ARE THERE CONTAGION EFFECTS IN THE DIFFUSION OF IT OUTSOURCING?

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Abstract. Growth in the IT outsourcing industry during the past ten years has been exceptional. In this study, we theorize about and analyze the growth patterns of IT outsourcing at the level of the industry and at the firm level. We analyze a data set of firms using a lognormal model as a means to gauge the presence of over-dispersed diffusion and contagion effects that seem to drive outsourcing. A critical aspect of our research methodology is to study instances of outsourcing events – especially mega-deals – that are likely to have affected decision-making by other firms in an industry. Our results suggest that during the periods where a rapid increase in the number of announcements following mega-deal announcements occurred, there is a hierarchical contagion effect. The diffusion of IT outsourcing is not distributed lognormally, which suggests the presence of other underlying dynamics. Our analysis shows the presence of other underlying drivers that do not permit the diffusion pattern to be lognormal. The diffusion pattern for smaller firms appears to depend on the extent of outsourcing diffusion among the larger firms.

Keywords. Contagion theory, diffusion, empirical research, industry analysis, IT services, outsourcing.

1. INTRODUCTION

Outsourcing has been around for a long time in different sectors of industry, but what is surprising about IT services outsourcing is how fast it has grown and how widely it has spread. Now any firm in any country with the requisite infrastructure and the right personnel can be a supplier of IT services. As a result, onshore and offshore IT outsourcing in the last decade has shown exceptional growth. The authoritative industry statistics firm, IDC, has reported that the business process outsourcing (BPO) market is expected to reach US$ 641 billion by 2009, with a cumulative annual growth rate (CAGR) of 10.9% from 2005 on [29]. The Gartner Group [8] predicts that worldwide spending on IT outsourcing will rise from US$408 billion in 2007 to US$441 billion in 2008, an increase of 8.1%. Gartner also expects worldwide end-user spending on IT services to grow by 7.3% annually through 2011 to reach US$958 billion.

As researchers interested in the development of new theoretical perspectives that explain a variety of business phenomena, we wish to establish the extent to which the spread of IT outsourcing is analogous to the spread of a contagious disease. Contagion effects are present in the spread of diseases, which have precipitating events that prompt diffusion across a population. They also constitute an economic phenomenon that may occur at random, independent of each other and across locations.

Our premise in this research is that there is more structure and a theoretical basis in the rationale that underlies the observed empirical regularities of IT outsourcing’s diffusion. So our exploration involves looking for evidence that runs counter to the most basic intuition that IT outsourcing follows a linear growth curve. This is much the same as we might expect for the diffusion of a disease, where predisposing situational factors, characteristics of the population, or aspects of a specific disease might lead to the spread of an epidemic in a manner that is not altogether random. We leverage this analogy and seek to refine our understanding of how the diffusion of IT outsourcing occurred at the firm and industry levels.

For over a decade academicians have been conducting research on outsourcing. Even though numerous studies have been conducted, most have focused on a particular aspect of outsourcing, for instance, the risks involved [2], the best practices [16], the reasons for outsourcing [18], and why firms have tended to form focal outsourcing relationships with their suppliers [15]. To our knowledge none of the studies looked at the empirical regularities of the diffusion of outsourcing as a whole, nor have there been attempts to explain the observed patterns.

We will focus on several research questions: How can the development of new theory help to shed light on the diffusion patterns of IT outsourcing? What should be the conceptual bases for such theory? What role have IT outsourcing mega-deals, contracts with amounts greater than US$1 billion, played in the observed empirical patterns of diffusion?

In addition to studying the diffusion of IT outsourcing from a contagion theory perspective, we also evaluate a new empirical methodology which has been applied in medical epidemiology, political science and economics, but not yet in the information systems (IS) discipline. Our model involves the log-normal distribution, which is appropriate when the data are overdispersed (i.e., not occurring at regular intervals in time or across space), and the underlying change or growth is multiplicative rather than additive and separable. Such models are intended to capture proportionate effects in diffusion [1]. So a given amount of diffusion, based on whatever drivers that explain it, is likely to produce a correlated amount of
growth in diffusion in a subsequent period.

