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## **Deriving Value by Signaling Good Citizenship: The Case of Open Source Software**

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I quantify the effect of firms' announcements of free software product/source code releases on their abnormal returns as well as their rivals'. A sample of 87 announcements from US News and Wires that are published between 1st of January 1999 and 31st of December 2010 is studied in the empirical analysis. The results suggest that giving away a firm's own software product/source code freely, on aggregate, leads to superior stock market performance than expected in financial markets for the focal firm contrary to the traditional theory on the protection of valuable knowledge. Moreover, I find positive effect of source code revealing on rival firm's market valuation.

# Driving Value by Revealing: The case of Open Source Software

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## Abstract

I quantify the effect of firms' announcements of free software product/source code releases on their abnormal returns as well as their rivals'. A sample of 87 announcements from US News and Wires that are published between 1<sup>st</sup> of January 1999 and 31<sup>st</sup> of December 2010 is studied in the empirical analysis. The results suggest that giving away a firm's own software product/source code freely, on aggregate, leads to superior stock market performance than expected in financial markets for the focal firm contrary to the traditional theory on the protection of valuable knowledge. Moreover, I find positive effect of source code revealing on rival firm's market valuation.

**Keywords:** open source software, event study, abnormal market returns

## **1. Introduction**

The literature on protecting the valuable knowledge is extensive (Rumelt, 1984; Barney, 1986). Closed innovation model suggests that a company generates, develops and commercializes its own ideas and it is managers' key challenge to retain the knowledge within the firm in order to appropriate returns (Teece, 1986). On the other hand, open innovation, which has come to the fore rapidly as a new paradigm for corporate innovation, focus on identifying, exploiting and integrating external knowledge into their internal R&D activities (West and Gallagher, 2006). Firms that adopt the open innovation model integrate these external sources (e.g. customers, suppliers, competitors or universities) into their internal innovation processes and competitive strategy to sustain the ability to introduce new products to the market successfully (Chesbrough, 2003). Open Source Software (OSS), which is freely available to all that accept the licensing terms of the software, is the outcome of such an open innovation model whereby companies collaborate with communities of volunteer developers.

Last decade witnessed several software vendors, which have previously been known for their emphasis on proprietary developments, change their ways of approaching OSS. The phenomenon has been investigated in depth by scholars with the aim of exploring pros and cons of OSS in terms of profitability for firms (Raymond, 1999; Feller and Fitzgerald, 2002; Lerner and Tirole, 2002; Bonaccorsi and Rossi, 2006; Franke and Shah, 2003; Dahlander and Magnusson, 2005; Henkel, 2006). However, there has been a lack in questioning how investors perceive and value the activities that the companies bear to profit from OSS. Today, many large firms are making significant efforts to engage in OSS either by sponsoring a project or by building strategic alliances with the aim of

starting up new OSS projects or even by open sourcing their own products to the public use with the aim of extracting benefits from further OSS developments. Google's release of own proprietary development tools under the Apache 2.0 license or IBM's transforming its business model to encourage open source are examples of firm activities that may accrue benefits for firms in return. However, investor's response to such activities in financial markets needs to be investigated in order to have a general outlook on the positioning of OSS in the future.

The next section corresponds to the theoretical framework that embraces the hypotheses to be tested. While in the third section the data and the empirical analysis are explained, the fourth section gives a brief discussion on the findings and then concludes.

## **2. Theoretical Framework and Hypotheses**

In this study, my focus is on investor's reactions to firm's willingness to share own proprietary developments with the general OSS community. Many studies have identified that announcements of innovation activities bring about positive abnormal returns under the assumptions that the markets are efficient, the information provided by the announcement is new to the market and there are no confounding effects from other events (McWilliams and Siegel, 1997; Chaney, Devinney and Winer, 1991). Such announcements are argued to result in positive abnormal returns as they enable market expansion and enhance firms' competitive position (Aaker, 1995; Suarez, 2002; Anand and Kanna, 2000); signal confidence, competence and optimism about the future (Sood and Tellis, 2009). On the other hand, announcements of innovation activities may lead to negative returns due to the associated uncertainty and risk of failure (Crawford, 1977);

and also because they alert competitors of progress and trigger imitators (Sood and Tellis, 2009). For instance, Aggarwal et al. (2006) report negative market response in their event study, which is a unique work in the field of open standardization, to open XML<sup>1</sup> standardization initiatives between 1999 and 2003. Current findings report contradictory results about stock market responses to announcements of innovation activities. Announcements of firms' software/source code releases may as well be argued to result in negative or positive abnormal returns for varying motives. They may lead to positive abnormal returns by signaling good citizenship. On the other hand, they may lead to negative abnormal returns because it entails the risk for the firm to lose its competitive edge since the technology is revealed to the public.

