Do Markets Prefer Open or Proprietary Standards for XML Standardization?
An Event Study

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ABSTRACT: Proprietary standardization seeks to increase a firm’s market share (pie sharing). Open standardization seeks to increase the size of the market (pie expansion). In order to determine which of these creates more value for a firm involved in standardization, this paper investigates the market value of standardization initiatives, using an event study based on 148 XML schema standardization initiatives collected from the Lexis-Nexis database between January 1999 and December 2003. The results show that financial markets respond positively to announcements of proprietary XML schema standardization, but not to those of open XML schema standardization. Moreover, investors do not develop a preference for open standards over time. These results have implications for the management of standardization strategies and identify future research opportunities.

KEY WORDS AND PHRASES: Event study, open standards, standard, standardization, XML.

As information technology (IT) becomes more integrated within and across firm boundaries, standardization becomes critical to business computing. Standardization is the array of activities associated with developing, promoting, executing, modifying, and maintaining a standard. It entails more than simply writing the details of the standard. It is an ongoing process whereby firms commit their resources to a technology specification and the products of which that specification is an element. Standardization is pursued by firms that wish to gain economic advantage from licensing the standard and also by firms that wish to gain economic advantage by selling a product which make use of the standard.

Firms that commit their resources to standardization have to choose between open standards and proprietary standards. A standard’s sponsors can keep the standard proprietary by tightly controlling the intellectual property rights to it, or they can make the rights available to other entities throughout the process of creation, implementation, and use of the standard [23]. The former leads to proprietary standards, the latter produces open standards. Open standards are available for use to any firm either for free or for a reasonable and nondiscriminatory price. Proprietary standards, in contrast, are owned by a single firm or a small group of firms that must give permission before the standard can be used in any way.

It is as yet unclear whether open standardization is superior to proprietary standardization. Firms are still experimenting with both strategies, sometimes simultaneously. IBM, for example, supports, promotes, and develops the open Linux standard. Microsoft, on the other hand, supports, promotes, and develops the proprietary Windows standard. A typical pattern in the standardization process for Web services is that technology vendors submit proposals for open standards and also engage in developing proprietary standards [32].
Unfortunately, there is a disconnect between the units of analysis used in considerations of open standardization and proprietary standardization. Proponents of open standards point to the social and industry-level benefits derived from wide-scale adoption of open standards [28, 30]. They argue that firms should collectively commit to open standards. Examinations of proprietary standards ignore the issue of social benefit and instead focus on how firms can compete in the standardization process to enjoy monopoly power [4]. Open-standard theories are not concerned with the value to individual firms of committing resources to a standard or the incentives for doing so. Proprietary-standard theories are not concerned with social benefit and how it influences willingness to commit to a standard. As a result, there has been very little empirical or theoretical comparison of the worldviews of open and proprietary standards.

IT research recognizes that firms exist in an industry, and therefore that the benefits to an industry from open standards accrue individually to all the firms in the industry [10]. Applied to standardization, this perspective shows that proprietary standards are concerned with pie sharing—trying to increase your share of the pie, and open standards are concerned with pie expansion—trying to increase the size of the pie while leaving your share fixed. The “pie” here is the total market for the technology that technology providers are trying to grab for profits. The value a firm gains from supporting one or the other type of standard depends on the relative merits of pie sharing versus pie expansion.

In the discussion that follows, the perceived value of open and proprietary standards will be made more clear by an examination of the stock market responses to standardization initiatives with XML technology using the event study methodology [29]. As will be shown, markets perceive more value in proprietary standards than in open standards. In other words, the market puts its resources into standardization initiatives aimed at increasing a firm’s share of the pie, and not into standardization initiatives aimed at pie expansion.

Theory

A theory for understanding proprietary and open standards is outlined below, followed by some proposed research hypotheses for ascertaining how investors value the two types of standards.

Standards and Standardization

A standard is “a set of technical specifications adhered to by a product, either tacitly or as a result of a formal agreement” [9]. Standardization is the process of getting those specifications or products adopted, and requires a commitment of resources by both the developer of the specification and the providers of the products that embody it.

Products that are compliant with standards are more valuable to users than those that are not standard-compliant. For example, as Brynjolfsson and
Kemmerer observe, spreadsheet software functionality that is compatible with
the market standard raises product prices after product quality is taken into
account [6]. Wide-scale standardization also encourages technology adoption
because it reduces the adoption cost. This is exemplified by the adoption of
XML technology in the mortgage industry, where the lower adoption costs
allow small firms to enter the industry with the desired technological infra-
structures [31].

Standards are especially important in markets characterized by network
effects—that is to say, positive interdependence between the value of the prod-
uct and the number of users [25]. In the presence of network effects, compat-
ibility between products from different suppliers makes the products more
valuable to users because it enables access to a large network [20]. A network
product becomes more valuable to users when it is compatible with comple-
mentary products [21]. In such markets, the existence of relevant standards
increases the likelihood of the compatibility that will in turn encourage user
adoption.

