Competing in Crowded Markets: The Dynamics of Competition in the Enterprise Systems Software Industry

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Abstract

Vendors of Enterprise systems software (ESS) offer a portfolio of software components to support a variety of specific business functions. Client organizations construct a digital platform for their business processes by buying software components from one or more ESS firms and expect the components to be compatible with each other. Each software component (e.g., ERP, CRM, analytics) forms a market, with multiple ESS firms competing in each of those markets. As a result, the ESS industry is characterized by multimarket competition. The existing literature in strategy suggests that multimarket competition is characterized by two findings: (i) Greater multimarket contact improves firm performance because of the potential for mutual forbearance and tacit collusion (ii) Greater domain overlap exposes a firm to the whirlwinds of intense competition and adversely affects its performance. Yet, the ESS industry exhibits another unique characteristic: potential for indirect network externality. In their desire to architect seamless digital networks, customers expect that components bought from multiple firms will integrate relatively easily and at low integration costs. Therefore, domain overlap might in fact create the potential for positive performance gains in the ESS industry. Therefore, the nature of multimarket competition in the ESS industry deserves fresh attention. We examine these competitive dynamics by analyzing data from a set of ESS firms that account for more than 95% of the revenue in this market over 3 time-periods. Our research suggests that the combination of multimarket contact and domain overlap do lead to findings that are contrary to extant research. First, our findings suggest that are no obvious benefits to simply increasing the number of component markets where an ESS firms competes. However, there is clear evidence of economies of scale and scope in expanding a functional component to serve multiple vertical industry segments. On the other hand, our research suggests that when firms strategically expand their component portfolio so as to increase their domain overlap, they show positive performance gains. We propose that the potential for indirect externality effects trumps traditional domain overlap considerations, whereby competing in markets with high overlap may actually be preferable for a firm in the ESS or digital goods industries. Thus, presence in highly competitive markets is desirable so as to be attractive to client organizations because it signals competitive strength and commitment to digital platforms. Though the impact of multimarket contact on firm performance is positive and consistent with prior findings, we find that firms are able to extract further value from their multimarket contact when they also have high a degree of market overlap thus underlining the strategic aspects to market selection. We conclude with recommendations for theory and practice.

Keywords: Enterprise software, standards, multimarket contact, network externality.
1. Introduction

Digital platforms to support enterprise-wide business processes are commonly provided by a category of software called Enterprise systems software (ESS). In most organizations, such a platform is constructed by integrating the functional modules or ESS components that support specific tasks in areas such as production, human resources, accounting, payroll and others (Davenport 1998). This business software industry boasts of giants such as SAP and Oracle, and it represents one of the largest software groups with sales exceeding 60 billion in 2003 (AMR Research – http://www.amrresearch.com).

Two aspects of business software create interesting competitive dynamics. First, enterprises or client organizations\textsuperscript{1} build a system of components, often sourced from multiple ESS vendors. Second, it is imperative that the components integrate seamlessly. Even as ESS firms respect their customers’ desire for seamless integration, it is evident that components from the same firm work well together, but those bought from different firms usually require costly integration efforts (Markus 2000, McKeen and Smith 2002). Thus, ESS firms are engaged in both systems and component competition: while they want to sell the entire system of components to their clients, they also want to be attractive to others who may have purchased a subset of the components from other firms.

Currently, there is little research on the competitive dynamics of this industry. At one end, traditional theories of economies of scale and scope would suggest that ESS firms should benefit from competing in as many product markets and serve as many

\textsuperscript{1} We use the terms “enterprise” or “client organizations” to refer to users of ESS and the terms “ESS firms” or “vendors” to refer to producers of business software components.
vertical industry segments as possible (Teece 1980). Further, since firms often compete with a common set of firms in multiple product markets, tacit collusion and mutual forbearance from multimarket contact could also be in play and affect performance (Jayachandran, et al. 1999). On the other hand, competition in this industry can also be characterized by indirect network externalities (Brynjolfsson 1996, Shapiro and Varian 1999). Since client organizations require component integration, it may very well be that firms that compete in important product segments might be more attractive to the customers while constructing their digital platform. This user-driven need for integration may actually require that ESS firms eschew any concern of intensity of competition and indeed participate even in highly competitive markets.

The goal of our research is to characterize the competitive dynamics in this industry through an empirical study. Three questions motivate our study. First, should an ESS firm compete in as many markets as possible? Second, should ESS firms be competing with like firms? And third, are they better off by avoiding crowded markets? Though literature in strategy, particularly that on multimarket competition, provides some answers to these questions, the potential for indirect network externalities motivates the need to examine these questions. In particular, we seek to examine whether the potential for network externality mediates the traditionally observed findings of the performance effects of multimarket contact and domain overlap. Do the competitive dynamics of the ESS and, relatedly, digital goods industries, require a different set of guidelines for strategic conduct?

To answer these questions, we first develop our conceptual arguments and hypotheses through a review of theoretical literature on competitive dynamics and
platform competition, particularly suited for technology industries. We then develop a random effects model of firm performance based on data collected from multiple independent secondary sources over three time-periods.

