Forecasting Market Reaction Permanence Based on Initial Reaction: The Case of Technology Partnerships in Finland

Saku J. Mäkinen, Veli-Matti Lahti
Tampere University of Technology, Department of Industrial Management, Tampere, Finland

***Abstract*--Technology alliances present in concurrent competitive global business environment an important corporate activity to enhance the innovative engineering and technology capabilities. In present research, there exist a large number of event studies conducted on the technology alliance announcements' effects on the stock price and hence corporate value creation for shareholders. However, the intra-day reaction to technology alliance announcements and persistence of this reaction over time as well as the forecasting of the later returns has eluded earlier research. This study uses technology alliances announced in NASDAQ HEX between 2006 and 2010 to examine the returns and their permanence on the share price over different intervals between 1 minute and 1 day after the announcements to study whether the initial reaction can be used to forecast later reaction on the share price returns. The research is using intra-day and day-level event study method to find out what level of Cumulative Abnormal Return (CAR) is generated by the announcements. As a difference to the earlier studies, this study aspires to show that the first reaction within minutes after the announcement can be used to forecast the returns in the longer term. This study investigates whether short term minute reaction can be used to forecast longer term reaction up to the following day.**

I. INTRODUCTION

There are a large number of studies done on the effect of non-financial information on the share price of the firms making the announcements [1]. The change in the share price – abnormal return – is seen as a reaction to a firm's signaling by investors who are expecting the announced action to have an effect on the firm's cash flow and thus on the dividends expected from the firm [2-4] which in turn have an effect on the value of the firm's share price. The reaction also happens in a short time frame as predicted by the efficient market hypothesis [5].

The research done previously on technology partnerships shows that there is a reaction on the partnership announcement. The majority of the research is done on day level event studies where the reaction is explored on the day long blocks around the event [6-9]. For example, Häussler [10] finds statistically significant abnormal returns generated on the day of the event and on the two following days. Also Anand and Khanna [3] find statistically significant abnormal return on the day of the event and shows that the cumulative abnormal return is statistically significant even nine days after the event.

As it is taken that the markets and participating investors are rational and thus make changes in the valuation of a firm only after they have received new information which gives reason to subsequent valuation change, the new estimation of the value of the share price should stick between the valuations as Anand and Khanna's [3] research shows.

Despite the large number of event studies there seems to be no studies done on predictive power of the initial share price reaction on the later share price behavior. One reason for the low number may be the non-existent usage of event study method in intra-day studies.

This research uses an intra-day event study method to clarify the movements of share prices in minute-level and its usage on predicting the share price behavior in the future.

II. BACKGROUND AND HYPOTHESES BUILDING

A. Stock valuation

In general the approaches to stock valuation can be grouped in two different mindsets. One is based on emphasizing the dividends and the other one efficient arbitrage-free markets. The first approach was developed by Gordon [11] in his article asking what a person purchasing is actually paying for. His formula can also be written in the form

$$P_0 = \frac{D_1}{k - g}$$

where P_0 is share price year t=0, D_1 is expected dividends year t=1, k is the required rate of profit and g is the expected dividend growth rate. This representation shows clearly, that the present price of a share depends on the amount of dividends, required rate of profit, and the dividend growth rate which is expected from the firm.

The second type of approach can be divided into three different theories although they all have same philosophy behind them but representing a different cases of the theory. This approach brings into the equation the influence of general environment's influence to the price of the shares. The first one of these theories, which can also be seen as most general presentation of this philosophy, is Arbitrage Pricing Theory (APT). Roll and Ross [12] state that in the absence of riskless arbitrage profits, and "since any market equilibrium must be consistent with no arbitrage profits, every equilibrium will be characterized by a linear relationship between each asset's expected return and its return's response amplitudes on the common factors." This can be represented as

$$\mathrm{E}(\mathrm{r_j}) = \lambda_0 + \lambda_1 \mathrm{b_{j1}} + \cdots + \lambda_\mathrm{i} \mathrm{b_{ji}}$$

where λ_0 is the riskless rate of return, λ_0, ..., λ_i are systematic response amplitudes, and b_{j1}, …, b_{ji} are correlation coefficients of share j. There are no standard set of systematic response amplitudes, but they are selected for each application.

There are also single- [13-15] and three-factor [16] Capital Asset Pricing Models (CAPM) which are basically APT with either one or three systematic response amplitudes used in the formula. The single-factor CAPM can be represented as

$$E(r_i) = r_f + \beta_i(r_m - r_f)$$

where r_f is risk-free rate of return, r_m is market risk and β_i is stock specific coefficient. In the three-factor CAPM in addition to the market risk premium there are two company specific factors added: market capitalization and book-to-market ratio which were added to improve the explaining power of the formula.