The paper is laid out as follows. §2 gives background and theory that explain the diffusion process for outsourcing. It also discusses growth models that have been used in prior studies, and offers primary statement of our theory. In §3 we present the hypotheses and in §4 we introduce our two data sets. Then in §5 we discuss the empirical regularities for IT outsourcing that we have observed and introduce the methodology that we apply to test our proposed theory. In §6, we provide the results of our analysis and extends our basic model to address the unexplained variance in the estimation of our base model, and presents the results. In §7 we discuss the results and broader theoretical implications. §8 concludes.

2. THEORY

A number of theoretical perspectives support our proposal for contagion-theoretic view of the diffusion of IT outsourcing. We consider diffusion of innovation theory and contagion effects theory. They offer an explanatory perspective on the diffusion of IT outsourcing at an industry and firm level.

2.1. Outsourcing

IT outsourcing is the “significant contributions by external vendors [to] the physical and/or human resources associated with the entire or specific components of the IT infrastructure in the user organization” [19]. Business process outsourcing often involves IT outsourcing, and is the contracting of a specific business process or service to a third-party contractor [10]. Generally, BPO includes the software, the process management, and the people to operate the service that is outsourced. We consider IT and IT-based BPO, since it accounts for a large share of overall outsourcing activities related to IT.

The growth of IT outsourcing has been exponential in the last two decades. One of the main reasons for the exponential growth of both onshore and offshore outsourcing is the technological advances that have occurred, dramatically affecting the way business is conducted. Cairncross [5] reminds us that this death of distance has led to developments in the field of IT outsourcing that are pervasive as compared to outsourcing in other fields such as manufacturing. For twenty years, IT outsourcing has spread across different industries and moved from routine back office work to strategic business processes.

2.2. Diffusion

Diffusion is the process by which information about a focal technological innovation is communicated through certain channels over time among members of a social system, leading to the technology’s adoption [25]. Technology diffusion generally follows an s-shaped curve, with five phases. Each is a proportion of the total number of adopters up to some time: innovators, early adopters, early majority, late majority, and laggards. To understand diffusion, one must understand the concept of network externalities. This is the change in utility a subscriber derives from a communication service as others join [26]. With interdependent demand, multiple equilibria can co-exist at any price. The observed equilibrium depends on the static model, on the disequilibrium conditions, and on the disequilibrium adjustment process.

A key characteristic of the related diffusion of innovations theory is its emphasis on communication channels. Social systems (e.g., industry associations, developers’ meetings, annual shareholder meetings, etc.) act as the sources of influence on adoption decisions [21]. The Bass [3] model, widely used in diffusion studies, argues that potential adopters are influenced by mass media and word of mouth [20]. In IS research, the diffusion of innovations theory has been used to study how technological innovations are embraced at different levels of analysis. In the present research, the focal innovation is IT outsourcing.1 The related social system consists of firms that may be located across different geographic regions, in different industries, and share similar characteristics that may make them competitors or business partners.

2.3. Contagion Effects

A contagion effect is defined as “the spread of a particular type of behavior through time and space as a result of a prototype or model performing the behavior and either facilitating that behavior in the observer or reducing the observer’s inhibitions against performing that same behavior” [22, p. 1006]. Contagion effects theory offers a refined expression of the diffusion of innovations theory, and provides a starting point for understanding the underlying processes of diffusion [14]. It does so through evaluating diffusion behavior on the basis of a different point of view. This view posits the possibility of the connectedness of outsourcing events over time. Contagion effects may arise in two ways. The first is spilllovers due to normal ties and interdependencies among different activities in a market. These include aligned senior management interests, business activities in an industry, in a region, across firms with similar interests or operating characteristics, etc. Another explanation is external to business, industry and geographical, based on macroeconomic drivers.

1 Loh and Venkatraman [19] refer to IT outsourcing as administrative innovation. Another way to think of it is as a technological innovation, since outsourcing has been made possible through the communication capabilities of information and communications technologies.
Contagion effects theory has been used to explain the adoption patterns of successive technology generations of analog and digital wireless phones [14]. The adoption patterns can be partly explained on the basis of hierarchical contagion effects. They are defined as the effects of variables that influence the extent of the connection between the behavior of the units of analysis of interest over time. So we might see hierarchical effects across industries, geography, firms, strategic business units, senior managers, and so on. Other studies use contagion effects theory and the related notion of co-movement to study how state-level shocks on the growth of networks propagate to the national level, and vice versa [13]. The theory has also been used to study the spread of financial turbulence, riots, civil disobedience, and other phenomena.