In IT industries, network effects are observed both in physical network prod-
ucts, such as automated teller machines, and in intangible network products,
such as spreadsheet software that delivers value in the context of user com-
munication and interaction [6, 22]. When a technology or a product becomes
the standard in a market, it achieves the maximal compatibility with other
products and has higher value than competing technologies. Thus it is strate-
gic for sponsors of technologies to make their respective technologies or prod-
ucts the standards in markets.

Standards are established through different processes. In some cases, rec-
ognized formal standardization organizations publish technology specifi-
cations for acceptance by firms in relevant industries. In other cases, standards
emerge when one product and its underlying technology specification becomes
dominant among the competing products in the market [15]. A variety of strat-
egies can be employed in standardization processes, including technology li-
censing, strategic alliances, product diversification, and aggressive positioning
[19]. On the one hand, a firm can use competitive strategies like penetration
pricing and preannouncement to expand and retain an installed base of users,
which is critical to making its proprietary technology the market standard
[17]. On the other hand, firms can form coalitions through alliances, licensing,
and cross-licensing their technologies to develop standards [1].

Pie Sharing and Pie Expansion in Standardization

Superficially, there seems to be no common theoretical framework for compar-
ing open and proprietary standards. The goal of proprietary standards is to be
monopolistic and thereby charge economic rents. The goal of open standards
is to foster adoption and create some societal value. One is a firm-level goal,
the other an industry-level goal. These two goals can be reconciled by looking
at standardization as a “pie-sharing” versus “pie-expansion” decision [27].

The “pie” refers to the firm’s market, and a “slice” of the pie is its market
share. When making pie-sharing decisions, firms are concerned about two
things: How big is the pie, and how much of it do I get? A firm can be equally happy with a small slice of a big pie or a big slice of a small pie. Figure 1 illustrates this principle. A firm must choose which “dark” slice it wants.

In the standardization context, the pie is not just the market for the standard. It is the market for a technology of which the standard is a component or for the products that embody the standardized technical specification. Standards are not interesting or valuable in and of themselves. They are only valuable when incorporated with other technologies that need to communicate with one another. For example, the 802.11 wireless standards are useless until incarnated into a device with wires and transistors and resistors that actually allows information to move from one place to another.

There are two types of activities a firm can undertake in a pie-sharing context. It can try either to get a bigger piece of the pie or to expand the pie [5]. Proprietary standards are aimed at getting a bigger piece of the pie—namely, all of it. Open standards are aimed at creating a larger pie. Thus, the change in a firm’s value is determined by an investor’s perceptions of the relative merits of increasing its share of the pie and increasing the size of the pie.

The proprietary approach is straightforward, as Shapiro and Varian explain in more detail [27, ch. 9]. The underlying premise is that the market, in the long run, prefers a single standard (i.e., customers are willing to pay more for it). In consequence, the supplier of the single standard can charge economic rents, and each entrant into the market must fight for the entire pie. Standard developers expend considerable resources in an attempt to corner the market and earn the associated rents. For example, Circuit City spent more than $200 million promoting the DIVX standard for DVD’s, even though it was not a success in the end [14]. These up-front expenditures are justified because of the profits the firm would have collected as a monopoly if it had succeeded in making DIVX technology the market standard. For DVD players, the license fee is about $14 plus $0.20 per disk. With about 1.5 billion disks shipped and 72 million players worldwide as of 2003, the potential pie for Circuit City was well over $1 billion. To summarize, the proprietary-standardization approach says that firms should devote their resources to gaining the entire pie.
To make this comparable with the open-standard approach, one must recognize that the pie-sharing approach in standardization does not differentiate between a product that embodies a standard and the standard itself. It assumes that there is no profit in manufacturing the standardized product. More specifically, it assumes that the product is a commodity good that can be had at marginal price, and so there is no profit to be made from the standardized product. However, Dell clearly disproves this assumption. There is profit to be made in manufacturing low-cost or high-quality products that make use of a standard.

In reality, many owners of proprietary technologies license them to competitors who then build, or compete in the building of, products that support a standard. For example, Sony licenses its proprietary CD technology to other firms that build CD players. Within the pie-sharing approach with a proprietary standard, the pie is the licensing fees or value added from the standard. A firm that owns a standard can license it to others and can also appropriate value from the standard by manufacturing products that embody it.

Control of a proprietary standard does not give any particular advantages or disadvantages in the technologies that make use of the standard. Proprietary standard setting ignores the rest of the pie—the market for a technology that incorporates the standard. It focuses on trying to capture all of the part of the pie that is attributable to the standard itself, which can be no bigger than the entire value of the market for the technology. Moreover, the standard-only pie is usually less than the entire technology pie.

Open standards, on the other hand, aim at the whole pie—technology plus standard. With an open standard, firms sacrifice some of the economic rents of monopoly control of the standard in exchange for more profit in the expanded market for a standardized product.