Combining the investors' expectations of dividends, systematic influence factors of macro-environment with rational expectations theory [17], which assumes that every investor has individually rational expectations about stock prices and if though individual investor's expectations may include errors, all investors as a group form an average where there are no systematic errors.

B. An Event's effect on Stock price and Hypotheses

Fama [5] constructed a theory about market efficiency which consists of three levels: weak form stating that all past public information is included in the share prices; semi-strong form stating that share prices instantly change to include the public information; strong form stating that the share prices include all existing information. These forms of market efficiency has been tested in several studies since the original article and the studies [18] are showing that at least the weak and semi-strong form of the theory are supported by the empiric tests. The studies also show that the investors' adjustment reaction to new information is relatively fast but not instantaneous [19].

There are several studies pointing out that technology partnership announcements are causing abnormal returns and the abnormal returns persists in the share prices up to several days [3, 20, 21]. This leads to the first research question: Does technology partnership announcements cause abnormal returns in the share prices of the announcing firms.

Research has also shown that the markets are not instantaneous in its adjustments to new information but the adaptation takes from minutes to tens of minutes [18]. Several event studies have also shown that the abnormal return persists with the price up to several days [10], which leads to the next research question: Can the initial share price adaptive reaction be used to predict later adaptive reaction.

III. RESEARCH METHODS

A. Description of Sample and Data

This research is studying can a share prices' initial reaction after a technology partnership announcement be used in predicting the share price behavior later in time. The sample used in the study is collected from the 39 417 stock exchange releases published by the firms listed in Helsinki Stock Exchange between 1st January 2006 and 31st December 2010. The releases were collected from the OMX Group's database which includes all releases and all language versions made by firms in the OMX stock exchange.

Of all the stock exchange releases 273 announcements were selected based on the heading which indicated that the stock exchange release might be about partnerships. All these releases were read and 57 of them were qualified to be technology partnership announcements. Selection criteria for technology partnerships was that the announcement mentioned that at least one of the purposes of the partnership was to research new technologies or new usage for existing technologies, development of new products or build a new facility with new or previously non-existing technology. Next step was to check possible confounding events to confirm that no other significant announcement or event effect the reaction. Also the timing of the events was checked to make sure that none of the events are too early in the defined time frame so that the estimation window can be properly calculated and that next event of same company is not inside event window of present event window causing disturbance to the observed reaction.

After these actions there were 47 events left. Of these 47 technology partnerships, five were licensing agreements, 26 were contractual technology or product development agreements and 16 were joint ventures with at least one of the purposes being new technology or product development.

B. Method of analysis

The method of analysis in this research is the event study methodology which is widely used in this type of studies [7, 22-25]. The difference when compared to the traditional event studies is that in this study the method is applied on intra-day values.

In the traditional event studies the abnormal return (AR) for a share has been calculated by the last trading value of the day. In the intra-day level – or transaction level – calculation, the AR is calculated for the step length selected, thus giving more precise picture of the share price movement as well as when and how the AR is formed.

For a firm i and event period τ the abnormal return $AR_{i\tau}$ is

$$AR_{i\tau} = R_{i\tau} - E(R_{i\tau})$$

where $R_{i\tau}$ is the actual *ex post* return and $E(R_{i\tau})$ is the expected normal return for the period τ in case there would not be any event.

The actual *ex post* returns $R_{i\tau}$ are the realized stock prices from the stock exchange. This research is using the single-index market model, also known as the market model [26] or ordinary least squares (OLS) market model [27], for the expected normal return. The OLS market model is widely used in partnership event studies [3, 4, 6, 8, 10, 28].

According to the OLS market model, for any firm the normal return $R_{i\tau}$ for stock i in period τ is

$$R_{i\tau} = \alpha_i + \beta_i R_{m\tau} + \varepsilon_{i\tau}$$

where α_i is the intercept and β_i is the market sensitivity level, which are estimated from the regression of the estimation

period, $R_{m\tau}$ is the market return for period τ, and $\varepsilon_{i\tau}$ is the zero mean disturbance term [29, 30].
When the above equations are combined, the OLS abnormal returns are

$$AR_{i\tau} = R_{i\tau} - E(R_{i\tau}) = \varepsilon_{i\tau}$$

The calculation of the abnormal return is based on the deviation of an individual stock price from the selected market index which should be selected so that it reflects all the changes happening in the general business environment, but is affected as little as possible by the changes in individual firm's abnormal reactions. This research is using OMXHPI index, which is a capitalization-weighted price index following all firms listed in the Helsinki stock exchange.