The paper is structured as follows. In the next section, we present the theory discussion and formulation of hypotheses in the ESS industry context. Section 3 discusses the method and measures employed in our empirical study. The model, analysis and results are presented in section 4. Finally, section 5 discusses our findings, managerial implications and directions for future research.

2. Competitive dynamics in the ESS industry

2.1. Structural aspects of business software competition

The digital infrastructure of client enterprises consists of software components purchased from a multitude of vendors. Collectively, these business software components are known as the enterprise systems software (ESS). The multiplicity of components can be primarily attributed to the client/server paradigm of computing, where a single client application can be used to manage complex functions that reside elsewhere on specialized servers (Duchessi and Shobha 1998, Stallings 1996). Today, in most organizations, the default client interface is the Web browser which communicates with a Web server that is tied into many business modules, or proprietary application components which store and retrieve data from databases. Further, as new business models emerge, new specialized software components are being added to the portfolio. Individual ESS firms typically do not develop all the components required to make a fully functional enterprise system. Instead, each firm often produces a subset of these components (Markus 2000). For example, i2 offers components such as advanced
planning and scheduling and SCM, while large vendors like SAP offer most of i2’s components as well as others such as CRM and product data management modules.

In our study, each of these software components defines a “market” in that a CRM module caters to a different market than a SCM component. These are two distinct markets even when the target buyers may belong to the same buyer organization. This is because the target buyers are functional managers – CRM is catered toward the marketing divisions of organizations, whereas buyers for the SCM and related modules are the manufacturing/purchasing/inventory groups within a firm. Thus a single firm can be competing in multiple markets. This is in itself not that uncommon; for example radio stations consider radio formats to be different markets where each format attracts a different type of audience (Greve 1998). Further, as a result of one firm competing in multiple markets, two or more firms may end up facing each other in many markets. While such multimarket contact can be commonly observed in the airline industry, global pharmaceutical industry, and amongst fast-food chains (Gimeno and Jeong 2001, Gimeno and Woo 1999), what is unique and distinct about multimarket contact in the ESS industry is the demand-side connection between markets.

Thus, if one were to abstract the entire system of components as providing a platform, there are supply-side contingencies (characterized by ESS firm behavior relative to each other) and demand-side needs (characterized by client-organizations’ choices).

2.2 Multimarket contact and the supply-side externalities of mutual forebearance

Multimarket competition occurs when firms compete with other firms in more than one product and/or geographical markets (Karnani and Wernerfelt 1985). The
multimarket contact of a firm increases with the number of overlapping markets with rival firms. Intuitively, one might think that higher multimarket contact presents more opportunities for the rival firms to intensify their competitive activity. However, research in strategy has argued that a form of externality benefit might occur as firms face the rivals in a repeated fashion. It can actually lower competitive intensity, which in turn leads to better overall performance (Jayachandran, et al. 1999). The main rationale behind this observation is that that multimarket contact can lead to mutual forbearance, that is, firms will not engage in price or promotional wars as the focal firm realizes that if it undercuts its multimarket competitor in one market, the rival firm might engage in similar tactics in another market (Baum and Korn 1996, Clark and Montgomery 1998). Competitive actions, such as a price war, may lead to decreasing profit margins to both rivals and thus deter any one rival firm from initiating a threatening action. As a result, a form of tacit collusion might arise and prices can remain high across all markets, resulting in higher overall performance of the firm and its rivals. Evidence of such supply-side behavior is well-documented both in industries where there is product diversification, e.g. telephone and cable (Parker and Roller 1997)), and geographic market diversification, e.g., airlines and supermarket chains (Evans and Kessides 1994).

The competitive elements that are known to foster such mutual forbearance are familiarity and deterrence. When a firm maintains multimarket\(^2\) with its rivals, its strategic actions are often guided by its close rivals, since these define the competitive

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\(^2\) Multimarket contact has been conceptualized and measured at the dyadic level (only between two firms) as well as at the firm level, as in a firm’s multimarket contact with respect to the rest of the industry in Gimeno, J. and E. Jeong, "Multimarket contact: Meaning and measurement at multiple levels of analysis," In *Multiunit Organization and Multimarket Strategy*, J. A. C. Baum and H. Greve (Ed.), 18, JAI Press, London, 2001, 408. Since our interest is in firm performance, and since the latter takes into account the dyadic relationships, we consider a focal firm’s multimarket contact, vis-à-vis the rest of the industry.
horizons and influence managerial cognition (Greve 1998). There is abundant opportunity for ESS firms to learn about their rivals, and thus provide familiarity through understanding past actions and gauging future strategic behavior. Not only is there a plethora of product and vendor information in the media (Swanson 1997), but the ESS industry is also characterized by a small group of technology consulting firms where personnel turnover and cross-firm movement is the norm (Gosain, et al. 2005, Keil and Tiwana 2006). Thus, when the same two ESS firms compete in multiple software markets, the opportunity to learn about each other’s Application Programming Interface (APIs), integration issues and other technical elements only increases.