Another stream of research in which contagion effects theory occurs is political science. The theory has been used to explain adoption of innovations [11] and social security policy by states [6], growth of terrorism [23], and other non-technical phenomena. One study on the spread of urban disorders in 1960s is especially interesting. Midlarsky [22] empirically tests whether the spread of civil disorders in small cities in the United States can be attributed to baseline diffusion effects, as well as hierarchical contagion effects. In Midlarsky’s work, the relevant hierarchical contagion effect that is proposed is the association between civil unrest in smaller cities and what has occurred in the larger cities – a large city to small city effect. He notes that this may occur even though there are differences in the critical mass of the minority populations in the smaller cities.

An important finding from the prior research is that contagion effects theory appears to be helpful in explaining fast-spreading, over-dispersed phenomena. We believe that it applies well to our efforts to explain the diffusion of IT outsourcing because the IT outsourcing data are over-dispersed.

3. HYPOTHESES

A US$625 million BPO deal signed between Nortel Networks and PricewaterhouseCoopers in 2000 was an important deal that had a major impact on the development of BPO outsourcing [28]. Some consider it as the deal that started the business process outsourcing wave [12]. Similarly, the outsourcing deal between Eastman Kodak and IBM in 1989 had a significant impact on IT outsourcing and is believed to have established IT outsourcing as a strategic choice for successful businesses and resulted in diffusion of IT outsourcing. Loh and Venkatraman [19] have called this the Kodak effect.

Another way to think about these kinds of problems is in modeling terms that describe the connectedness of the events that precede later events, and the extent to which the events themselves are random. In our study, we find that the precipitating events, the mega-deals, are random and occur across unrelated industries and do not follow any fixed pattern. We can view randomly occurring independent precipitating events as potentially influencing the later diffusion of IT and BPO outsourcing. This occurs on a proportional basis, so the number of new outsourcing deal announcements is proportional to the number of deals that have been concluded:

- **Hypothesis 1 (The Outsourcing Diffusion Hypothesis):** The outsourcing diffusion process will be randomly proportionate to the set of responses to prior precipitating events.

Evidence of a contagion effect might include a statistically significant increase in the number of IT outsourcing contract announcements in a period immediately following an earlier period which had IT outsourcing announcements from leading firms. Indicating presence of a contagion effect where the leading firms act as prototype or model for other firms to follow. An alternative explanation is the hierarchical contagion effect that we mentioned earlier, which involves managerially interesting stratifiers and theory-based observations of their relevance:

- **Hypothesis 2 (The Hierarchical Outsourcing Adoption Hypothesis):** With contagion effects, the diffusion of outsourcing will depend on the influence of one or several contagion variables whose effects act in a hierarchy.

The Outsourcing Diffusion Hypothesis (H1) characterizes patterns of IT outsourcing. The Hierarchical Outsourcing Adoption Hypothesis (H2) does this at a more fine-grained level. The hierarchical effect could be from larger to smaller firms, or from firms in close by to those that are farther away from each other. We only consider hierarchical effects that occur due to firm size. This is a good start for analysis, and is defensible. It is done in studies of firm performance and strategic management.

4. DATA

We used two data sets in this study. The first captures the IT outsourcing information at the indus-

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*2 A related technical requirement of the estimation models that we will use is the independence of the precipitating events. Similar to Midlarsky [22], we conduct our analysis under the premise that this assumption is appropriate. In fact, however, this is an empirical issue that requires additional exploration and analysis on our part to nail down. We can nail this down when we have more data from more industries and more diverse geography, for example, outsourcing across different countries.*
try level. The second relates to IT and BPO outsourcing information at the firm level. The first set is annual data for 60 non-farm industries in the U.S. private sector provided by the Bureau of Labor Statistics (BLS) and the Bureau of Economic Analysis (BEA) for 1998 to 2006. The industries are defined by the four digits 1997 North American Industry Classification System (NAICS).

Appendix 1 provides details on the sources, construction procedure, and deflators used for the industry data. We used chain-type quantity indices as deflators, which show the growth of output (or other variables) over time holding prices constant [27]. The BEA introduced these indices in 1996 to improve the accuracy of its estimates of the growth in real GDP by eliminating the bias present in fixed-weight indices that had been used.