Corporate citizenship highlights the fact that the corporations should be seen as a part of the society, alongside other "citizens", with whom the corporation forms a community (Matten, Crane and Chapple, 2003). Yet, citizenship emphasizes the rights and responsibilities of all members of the community, for the benefit of the company and the society as a whole (Waddell, 2000). Although several studies have focused on the relationship between corporate citizenship and business benefits (Maignan, Ferrell and Hult, 1999; Logsdon and Wood, 2002; Waddock, 2001; Wood and Logsdon, 2002), to the best of my knowledge, there are no academic studies that focus on OSS phenomenon as a suitable platform to demonstrate good citizenship, which in turn will bring about benefits for practicing firms.

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<sup>1</sup> Extensible Markup Language (XML) is a markup language that enables sharing of data across different systems.

Building upon the notion of corporate citizenship<sup>2</sup>, I suggest that open source citizenship entails contributing and supporting the community actively, sharing improvements for the well-being of the community and serving community with pure value-based actions. Oracle's efforts to detail its commitment to open source by publishing an Open Source Social Responsibility Report, for instance, might be viewed as expressing its identity as a good open source citizen. Although, building an identity as a good open source citizen would take time for a firm and necessitates being coherent in its actions in the long run, individual activities, which can be seen as building blocks for the firm reputation as a good citizen, might be received as signals of good citizenship in financial markets and thus may lead to superior performance in terms of market valuation.

*Hypothesis 1a: a firm's open source software / source code release will result in positive abnormal returns for the focal firm.*

A counter argument suggesting negative relationship between source code revealing and stock market valuation might be developed drawing upon the traditional theory on protecting the valuable knowledge (Rumelt, 1984; Barney, 1986). Traditional incentive theory suggests that firms can only sustain the competitive advantage by retaining the intangible resources that are difficult to imitate and redeploy. From this point of view, we might expect investors to punish the giving away attitude of a firm that reveals the source code of software in financial markets.

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<sup>2</sup> Corporate citizenship (CC) was developed in late 1990s as a new way of framing business and society social responsibility. (CSR) is essentially the building block of the modern business-society relations literature and keeps its position to be one of the most popular concepts in explaining the topic. The rationale for using corporate citizenship concept instead of CSR lies under its strength at modeling the firm as a citizen, deeply embedded in a global society of communities and institutions (Godfrey, 2005). For this reason, corporate citizenship offers a suitable basis in explaining the community-firm relationships in OSS phenomenon, in which collaborative work between companies, developers and other participants of the community is crucial for the success of an open source project.

*Hypothesis 1b: a firm's open source software / source code release will result in negative abnormal returns for the focal firm.*

While the effect of a firm's own innovation activities on its financial market value is widely studied, studies focusing on the effect of rival firm's innovation activity on a focal firm's financial market value are only very few. The theoretical grounding on the aforementioned relationship remains unclear. A firm may be affected positively from rivals' activities due to spillover effects or it may be affected negatively due to market-stealing effects (McGahan and Silverman, 2006). Empirical studies report conflicting findings as well. For instance, Fosfuri and Giarratana (2009) report negative abnormal returns on rival firm's product introduction announcements in carbonated soft drinks industry. Interestingly enough, the authors find a positive relationship between rival firm's trademark filing activities and focal firm's abnormal returns due to generic advertising effect that boosts both firms' market share and total demand. In his event studies, Austin (1993, 2000) argues that announcements of patent granting to a rival firm, on average, is associated with positive stock-market reaction for the focal firm in biotechnology industry. McGahan and Silverman (2006) report both positive and negative effects of patents granted to competitors on focal firms' financial market value under different circumstances such as industry characteristics.

In the framework of OSS, a similar theoretical ambiguity is present. A firm may be affected positively from rivals' source-code release because the underlying technology, the source-code, is revealed leading to a spillover effect or it may be affected negatively because the rival firm signals competitiveness and technical excellence leading to a market-stealing effect.