There is normal variation in the stock price movements, which may seem to be small abnormal returns. Due to this variation, significance of the detected stock price changes were tested using J2 as suggested by Campbell [31]. J2 is a special case of commonly used binomial Z where p is set to 0.5 to confirm that possible outliers are not causing the observed significance. The higher the J2 figure, the lower the probability for the perceived reaction being within the normal stock price variation.

The null hypothesis was tested using J2 with the following equation:

$$J_2 = \left(\frac{N(L_1 - 4)}{L_1 - 2}\right)^{½} \overline{SCAR}(\tau_1, \tau_2) \overset{a}{\sim} \mathcal{N}(0,1)$$

where N is number of events in the group tested, L_1 is the length of estimation window, and $\overline{SCAR}$ is average standardized cumulative abnormal return from τ_1 to τ_2.

IV. RESULTS

The calculations show that the abnormal reaction is on average 0.28% after the first minute for all types of technology partnerships varying from 0.20% for contractual partnerships to 0.39% for JVs. There is a gradual increase in the abnormal return up until 1 day when the average abnormal return is 1.52% for all on average varying from 1.27% for JVs to 3.51% for licensing. The detailed results can be seen on table 1. The significance of the reaction stayed above 0.1% the whole time from 1 minute to 1 day.

The nonparametric independent-samples Kruskal-Wallis test showed that there is statistically significant (0.01) difference in the cumulative abnormal reaction (CAR) in minute step between contractual partnerships and joint ventures. Between licensing and contractual and licensing and joint ventures there was no statistically significant difference in CAR. This could be due to the very small sample of licensing events.

Regression tests were used to calculate equations to predict the abnormal return based on the reaction after one minute after the announcement. Next the explanatory power of the equation calculated on the observed reaction on one minute point for the reaction observed later was calculated. The R^2 for all events on CAR at 2 minute point based on CAR at 1 minute point is 94% varying from 99% for licensing to 91% for joint ventures. The explanatory power of the equation stays very high for a few minutes after which it gradually drops to 0.1% for all varying from 32% for licensing to 1% for contractual partnerships. The R^2s are shown on figure 1.

TABLE 1. ABNORMAL RETURNS OVER TIME BY PARTNERSHIP TYPE

Time	All	License	Contractual	JV
1min	0,28 %	0,32 %	0,20 %	0,39 %
2min	0,26 %	0,21 %	0,16 %	0,44 %
3min	0,22 %	0,11 %	0,16 %	0,34 %
4min	0,28 %	0,17 %	0,20 %	0,43 %
5min	0,28 %	0,22 %	0,22 %	0,38 %
6min	0,27 %	0,12 %	0,26 %	0,34 %
7min	0,40 %	0,30 %	0,39 %	0,46 %
8min	0,48 %	0,26 %	0,54 %	0,44 %
9min	0,42 %	0,26 %	0,49 %	0,36 %
10min	0,39 %	0,26 %	0,44 %	0,36 %
15min	0,48 %	0,30 %	0,67 %	0,22 %
20min	0,66 %	0,51 %	0,93 %	0,26 %
25min	0,57 %	0,26 %	0,81 %	0,26 %
30min	0,47 %	0,15 %	0,65 %	0,27 %
40min	0,51 %	0,40 %	0,68 %	0,27 %
50min	0,48 %	0,82 %	0,48 %	0,37 %
1h	0,37 %	0,91 %	0,21 %	0,47 %
3h	1,14 %	2,06 %	1,13 %	0,86 %
1d	1,52 %	3,51 %	1,29 %	1,27 %

V. CONCLUSIONS

The research's results show that there is clear and statistically significant reaction to technology partnership announcements which gives on average 0.28% CAR after one minute of the partnership is known to market participants. There is also statistically significant difference in reaction to contractual partnerships compared to joint ventures. There is no statistically significant difference between licensing and other technology partnering forms probably due to small number of licensing events. This is confirming the first research question.

Table 1 shows the change in cumulative abnormal reaction over several steps after the announcement to the markets. The table displays CAR with upward trend from one minute up to one day with small fluctuation over time.

The coefficient of determination calculated to the linear regression calculated to CAR in other time points compared to the CAR after one minute after the announcement of the partnerships stays over 0.8 for 50 minutes for licensing, six minutes for contractual partnerships and three minutes for joint ventures after which R^2 falls to 0.5 level up until 50 minutes to contractual and joint venture partnerships and over 3 hours for technology licensing. The R^2 reaches virtually zero within 24 hours after the technology partnership announcement. These results show that the initial reaction can be used to predict the share price reaction for up to few minutes with relatively high certainty and almost up to one hour with higher uncertainty confirming the second research question.