The second data set was collected from a full text search of company announcements related to IT and BPO outsourcing between April 1, 1999 and March 31, 2008. We used two leading news sources: PR Newswire and Business Wire. See Appendices 2 and 3. We also used the online Lexis/Nexis database to search the news wires for announcements containing the words “deal” or “contract” or “launch” or “announcement” in the same sentence as the words “BPO” and “IT,” and “outsourcing” or “offshoring.” The search yielded 583 announcements in total, of which 210 announcements were relevant.

Not all of the relevant details – for example, dollar amounts for the contracts required for analysis – were found in the company announcements, however. To collect these data, we searched other secondary sources, including trade journals, company websites, magazine articles, and newspaper articles. We took extra care to differentiate between independent announcements and announcements that were a part of ongoing deals. We only include independent announcements. We collected announcement data at the firm level which involved either clients or vendors, or both that were located in the U.S. We did this to maintain consistency across the industry and firm-level data. Our final data set consisted of 70 announcements with complete information.

5. INDUSTRY-LEVEL EMPIRICAL ANALYSIS

We look at the industry level IT outsourcing data and compare the patterns observed with the announcement data that we collected. We expect to see similar kinds of empirical regularities that are specific to the diffusion of IT outsourcing across firms. We focus on 1999 to 2006 across a few industries where there is high usage of IT. We called these IT-intensive industries. We selected these industries because these industries have the largest share of the worldwide BPO market [4]. They include broadcasting and telecommunication (NAICS 5130) banking and finance (NAICS 5210, 5220 and 5230), computer systems design and related services (NAICS 5415), and information and data processing services (NAICS 5140). Figures 1, 2, and 3 present IT outsourcing trends over time within and across these NAICS industries over the same time period.

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3 The BEA introduced the chain-type Fisher index into its measures of real output and prices to address the problem of choosing the base period with which all other periods are compared. This index is the geometric mean of the conventional fixed-weighted Laspeyres index, which uses the weights of the first period in a two-period setting, and the Paasche index, which relies on the weights of the second period. Changes in the Fisher index are calculated using the weights of adjacent years. These annual changes are chained or multiplied together to form a time-series that allows for the effects of changes in relative prices and in the composition of output over time. See Landefeld and Parker [17] for additional details.

We observe the following patterns across IT-intensive industries. Based on industry-level data, there is sharp growth from 1999-2000 and then a sharp decline from 2000-2002, after this period we observe a steady growth. For our announcement data
for the same industries, there are similar patterns except for the period 2001-2002. Our data show an increase in the number of announcements during this period, except for this period. These observations suggest that: IT outsourcing has been growing consistently across IT-intensive industries from 2003 onwards; and the industry outsourcing announcement data that we have collected reflect the industry trends except for the period of 2001-2002.

**Fig. 3. IT Services by NAICS Industry in US$, 1999-2006**

For the industry level of analysis, we see somewhat different patterns. Different industries followed similar patterns from 1999 to 2002, but from 2002 onwards somewhat different patterns occurred. When we compare the outsourcing patterns within different industries with that at industry level we find some marked differences. We observe a consistent growth pattern in the broadcasting and telecom industries.

### 5.1. Modeling Background

We examine the overall patterns of outsourcing at the firm level over time with a methodology based on the estimation of a lognormal diffusion model [1, 22]. The underlying reason for the application of this model to the study of outsourcing is its emphasis on the proportionate effect of the diffusion process. Our conjecture is that outsourcing diffusion develops over time via a mechanism in which each additional increment of outsourcing-related events is proportional to the existing size of the process – in other words, the current installed base of outsourcing contracts. We next provide empirical results to justify the application of this model to IT outsourcing.

### 5.2. Empirical Model Development

The lognormal distribution model has been used to describe different growth processes (e.g., personal income, gross national income, etc.). It incorporates an assumption of independence regarding observations of diffusion. It incorporates a high degree of skewness and leptokurtosis, compared to other distributions [1]. We apply this to test the diffusion patterns and gauge the proportionate effect for diffusion.