The second element leading to mutual forbearance is deterrence, or the extent to which a firm can prevent its rivals from initiating aggressive tactics which eventually are strategically harmful (Bernheim and Whinston 1990, Jayachandran, et al. 1999). Certain characteristics of ESS products make it possible for the vendors to present a credible threat to its competitors. For instance, most often ESS components do not incorporate strongly patented technology, thus making it easier for competitors to retaliate by mimicking rivals’ products. Further, the highly capital intensive nature of software implementation for client organizations also makes it feasible for ESS vendors to engage in flexible pricing. This creates the opportunity to engage in competitive pricing if the need to retaliate ever arises (Cusumano 2004). For example, since the marginal cost of software components is negligible, ESS vendors are able to offer highly discriminatory pricing to buyers by manipulating licensing fees, service, maintenance, training and installation contracts. In addition, ESS vendors also have the ability to engage in bundle pricing by providing complementary components at relatively nominal prices. All these
price dimensions allow ESS vendors to easily re-price their products as retaliatory tactics. Further, whereas in some industries (e.g., semiconductor design and manufacturing), investments in long-term basic research and development go a long way, the most central characteristic of ESS products are prices and continued support. Thus, one can observe frequent promotions and re-pricing decisions, thereby creating an environment where mutual forbearance is most likely to be fostered.

The supply-side externalities of familiarity and deterrence with market rivals is considered as essential for fostering mutual forbearance (Jayachandran, et al. 1999). Thus we can argue that ESS firms that enjoy high multimarket contact, i.e., repeated contacts with multiple rivals are in great position to enjoy the benefits of mutual forbearance and in effect strengthen their position through tacit collusion.

**Hypothesis 1:** The performance of an ESS firm is positively related to its degree of multimarket contact with the other ESS firms.

### 2.3 Demand-side need for integration and product domain overlap

Extant research in strategy has hypothesized that market domain overlap can intensify competition and lead to lower performance. Market domain overlap is a concept borrowed from the population ecology literature (Hannan and Freeman 1977, McPherson 1983) and it refers to the extent to which firms compete in rivalrous markets. Therefore, at the firm level, market domain overlap is the extent to which a firm has overlapping markets with all other firms in the industry (Baum and Korn 1996). A market with high overlap is understood to have a higher intensity of competition for resources and consumers because many rivals participate in these markets (McPherson 1983). This is possible in the ESS industry because each component market requires skilled technical
personnel and some amount of specialization. The same potentially applies to the consumer base because a greater number of firms compete for the same consumers in a market with high overlap. Thus, consistent with the notion that market domain overlap is a measure of intensity of competition (Baum and Korn 1996), firms with high degree of market overlap might be expected to have lower levels of performance.

However, we propose that, unlike many physical goods and services markets, ESS markets exhibit indirect (client-organization driven) externalities that might trump resource considerations present in markets with high domain overlap. At a very fundamental level, the ESS industry is devoid of plug-and-play standards, i.e., an enterprise cannot expect to buy its supply chain module from i2 and human resources module from Oracle and expect them to work seamlessly without significant integration costs. However, as discussed earlier, it is also imperative that independent of where the modules are acquired, they all operate as a system. Furthermore, it is well established that components from the same firms work better with each other. Thus, in other words, a client enterprise’s choice in component market is not independent of its choice of other components. At one end, a strategy for ESS firms could be to simply offer all or as many components as possible. Research on IT industries has suggested when such complementarity benefits exist, the entire product suite becomes far more attractive for organizational buyers than a single component (Chen and Forman 2006). However, this might be a costly proposition, particularly if firms follow a best of breed approach to buying components (Markus, et al. 2000).

On the other hand firms have the potential to strategically participate in selective markets so as to appear attractive to their customer base. The question therefore is which
product markets signal this attractiveness to consumers? We propose that such positive externalities exist when firms choose markets that are considered important and core to client firms. An obvious manner to identify such core markets is to choose those with the largest customer base. However in an industry where new components are consistently being created with advances in technology, it may be difficult to apriori ascertain which product market is likely to be most important to consumers. For example prior to the advent of the Web-based strategies and establishment of data acquisition and mining techniques, CRM modules were not considered critical by most client organizations. For an ESS firm, an easier way to identify such product markets is to look at the actions of the rest of the industry. In such industries, where new markets can constantly emerge, it has been suggested that firms often adopt a mimetic or herding behavior to market selection rather than through strategic, e.g., game-theoretic methods (Haveman 1993, Haveman and Nonnemaker 2000). A simple reason is that it is often difficult to a priori calculate the cost-benefits of participating in these markets.

