International Journal of Scientific Research and Management (IJSRM)
||Volume||07||Issue||12||Pages||EM-2019-1459-1470||2019||
Website: www.ijsrm.in ISSN (e): 2321-3418
DOI: 10.18535/ijsrm/v7i12.em04

Strategic Alliances and Financial Performance: Some Empirical Evidence of Bio-Pharmaceutical Industry

Houda Chakir Lamrani

Abstract
Over the last decades, strategic alliance have played an important role among high tech firms, including biotech and pharmaceutical companies, showing an impact on financial performance. This study focuses on this topic and analyses how strategic alliances portfolios and types of the partnerships affect bio-pharmaceutical companies' financial performances. Drawing upon a panel data set of 158 alliances during the period of 2003-2013, empirical findings highlight that the number of alliances has a negative relationship with financial performance, whereas partnership types such as licensing and co-development have a positive relationship with the financial performance of biotech and pharmaceutical companies.

Keywords: *Strategic alliances, financial performance, licensing, Co-development partnership, biotechnology -pharmaceutical industries.*

1. Introduction

The strategy to allying with other firms have received wide attention by practitioners and scholars (Gulati, 1998, 2007; Faems *et al.*, 2010; Gottinger and Umali, 2008), as well as has the analysis of its effect on firm performance (George, Zahra, Wheatley and Khan, 2001; Jiang et al., 2010; Anand and Khanna, 2000; Lavie, 2007; Martynov, 2017) in view of the dramatic growth of this practice over the last two decades particularly in high technology industries (Hagedoorn, 1993; Booz and Hamilton, 1997). Many companies found that it is difficult to go it alone (Doz and Hamel, 1998) without any relationships with other firms that share similar goals and with which they aspire for mutual benefits (Mohr and Spekman, 1994; Ireland *et al.*, 2002).

According to previous studies, strategic alliances are defined as voluntary agreement, starting from simple deals occurring between one or more individuals or independent firms to comprehensive agreements that enable companies to achieve common goals involving exchange, sharing or co-development of products, technology or services (Gulati, 1998; Elmuti and Kathawala, 2001; Deeds and Rothaermel, 2003; Faems *et al.*, 2005). It is well known that firms are motivated entering into specific alliances in an effort to share new technologies, and to increase voluntary knowledge transfers (Mowery, Oxley and Silverman, 1996; Gulati, Nohria and Zaheer, 2000; Rothaermel and Boeker, 2008; Parmigiani and Rivera-Santos, 2011) commercialize innovations (Gulati, 1998; Deeds and Rothaermel, 2003), contribute to the performance of business allies, in order to gain competitive advantage (Elmuti and Kathawala, 2001; Tan and Thai, 2014), and to attain financial support to develop new drugs (Hopkins *et al.*, 2013; Liu *et al.*, 2015). Therefore, the diversity of research and development, and technology platforms encourages the use of alliances as a preferred mechanism for exploration or exploitation (Gottinger and Umali, 2008; Yamakawa *et al.*, 2011; Rothaermel and Deeds, 2004; Hoang &Rothaermel, 2010).

Although strategic alliances are more attractive than other strategy types like mergers and acquisition (M&A), its outcome is not always satisfactory. In fact, prior studies showed that alliances effect on firm performance has a positive direct effect (Colombo *et al.*, 2009; Lavie and Miller, 2008; Lin *et al.*, 2012; Pangarkar and Wu, 2013). Other studies found that firms were disappointed to have no benefit on their performances from strategic alliances (Stuart, 2000; Jang, Tao, and Santoro, 2010; Kim and Choi, 2014). Yet other researchers have found that the impact of strategic alliances depended on other factors (Baum, Calabrese and Silverman, 2000; Koka and Prescott, 2008; Lahiri and Narayanan, 2013). Therefore, in addition to the firm's internal outlines, competences and capabilities (Gottinger and Umali, 2008),

companies are seeking for other external factors enabling them to improve their performance. For this reason, biotech and pharmaceutical companies have expanded the range of their strategic alliances (Niosi, 2003; Gulati, 1998) carrying different types of agreements with varying costs and benefits.

This specific industry is selected mainly because in the last two decades there has been a significant increase in the number of strategic alliances among firms within the industry. Furthermore, it is one of the most profitable in the high technology business sector throughout the globe. The study period we selected (2003-2016) coincided in the period in which the sector saw a tremendous increase in the number of strategic alliances among firms. Therefore, it is worth studying the impact of these strategic alliances on the financial performance of firms.