We next specify the lognormal diffusion model that we will apply to our data. Let \{\mu_i\} be the set of mutually independent random drivers for IT outsourcing growth, and \{x_i\} be the dollar amounts associated with the set of \(i = 1\) to \(n\) outsourcing announcements. The variation among the announcements is expressed by the different dollar amounts of the underlying contracts. Based on the reasoning that we discussed involving a proportionate effect, the incremental change, \(x_i - x_i,1\), should be a random proportion of the existing value:

\[
x_i - x_i,1 = \mu x_i,1, \quad i = 1, 2, \ldots, n
\]

Equation 1 can be interpreted as the change in the dollar amount of IT outsourcing as the result of an additional announcement and is proportional to the size of the dollar amount of the IT outsourcing contract. The equation can be stated as the fundamental equation underlying a lognormal distribution [1]:

\[
\log x_n = \log x_0 + \mu_1 + \mu_2 + \ldots + \mu_n
\]

Log \(x_n\) is normally distributed in the limit by the additive form of the central limit theorem. So \(x_n\) also is lognormally-distributed as:

\[
f(x) = \frac{1}{x\sigma\sqrt{2\pi}} \exp \left(-\frac{1}{2} \frac{\log x - m}{\sigma}^2\right), \quad x > 0
\]

where \(m\) is the mean of the logarithm of \(x\) with standard deviation \(\sigma\). The parameters \(m\) and \(\sigma\) can be estimated by two additional equations:

\[
m = \frac{\sum \log_2 x_i}{n}
\]

\[
\sigma^2 = \frac{\sum (\log_2 x_i - m)^2}{n-1}
\]

This model gives us an opportunity to look at whether the data exhibit proportional behavior and fits the lognormal distribution. If the model does not fit, then we might have to extend it by including other variables, a different functional form or different underlying assumptions to capture the true behavior.

### 5.3. Statistical Tests of the Main Hypothesis

The main purpose of this part of our analysis is to see if the lognormal distribution fits our data. If the distribution fits then we can conclude that the IT diffusion follows a normal growth pattern. To accomplish this, we use the \(\chi^2\) goodness of fit test. The null hypothesis is whether the frequency distribution of the relevant events observed in our sample is consistent with a lognormal distribution.

The variable \(x_i\) is the dollar amount for each out-
sourcing announcement as before. We use logarithmic (base 10) values for the dollar amounts to define announcement categories. The different categories are defined as follows: $10^5$ for $100$K-$1$M, $10^6$ for $1$M-$10$M, and so on. All outsourcing contract announcements had value more than $100$K thus we selected our start value as $10^5$. For analysis purposes, we selected the beginning points of each range rather than the mid-points to represent the logarithmic values. This does not change our conclusion, since it applies to all categories.

From Equations 2 and 3, we can see that log \( x_i \) is normally distributed, and this form is necessary for us to implement the \( \chi^2 \) test. Table 1 reports the values that we obtained with k-3 degrees of freedom, with \( k \) representing the number of categories.

<table>
<thead>
<tr>
<th>DEAL RANGE</th>
<th>LOG$_{10}$ US$</th>
<th>FREQUENCY</th>
<th>EXPECTED FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10^5$: US$100$-$1,000K</td>
<td>5</td>
<td>5</td>
<td>2.3</td>
</tr>
<tr>
<td>$10^6$: US$1$-$10$M</td>
<td>6</td>
<td>13</td>
<td>16.4</td>
</tr>
<tr>
<td>$10^7$: US$10$-$100$M</td>
<td>7</td>
<td>24</td>
<td>35.5</td>
</tr>
<tr>
<td>$10^8$: US$100$-$1$B</td>
<td>8</td>
<td>31</td>
<td>23.0</td>
</tr>
<tr>
<td>$10^9$: US$1$-$10$B</td>
<td>9</td>
<td>9</td>
<td>4.5</td>
</tr>
</tbody>
</table>

Notes. Lognormal distribution of dollar amounts for outsourcing deals; 82 announcements total; mean by deal range of 7.14; std. dev. = 0.91. Also, \( \chi^2 = 11.90 \) with 1 d.f. (\( p < .05 \)). The values of the first two categories were combined for the \( \chi^2 \) analysis.

5.4. Results for the Base Modeling Approach

Our null hypothesis is that our data follows a lognormal distribution. Our analysis shows that the observed distribution does not fit the lognormal distribution very well though. This is reflected in the \( \chi^2 \) value of 11.90 (1 d.f.). Most of the observed values demonstrate positive skewness. For the US$ categories \( 10^5, 10^6 \) and \( 10^7 \), the observed values are higher than the expected values. Also, the observed values in the upper range of US$1 to 100 million of the announcement data are under-represented, whereas those in the lower range of US$100 million to US$10 billion are over-represented.