Therefore, one way to identify a potentially important market that might generate network externalities is to consider those that are also attractive to other firms in the industry. Market domain overlap provides us with one such measure. In fact this tradeoff – for and against participating in a less crowded versus highly crowded markets - - has been examined by research on niche theory as well. The specialization argument would suggest that firms will want to minimize market overlap so that they can exploit a narrow set of resources not exploited by other firms, i.e., they will compete in a specialized niche (Carroll 1985). On the other hand the generalization approach would suggest what Porter (1996) characterizes as a “variety-based” strategy for competitive
positioning. Here, firms provide a larger set of goods, a wider niche – the main advantage being that they mitigate risks of a particular niche becoming irrelevant due to shifting of environmental resources (Hannan and Freeman, 1977). Note that the motivation of this extant strategy area is purely from a competition for resources in a given market. However, in the ESS industry we suggest that these actions have less to do with resources and more to do with externality benefits from signaling to the client base that the firm is an important player since it participates in markets considered important by others.

In the ESS industry, consideration of support, service, maintenance, cross-product integration and upgrades are all important part of the pre-purchase process (Tingling and Parent 2004) as well as to the post-purchase lifecycle of the products (Sabine and Swanson 1999). One way to assure client firms is to demonstrate through resource pool of consultants and implementers, e.g., certified SAP consultants. Typically, an ESS firm will draw a large pool of such resources only if it has a presence in the important markets. Thus not only to attract customers, but even to attract certain resources, firms may have to strategically choose to participate in certain component markets even if it is crowded with other firms. Therefore we suggest that in software markets with externality benefits across markets, ESS firms benefit being present in markets with high domain overlap.

**Hypothesis 2:** The performance of an ESS firm is positively related to its degree of market overlap.

Our discussion of multimarket contact emphasized the benefits of mutual forbearance and tacit collusion. Now we examine the question as to what type of firms is better able to leverage the opportunity to exercise mutual forbearance or engage in tacit
collusion? The benefits of multimarket contact depend on the competitive processes of familiarity and deterrence. Clearly, an ESS firm that is present in crowded or high-overlap markets has a greater opportunity to learn about its rivals. Similarly presence in these markets is also a show of strength and hence such a firm can also credibly deter a rival in any attempt to undercut prices or engage in other multimarket competitive action. Therefore we suggest any benefits of multimarket contact are better extracted by a firm with a higher degree of domain overlap.

**Hypothesis 3**: The impact of multimarket contact on firm performance is increasing in an ESS firm’s market overlap.

2.4 Control variables

It is important to control for two theoretically salient variables in explaining firm performance – number of software components and net market size of firms. From a resource-based point of view, high technology industries are known to exhibit economies of scale and scope (Teece 1980). In particular, multi-product firms are known to possess opportunities that are based on transferring technologies across product lines and even melding them to create new ones. Even if functional areas are distinct and require specialists, the programming itself can be leveraged across disciplines and hence offering a greater number of software components can be profitable. Many software suites exhibit economies of scope, e.g., Microsoft leverages economies of scope in the desktop publishing arena and offers software for functionally diverse areas such as word processing, spreadsheet management and presentation management. The source of economies of scope is not only restricted to programming and functional capabilities but it also includes access to consultants and implementation specialists. While the end-user
of an ESS software component is the organizational user, e.g., accountants, and shop-floor managers, the components themselves are installed by third-party consultants as there is always a degree of customization required to support organization specific business processes. These management consultants such as CGEY, KPMG, Accenture and others, implement software components that cut across various functional disciplines and develop close relationships with the ESS vendors themselves. Therefore if such advantages from economies of scope exist, an ESS vendor producing a larger number of software components should see positive impacts on performance.

Further, unlike end-user oriented software such as desktop publishing suites, ESS components are developed for specific industries such as the automobile, defense, or aerospace industry segments (Sandoe, et al. 2001). The components are built with templates that are specific to a particular industry and the business processes conducted within, and such templates are then customized to suit the needs of the specific organization. For example, one industry type may follow a first-in-first-out accounting practice while another may follow a last-in-first-out method for its inventory management practices (Davenport 1998). Generally, customizing a software component for a given industry implies providing an instance of a business process specific to that industry type; it does not imply a full customization since that is managed by the implementers hired by the client-organization. Prior research has suggested that when such large degree of code reuse is possible, there are indeed production economies of scale in software development (Banker and Kemerer 1989). These arguments would suggest that an ESS firm is better off by customizing software components for a number of different industry segments. Thus, we should control for the total market size of an
ESS firm before we discern any specific impact of multimarket contact and domain overlap.

Also, this is a technology industry with many mergers and acquisitions of large and small firms. Generally it has been suggested that in any temporal analyses of such industries (Hagedoorn and Duysters 1999), firm-level changes need to be accounted for and hence we control for any such event. Finally firms differ largely in their base resources and prior research suggests that controlling for firm-size is important to any analysis on firm-performance (Haveman 1993).

3 Data and Method

We collected data from two independent sources. Our first source is an unbiased (not related to any ESS firm or end-user organization) industry group (Reed Elsevier Inc.) that employed a consulting organization to collect revenue and other information for nearly a complete set of ESS firms, to be included in its publication (MSI index and newsletter). Since most of the firms in the ESS industry are privately held firms, the only way to acquire revenue, component markets competed in and other information is to directly solicit this information from the firms. To this end, the consulting organization sends out a survey every other year to collect this information and nearly all ESS firms (big and small) participate in this survey. While the term “survey” is used, it is actually a reporting of factual numbers from the top 100 firms in this field, i.e. the “survey” does not include subjective or perceptual questions. The list of firms, to whom the survey is sent to, is compiled by a group of consultants who are highly experienced professionals in the industry. Over the three time-periods considered in our research, the actual sample
consisted of only 97, 98 and 95 firms (even if it is a Top 100 list) since there was incomplete data from a few firms.