Although, revealing source code contradicts to the economic theory of innovation, companies continue to reveal code voluntarily (Harhoff, Henkel and von Hippel, 2003). According to the classical view, when a firm reveals information a spillover effect would take place that enables other firms utilize the revealed information for their own sake. Since the subject matter is the source code, investor of a firm might view source code revealing of the rival firm as a favorable event. Each announcement on source code/product release will lead to positive abnormal returns for all the participants of the community since they may be considered as a cumulative advance for the OSS technology. Hence, positive effect is expected by rival firm's proprietary software source code release on focal firm's abnormal market returns.

*Hypothesis 2a: Rival's open source software / source code release will result in positive abnormal returns for the focal firm.*

On the other hand, a rival firm's own technology revealing to the market might result in negative abnormal returns for the focal firm due to the technical excellence signaled and competitiveness by the rival firm. Investor's expectations from the focal firm might decrease since the firm would face a loss of market share when a new product from the rival is released.

*Hypothesis 2b: Rival's open source software / source code release will result in negative abnormal returns for the focal firm.*

### **3. Data and Empirical Analysis**

An event study methodology is adopted in order to quantify the effect of a firm's software source code releases on abnormal market returns of both the focal firm and rival

firms. The main event is defined as the release of a proprietary software product/source code either to the use of an OSS community that is gathered around an existing public open source project or with intentions to start up a new public open source project. 87 announcements that are published during the time span between 1999 and 2010 are included in the analysis to determine the effect of source code releases in financial markets.

First, from PROMT database, the announcements including the search term “open source” with the event code that corresponds to product introduction category and the product code that corresponds to the software related products category<sup>3</sup> are retrieved. Afterwards, from Lexis-Nexis database and by applying a similar search algorithm, the announcements with the search term “open source software” in the subject term including at least one of the words from “evaluation”, “release”, “announce” or “introduction” in the text are gathered in a pool to avoid any possible loss of data. Once the data is collected, the announcements of companies operating in software-related industries from the *Fortune* 500 list are decided to be analyzed. The rationale for doing so is to include in the empirical analysis only the firms that are listed on the NYSE or NASDAQ and also those that have a significant number of events that fit to the event definition.

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Insert Table 1 about here  
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Table 1 presents the distribution of announcements across firms. Since several data sources have been utilized, each press release is read through carefully to avoid including the same event of a firm more than once in the sample. The final sample consists of 87

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<sup>3</sup> Standard industry classification code 7372.

announcements of eight large firms<sup>4</sup> from US News and Wires that are published between 1<sup>st</sup> of January 1999 and 31<sup>st</sup> of December 2010. The abnormal stock market returns to these events are estimated via the model of Austin (1993). The model is enriched with control variables suggested by Fama and French (1992)<sup>5</sup>,  $SMB_t$  and  $HML_t$ , to avoid the risk to depend solely on the coefficient. The modified base model used in estimating the abnormal returns is as follows:

$$(r_{it} - rf_t) = \alpha + \beta_1 (rmkt_t - rf_t) + \beta_2 SMB_t + \beta_3 HML_t + \sum_v \delta_v D_{vt} + \varepsilon_{it}$$

where  $r_{it}$  is the return on shares of firm  $i$  over the time  $t$  window,  $rf_t$  is the risk-free rate of return at time  $t$ ,  $rmkt_t$  is the return on all firms in NYSE, AMEX and NASDAQ at time  $t$ ,  $SMB_t$  is the index of small versus big capitalization at time  $t$  and  $HML_t$  is the index of high versus low book/price ratio at time  $t$ . The data on daily stock prices are from Yahoo! Financial. The dummy variable,  $D_{vt}$ , is equal to one if event  $v$  occurs at time  $t$ . There are two main events:  $DFIRMPRODUCT$  (focal firm releases software product/source code to the public) and  $DRIVALPRODUCT$  (rival firm releases software product/source code to the public). Dummies are included to control for firm specific characteristics. Other control variables included in the model are:  $ADVERTISING$ , which is measured by the total number of times (log transformed) that a firm appears in the news; and a dummy,  $BUBBLE$ , that corresponds to the dot-com bubble<sup>6</sup> and takes one during the period 1999 to mid 2000. The variable definitions are shown in Table 2.

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<sup>4</sup> Announcements of Microsoft, Oracle, Hewlett-Packard, Apple, Google, Intel, IBM and Nokia constitute the final sample since these are the most active large firms in OSS phenomenon that are publicly traded. It has not been possible to include announcements of other firms because either the firm is not publicly traded in financial markets or the announcements of the firms do not fit to the event definition.