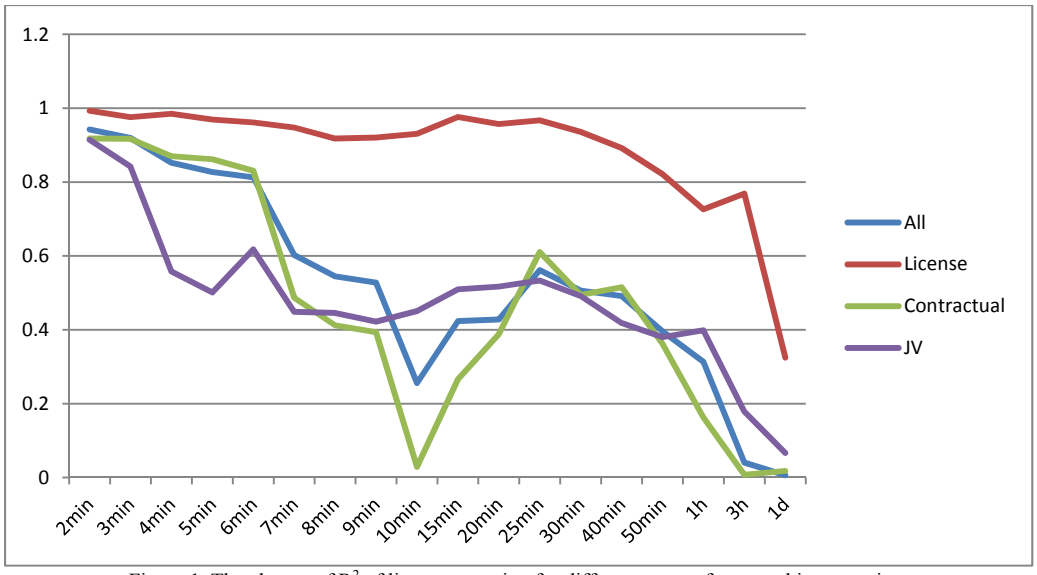

Figure 1. The change of R^2 of linear regression for different types of partnerships over time.

The results of the research show that there is a predictable reaction in the firms' share prices after a technology partnership announcement with small uncertainty. However, the uncertainty increases over time very quickly. This predictable reaction can be used to earn additional rents from the share markets by investors who can buy and sell shares quickly and use formulas to calculate the behavior of share prices.

The reaction was studied with a relatively small sample so that may have an effect on the result either weakening or strengthening the phenomenon. The groups of different types of partnerships were even smaller reducing the certainty of the results. Additionally, the used time period from 2006 to 2010 included periods with very fast increases and decreases in stock markets which could also decrease the certainty of the results. This research did not study whether the reaction changed over time relative to the general stock market behavior. A study of longer time period should be carried out to clarify the possible changes in reactions over time as well as in other stock markets.

Future research should be conducted clarifying the results. For example, a study to further test whether the CAR at 2 minute point can be used to predict the CAR value in 3 minute point, whether CAR at 3 minute point can be used to predict CAR at 4 minute point and so on. Overall, the reaction should be further studied with a larger group of events and with longer time period.

REFERENCES

[1] B. C. Fernandez, Y. F. Callen and J. A. L. Gadea, "Stock Price Reaction to Non-financial News in European Technology Companies," *European Accounting Review,* vol. 20, pp. 81-111, 2011.

[2] J. Prabhu and D. W. Stewart, "Signaling strategies in competitive interaction: Building reputations and hiding the truth," *J. Market. Res.,* pp. 62-72, 2001.

[3] B. Anand and T. Khanna, "Do firms learn to create value? The case of alliances," *Strategic Manage. J.,* vol. 21, pp. 295-315, MAR, 2000.

[4] H. Merchant and D. Schendel, "How do international joint ventures create shareholder value?" *Strategic Manage. J.,* vol. 21, pp. 723-737, JUL, 2000.

[5] E. F. Fama, "Efficient Capital Markets: A Review of Theory and Empirical Work," *The Journal of Finance,* vol. 25, pp. pp. 383-417, May, 1970.

[6] R. Gulati, D. Lavie and H. Singh, "The Nature of Partnering Experience and the Gains from Alliances," *Strategic Manage. J.,* vol. 30, pp. 1213-1233, NOV, 2009.