In order to analyze the impact of strategic alliances on firm's financial performance, we first identify the type of agreements included in the alliances of biotech and pharmaceutical companies. And then we divide the different types of alliances in to two categories: co-development and licensing. This is because many authors emphasized the importance of studying alliance portfolios instead of single type of alliances (Duyters and Lokshin, 2011; Faems *et al.*, 2010; Martynov, 2017).

There are different types of strategic alliances, this study, however, will be limited to an examination of two particular cases of partnership that involve agreements of licensing and co-development among biotech and pharmaceutical companies. An investor, on one hand, is interested in securing value and reducing risk by his portfolio companies' entering license agreements enabling the transfer of technology and best practices (Koka and Prescott, 2008), but on the other hand, he wants a substantial upside potential for his investment. In contrast, a co-development agreement included in many alliances allows to the licensor many advantages. He reduces his capital needs in which they agree to develop a compound or technology jointly, stipulating the participation in a product's advanced clinical development and commercialization of the resulting product. The alliance may also include co-promotion or co-marketing agreements. However, despite their increasing importance, strategic alliances have often encountered problems with unsatisfactory performance (Geringer, 1986)

This study focuses on analysis the impact of company's alliances on financial performance, with a particular emphasis to the two types of alliances: co-development and licensing. Despite the fact that biotech and pharmaceutical industry is the most important sector as a strategic asset in the world economy, few researchers have attempted to analyze that sector from this perspective.

The analysis of financial performance is frequently a matter for debate by decision makers such as managers, planners, economists and others since the last decade (Boldeanu and Pugna, 2014). According to Tailab (2014), financial performance plays a key role in measuring the overall financial health of companies over the short and long term and can also be used to compare similar firms across the same industry. Consistent with previous studies on financial performance (Mirza and Javed, 2013; Martynov, 2017; Tailab, 2014) there are many different measures of financial performance and these include return on assets (ROA), return on equity (ROE) and returns on sales (ROS). We selected financial performance measured by return on assets (ROA) ratio as an outcome by following the earlier studies (Dupont, 1919), and recent researchers (Mishra et al, 2009; Tailab, 2014; Martynov, 2017). It is a traditional indicator used to show how efficiently the resources of the company are used to generate income.

This study has the following specific objectives: (1) to establish the influence of two types of strategic alliances (licensing and co-development agreements) on the return on asset (ROA) of biotech pharmaceutical companies (2) to investigate the impact of the alliance portfolios on the financial performance in this sector. In order to achieve these objectives we constructed a sample of top large, medium and small U.S, Europe and Asian biotech pharmaceutical companies, by using data collected from multiple sources, including Recap IQ, MedTrack, and Osiris database, we found that the number of strategic alliances has a negative relationship with a financial performance of the companies, measured by the return on assets. Furthermore, we found that strategic alliance types such as licensing and co-development have a positive relationship with a firm's financial performance. Firms with only one alliance have weaker financial performances as compared to firms which have more than one alliance.

The remainder of the paper is structured as follows. The following section introduces the conceptual and theoretical framework with the hypotheses. The third section of this paper presents the research methodology, data and data sources and the variables used in the analysis. The fourth section will present empirical analyses and results. Finally, we conclude with a discussion.

2. Conceptual Framework and Hypotheses

The main focus of this study is to set up the influence of strategic alliances on the financial performance of biotech and pharmaceutical companies. We hypothesized that licensing, co-development agreements and the portfolios of strategic alliances can be related to the company's financial performance as shown in the model of conceptual framework developed in Fig.3.1.