Not only does proprietary standard setting ignore the technology profits, it also ignores the rate of adoption. Competition among proprietary technologies slows down the growth of both the technology and the market because potential adopters are concerned about the risk of choosing a technology that will not build up a sizable user network in the future and limit the value of the technology [17]. For example, the competition between 3Com and Rockwell with the incompatible 56K modem slowed down the market growth for this technology and the enrollment in ISP services [27]. Growth rate is particularly important in IS standards, where a technology may be obsolete in a few years. When faced with too many choices, consumers tend to put off choosing [26]. The problem is compounded when consumers believe that only one standard will eventually emerge as victorious. Consumers do not want to risk adopting the wrong technology, so they wait.

By promoting an open standard, a firm encourages other firms to use the same standard. By definition, an open standard is made available to others for development, maintenance, and implementation. Usually, it is made available on reasonable and nondiscriminatory (RAND) terms. This is because the purpose of open standards is both sharing and an artifact of U.S. law. If several firms collaborate to set high or discriminatory prices, that is considered anticompetitive and therefore illegal. This aspect of open standards allows for maximum interoperability between different technologies and products, and
reduces the costs for coordinating the production of complementary products. With enhanced interoperability, organizations that implement open standards are able to deploy system integration and respond to technological changes cost-effectively [28]. Thus, open standards create a safe adoption environment relative to proprietary standards and are more likely to be adopted quickly and to be adopted en masse.

Furthermore, open standards avoid the typical intensive competition between incompatible products and proprietary standards, as well as the associated costs. By making adoption occur on RAND terms, open standards remove a good part of the economics rents that originate from the property rights to proprietary standards and that motivate interfirm competition with incompatible products. Thus, open standards are less expensive to produce and promote. On top of this, with proprietary standards, firms have to bear much of the cost of coordinating with complementary product providers through market mechanisms [16]. In contrast, open standards make it easier for producers of complementary products to comply with the standard. This means that technology vendors who incorporate the standards into their products can charge less or enjoy higher margins. If they charge less, then the standard is more widely adopted. If they enjoy higher margins by charging the same price for a less costly product, then there is more profit to be had. In either case, the market is expanded.

To summarize, open standards increase market size in a variety of ways. They encourage faster adoption, they encourage greater adoption through RAND terms, and they make larger margins possible. Any particular standard may provide these benefits to a greater or lesser degree, but the point is that the benefits of open standards accrue to the market. An individual firm benefits from supporting open standards because it is able to participate in a bigger market, and not because it charges monopoly rents for the use of the standard. Thus, open standards increase the size of the pie, not the share of the pie.

Theory Applied to XML Standardization

Before applying the theory to XML standards and developing hypotheses, the next step is to clarify the nature of XML standards. IT is often conceptualized as a stack of technologies. At the low levels of the stack are basic operations largely concerned with binary data or even with electrical flows. Higher in the stack are more abstract technologies that allow for the representation and presentation of information in some human-understandable form. XML resides at two adjacent levels. At the lower level are the technical details of XML, such as how tags are represented and how packets are addressed. This level is an open technology made freely available by the World Wide Web Consortium.

It is the next level that is of concern in the present research. At this level, the focus is on the semantic meaning of tags—the entities to be represented and their relationships to one another. XML provides a standard structure for describing the semantic contents of the document. The rules that define a set of
tags and the relationships among them constitute the XML schema. Since a standardized XML schema is needed if two information systems are to share data using XML technologies, standardized XML schemas are critical in the adoption of XML-enabled technology. This study focuses on the value of a standardized XML schema and the pie created by using it.

XML schemas are only one of the components of an information system. Among the other components are the software applications and the IT infrastructure within which the schema resides, the data, and the people who interact with the system. A schema in itself is only a representation of the structured data—it has to be used in a context to create value. For example, an organization might use a schema-defined structure to store invoice data, but preparing invoices requires a software application package, such as Tenrox PSA, which can generate invoices as XML files in compliance with a given schema from accounting records. Thus, XML In the example given above, an XML schema is embodied in the software application package TenroxPSA.

**Research Hypotheses**

Event study is a common method for investigating IT value in various contexts [11, 13, 29]. Investors often use a firm’s announcements of IT initiatives to assess the value the initiatives can bring to the firm, and their valuation will be reflected in changes in the share prices of the company’s stock. Following the same line of reasoning, the value relevance of standardization can be studied by examining the returns on stock prices on the announcements of standardization initiatives.

Both open and proprietary standardization perspectives suggest that standardization is a valuable investment of resources. Since bigger pies are better with expanded total market, and bigger slices are better with increased market share, standardization in either manner should be valuable. Therefore, consistent with both perspectives:

_Hypothesis 1 (Value of XML Standards): Firms obtain positive abnormal returns from the announcement of XML schema standardization._

Sponsors of open XML standards make the rights to the standard available to other entities through the whole process of creation, implementation, and use of the standard [23]. This is done in hopes of stimulating the rate of adoption and total market size for technologies that make use of the XML standard.