The under-representation of US$1 billion-plus deals can be explained on the basis of industry trends. In the IT outsourcing industry, not many mega-deals have been signed. Those that have been signed encompass services contracts for multiple locations across multiple nations and sometimes even multiple business functions. The number of vendors that can provide such large-scale services based in the U.S. is small, as suggested by our data. A plausible explanation for the over-representation of the lower dollar range deals may be that higher dollar outsourcing deals get more press. Clearly, we have some additional details to understand in this context.

Our results suggest that the lognormal distribution may not be capable of characterizing the diffusion patterns of IT outsourcing for the data and time period that we used. There are two possible explanations. First, the model may not be suitable, even though the lognormal model is generally appropriate for representing over-dispersed data. Our data are over-dispersed beyond the range of lognormal distribution. Another possibility is that some other process is at work here, such that the combination of two processes makes a single pattern representation of the lognormal model ineffective.

6. EXTENSION AND RESULTS

To capture the patterns of diffusion beyond the lognormal model, we need to adjust our approach.

6.1. Background on the Modeling Extension

We evaluate our data longitudinally as the sum of the dollar amounts of announcements. These should approximate a straight line if the announcements occur randomly. We also test for the presence of a hierarchical contagion effect in diffusion for IT outsourcing. Prior diffusion contagion studies [6, 14] have shown that adoption follows a hierarchical pattern. We represent the hierarchical adoption effect in term of large and small firms. Diffusion patterns in prior studies suggest that a hierarchical contagion effect may come into play when we see a rapid increase in the outcome variable of interest. In this case, it is the number of outsourcing announcements following news of a mega-deal. To test for a hierarchical contagion, we analyze outsourcing announcement frequency by firm size, for different time periods. We use the number of employees for firm size. (See Appendix 4.) We check for over or under-representation of mid-to-small firms.

6.2. Variables and Empirical Model

Pattern analysis. To represent the data in longitudinal form, we adopt the transformation equations from Midlarsky [22] in our context. We sum the dollar amounts of announcements and apply log transformations to them. We represent the dollar amount associated with announcements \( i = \{1, \ldots, n\} \) as \( x_i \), with \( \mu \) representing the random precipitating event – the mega-deals. The related expression is:

\[
x_1 = k_1 e^{\mu_1}, \quad x_2 = k_2 e^{\mu_2}, \ldots, \quad x_n = k_n e^{\mu_n}
\]

where \( k_i \) is the constant of proportionality between the dollar amount and the exponential function.

Multiplying Eq. 6’s terms by one another gives:

\[
\prod_{i=1}^{n} x_i = \prod_{i=1}^{n} [k_i e^{\mu_i}] = \left[ \prod_{i=1}^{n} k_i \right] e^{\mu}
\]
\[ = (k_1 k_2 \ldots, k_n) e^{\mu_1 + \mu_2 + \ldots + \mu_n} \]  

(7)

The log of Equation 7 is:

\[
\sum_{i=1}^{n} \log x_i = k' (\mu_1 + \mu_2 + \ldots + \mu_n)
\]  

(8)

Precipitating incidents occur in time-order, so \( \mu_n \) occurs after \( \mu_{n-1} \). Thus:

\[
\sum_{i=1}^{n} \log x_i = k' t
\]  

(9)

It follows that the sum of the logarithms of the dollar amounts of the outsourcing deals is proportional to time. To understand the overall pattern, we plotted the logarithms of the cumulative outsourcing dollar amounts for 1999 to 2007 in Figure 4.

Fig. 4. Outsourcing Events by Year, 1999 to 2007

We see marked differences in the pattern between years. Three years – 2000, 2003 and 2006 – are of interest to explore the contagion effect phenomena because of the rapid increase we see in the announcement data. To get an understanding of how the dollar amounts are distributed, we plotted the log of total outsourcing deal values for selected quarters from 2002 to 2007 in Figure 5.

We observe a rapid growth in the log of the dollar amounts of outsourcing deals from 1999 to 2000, from 2002 to 2003, and from 2005 to 2006. These periods of rapid increases coincide with the periods in which we observed either mega-deal announcements or multiple announcements that are above US$100 million. Although we have not tested this for significance, we observed an increase in the number of smaller dollar amount deals that appear to follow these higher-value deals also.