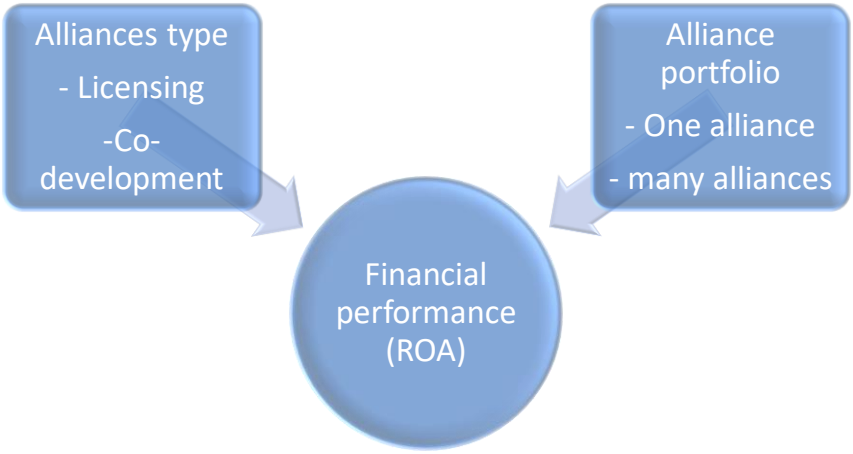

Fig.3.1 Conceptual framework

Relationship between License Agreement and Financial Performance

The effect of a contract depends on the types of provisions included and differentiates between the consequences of control and coordination provisions (Schilke and Lumineau, 2016). It is necessary to determine the cooperation and its corresponding output of alliances. Hence, the partners should be sufficiently differentiated based on each one's needs or gaps in order to provide missing elements or new/complementary capabilities (Osborn and Hagedoorn, 1997). Firms search for alliance partners with resources that they can leverage and integrate to create synergy (Lin, Yang, and Demirkan, 2007).

The alliance management capability has a huge impact on financial performance (Niesten and Jolink, 2015). The capability of alliances (Wang *et al.*, 2015) means their capabilities in terms of their effects on value creation and value capture. Specifically, they are five key parameters which can be used to improve organizational performance based on alliance partners (Albers *et al.*, 2013). These are the structural interface between partners, the structural "interface" within partners, and the specialization, formalization, and centralization of the alliance organization.

H_1: Companies with a licensing agreement(s) achieve higher financial performance than similar firms without such alliance(s).

Interaction between co-development agreement and financial performance

Alliances are assuming a role in the performance of leading players in an industry that is showing signs of a slowdown and increased competitiveness, which is the case of the Brazilian shopping center industry (Gomes *et al.*, 2017).Co-development alliances are formed to create new capabilities (technologies, products, services, processes, etc.) that partner organizations need in order to reach their goals (Bidault, 2012). Thus, success of a co-development (Feng *et al.*, 2010) alliance depends on the close cooperation between partners. Therefore partner selection for co-development is based on the individual and collaborative utilities.

Due to co-development alliances, the effect of new product failures is reduced (Hu, *et al.*, 2017). Massive growth are also considered, such as characterized with SC-industries of emerging markets in the last decade, as reported by Cushman & Wakefield (2014), the Brazilian SC-industry, that doubled in size during this period (ABRASCE, 2015), is presently suffering from an increase in vacancies (IBOPE, 2014) and a decrease in sales growth (IBGE, 2015).

H_2: Companies with co-development agreements are likely to see influence on their financial performance

Impact of financial performance by number of alliances

Alliance portfolio size is an important antecedent of competitive action frequency (Andrevski *et al.,* 2016) it is used to analyze the role of inter-organizational alliances in creating legitimacy for a sustainable technology (Kishna *et al.*, 2017). Firm boundaries could change based on the impact of alliance portfolio size on innovation and financial performance (Lahiri and Narayanan, 2013). Hence, maintaining the alliance portfolio (Hoffmann, W. H., 2007) is an important thing.

The concept of alliances portfolio and firm performance provides the detailed explanation of multifaceted contribution of alliance portfolios to firms' market performance (Lavie, 2007). Certain characteristics of alliances (Reuer *et al.,* 2002) also improve the performance of firms. When the number of alliances is smaller, the consider activity is also limited (Dussauge, 2006). To increase the firm's performance, there is a need to create a dedicated alliance function and develop company-wide standards (Dussauge and Wassmer, 2006) and customized tools for multi-alliance management. Organizations might have the knowledge about strategic alliances when expanding their alliance portfolio (Hashai, 2015), and that can help to enhance their portfolio performance. Additional alliances may give access to advanced knowledge, innovate technologies, new markets, or resources and improvement in the firm's performance. We could argue that the companies that have more than one alliance in their strategic portfolio should show the best performance.

H_3: As the number of company's alliances increases, the financial performance increases.

H_4: Having only one alliance does not play a significant role in company's financial performance.

3. Methodology

3.1. Data and Sample:

This study focuses on biotech and pharmaceutical companies. A total of 233 biotech and pharmaceutical companies [Standard Industrial Classification (2834; 2835; 2836)] and 472 alliances were found during the period 2003 to 2013. In order to test our hypotheses, we exclude companies that are created before 2003. Because of missing values on the constructed variables, we were obliged to exclude many companies and agreements, and hence the sample size was reduced to 66 biotech and pharmaceutical companies that have had 158 alliances in the period of 2003 – 2013. The availability of data is the sole reason for the final sample size. All agreements were codified based on their alliance sub-categories in order to classify the type of agreement following the prior research (Lavie and Rosenkopf, 2006; Rothaermel, 2001). We coded strategic alliances in the two types of alliances as either licensing and co-development alliances. We studied the impact of these two types of alliances on the firm's financial performance for the period 2003 to 2016. Secondary data was collected from multiple sources, including Recap IQ, MedTrack, and Osiris database, for a sample of top largest, medium and small U.S, Europe and Asia biotech and pharmaceutical companies.
The empirical analysis is done on panel data by following previous studies in this area. The use of data as a panel helps us to get less collinearity and to account for heterogeneity. In order to get the regression results, we used the STATA statistical program.