For XML there is reason to believe that the pie expansion associated with an open schema is more valuable to a given firm than the potential for capturing a larger slice of a smaller pie. The technologies and products that make use of an XML schema are much more complex and expensive to build than the XML schema itself. In fact, it is not unusual for an XML-using product to perform other useful tasks that are independent of the choice of XML schema, like generating reports or performing statistical analyses. This leads to two strikes against proprietary XML standards. First, the XML-schema piece of
the pie is small relative to the whole pie. Second, other organizations that are capable of creating the more complex complementary products are also capable of creating their own XML schemas, which reduces the chance that a proprietary schema will be used.

On the other hand, XML-enabled products, such as supply-chain management applications, will not work without a schema. Therefore, if a firm succeeds in standardizing a proprietary XML schema, it gains tremendous leverage. Given a monopoly position and an essential component, the firm can make enormous profit, particularly for intellectual property which has no reproduction cost.

The following two hypotheses can be proposed from this pie-sharing and pie-expansion standardization perspective:

Hypothesis 2a (Pie Sharing): Companies will obtain positive abnormal returns to announcements of proprietary XML schema standardization.

Hypothesis 2b (Pie Expansion): Companies will obtain positive abnormal returns to announcements of open XML schema standardization.

The contrast between pie sharing and pie expansion is a classical prisoner’s dilemma [18]. Each individual firm is better off fighting for a larger piece of the pie, but firms that cooperate can create and split an even bigger pie. Learning is a very important factor in a prisoner’s dilemma situation [8]. People who play the game only once usually fight, but if they play the game multiple times, they build trust in one another and learn how to have the biggest pie.

In the real world, firms persist and interact and develop reputations over time. In other words, they learn. Learning favors pie-expansion efforts because there is more surplus to go around. On the other hand, even in a repeated prisoner’s dilemma, players can fight repeatedly. If one firm gets a reputation for pursuing the monopoly route, then the best response for other firms is to do the same. Moreover, in a multiple-player prisoner’s dilemma, the chance that at least one of the players will break ranks increases. Thus, the following hypotheses:

Hypothesis 3a (Learning Effects of Pie Sharing): The abnormal returns to companies announcing proprietary XML schema standardization will increase over time.

Hypothesis 3b (Learning Effects of Pie Expansion): The abnormal returns to companies announcing open XML schema standardization will increase over time.

Research Method

The event study methodology was used to investigate the implications of this theory. This well-known and widely used method makes it possible to gauge how markets react to announcements of XML schema standardization efforts.
The method has a variety of nice properties for investigating XML schema standardization. Using it, one can reach in and form a consensus estimate of value from many investors who are motivated with their own money. In addition, one can look at multiple instances of the same type of standard—an XML schema. This is very useful because a given type of standard often only offers one or two instances (e.g., VHS vs. Betamax, DVD vs. DIVX, Linux vs. Windows). It is difficult to draw statistical conclusions from a sample size of two. While some authors have used nonstatistical methods to look at events, it is important to use every available means of exploration to paint the widest possible picture.

**Data Collection**

The first step in event study is to identify instances of events—XML schema standardization in this case. For the purposes of the present study, announcements on initiatives of developing and executing XML schemas were collected from PR Newswire and Business Wire announcements on Lexis-Nexis from January 1999 to December 2003. The search terms were: *XML, schema or specification, develop or create, and adopt, implement, or support*. The events were limited to publicly traded companies. In total, the search retrieved 856 newswire announcements containing the specified terms, and among these, 196 events about XML schemas were identified.

Excluded from observation were companies that had board changes, earnings announcements, or merger activity within two days before or one day after the announcement. For the companies that made XML announcements, returns on stock prices on the event dates were collected from the CRSP database, NAICS code, and annual sales from Compustat. Excluding announcements with incomplete data, 148 observations were obtained.

The openness of an XML schema was determined in accordance with the definition of open standards that synthesizes from the views of various players in the standardization process [23]. Specifically, an XML schema is open if the rights to it are available to economic actors other than the sponsors through open participation in the development process, open documents, and open use. The coding guidelines and examples are shown in Table 1.

In addition to openness, other factors may also affect the value of standardization initiatives. These factors are discussed in the study as control variables. To control for time, there was a different dummy variable for each year. This was because many of the announcements took place in the dot.com era, and the market reaction to technical announcements may have been different in that time frame than in other time frames. Since the dot.com era had no clear beginning or end, however, it was not possible to control for time directly, and instead it was controlled for indirectly by considering returns on a year-to-year basis.

The natural logarithm of sales was used to control for the size of the company. The study controlled for size because, as is well known, the information content of announcements by small firms may differ from the information content of announcements by large firms. Also, since large firms may be en-
| Open       | No individual company owns the XML schema. The rights to the XML schema are available to companies free or at reasonable and nondiscriminatory terms. | June 15, 1999: webMethods, Inc., the leading provider of XML-based solutions for B2B e-commerce and integration, today announced support for the FpML(TM) standard (Financial Products Markup Language: www.fpml.org), an open XML-based protocol that supports financial derivatives, e-commerce and data sharing between applications. Led by J.P. Morgan & Co. Inc. and PricewaterhouseCoopers LLP, the FpML standard will facilitate seamless Internet-based integration for a wide range of client services, allowing the financial services market to take full advantage of Internet connectivity while lowering operational risks. |
| Proprietary | A single company or a small group of companies own the property rights to the XML schema. | Oct. 13, 1999: QRS Corporation, a leading provider of e-commerce solutions to the retail industry, announced today it will release QRS XML (qXML(TM)), an implementation of XML for the exchange of product information in the retail industry. qXML is the first XML-based exchange format designed specifically to optimize retail supply chains, simplify the integration of EDI-based product information, and expand the breadth of product information exchanged between trading partners. |