To test the hypothesis of hierarchical contagion effects, we tabulated the number of announcements by firm size for this time period. We did this for 2003, 2006 and 2007, and for all the other years where we did not see a rapid increase in the cumulative logarithmic dollar amounts.4 See Table 2.

Fig. 5. Log of Total Outsourcing in Selected Quarters in US$, 1999-2007

We test for whether the proportion of smaller sized firms is greater in the contagion periods as compared to that in the non-contagion periods, as suggested by the contagion theory. We find that the proportion of smaller firms is greater in the contagion period. Thus, there seems to be a hierarchical contagion effect: smaller firms adopt based on the external influence of large outsourcing-adopting firms’ adoption. More analysis is needed to confirm the finding.

Table 2. Announcement Frequency by Firm Size

<table>
<thead>
<tr>
<th>PERIOD OF TIME</th>
<th>FIRMS WITH &lt; 50,000 EMPLOYEES</th>
<th>FIRMS WITH &gt; 50,000 EMPLOYEES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contagion (2003, 2006-2007)</td>
<td>16</td>
<td>8</td>
</tr>
</tbody>
</table>

Notes. There are 16 announcements in the data set for which no client information was available, and so we did not include them.

An alternative explanation, but one that still represents a hierarchical contagion is based on deal size. For example, it may be the case that observations of larger deals by different firms drive their willingness to do larger deals themselves. Similarly, smaller deals may beget other smaller deals that cut

4 It is important to ask: What are the alternative explanations for these patterns? How can they be excluded? For example, the years 2002 and 2005 had improving economic conditions. These may have enabled firms to do more IT outsourcing. Smaller deals may have increased more than bigger ones because they required more financial resources. We have not tested this assertion directly, but it is possible to conceptualize this as a hierarchical diffusion effect. It would be led by the financial condition of the firms. We will explore number of alternative explanations like this in more data work as we further develop this research.
8. CONCLUSION

We conclude with the primary contributions of our research, and then we consider limitations.

8.1. Contributions

The results of this study have theoretical and practical implications. We apply diffusion contagion effects theory in a new context: to study the diffusion patterns of IT outsourcing. This helps us to understand hierarchical adoption patterns in this context. Our perspective is to look at aspects of the growth pattern for IT outsourcing that does not fit the expectations of a simple baseline model. We also demonstrate a new methodology for empirical research on IS diffusion: the lognormal model.

A problem with this type of field research on outsourcing is the difficulty in obtaining meaningful data. We created a new data set, which provides a different vantage point for the analysis of contagion effect-driven IT outsourcing diffusion. We also demonstrated the analogy development of an empirical model from medical epidemiology and political science, something which offers an interesting perspective on the broader development of new methodology for the IS field. Our results also will help managers understand the diffusion patterns of IT outsourcing, at the industry and firm level. This will enable them to make decisions related to IT outsourcing with an awareness of the macro and micro levels. Our results are specifically helpful for vendors, who stand to gain a lot by making the information about their contract wins public. Especially if their clients are either high profile clients or the contract deals are high value.

8.2. Limitations

We note several limitations of the present research that we will address in future work. First, our results are based on outsourcing contract announcements and contract details from two well-accepted news sources. So they may be biased to the extent that not all outsourcing contract announcements and details are covered by these sources. Also, the announcement rate and time are dependent on corporate guidelines and because of that there might be a time lag, between the time when actual contract is signed and the announcement is released. Still they represent industry trends, so excluding contracts not covered by these sources probably has not adversely affected our results. Also, our results are similar to Loh and Venkatraman’s [19], who showed organizations mimic the behavior of other organizations in terms of the use of their communication channels.

Second, we have focused on firm size as our main stratifier for observing contagion effects. There are other possible criteria that can be used to analyze...
the contagion effect, for instance, geographic location, industry, international linkages, IT-intensity, and managerial structure, etc. The variable that we chose, firm size, is measurable and valid based on our field study observation, and consistent with control variables used in other research on firm strategy [7, 24]. Size via scale economies is important because it represents how firms can produce internally, if they make the decision to outsource. Third, the trend of IT and BPO outsourcing is very recent in companies for the smallest two size categories of firms.