3.2. Variables

3.2.1. Dependent variable:

Financial performance: is the annual financial performance of a firm for the period 2003-2016, is measured by Return on Assets (ROA). The choice to measure financial performance of the biotech-pharmaceutical companies by ROA instead of various financial ratios used in many previous articles in the related literature, including return on equity (ROE) (Boldeau and Pugna, 2014), return on investment (ROI) (Narware, 2010), and net profit margin (NPM) (Oswald *et al.,* 1991), it because this indicator of profitability shows how well the company can use its resources to develop its income. Moreover, it has been widely used as the best indicator of financial performance in earlier and recent research (Burns *et al.,* 2008; Martynov, 2017). We collected ROA from OSIRIS database for the period of 2003 to 2016, commercially provided by Bureau Van Dijk, which contains information on listed and unlisted companies throughout the world with very detailed financial reports.

3.2.2. Independent variables:

Alliance portfolios: it is defined as the total number of all alliances entered by companies in the period from 2003 to 2013. Earlier studies (Lavie and Miller, 2008; Duysters and Lokshin, 2011; Martynov 2017) used alliance portfolios as a standard measure of strategic alliances' contribution to the company's financial performance. Companies usually tried to increase their alliance portfolios by entering into several alliances in order to gain external knowledge and enhance their profitable capabilities and competitiveness in the market.

We obtained the alliance portfolio data for pharmaceutical and biotech companies from two sources. Recap IQ database and MedTrack database. Recap IQ database is a commercial database available from Thomson Reuters. This database provides detailed, relevant information of pharmaceutical industry alliances, including the functional activities performed by the alliance, partners, agreement date, descriptive information about the targeted technology, and the use of equity arrangements. MedTrack archive is the most comprehensive database of private and public biotech companies. The data for alliance portfolio ranges from 2003 to 2013. Since we are hypothesizing that the impact of alliance portfolios on firm's performance that would come after four years after the agreement, we used lagged alliances of portfolios variable by four years in the regression $t-4$.

Total Alliance (1ally): was captured by a dummy variable in which 1 indicates companies that have one agreement and 0 for the companies that have allied many times.

Alliance types: In order to test the impact of the different types of alliances on firm's financial performance, we categorized the alliances into two types of alliances: license agreements that enables the transfer of technology and best practices-*Licensing* (Koka and Pescott, 2008) and Co-development agreements included in many alliances that allow the partners to share the resources in products' advanced clinical development-*Co-development* (Fang, Lee, and Yang, 2014). The number of agreements was obtained from Recap IQ. The data on the type of agreements was codified into 12 categories by using MedTrack for detailed information concern subcategories of alliances. We do not include joint venture in this study.

Licensing: represent the total number of license agreement's the company has. In this independent variable, we used lagged licensing variable by four years in the regression $t-4$.

Co-development: is the total number of co-development agreements the company is engaged in.

3.2.3. Control variables:

We incorporated control variables which previous literature on the alliances and performance found to be important and influential on financial performance. We controlled for; (a): *Firm age* in order to capture the firm's experience in the industry measured by its age since foundation. It is controlled because age difference will greatly change the ultimate result of the alliance (Baum *et al.*, 2000); (b): *R&D intensity*; is used to control for the increase in R&D expense that often accompanies the firm growth indicated. We calculated R&D intensity by dividing total R&D expenses by total sales. We also controlled for (c): *sales growth;* as sales growth could impact the financial performance of companies directly. In the most strategic alliances, the licensee is biotech companies, while the pharmaceutical company is the technology licensor. Hence, we included two dummy variables: licensor (1/0); licensee (1/0).

3.3. Estimation model:

The approach this study follows is to estimate the panel data model as follows:

$$Y_{i,t} = \alpha + \beta_1 X_{1i,t} + \beta_2 X_{2i,t} + \ldots + \beta_n X_{ni,t} + \varepsilon_{i,t} \ldots\ldots\ldots\ldots (1)$$

Where $Y_{i,t}$ is the dependent variable for firm i at time t, α is a constant coefficient and β_n represents the regression coefficient for the regressor X_n and $\varepsilon_{i,t}$ is an error term which captures all others omitted factors with $E[\varepsilon_{i,t} \mid X_{i,t}] = 0$ for all i and t.

