1 | | | |
| govnonfed | 0.104 | -0.336 | -0.198 | -0.181 | 0.037 | -0.037 | -0.107 | 1 | | |
| notforprof | -0.154 | -0.055 | 0.188 | 0.179 | 0.249 | 0.044 | -0.140 | -0.574 | 1 | |
| nonmetro | -0.065 | -0.432 | -0.332 | -0.215 | 0.096 | -0.039 | 0.002 | 0.339 | -0.040 | 1 |