While this data source provides much of the revenue and product-portfolio information of ESS firms, additional elements such as firm-size and alliances had to be acquired from other independent sources. These include Mergent Online company database, Security and Exchange Commission filings, Gale Group database and OneSource Business Browser; we compared the information from the primary data source with publicly available ones and found no discrepancy. Further, each firm in the list was contacted over telephone by a revolving group of research assistants over the data collection period, and was compared with a manager and senior manager at Ernst & Young (now CGEY) who have extensive knowledge on the partnerships between ESS firms since they implement most of these modules. To the best of our knowledge this is a comprehensive list, as there are no secondary data sources that maintain this information.

Firms compete in a number of different software component markets, e.g., Enterprise Resource Planning, Customer Relationship Management, Advanced Planning and Scheduling, Supply Chain Planning, Transportation and Logistics, Business Intelligence modules. In addition these firms also customize their generic products for specific vertical industry segments, e.g., Aerospace and Defense, Automotive, Consumer Packaged Goods, Electronics and Computer Industry, Food and Beverages, Pharmaceuticals, Service Parts, etc. The information about the specific components was acquired from a combination of the above-mentioned sources. Overall, we have data for three time cross-sections between 1999 and 2003 for an initial panel of 69 ESS firms with a total of 180 usable observations.
3.1 Measures

We now provide a description of our dependent and independent variables. To avoid any causal ambiguity along the lines of earlier work (Li and Greenwood 2004), the control and independent variables are measured in year $t$, and the dependent variable is measured in year $t+1$.

ESS firm performance (LSREV): This is our dependent variable and we use the natural logarithm of revenue from software licensing as an indicator of firm performance. Revenue has been commonly used as a measure of firm performance in studies investigating impact of multi-market contact (Jayachandran, et al. 1999) among others (Zaheer 1997).

Firm Size (EMP): Literature provides many ways to control for the effect of organizational size when investigating the effect of other dependent variables on firm performances (see (Haveman 1993)) for an extensive review on measuring organizational size). In our study we use employee strength (in thousands) to represent firm size and this is appropriate as the ESS industry is primarily dependent on human capital (programmers).

Merger/acquisition (MAQ): Any merger/acquisition activity has to be controlled for and we use a binary variable (MAQ) for this purpose. MAQ is 1 when a firm has undergone a merger or acquired another firm in a given year $t$, and 0 otherwise.

ESS firms’ software components markets (SFT): For each time period, data on the number of software components produced by the firm was acquired. This was normalized with respect to the total number components that make up an entire enterprise system.
**ESS firms’ total market size (MSIZE):** Data on number of industry segments for which each software component was produced was collected for each time period. The total market size is given by the software components produced multiplied by the industry segments competed in; this number was then normalized with respect to the maximum possible market size in the industry.

**Extent of multimarket contact (MMC):** We compute multimarket contact along the lines of Baum and Korn (1996, p.273). An intuitive explanation to MMC is that it is a measure of how often a focal firm meets a rival firm, a dyadic connection. Thus the extent of multimarket contact is a measure of each such dyadic connection in the entire industry for the focal firm. Thus if you consider a firm $i$’s multi-market contact in each market separately, you can compute the sum of all multimarket contacts in each software component market for a firm $i$. As per Baum and Korn (1996), multi-market contact for a firm $i$ in a market $m$ is given by

$$MMC_{im} = \frac{\sum_{j} \sum_{m} D_{ij} \cdot D_{jm}}{\sum_{m} D_{jm} \cdot N_{MMC}}, \forall j \sum_{m} (D_{ij} \cdot X_{jm}) > 1$$

(1)

$D_{im} = 1$ if firm $i$ competes in market $m$ (as in Table 2) and $D_{jm} = 1$ if firm $j$ competes market $m$. $N_{MMC}$ is the number of firms that contact the firm $i$ in at least one market other than market $m$. To calculate MMC for a firm $i$, we aggregated the multi-market contact of firm $i$ (equation (1)) across all the software component markets it participates in. Thus,

$$MMC_i = \begin{cases} \sum_{m=1}^{SFT_i} MMC_{im} & \text{when } SFT_i > 1 \\ 0 & \text{when } SFT_i = 1 \end{cases}$$

(2)

i.e., multi-market contact in software component markets can occur for a firm $i$ only if it participates in more than one market.
Market Overlap (MOVP): This measure is also derived from by Baum and Korn (1996), and represents the set of markets in which a firm operates. Intuitively it simultaneously measures not only the number of markets a firm participates but also how many other firms participate in each of those markets. Formally, it is given by:

$$\text{MOVP}_i = \sum_{i \neq j} \frac{\sum_mD_{im}D_{jm}}{\sum_mD_{im}}$$

where $m$ denotes the given market in full set of component markets. The market domain overlap of firm $i$ with the rest of the vendors in the sample varies from zero to $n-1$, where $n$ is the number of ESS vendors in each time period in our sample. When a firm $i$ competes with other ESS firms by offering the entire range of software components that they offer, then the market domain overlap is said to be at its maximum. This measure is a much more fine-grained assessment of the intensity of competition than can be obtained by using common measures such as the Herfindahl index that assumes significant homogeneity among firms in terms of their products and customer base.