Table 1. Sample Announcements of Open and Proprietary XML Schema Standardization Initiatives.
gaged in many lines of business, the announcement may have an impact on a smaller portion of the firm’s overall value. Again, no hypotheses were formulated about whether this is a situation in which firm size matters, but controlling for it was desirable.

To control for the industry, a dummy variable was included if the firm was listed by NAICS 5112—software publishing. It was necessary to control for industry because software publishers may have a disproportionate advantage in fighting a standards war by virtue of their installed base and technical expertise.

The study also controlled for the role of the standardization announcement. An announcement can be limited to a firm’s developing, maintaining, or promoting an XML schema, or it can focus on the firm’s executing an XML schema in a particular product, such as a packaged software system. The information contents of these two types of announcement might differ. The main concern was the possibility that a schema alone has less value than a schema embedded in a technology. This was coded for by using the dummy variable SchemaOnly, which takes a value of unity if the announcement focused only on a schema, and a value of zero if the announcement also discussed a product that embodied or made use of the schema.

As discussed above, the study used as control variables whether the announcement was about the creation of the schema only, sales, the date of the announcement, and whether the announcement was made by a firm in the software publishing industry. The variables are summarized in Table 2, and their correlations are listed in Table 3.

Two authors of the paper coded the announcements separately, and the third author compared the results. The overall inter-rater reliability was 73 percent. In comparison, Fich and Fich had 77 percent [2], and Richardson and Zmud had 80–82 percent [24]. Differences were resolved through discussion.

The distribution of the 148 announcements is summarized in Table 4 and Table 5. Table 4 shows that about 68 percent of the announcements were made

<table>
<thead>
<tr>
<th>Variables</th>
<th>Definition</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSAR</td>
<td>Cumulative standard abnormal return on stock prices; dependent variable</td>
<td>CRSP</td>
</tr>
<tr>
<td>Open</td>
<td>Announcement is about an open schema; independent variable</td>
<td>Lexis-Nexis</td>
</tr>
<tr>
<td>Schema Only</td>
<td>Role company played in making announcement is to create XML schema; independent variable</td>
<td>Lexis-Nexis</td>
</tr>
<tr>
<td>Sales</td>
<td>Annual sales of company that made announcement; control variable</td>
<td>CompuStat</td>
</tr>
<tr>
<td>Date</td>
<td>Data of announcement with 01/01/99 = 1; independent variable</td>
<td>Lexis-Nexis</td>
</tr>
<tr>
<td>DumXXXX</td>
<td>Dummy variable indicating year of the announcement; control variable</td>
<td>Lexis-Nexis</td>
</tr>
<tr>
<td>SWPub</td>
<td>Dummy variable indicating whether company making an announcement is software publisher; control variable</td>
<td>NAICS code</td>
</tr>
</tbody>
</table>

Table 2. Definition of Variables.
by software publishers, 12 percent by computer-related service providers, and another 7 percent by computer hardware and electronic device manufacturers. Table 5 shows the distribution of the announcements over the years from 1999 to 2003. The year 1999 had 41 announcements. Year 2000 saw the most announcements, 53. Since year 2001, the number of announcements has decreased over time, with 29 announcements in 2001, 16 in 2002, and 9 in 2003. Columns 3 and 4 of Table 5 break down the announcements of standardization initiatives on open XML schemas over the years. Overall, 80 announcements (54.0%) pertained to open schemas, and the majority of the open XML standardization announcements were made in 2000 and 2001. Columns 5 and 6 show the number and percentage of announcements of standardization initiatives that only create, promote or maintain XML schemas. In total, there were 72 (48.6%) such announcements, and the majority of them were made in 2000.

**Table 3. Correlation Matrix.**

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>Open</th>
<th>Creator</th>
<th>Log(Sales)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open</td>
<td>0.541</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creator</td>
<td>0.486</td>
<td>0.192</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log(Sales)</td>
<td>2.818</td>
<td>0.151</td>
<td>0.190</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td>651.7</td>
<td>0.217</td>
<td>0.059</td>
<td>-0.099</td>
<td>1</td>
</tr>
<tr>
<td>SWPub</td>
<td>0.676</td>
<td>0.027</td>
<td>0.039</td>
<td>-0.139</td>
<td>0.098</td>
</tr>
</tbody>
</table>