Hence, our final regression model by selecting control and independent variable will be as follows:

$$ROA_{i,t} = \alpha + \beta_1 NAP_{i,t-4} + \beta_2 ll_{i,t-4} + \beta_3 CD_{i,t} + \beta_4 1ALLY_{i,t} + \beta_5 FA_{i,t} + \beta_6 R\,\&\,D_{i,t} + \beta_7 GS_{i,t}$$
$$+ \beta_8 LICE_{i,t} + \beta_9 LICER_{i,t} + \varepsilon_{i,t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where, $ROA_{i,t}$ is return on assets for firm i at time t, α is a constant coefficient, $NAP_{i,t-4}$ is number of alliances (Alliance portfolios) of firm i at time $t-4$, $ll_{i,t-4}$ is the number of licensing of firm i at time $t-4$, $CD_{i,t}$ is the number of co-development of firm i at time t, $1ALLY_{i,t}$ is Dummy variable of total alliances i at time t, $FA_{i,t}$ is firm age of firm i at time t, $R\&D_{i,t}$ is research and development intensity firm i at time t, $GS_{i,t}$ is the growth of sales of firm i at time t, $LICE_{i,t}$ is a dummy variable with 1 if the firm is licensee and 0 otherwise, $LICER_{i,t}$ is a dummy variable with 1 if the firm is licensor and 0 otherwise, $\varepsilon_{i,t}$ is an error term which captures all others omitted factors with $E[\varepsilon_{i,t} \mid X_{i,t}] = 0$ for all i and t.

3.4. Estimation Technique:

In order to achieve the aims of this study, the random effects generalized least squares (GLS) was carried out to perform the results of every hypothesis. Random-effects GLS is considered more efficient and appropriate than fixed effects (Jiang *et al.*, 2010). Because we have dummy variables, it is not possible for us to use fixed effect estimator and compare the results. We used robust standard errors estimation clustered at the firm level in order to control for heteroskedasticity and autocorrelation of our panel dataset. The analysis is done using STATA software version 13.

4. Results

Table 1, below, presents the summary statistics of the variables used for the analysis. The mean, standard deviation minimum and maximum of the variables used in the study are presented.

Table 2, presents the correlation matrix of the variables used in the analysis. As can be seen in the table, most of the regressors are correlated with ROA. Furthermore, the signs of the correlations are consistent with the theoretical hypotheses we formulated in the former section. The other control variables included from the literature appear to have the same expected sign in the correlation matrix as well.

Table 1: Summary statistics

	Variables	Obs	Mean	Std. Dev.	Min	Max
1	ROA	924	-0.4344614	2.865577	-80.83621	6.954387
2	Alliance Portfolio	726	0.2176309	0.5005023	0	4
3	licensing	726	0.4752066	1.274175	0	11
4	co-development	726	0.2231405	0.6473833	0	5
5	R&D Intensity	922	13.02815	72.29609	-4.98053	1212.791
6	log firm age	924	3.16557	0.8853767	0	5.030438
7	Sales growth	924	0.1126856	0.8343037	-6.137142	5.441257
8	licensor	924	0.2997835	0.4584112	0	1
9	licensee	924	0.288961	0.4535253	0	1
10	1Ally	924	0.5454545	0.4981993	0	1

Table 3, present the test of multicollinearity controlled by using the VIF (Variance Inflation Factor). The result shows that there is no multicollinearity among all independent variables in the model because all the VIF values are less than 10 (Gujarati, 2003).

Table 4 presents the regression results of random effect least squares (GLS) model used to test our hypotheses. In our first hypothesis, we expected licensing alliances to influence firm performance (we used ROA to proxy firms' financial performance) positively. As can be seen in the regression table below, the coefficient for licensing is positive and strongly significant (β=0.059, $p< .05$) at 5% significance level in all the models. Hence, from the result, we can say that our first hypothesis, H1, is strongly supported.