3.2 Model and analysis

We formally test our model through a time-fixed effect, random-coefficient regression model as given by the following equation. While we can possibly use ordinary multiple regression techniques on panel data, they may not be optimal since the estimates may be subject to omitted variable bias. With our current data and analyses, it is possible to control for some types of omitted variables even without observing them, by observing changes in the dependent variable over time.
The dependent and independent variables are as described in the earlier section. Random effect models for longitudinal data are regression models in which the regression coefficients are allowed to vary across the subjects. There are essentially two components to this model; a within-firm component where a firm’s change over time is given by a regression with population-level intercept and slope. The second element is the between-firm component where variation in firm intercepts and slopes are captured. In our model $\nu_i$ is the firm-specific residual and $\epsilon_{i,t}$ is the standard residual with mean zero and uncorrelated with the other terms in the model. While there are a number of ways of analyzing longitudinal data, the random effects analyses does not require that subjects are to be measured on the same number of time points and the time points do not need to be equally spaced. Since many mergers and acquisitions take place in the ESS industry over time, and as information on some firms was not available for all time cross-sections, we essentially have an unbalanced panel.

While the fixed-effects model makes a strong assumption that $\sigma_\nu = 0$ (firms are unchanged over time), we can instead think of each firm as having its own systematic baseline where each intercept is the result of a random deviation from some mean intercept. In the random-effects model, the intercept is a draw from some distribution for each firm and instead of trying to estimate $n$ (no. of firms) parameters as in the fixed effects case, we only need to estimate parameters describing the distribution and hence a $\sigma_\nu$ is reported. More importantly, the results from the random-effects model can be generalized.
Note that while $\beta_0$ is intercept of the regression, coefficients $\beta_1, \beta_2$, and $\beta_{10}$ are additional intercepts for each year. Note that we take $t_3$ to be the base year and hence $\beta_{10} = 0$.

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<td>Market Overlap</td>
<td>MOVP</td>
<td>0.56</td>
<td>0.19</td>
<td>-0.06</td>
<td>-0.09</td>
<td>-0.26</td>
<td>-0.22</td>
<td>-0.24</td>
</tr>
</tbody>
</table>

**Table 1: Descriptive and Bi-variate Statistics**

Table 1 provides the descriptive statistics of our dependent and independent variables. As can be seen from the pair-wise correlations, there are no multicollinearity problems except in the case of software components and net market size (high correlation but not significant). To further examine for any potential problems, we conduct collinearity diagnostics and the Variance Inflation Factor (VIF) is less than 3.9 – this suggests that no obvious multicollinearity problems exist. In Table 2, Model 1 corresponds to the base model with the control variables. Model 2 includes our variables of interest to capture competitive dynamics in this industry. We use the Schwarz'
Bayesian Information Criterion (BIC) to compare the two models, given any two estimated models, the model with the lower value of BIC is the one to be preferred. The BIC is a decreasing function of residual sum of squares, the goodness of fit, and an increasing function of the number of free parameters to be estimated. The BIC penalizes free parameters more strongly than does the Akaike information criterion (AIC) and is generally considered to be a better metric than AIC or -2log likelihood measures. The table also reports the variance of firm-specific residuals and uncorrelated error term with zero mean.

3.2 Results

Table 2 presents the results of our model. At the outset we should note that the control variables firm-size and the occurrence of merger/acquisition are both significant at 99% confidence level and positive along expected lines. This simply tells us that large firms have large revenues and a merger or acquisition adds to the revenue. An important reason to control for these two variables is to ensure that any variance in the dependent variable caused by differences in firm size and merger-related activity is soaked up.