<sup>5</sup> Available at [http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data\\_Library/f-f\\_factors.html](http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/f-f_factors.html)

<sup>6</sup> The dot-com bubble was a stock market bubble covering roughly 1995–2000 (with a climax on March 10, 2000, which popped to near-devastating effect in 2001).

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Insert Table 2 about here  
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Figure 1 depicts the distribution of events over time. The trend does not show a consistent decline or increase. However, there are two falls that is worth noting. First fall starts in 2001, following the burst of dot-com bubble. Second fall starting in 2007 and following in 2008 is an expected trend due to the global crises that has occurred. The correlation matrix is presented in Table 3.

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Insert Figure 1 about here  
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Table 4 shows the descriptive statistics and the results of the ordinary least squares (OLS) robust regression for different event windows (5 days, 3 days and same day). Coefficients for the dummy events correspond to daily abnormal returns due to the occurrence of the event. In order to avoid the confounding event effects, the window of days to the events is limited to at most two days before and two days after the event occurs. As the event window enlarge from zero to five, coefficients for the dummy events become smaller suggesting that the effect of the event is stronger in the day of the event when the risk of being affected by confounding events is less.

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Insert Table 3 about here  
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The findings support that, firms' own software product/source code release, on aggregate, results in positive abnormal returns in financial markets. Interestingly enough, rival's software product/source code releases, as well, lead to positive abnormal returns for the focal firm. These results are in support of Hypothesis 1a and Hypothesis 2a. The findings reveal that when a firm releases proprietary product/source code to the public,

the abnormal returns to the focal firm (rival firm) increases by 13% (3%) at the 0.01 level. Even if the contribution to open source comes from a rival, other active members of the community also reap benefits in financial markets because OSS phenomenon differs from other settings by its collaborative nature, in which voluntary contributions by both individual developers and companies are the backbone of a successful open source project. On the other hand, Hypothesis 1b and Hypothesis 2b are rejected. Contrary to the classical incentive theory whereby valuable knowledge is retained inside the firm in order to sustain competitive advantage, investors favor knowledge sharing behavior of companies in the OSS arena.

Another argument in favor of positive relationship might be stimulated from the broad acceptance of OSS in commercial settings. Widely known successful open source projects (e.g. Linux, Apache, Debian and Android) may offset the risk of failure that is associated to uncertainty perceived by the investors. In other words, OSS is a phenomenon that has gained prominence in practice as much as in academia. As OSS gains adoption and acceptance in commercial settings, investors of the focal firm might be less concerned about the future of the technology. Regarding to the positive effect of rival firm's announcement on the focal firms market returns, a similar logic applies. Saying something good on the technology, even if it comes from a rival firm, might increase the expectations of investors on the future outlook of a technology leading to superior stock market performance of firms that invest in the aforementioned technology. Positive effect might be dominating since investors are becoming more and more socially conscious when investing their money. Conscious investors prefer to sacrifice a small amount of return and make investment in corporations that comply with the standards of

the technology. That is, contributing to OSS with further developments and thus sharing source code.

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Insert Table 4 about here  
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The sample is further analyzed to find out which of these announcements lead to greater abnormal returns. In order to do so, the announcements are split into two sub-groups. First group of announcements corresponds to the software product/source code releases whose target audience is developers. On the other hand, the target audience of software product/source code releases in the second group is end-users. The results show that the abnormal returns to product/source code releases that target end-users is slightly larger than that of product/source code releases that target developers. In other words, when a firm freely gives away software product/source code that is targeted to end-users, it may earn higher values in financial markets. However, when a rival firm freely gives away software product/source code, either targeted to developers or targeted to end-user, the focal firm earns benefits at the same amount only at different significance levels (0.01 for the former and 0.1 for the latter). Although end-user products are more favorable in financial market, source-code releases targeted to developers may be perceived as more of a pure value-added action, which is designed to facilitate further developments for programmers or the community of OSS users in general. Henceforth, such announcements targeted to developers will have a more significant effect on other community members as they are aimed to leverage the well being of the society instead of gaining market share.

#### **4. Conclusion and Discussion**

In this study, an event study methodology is implemented in order to explain the effect of OSS releases on firms' abnormal returns in financial markets. The findings are twofold. First, a firm's own software product/source code release has positive effect on its abnormal market returns. The effect is larger on the day of the event. Signaling good open source citizenship through sharing own developments- specifically, by releasing proprietary software product/source code to the public- help firms obtain benefits in financial markets. Second, competitors' software product/source code release leads to positive abnormal market returns for the focal firm. This finding is contradictory to the general understanding that competitors' moves negatively effect focal firm's financial valuation. Due to the nature of OSS, which is perceived as a public good, firms that reveal signal good open source citizenship obtain benefits in financial markets also by competitors' release of open source product/source code. However, this effect is not as strong as the effect of firms' own product/source code revealing.