This study is exploratory. We focused on the overall pattern of IT outsourcing. We have given no consideration to external factors, like regulatory and non-business considerations that may influence the diffusion of IT outsourcing within an industry or even across different geographic locations. These are issues that we will explore in continuing research.

REFERENCES

### Appendix 1. Data Sources and Construction Procedure

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>BEA SOURCE</th>
<th>CONSTRUCTION PROCEDURE</th>
<th>DEFLATOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>Industry accounts</td>
<td>Gross output by industry in 2000 US$.</td>
<td>Chain-type quantity index for outputs</td>
</tr>
<tr>
<td>IT capital</td>
<td>Fixed asset data</td>
<td>Net stock of info. proc. equip. and software (comp. and peripheral equip., comm... instruments, photocopy equip., office/ acct. equipment, software), by industry, 2000 US$.</td>
<td>Chain-type quantity index for fixed assets by type</td>
</tr>
<tr>
<td>Non-IT capital</td>
<td>Fixed asset data</td>
<td>Net stock of private fixed assets, excluding information processing equipment and software by industry, 2000 US$.</td>
<td></td>
</tr>
<tr>
<td>Labor</td>
<td>Industry accounts; BLS empl. statistics</td>
<td>Total full-time equivalent employees by industry multiplied by average annual work hours of 2,080 hours).</td>
<td>None</td>
</tr>
<tr>
<td>IT outsourcing</td>
<td>KLEMS intermediate use estimates</td>
<td>Sum of an industry’s intermediate inputs purchased from NAICS 5142 (Data Proc. Serv.) and NAICS 5415 (Comp. Sys. Design and Related Serv.), in 2000 US$.</td>
<td>Chain-type quantity index for intermediate inputs</td>
</tr>
<tr>
<td>Non-IT services</td>
<td>BEA industry use tables</td>
<td>Industry’s total intermediate inputs, excluding purchased IT services, in 2000 US$.</td>
<td>Chain-type quantity index for intermediate inputs</td>
</tr>
</tbody>
</table>

### Appendix 2. Sample of Representative Announcements

Two announcements from *BusinessWire* and *PRWire* are shown below. When US$ were not mentioned, we used secondary sources (e.g., trade magazine, newspaper articles, and company websites) for the relevant details.

- **Hewitt Associates to Provide HR BPO Services to PepsiCo; Firm Continues Growth of HR BPO Business, Signing Eighth Deal Since Close of Hewitt and Exult Merger.**
  Dateline: Lincolnshire, IL. April 12, 2005
  Hewitt Associates (NYSE:HEW), a global human resources services firm, announced today that it will provide comprehensive HR BPO services to PepsiCo (NYSE:PEP), a world leader in convenient foods and beverages. ... Under a ten-year agreement, Hewitt will provide HR BPO services in the U.S. and HR application development and hosting for the U.S. plus 67 additional countries globally. ... The HR application development and hosting will support PepsiCo's approximately 64,000 employees in the U.S., and approximately 38,000 of PepsiCo's employees in 67 countries globally.

- **CSC Signs $20 Million Outsourcing Contract with Wilton Re; CSC’s Life Insurance BPO Services to Support Reinsurer’s Acquisition Strategy**
  Computer Sciences Corporation (NYSE:CSC) today announced that it has signed a 10-year, $20 million business process outsourcing (BPO) contract with Wilton Re to support the privately owned life reinsurance group's growth strategy of acquiring large blocks of insurance policies. Under the agreement, CSC will transition approximately 80,000 policies acquired by Wilton Re to CSC’s insurance BPO operations and provide full back-office administration services, including policy and claims administration, customer service, billing and premium processing ...

### Appendix 3. Coding Sample Announcements

We implemented the following process to code the announcements. Only announcements for IT and IT-based BPO were included. All announcements for a contract amount greater than US$1 billion were classified as mega-deals. All others based on the dollar amount were put into different groups, for example, deals from US$100K-1M. Five such groups were formed.

### Appendix 4. Size Classification of Firms

Based on the number of employees the firms were classified into following categories: extra small with less than 1,000 employees; small with greater than 1,000 but less than 10,000 employees; medium with more than 10,000 but less than 50,000 employees; large with greater than 50,000 but less than 100,000 employees; and extra large with greater than 100,000 employees.