The next two control variables account for the number of software component markets a firm participates in and the total vertical industry segments it serves. Note that from the correlation matrix and collinearity diagnostics, there is no correlation between firm-size and these variables, i.e., it is not necessary that larger firms participate in more markets. But interestingly observe that the coefficient for SFT ($\beta_3$) is negative and significant at the 95% confidence interval. This tells us that simply participating in large number of markets actually make the firm worse-off, thus rejecting any economies of scope argument.
<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>3.45*** (0.20)</td>
<td>3.42*** (0.19)</td>
</tr>
<tr>
<td>Firm Merged or Acquired MAQ</td>
<td>0.41*** (0.15)</td>
<td>0.41*** (0.15)</td>
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<tr>
<td>Firm Size EMP</td>
<td>0.09*** (0.02)</td>
<td>0.09*** (0.02)</td>
</tr>
<tr>
<td>Software Components Produced SFT</td>
<td>-1.36** (0.87)</td>
<td>-1.97** (1.10)</td>
</tr>
<tr>
<td>Net Market Size MSIZE</td>
<td>1.85*** (0.93)</td>
<td>2.59*** (0.98)</td>
</tr>
<tr>
<td>Multi Market Contact MMC</td>
<td></td>
<td>0.55** (0.55)</td>
</tr>
<tr>
<td>Market Overlap MOVP</td>
<td></td>
<td>0.88* (0.60)</td>
</tr>
<tr>
<td>Multi Market Contact * Market Overlap MMC</td>
<td></td>
<td>3.86*** (1.49)</td>
</tr>
<tr>
<td>YR1</td>
<td>0.84*** (0.17)</td>
<td>0.96*** (0.17)</td>
</tr>
<tr>
<td>YR2</td>
<td>0.28** (0.16)</td>
<td>0.34** (0.16)</td>
</tr>
<tr>
<td>YR3</td>
<td>0.00 (BASE)</td>
<td>0.00 (BASE)</td>
</tr>
<tr>
<td>$\sigma_u$</td>
<td>0.807***</td>
<td>0.7761***</td>
</tr>
<tr>
<td>$\sigma_x$</td>
<td>0.348***</td>
<td>0.3263***</td>
</tr>
<tr>
<td>BIC</td>
<td>530.0</td>
<td>526.9</td>
</tr>
<tr>
<td>No. of Observations</td>
<td>180</td>
<td>180</td>
</tr>
</tbody>
</table>

*** p<0.01, ** p<0.05, *p<0.1

Table 2: Results
On the other hand the coefficient for MSIZE ($\beta_4$) is positive and significant at the 99% confidence interval implying that once a firm sells a component, creating templates for different vertical industry segments is beneficial – suggestive of economies of scale in serving multiple vertical industry segments.

In Model 2, we introduce the hypothesized variables of multimarket contact, market overlap and their joint effect. We see that the coefficient for MMC ($\beta_5$) is positive and significant lending support to our Hypothesis 1 that higher multimarket contact leads to better firm performance. This suggests when an ESS firm engages multiple rivals in multiple markets, it enjoys the benefits of mutual forbearance. The coefficient for MOVP ($\beta_6$) is positive and weakly significant at the 90% confidence level suggesting there is some evidence of the suggested externality benefit in Hypothesis 2. Importantly, we find that firms with a high degree of multimarket contact gain further by extending their domain overlap, supporting our earlier assertion that the power of mutual forbearance and tacit collusion can be better exercised when the firm also participates in the important markets. The coefficient for MMC*MOVP ($\beta_7$) is relatively large in magnitude, positive and highly significant at the 99% confidence level, thus lending strong support for Hypothesis 3. Note that the coefficients for both $t_1$ and $t_2$ are both significant and positive, while the third time period $t_3$ was the base; given that the base year was 2003, which is well after Y2K we can see that the revenues before 2003 were higher. This is consistent with changes in investments in systems software which saw their peak around 1999.
Table 2 also presents information on the firm-specific residual and the uncorrelated error-term; for the final model (Model 2) with all the hypothesized independent variables included, the results show that the former has a variance of 0.776 while the latter with zero mean has a variance of 0.326. Note that both these measures are highly significant \((p < 0.001)\) suggesting that the firm-specific effect on firm performance can be drawn from a distribution whose variance is 0.776. Also note that our analysis categorically shows that Model 2 with the competitive effects included is a superior fit since it has a lower BIC. Further, while the SAS procedure used for this method does not automatically provide the Chi-Squared \((\chi^2)\) value, it can be computed by subtracting the -2 log likelihood value of the models and comparing it a Chi-Squared table for the relevant degrees of freedom. The Chi-Squared test values are also highly significant indicating that the models proposed have sufficient goodness of fit.

4 Discussion

Literature in information systems (IS) recommends the adoption of uniform standards within an organization, known as the corporate information technology (IT) standards (Aach 1994, Gordon 1993), wherein an organization frames policies to ensure enterprise-wide compatibility of its systems and processes. This often translates to “all departments running on the same (software) suite so information can be shared more easily,” (Dewan, et al. 1995). The benefits of adopting such a corporate IT standard include those from coordination (Malone 1987), enhanced connectivity from data integration (Goodhue, et al. 1992, Wybo and Goodhue 1995), reduction in IT maintenance costs and local IT responsiveness (Kayworth and Sambamurthy 2000),
among others. Clearly, components of the same firm are most compatible with each other. Thus, the need for compatibility combined with the potential for economies of scope would indeed suggest an ESS firm should simply increase its portfolio of product offerings. Our research provides clear evidence against this, that firms that simply have a large number of products (i.e., software components) are actually worse-off. Does this then imply that client enterprises do not care about integration anymore?