Today, managers should acknowledge the importance of society-business relations in order to be successful. Profitability is not any more the only path that leads a company to triumph. Both practitioners and researchers have come to realize the fact that society has the will to exert power on how businesses should be run in certain settings. IBM transforming its business model in such a way to encourage open source since 1999; Oracle demonstrating commitment to open source via its corporate citizenship report in 2008; Microsoft's significant recent efforts to become a regular citizen of the open source environment by releasing source code under GPL; Google's steps towards being the largest open source-based company; Nokia, Apple, Intel and HP contributing and

sponsoring open source projects with the aim of making open source development a key part of their ongoing software strategy are only a few examples that might have been stimulated from society's desire to see firms work for the welfare of a public good.

There are a number of limitations to be mentioned. First, the general assumptions common to the event studies are made for this study as well. Since the firms studied are all large firms, the risk of being affected by confounding events is higher. To avoid this problem, the window of events is limited to five days at most. Second, only eight large firms that are engaged in OSS developments are included in the analysis since most of the small firms are not publicly traded and release of a proprietary source/product freely is still not a widely practiced exercise among many large firms. Although the number of firms included in the empirical analysis is small and the sample is skewed towards large enterprises, the findings are believed to be generalized for certain settings in other industries in which there are large players that adopt open innovation practices. On the other hand, the case might be different for small firms since sharing knowledge might be perceived more risky by the investors of these firms and spillover effects might dominate since small firms would have less property right protection mechanisms than their larger competitors in the industry. These are only a couple of issues that are needed to be investigated by future studies.

It is also possible that some firms make more effort than others to be participative in the community from one period to the other during the years studied in the analysis. It would be interesting to examine the effect of complementary good open source citizenship signaling activities- such as sponsoring communities, funding projects or collaborating with other participants- on the relationship between firms open source

software releases and abnormal market returns. Such complementary activities may have a moderating effect since they can be used as a proxy for firm authenticity<sup>7</sup> in terms of how sincere firms are in their identities as good open source citizens. The analysis is aimed to be deepened with additional variables that are going to be created utilizing announcements on aforementioned activities.

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<sup>7</sup> Firm authenticity refers to a firm expressing its identity as its character in action which is not originated from a temporary faddishness (Beverland, 2005; Brown, Kozinets, and Sherry, 2003).

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Table 1. Distribution of Announcements across Firms

Firm	No. of events	%	Targeted to developers	Targeted to End-users
Microsoft	11	12.5	8	3
Oracle	13	15	8	5
Hewlett-Packard	7	8	4	3
Apple	10	11.5	5	5
Google	13	15	5	8
Intel	11	12.5	10	1
IBM	16	18	11	5
Nokia	6	7.5	6	0
Total	87	100	57	30

Table 2. Variable definitions

<b>Variable Name</b>	<b>Description</b>	<b>Source</b>
$r_{it} - rf_t$ (Dependent Variable)	return on shares of firm $i$ over the time $t$ window - risk-free rate of return at time $t$	Yahoo! Financial + Fama & French (1992)
$rmkt_t - rf_t$	return on all firms in NYSE, AMEX and NASDAQ at time $t$ - risk-free rate of return at time $t$	Fama & French (1992)
$SMB_t$	index of small versus big capitalization at time $t$	Fama & French (1992)
$HML_t$	index of high versus low book/price ratio at time $t$	Fama & French (1992)
$DFIRMPRODUCT$	equals 1 if focal firm releases software product/source code to the public, 0 otherwise	PROMT + Lexis-Nexis
$DRIVALPRODUCT$	equals 1 if rival firm releases software product/ source code to the public, 0 otherwise	PROMT + Lexis-Nexis
$ADVERTISING$	total number of times that a firm appears in the news each year (Log transformed)	PROMT + Lexis-Nexis
$BUBBLE$	equals 1 during 1999 to mid 2000, 0 otherwise	Wikipedia