Table 2: Correlations Matrix

	Variables	1	2	3	4	5	6	7	8	9	10
1	ROA	1									
2	Alliance Portfolio	0.0474	1								
3	licensing	0.0428	0.8736	1							
4	Co-development	0.0367	0.7949	0.6922	1						
5	R&D Intensity	-0.0228	-0.0605	-0.0549	-0.0492	1					
6	log firm age	0.063	0.0563	0.0416	0.0286	-0.0237	1				
7	Sales growth	0.0627	0.041	0.0442	0.0258	-0.1901	0.0038	1			
8	licensor	0.0277	0.6526	0.5781	0.5288	-0.0476	0.0355	0.0778	1		
9	licensee	0.0403	0.6758	0.5355	0.5269	-0.0434	0.0391	-0.0081	0.0373	1	
10	1ally	-0.1116	-0.2768	-0.2301	-0.2019	0.1183	-0.1903	-0.0401	-0.1689	-0.2413	1

In hypothesis two, we expect co-development to impact financial performance positively. As depicted in table-3- below, in model one and two, the coefficient for co-development is positive and significant (β=0.042, β=0.037; $p< .05$), $p< .1$) at 5% and 10% respectively. This appears to give evidence that firms with higher numbers of co-development alliances perform better than firms who have a lower number of co-development alliances. Hence, our result appears to supports our hypothesis two (H2). Concerning model three and four, the results show that the co-development has a positive coefficient and insignificant relationship with ROA (β= 0.030; 0.027, $p> .01$) when we controlled by licensee. This result was rejected.

Table 3: Multicollinearity Test

Variable	VIF
Alliance Portfolio	4.43
Licensing	4.27
Licensee	1.7
1ALLY	1.28
Co-development	2.23
Licensor	1.59
Log firm age	1.05
R&D Intensity	1.07
Sales growth	1.05
Average VIF	2.07

However, we found negative coefficient for the number of alliances. Furthermore, in all the models it is strongly significant (β= -0.261, p< .05) at 5% significance level. Hence, our result indicates that when the number of alliances increases the firm's financial performance with a proxy of ROA decreases. Our result is the opposite of what we hypothesized in H3. This bizarre relationship might be because of the real relationship between the number of alliance and firms' financial performance is non-monotonic. To wit, the real relationship between the two variables might be U-shaped, inverted U-shaped, J-shaped or otherwise.

Table 4: Determinants of ROA as Dependent variables estimates

	model1	**model2**	**model3**	**model4**
Number of Alliances	-0.261**	-0.261**	-0.261**	-0.261**
	(0.113)	(0.113)	(0.113)	(0.113)
licensing	0.059**	0.059**	0.059**	0.059**
	(0.023)	(0.023)	(0.023)	(0.023)
Co-development	0.042**	0.037*	0.030	0.027
	(0.019)	(0.021)	(0.022)	(0.023)
R&D Intensity	-0.001**	-0.001**	-0.001**	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)
log firm age	0.175*	0.175*	0.175*	0.174*
	(0.097)	(0.096)	(0.097)	(0.096)
Sales growth	0.053	0.053	0.053	0.053
	(0.041)	(0.041)	(0.041)	(0.041)
licensor	-0.020		-0.008	
	(0.048)		(0.053)	
1ally	-0.401***	-0.400***	-0.398***	-0.397***
	(0.114)	(0.114)	(0.114)	(0.113)
licensee			0.040	0.044
			(0.063)	(0.058)
_cons	-0.593*	-0.594*	-0.597*	-0.596*
	(0.314)	(0.311)	(0.316)	(0.311)

t-statistics are in parentheses: *** p< .01, ** p< .05, * p< .1 .

We also tried to compare the performance of companies which have only one alliance with the performance of others which have more. In our H4, we expected companies who have only one alliance would perform lower than other firms who have more than one alliance. In all the models, the coefficient for 1Ally (a dummy variable with 1 if the company has only one alliance and 0 otherwise) is negative and strongly significant (β = -0.401, p< .01) at 1% significance level. Hence, our finding has the evidence to support H4. In all the models we run, as can be seen below in table-4-, we found the expected sign as well as significant coefficient at different significance levels.

5. Discussion and Conclusion

The biotech and pharmaceutical industry is one of the high technology industries which have historically been successful at the global level. The top and younger high technology firms enter into strategic alliances to find financial support and hence utilize each other's skills while aiming to reach their multiple goals.

We attempted to investigate the effect of strategic alliances on firms' financial performances. Our study focuses on biotech and pharmaceutical companies in which alliances between upstream and downstream companies are specifically prevalent (Wuyts, Dutta, and Stremersch, 2004). The sample consisted of 66 biotech and pharmaceutical companies that entered into over 158 strategic alliances in the period of 2003-2013 combined with a financial data covering the period of 2003-2016.

Overall, we found a complex relationship between different alliance categories and firms' financial performance. The results we found are mixed.