**Table 4. Distribution of Announcements Across Industry Segments.**

<table>
<thead>
<tr>
<th>Industry segment</th>
<th>NAICS code</th>
<th>Number of events</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software publishing</td>
<td>5112</td>
<td>100</td>
<td>67.6</td>
</tr>
<tr>
<td>Computer hardware and electronic device manufacturing</td>
<td>3341, 3342</td>
<td>11</td>
<td>7.4</td>
</tr>
<tr>
<td>Computer-related services</td>
<td>5415</td>
<td>18</td>
<td>12.2</td>
</tr>
<tr>
<td>Internet services</td>
<td>518</td>
<td>3</td>
<td>2.0</td>
</tr>
<tr>
<td>Financial services</td>
<td>522, 523, 524</td>
<td>5</td>
<td>3.4</td>
</tr>
<tr>
<td>Administrative and support services</td>
<td>561</td>
<td>3</td>
<td>2.0</td>
</tr>
<tr>
<td>Others</td>
<td>8</td>
<td></td>
<td>5.4</td>
</tr>
<tr>
<td>Total</td>
<td>148</td>
<td></td>
<td>100.0</td>
</tr>
</tbody>
</table>

by software publishers, 12 percent by computer-related service providers, and another 7 percent by computer hardware and electronic device manufacturers. Table 5 shows the distribution of the announcements over the years from 1999 to 2003. The year 1999 had 41 announcements. Year 2000 saw the most announcements, 53. Since year 2001, the number of announcements has decreased over time, with 29 announcements in 2001, 16 in 2002, and 9 in 2003. Columns 3 and 4 of Table 5 break down the announcements of standardization initiatives on open XML schemas over the years. Overall, 80 announcements (54.0%) pertained to open schemas, and the majority of the open XML standardization announcements were made in 2000 and 2001. Columns 5 and 6 show the number and percentage of announcements of standardization initiatives that only create, promote or maintain XML schemas. In total, there were 72 (48.6%) such announcements, and the majority of them were made in 2000.

**Standard Stock Returns**

Standard daily stock return on stock price was used as the measure for the value of public announcements on XML schema initiatives. As in earlier event studies, the following model was used to compute daily common stock returns:

\[ R_{it} = \alpha_i + \beta_i R_{mt} + \epsilon_{it} \]
where $R_i$ is the rate of return on the common stock of the $i$th firm on day $t$, $R_{mt}$ is the market rate of return on day $t$, $\alpha_i$ is the intercept, $\beta_i$ is the slope parameter, and $\epsilon_{it}$ is the disturbance term. From this, the abnormal returns were calculated as:

$$A_{it} = R_{it} - \left( \hat{\alpha}_i + \hat{\beta}_i R_{mt} \right),$$

where $\hat{}$ denotes an estimated parameter value, the parameters were calculated using an estimation period 255 days long that ended five days before the event. If an event did not have 255 trading days preceding it, the window was shortened to 100 days. For market returns the CRSP equally weighted market index was used. Standardized abnormal return was then calculated by dividing each abnormal return by the standard error of prediction:

$$S_{A_{it}} = \frac{\sum_{k=b+1}^{e} A_{ik}^2}{D_t - 2} \left[ 1 + \frac{1}{D_t} + \frac{(R_{mt} - \bar{R}_m)^2}{\sum_{k=b+1}^{e} (R_{mk} - \bar{R}_m)^2} \right],$$

where $b$ and $e$ are the beginning and end of the prediction period, $D_t$ is the number of trading days in the estimation period, and $\bar{R}_m$ is the average market return over the estimation period. The standardized abnormal return over the event window $[-1, 0]$ was then added to arrive at a cumulative standardized abnormal return (CSAR) for each event. This is a measure of the stock market reaction to an event that controls for overall market movements, stochastic trend, differences in stock price, and differences in price variance.

### Analysis Results

The first test asks whether or not XML schema standardization announcements had any effect at all. This testing used both the market model detailed above and a market-adjusted model, using both cumulative standardized

<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
<th>Open (dummy = 1)</th>
<th>Schema only (dummy = 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>41</td>
<td>9</td>
<td>17</td>
</tr>
<tr>
<td>2000</td>
<td>53</td>
<td>33</td>
<td>27</td>
</tr>
<tr>
<td>2001</td>
<td>29</td>
<td>22</td>
<td>13</td>
</tr>
<tr>
<td>2002</td>
<td>16</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>2003</td>
<td>9</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>148</td>
<td>80</td>
<td>72</td>
</tr>
</tbody>
</table>

*Table 5. Distribution of Announcements over Time.*
abnormal returns and cumulative abnormal returns. The results are shown in Table 6 and are consistent across all specifications. The rest of the analysis only used CSAR from the model, as above, but the results from the other models all show the same patterns and are available upon request. Overall, firms making announcements of the development of XML schemas enjoyed a slight 0.139 standard deviation abnormal return ($p = 0.048$ on a one-tailed test). This corresponded to a cumulative abnormal return of 1.018 percent, which is consistent with other event studies measuring IT investments [7, 12, 13]. Table 6 also shows the stock returns by XML schema types: open versus proprietary XML schemas. The results indicate that proprietary XML schemas, overall, generated significant positive returns, whereas open XML schemas did not. This indicates that investors prefer proprietary standards over open standards.