[7] D. E. Boyd and R. E. Spekman, "The market value impact of indirect ties within technology alliances," *Journal of the Academy of Marketing Science,* vol. 36, pp. 488-500, WIN, 2008.

[8] J. Koh and N. Venkatraman, "Joint Venture Formations and Stock Market Reactions: An Assessment in the Information Technology Sector," *The Academy of Management Journal,* vol. 34, pp. pp. 869-892, Dec., 1991.

[9] L. Sleuwaegen, K. Schep, G. den Hartog and H. Cornmandeur, "Value creation and the alliance experiences of Dutch companies," *Long Range Plann.,* vol. 36, pp. 533-542, DEC, 2003.

[10] C. Häussler, "When Does Partnering Create Market Value?" *European Management Journal,* vol. 24, pp. 1-15, 2, 2006.

[11] M. J. Gordon, "Dividends, earnings, and stock prices," *Rev. Econ. Stat.,* vol. 41, pp. 99-105, 1959.

[12] R. Roll and S. A. Ross, "An empirical investigation of the arbitrage pricing theory," *J. Finance,* pp. 1073-1103, 1980.

[13] W. F. Sharpe, "Capital asset prices: A theory of market equilibrium under conditions of risk," *The Journal of Finance,* vol. 19, pp. 425-442, 1964.

[14] J. Lintner, "The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets," *Rev. Econ. Stat.,* vol. 47, pp. 13-37, 1965.

[15] J. Mossin, "Equilibrium in a capital asset market," *Econometrica: Journal of the Econometric Society,* pp. 768-783, 1966.

[16] E. F. Fama and K. R. French, "The cross-section of expected stock returns," *J. Finance,* pp. 427-465, 1992.

[17] J. F. Muth, "Rational expectations and the theory of price movements," *Econometrica: Journal of the Econometric Society,* vol. 29, pp. 315-335, 1961.

[18] J. A. Busse and T. Clifton Green, "Market efficiency in real time," *J. Financ. Econ.,* vol. 65, pp. 415-437, 2002.

[19] M. J. Barclay and R. H. Litzenberger, "Announcement effects of new equity issues and the use of intraday price data," *J. Financ. Econ.,* vol. 21, pp. 71-99, 1988.

[20] J. D. Neill, G. M. Pfeiffer and C. E. Young-Ybarra, "Technology R&D alliances and firm value," *The Journal of High Technology Management Research,* vol. 12, pp. 227-237, 9, 2001.
[21] B. Cuéllar-Fernández, Y. Fuertes-Callén and J. A. Laínez-Gadea, "The impact of strategic alliances on the market value of telecommunications firms," *The Journal of High Technology Management Research,* vol. 22, pp. 1-13, 2011.
[22] J. Xia, "Mutual Dependence, Partner Substitutability, and Repeated Partnership: the Survival of Cross-Border Alliances," *Strategic Manage. J.,* vol. 32, pp. 229-253, MAR, 2011.
[23] V. Swaminathan and C. Moorman, "Marketing Alliances, Firm Networks, and Firm Value Creation," *J. Market.,* vol. 73, pp. 52-69, SEP, 2009.
[24] D. T. Robinson, "Strategic Alliances and the Boundaries of the Firm," *Rev. Financ. Stud.,* vol. 21, pp. 649-681, APR, 2008.
[25] L. S. Gao and B. Iyer, "Value creation using alliances within the software industry," *Electronic Commerce Research and Applications,* vol. 8, pp. 280-290, 2009.
[26] P. K. Chaney, T. M. Devinney and R. S. Winer, "The impact of new product introductions on the market value of firms," *Journal of Business,* pp. 573-610, 1991.
[27] S. J. Brown and J. B. Warner, "Using daily stock returns* 1:: The case of event studies," *J. Financ. Econ.,* vol. 14, pp. 3-31, 1985.
[28] P. Kale, J. Dyer and H. Singh, "Alliance capability, stock market response, and long-term alliance success: The role of the alliance function," *Strategic Manage. J.,* vol. 23, pp. 747-767, AUG, 2002.
[29] A. C. MacKinlay, "Event studies in economics and finance," *Journal of Economic Literature,* vol. 35, pp. 13-39, 1997.
[30] G. V. Henderson Jr, "Problems and solutions in conducting event studies," *J. Risk Insur.,* pp. 282-306, 1990.
[31] J. Y. Campbell, A. W. Lo and A. C. MacKinlay, *The Econometrics of Financial Markets.* Princeton, New Jersey, 611 p: princeton University press, 1996.