Results show that there is a complex relationship between different alliance categories and firms' financial performance. The number of licensing agreement impacts financial performance. Likewise, other type of agreement, such as co-development, impacts financial performance positively.

However, our result indicates negative relationship between the number of alliances and firm's financial performance. This bizarre relationship might be because of the real relationship between the number of alliance and firms' financial performance is non-monotonic. To wit, the real relationship between the two variables might be U-shaped, inverted U-shaped, J-shaped or otherwise. For instance, Martynov, (2017), found an inverse U-shaped pattern in the effect of larger alliances on future firm performance. Likewise, Jiang *et al.,* (2010), found U-shaped relationship between firm performance and partner industry diversity. Testing this kind of relationship is beyond the scope of this paper. Yet Stuart (2000) found no positive impact of alliances on firm performance. It is not the number of alliances that are important, but rather the partner's characteristics.

Furthermore, our result indicates that firms with only one alliance appear to perform more poorly financially. This result supported the argument of Martynov (2017) who indicated that entering in alliance or not at all resulted in worse firm performance. As well Hagedoorn and Schakenraad (1994) stated that there is no effect of technology alliances on profitability.

The number of licensing agreement impacts financial performance positively. Likewise, other type of agreement such as co-development impact financial performance positively, whereas the results appear to indicate that the number of alliances impacts financial performance negatively. Similarly, firms with only one alliance appear to perform more weakly financially as compared to firms which have more than one alliance.

6. Acknowledgements

I would like to gratefully acknowledgement the collaboration of Daniela Baglieri in the data collection and her comments and suggestions of this research.

References

[1] Albers, S.; Wohlgezogen, F. & Zajac, E. J. (2016), 'Strategic alliance structures: An organization design perspective', Journal of Management 42(3), 582--614.

[2] Anand, B. N. & Khanna, T. (2000), 'Do firms learn to create value? The case of alliances', Strategic management journal, 295--315.

[3] Andrevski, G.; Brass, D. J. & Ferrier, W. J. (2016), 'Alliance portfolio configurations and competitive action frequency', Journal of Management 42(4), 811--837.

[4] Baum, J. A.; Calabrese, T. & Silverman, B. S. (2000), 'Don't go it alone: Alliance network composition and startups' performance in Canadian biotechnology', Strategic management journal, 267--294.

[5] Bidault, F. (2012), Managing joint innovation: How to balance trust and control in strategic alliances, Palgrave Macmillan.

[6] Boldeanu, D.-M. & Pugna, I.-B. (2014), 'The analysis of the influence factors affecting the performance of pharmaceutical companies.', Theoretical & Applied Economics 21(7).

[7] Burns, D. C.; Sale, J. T. & Stephan, J. A. (2008), 'A better way to gauge profitability', Journal of Accountancy 206(2), 38.

[8] Cohen, J.; Gangi, W.; Lineen, J.; Manard, A. & Hughes, E. X. (2004), 'Strategic alternatives In: The Pharmaceutical Industry', Kellogg School of Management, Northwestern University: US.

[9] Colombo, M. G.; Grilli, L.; Murtinu, S.; Piscitello, L. & Piva, E. (2009), 'Effects of international R&D alliances on performance of high-tech start-ups: A longitudinal analysis', Strategic