The answer to the above question lies in understanding the common ways in which ESS products are purchased and implemented. First, all ESS components are not typically purchased at the same time, client organizations typically roll out a sequential implementation schedule. Second, new components markets continue to emerge as new business processes and model emerge. Finally, there are always integration consultants who can make two different components from two different vendors work, albeit at a cost. These suggest simply having a portfolio of all components are not intrinsically the only influencing factor. Rather, our results clearly suggest that an ESS firm stands to gain if it strategically chooses markets that are considered significant. Even if a firm does not know what these markets, evidently participating in markets that most other vendors competes is a credible show of strength to the consumer. This suggests that client organizations when buying components prefer firms that offer components in important markets. Thus any externality benefit driven by the user need to integrate components can be extracted only by such strategic choices of markets. Therefore, our results suggest that the common fear of competing for resources (and hence avoiding markets with high overlap) as observed in other industries is not a valid concern for competition in ESS and
other digital goods industries. Rather, the user driven need to integrate and the resulting indirect externalities trump any resource consideration arguments.

Note that result also go against the grain of analytical models in economics of standards that have suggested that firms should offer a large number of software components to extract externality benefits by internalizing the complementarity effects (Economides 1988, Matutes and Regibeau 1988). Our results suggest that these complementarity benefits exist only when components are offered selectively, i.e., vendors should strategically extend their functionality footprint across the ESS portfolio. The resource-based view research provides another plausible explanation for why simply participating in a large number of component markets may not be beneficial. Gimeno and Woo (1999, p.329) argue that a firm’s success in leveraging the economies of scope is intricately related to the possibility of competitors also pursuing the same strategies, “even if economies of scope make firms more efficient, those economies may not result in superior performance if rivals are able to draw on similar economies and are motivated to compete intensely.” This is perhaps supported from the fact that multimarket contact is a common occurrence in this market.

Interestingly, while competing in multiple component markets may not be beneficial, it is evident that ESS firms benefit from customizing whatever components they produce to different industry sectors. We find supporting arguments for such scale economies in other high technology industries as well where it has been observed that “Product proliferation involves serving as many niches in the market as feasible by customizing the product offering to appeal to different users. To the extent that such a
strategy is successful, it maximizes the potential size of the market and, therefore the rate of growth of the installed base.” (Hill 1997).

Theories of multimarket competition argue in favor of firms engaging in mutual forbearance, implying that when firms compete with each other in many markets they may engage in a form of tacit collusion leading to higher prices and revenue (Bernheim and Whinston 1990). While there is adequate evidence of this phenomenon in many different industries, prior research underlines the need to investigate multimarket contact together with other market characteristics (Gimeno and Woo 1999). Our empirical findings not only support the mutual forbearance hypothesis (Jayachandran, et al. 1999) but do so in the face of other variables. An important assumption in the mutual forbearance theses for Berheim and Whinston (1990) and others is that multimarket contact is result of conscious decisions by firms. While multimarket contact is implicitly assumed to be a deliberate strategic intention on the part of a firm to trigger mutual forbearance, such a contact could also simply be an incidental outcome of market dynamics (Jayachandran, et al. 1999). However, we can see that while multimarket contact and domain overlap are not correlated (i.e., firms with high multimarket contact do not necessarily have high domain overlap), ESS firms are able to better leverage the multimarket benefits when they also simultaneously make strategic choices about their market participation. This is an important finding in the face of digital competition where constantly newer markets emerge.

4.1 Managerial insights

Several managerial insights can be drawn from our results: First, ESS firms are better off by focusing on fewer number of software components while ensuring that they
can instantiate a version or template for multiple industry segments. Thus while there
may not be benefits of SAP attempting to leverage its programmers who write code for
HR modules into writing Accounting modules, there are indeed advantage of positioning
its HR module for not only the automobile industry but perhaps for food, services,
telecommunications and others as well. Second, the market selection should be a
strategic one, i.e., even if a firm has expertise only in one or two component markets, it
benefits by participating in core product markets as defined by the industry. If a market
is deemed to be important resulting in multiple firms, it is judicious for the focal firm to
participate in there as well without fear of intensity of competition. Finally, firms should
simultaneously identify multimarket rivals so to maintain this rivalry as they branch into
newer markets.

Note that these results are not only applicable to ESS firms but also to the wide
array of information services firms like Google, Yahoo! and others. A key takeaway
being that a new firm with a specialized portfolio cannot survive if it also doesn’t offer
services in the already crowded email, portal and other service arena. It perhaps speaks
to why firms such as YouTube are quickly absorbed into larger portals, and very few
independent niche providers survive in the long term.

4.2 Limitations and future research

One limitation of our dataset is that we do not have individual performance
metrics for each component market, this might have allowed us to further identify market
level phenomenon in addition to our current industry level analyses. Further, we also
know that ESS firms engage in alliances to overcome product incompatibility, it would
be interesting to relate market participation decisions and alliance choices. Further, the
nature of enterprise software is such that new functional requirements continually emerge as business practices change and it would be interesting to study how incumbents choose to enter into new markets and study their survival.

The movement of organizational consumers toward Web services rather than installed components provides future researchers a rich base to study multimarket competition and related vendor strategies. Future studies can also perhaps try to test the recent argument that mutual forbearance may be limited or cease to exist with constant innovation (Roy and Prescott 2002)

References