Two cross-sectional regression models were used to further investigate Hypotheses 2 and 3. Thus the CSAR was regressed against variables of interest, namely, whether or not the standard is open and controls. The regression models are of the form:

$$CSAR = \beta_0 + \beta_1 OPEN + \beta_2 OPEN \times TIME + \beta_3 Controls + error.$$ 

In the models the controls are SWPub, SchemaOnly, and log(Sales), so that $\beta_3$ is a vector of parameter estimates. Measures of time were excluded in model 1, so $\beta_2$ is zero. Model 2 controlled for time by having a separate $\beta_2$ and $\beta_1$ for every year, and setting $\beta_2$ to zero. In model 3, time was controlled for by interacting the date with whether or not the announcement was open. The results of these cross-sectional analyses are presented in Table 7.

The test of Hypothesis 2 depends on $\beta_1$. If $\beta_1$ is positive and significant, it shows that markets prefer investing in firms that standardize on open XML schemas. If $\beta_1$ is negative and significant, it shows that markets prefer investing in firms that standardize on proprietary XML schemas. The analysis results in column 2 and 3 of Table 7 show that $\beta_1$ is negative and significant when tested in total, suggesting that markets prefer investing in firms that commit to proprietary XML standards. In other words, markets perceive the benefits to a firm to be greater from enlarging its own share of the pie than from enlarging the pie for the whole market—at least with respect to XML standards. Hypothesis 2 was also tested on a year-by-year basis, so that $\beta_1$ is a vector of five values—one for each year (see Table 7, cols. 4 and 5). This made it possible to control for different market effects in different years. The main concern was the possibility that markets may have acted differently during the dot.com period than before and afterwards. In fact, market reactions to XML announcements were different in different years. Markets reacted the same in 1999, 2000, and 2002, preferring proprietary to open standards. In 2003, with only nine events, there was no detectable difference between the two. The interesting switch occurred in 2001, when open standards were positive and significant. This means that in 2001 the market preferred investing in firms that standardized on open XML schemas. Interestingly, the intercept term for 2001 was negative, and 2001 was the only negative year. The intercept represents the baseline market reaction, and in this model, the baseline is
propositional. The coefficient on open represents the difference between proprietary and open standards. In this year, and this year only, markets reacted poorly to proprietary XML standards, and that is what made open XML standards perform better in 2001. Thus, 2001 was a complete reversal of the other three significant years.

Hypothesis 3 was tested via $\beta_2$. The coefficient on $\beta_2$ is not statistically significant, suggesting that there are no linear changes in preferences for proprietary over open over time. (see Table, cols. 6 and 7).

Thus far, the analysis has been based on linear regression. However, there is a well-known, but often unaddressed, problem in using regression on abnormal returns. If the abnormal returns are cross-sectionally correlated, then regression will tend to underestimate the variance and lead to excessive rejection of the null hypothesis [3]. This problem was addressed by using nonparametric analysis, which does not require estimating the variance of the returns.

The most straightforward and intuitive test is to consider the number of positive and negative reactions. If there is no systematic information entering the market, one would expect the number of positive and negative reactions to be the same. Given the total number of events and the number of positive stock market reactions, the probability of observing the ratio actually observed can be calculated under the null hypotheses that there is no systematic effect. If the probability of observing the results actually observed is very small, then the null hypothesis that there is no systematic effect can be rejected. This analysis is presented in Table 8.

Correcting for cross-sectional correlation tells the same story, and, in fact, illustrates it more clearly. The pooled sample of XML announcements has more positive than negative reactions, but the null hypothesis that they occurred by chance cannot be rejected. However, this null-result is driven by the announcements of open XML standards, which actually have slightly more negative than positive reactions. Proprietary XML announcements have nearly twice as many positive as negative reactions, and the null that this result occurred by chance can be rejected.

Table 6. *t*-Statistics of Event Study Returns by Schema Type.

<table>
<thead>
<tr>
<th></th>
<th>Complete sample $(N = 148)$</th>
<th>Open XML $(N = 80)$</th>
<th>Proprietary XML $(N = 68)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSAR (market model)</td>
<td>0.139</td>
<td>1.68**</td>
<td>-0.048</td>
</tr>
<tr>
<td>CAR (market model)</td>
<td>1.018</td>
<td>1.53*</td>
<td>-0.131</td>
</tr>
<tr>
<td>CSAR (market adjusted returns)</td>
<td>0.126</td>
<td>1.56*</td>
<td>-0.036</td>
</tr>
<tr>
<td>CAR (market adjusted returns)</td>
<td>1.121</td>
<td>1.65*</td>
<td>0.206</td>
</tr>
</tbody>
</table>