Figure 1. Distribution of events by years

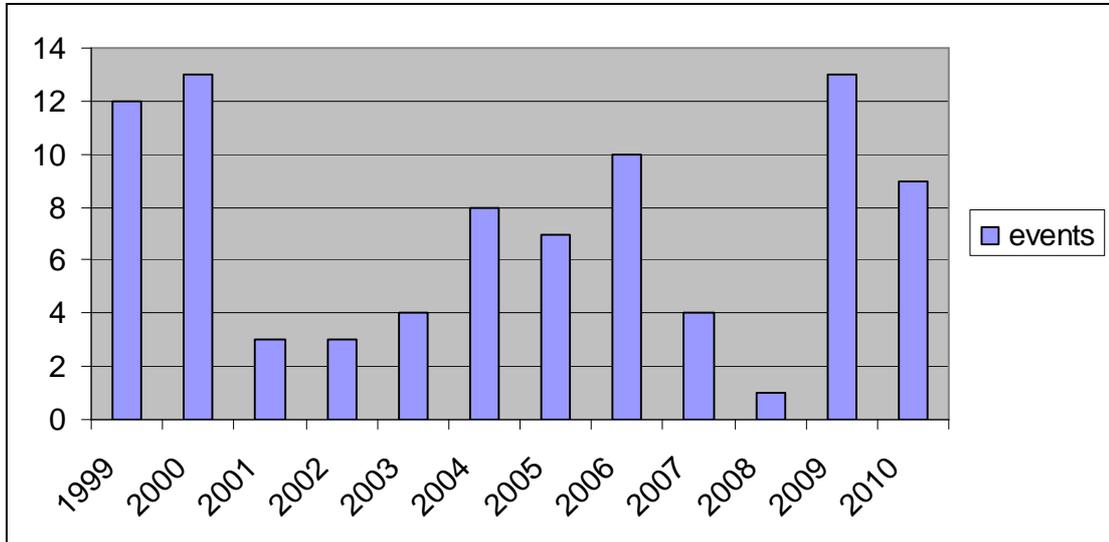


Table 3. Correlation Matrix

Variables	1	2	3	4	5	6	7	8
1. $r_{it} - rf_t$	1.000							
2. $Rmkt_t - rf_t$	0.577	1.000						
3. $SMB_t$	0.036	0.020	1.000					
4. $HML_t$	-0.211	-0.030	-0.148	1.000				
5. $DFIRMPROD$	0.030	0.007	-0.004	-0.009	1.000			
6. $DRIVALPROD$	0.017	0.003	-0.016	-0.007	-0.004	1.000		
7. $BUBBLE$	-0.114	0.008	0.006	-0.030	0.023	0.022	1.000	
8. $ADVERTISING$	-0.017	-0.001	0.002	0.002	-0.005	0.001	0.047	1.000

Table 4. Robust OLS Estimations

Variable	Summary Statistics		Main Results (Number of Events:87)			Targeted Audience	
			Window of days			Developers N=56	End-users N=31
	Mean	Std. dev.	0	-1 +1	-2 +2	Window of days=0	
Dependent variable							
$r_{it} - rf_t$	-0.01	0.028					
Fama and French (1992) controls							
$rmkt_t - rf_t$	0.013	1.370	0.012*** (0.000)	0.012*** (0.000)	0.012*** (0.000)	0.012*** (0.000)	0.012*** (0.000)
$SMB_t$	0.022	0.640	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
$HML_t$	0.019	0.715	-0.008*** (0.000)	-0.008*** (0.000)	-0.008*** (0.000)	-0.008*** (0.000)	-0.008*** (0.000)
$\alpha$			-0.007*** (0.002)	-0.007*** (0.002)	-0.008*** (0.002)	-0.007*** (0.002)	-0.007*** (0.002)
Dummy events							
DFIRMPRODUCT	0.004	0.062	0.013*** (0.002)	0.004*** (0.001)	0.003*** (0.001)	0.011*** (0.002)	0.015*** (0.005)
DRIVALPRODUCT	0.019	0.138	0.003*** (0.001)	0.002*** (0.001)	0.002*** (0.001)	0.003*** (0.001)	0.003* (0.002)
Other controls							
ADVERTISING	9.464	0.735	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
BUBBLE	0.136	0.343	-0.010*** (0.001)	-0.010*** (0.001)	-0.010*** (0.001)	-0.010*** (0.001)	-0.010*** (0.001)
FIRM DUMMIES			included	included	included	included	included
Observations			22,637	22,637	22,637	22,637	22,637
R-squared			0.387	0.387	0.387	0.387	0.387

Robust standard errors in parentheses \*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1