Significance level: *** = 0.01 level; ** = 0.05 level; and * = 0.1
<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>t-statistic</th>
<th>Coefficient</th>
<th>t-statistic</th>
<th>Coefficient</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open</td>
<td>-0.393</td>
<td>-2.36**</td>
<td></td>
<td></td>
<td>-0.610</td>
<td>-2.21**</td>
</tr>
<tr>
<td>Open*date</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year1999</td>
<td>0.669</td>
<td>2.32**</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year2000</td>
<td>0.859</td>
<td>2.69***</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Year2001</td>
<td>-0.444</td>
<td>-1.00</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Year2002</td>
<td>1.042</td>
<td>2.01**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year2003</td>
<td>0.287</td>
<td>0.58</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open1999</td>
<td>-0.846</td>
<td>-2.26**</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Open2000</td>
<td>-0.784</td>
<td>-2.80**</td>
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</tr>
<tr>
<td>Open2001</td>
<td>0.975</td>
<td>2.35**</td>
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<tr>
<td>Open2002</td>
<td>-0.916</td>
<td>-1.64</td>
<td></td>
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<tr>
<td>Open2003</td>
<td>-0.008</td>
<td>-0.01</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Intercept</td>
<td>0.732</td>
<td>2.74***</td>
<td></td>
<td></td>
<td>0.706</td>
<td>2.63***</td>
</tr>
<tr>
<td>SWPub</td>
<td>-0.101</td>
<td>-0.58</td>
<td>-0.075</td>
<td>-0.43</td>
<td>-0.118</td>
<td>-0.67</td>
</tr>
<tr>
<td>SchemaOnly</td>
<td>0.195</td>
<td>1.17</td>
<td>0.239</td>
<td>1.42</td>
<td>0.187</td>
<td>1.12</td>
</tr>
<tr>
<td>Log(sales)</td>
<td>-0.145</td>
<td>-1.95*</td>
<td>-1.099</td>
<td>-1.46</td>
<td>-0.129</td>
<td>-1.70*</td>
</tr>
<tr>
<td>F-statistic</td>
<td>2.73**</td>
<td></td>
<td></td>
<td></td>
<td>2.33*</td>
<td></td>
</tr>
<tr>
<td>R²</td>
<td>0.071</td>
<td></td>
<td></td>
<td></td>
<td>0.183</td>
<td></td>
</tr>
</tbody>
</table>

Table 7. Cross-sectional Regression Results (CSAR Market Model) (N = 148).

Significance level: *** = 0.01 level; ** = 0.05 level; * = 0.1.
Overall, the analysis suggests that investors are willing to put their money behind proprietary XML standardization initiatives, but not open XML standardization initiatives. Standardization on proprietary XML schemas results in an average 2 percent increase in stock price, which for a firm like IBM or Microsoft is $1 billion. Conversely, standardization on open XML schemas reduces a firm’s stock price slightly. Thus, despite a great deal of effort and discussion to the contrary, financial markets do not reward open standards or standardization initiatives, at least not in XML schemas. This is somewhat alarming, not because there has been a great deal of discussion about the benefits of open standards, but because so many firms are actually executing open standardization. Management should care what financial markets think because they are often very insightful and because their beliefs generate real value for firms. However, the results described in this paper suggest that managers are investing effort in something that financial markets punish.

### Conclusion

This study makes several contributions to the literature on technology standards. First, its empirical research expands our understanding of the value of standards, especially the shareholder wealth that standards can generate through financial markets. Second, it proposes an overarching theory of pie sharing and pie expansion that explains the benefits to an individual firm from standardizing on open versus proprietary standards. This is a vital contribution because firms make decisions based on their individual perceived benefits and not the perceived benefits of the whole market. Proponents of open standards often discuss how openness benefits an industry, but ignore the fact that any individual firm only gets a piece of that benefit. Dranove and Gandal made a similar point when they said, “A monopoly in the bush may be worth more than an oligopoly in the hand” [14, p. 10]. The perspective of the authors can be summarized as, “A small monopoly may be worth more than a big oligopoly.” Finally, the study contributes to the literature on diffusion of innovation by shedding light on how standardization strategies affect the benefits of adopting an innovative technology.

The study has some limitations due to the constraints of the available data. Like other event studies, it deals with a sample of public companies. This
leaves privately held companies out of the study, and as a result, the results may be biased. In addition, as the distribution of the data shows, the majority of the sample comprised firms in IT industries. This may limit the generalizability of the results and presents an opportunity for future research to look into the value of standardization to other industries. Another limitation is that the study estimated the direct associations between stock returns and standardization events, but did not fully consider issues that may mediate the impact of standards even though it controlled for certain firm characteristics, such as annual sales. Also, the test for learning effects included both market behavior and announcement behavior, so one cannot tell whether it was the market that changed or the nature of the announcements. The authors feel that the announcements were comparable over the years in question, but admittedly may have missed some important consideration. Thus, for a further understanding of how standards affect firm performance, future studies will have to investigate the factors that release business value through standardization.

In conclusion, the present research investigated the value from proprietary standards development versus open collaborative standards development by studying the premium the stock market places on the decisions of companies. As a main application of XML technology is in the area of interfirm data exchange, there are strong network effects in the development and adoption of XML schemas that define the structure and semantics of XML documents. In the presence of network effects, standards are critical to the diffusion of new technologies, and standardization initiatives are rewarded in financial markets.

REFERENCES


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