Entrepreneurship Journal 3(4), 346--368.
[10] Deeds, D. L. & Rothaermel, F. T. (2003), 'Honeymoons and liabilities: The relationship between age and performance in research and development alliances', Journal of Product Innovation Management 20(6), 468--484.
[11] Doz, Y. L. & Hamel, G. (1998), Alliance advantage: The art of creating value through partnering, Harvard Business Press.
[12] Dussauge, P. & Wassmer, U. (2006), Alliance Portfolios and Value Creation: a Resource-based and Competitive Dynamics Perspective, in 'EURAM Conference'.
[13] Duysters, G. & Lokshin, B. (2011), 'Determinants of alliance portfolio complexity and its effect on innovative performance of companies', Journal of Product Innovation Management 28(4), 570--585.
[14] Elmuti, D. & Kathawala, Y. (2001), 'An overview of strategic alliances', Management decision 39(3), 205--218.
[15] Faems, D.; De Visser, M.; Andries, P. & Van Looy, B. (2010), 'Technology alliance portfolios and financial performance: value-enhancing and cost-increasing effects of open innovation', Journal of Product Innovation Management 27(6), 785--796.
[16] Faems, D.; Van Looy, B. & Debackere, K. (2005), 'Inter-organizational collaboration and innovation: Toward a portfolio approach', Journal of product innovation management 22(3), 238--250.
[17] Fang, E.; Lee, J. & Yang, Z. (2015), 'The timing of codevelopment alliances in new product development processes: Returns for upstream and downstream partners', Journal of Marketing 79(1), 64--82.
[18] Feng, T.; Sun, L. & Zhang, Y. (2010), 'The effects of customer and supplier involvement on competitive advantage: An empirical study in China', Industrial Marketing Management 39(8), 1384--1394.
[19] George, G.; Zahra, S. A.; Wheatley, K. K. & Khan, R. (2001), 'The effects of alliance portfolio characteristics and absorptive capacity on performance: A study of biotechnology firms', The Journal of High Technology Management Research 12(2), 205--226.
[20] Goerzen, A. & Beamish, P. W. (2005), 'The effect of alliance network diversity on multinational enterprise performance', Strategic Management Journal 26(4), 333--354.
[21] Gottinger, H.-W. & Umali, C. L. (2008), 'Strategic alliances in global biotech pharma industries', The Open Business Journal 1(1), 10--24.
[22] Gujarati, D. N. & Porter, D. C. (2003), 'Basic Econometrics. 4th', New York: McGraw-Hill.
[23] Gulati, R. (1998), 'Alliances and networks', Strategic management journal 19(4), 293--317.
[24] Gulati, R. (2007), Managing network resources: Alliances, affiliations, and other relational assets, Oxford University Press on Demand.
[25] Gulati, R.; Nohria, N. & Zaheer, A. (2000), 'Strategic networks', Strategic management journal, 203--215.
[26] Hagedoorn, J. (1993), 'Understanding the rationale of strategic technology partnering: Nterorganizational modes of cooperation and sectoral differences', Strategic management journal 14(5), 371--385.
[27] Hagedoorn, J. & Schakenraad, J. (1994), 'The effect of strategic technology alliances on company performance', Strategic management journal 15(4), 291--309.
[28] Hashai, N. (2015), 'Within-industry diversification and firm performance—an S-shaped hypothesis', Strategic Management Journal 36(9), 1378--1400.
[29] Hoang, H. & Rothaermel, F. T. (2010), 'Leveraging internal and external experience: exploration, exploitation, and R&D project performance', Strategic Management Journal 31(7), 734--758.
[30] Hoffmann, W. H. (2007), 'Strategies for managing a portfolio of alliances', Strategic management journal 28(8), 827--856.
[31] Hu, Y.; McNamara, P. & Piaskowska, D. (2017), 'Project Suspensions and Failures in New Product Development: Returns for Entrepreneurial Firms in Co-Development Alliances', Journal of Product Innovation Management 34(1), 35--59.
[32] Ireland, R. D.; Hitt, M. A. & Vaidyanath, D. (2002), 'Alliance management as a source of competitive advantage', Journal of management 28(3), 413--446.
[33] Jiang, R. J.; Tao, Q. T. & Santoro, M. D. (2010), 'Alliance portfolio diversity and firm performance',

Strategic Management Journal 31(10), 1136--1144.
[34] Kale, P. & Singh, H. (2009), 'Managing strategic alliances: what do we know now, and where do we go from here?', The Academy of Management Perspectives, 45--62.
[35] Kim, H.-S. & Choi, S.-Y. (2014), 'Technological alliance portfolio configuration and firm performance', Review of Managerial Science 8(4), 541--558.
[36] Kishna, M.; Niesten, E.; Negro, S. & Hekkert, M. P. (2017), 'The role of alliances in creating legitimacy of sustainable technologies: A study on the field of bio-plastics', Journal of Cleaner Production 155, 7--16.
[37] Koka, B. R. & Prescott, J. E. (2008), 'Designing alliance networks: the influence of network position, environmental change, and strategy on firm performance', Strategic Management Journal 29(6), 639--661.
[38] Lahiri, N. & Narayanan, S. (2013), 'Vertical integration, innovation, and alliance portfolio size: Implications for firm performance', Strategic Management Journal 34(9), 1042--1064.
[39] Lavie, D. (2007), 'Alliance portfolios and firm performance: A study of value creation and appropriation in the US software industry', Strategic management journal 28(12), 1187--1212.
[40] Lavie, D. & Miller, S. R. (2008), 'Alliance portfolio internationalization and firm performance', Organization science 19(4), 623--646.
[41] Lin, Z.; Yang, H. & Demirkan, I. (2007), 'The performance consequences of ambidexterity in strategic alliance formations: Empirical investigation and computational theorizing', Management science 53(10), 1645--1658.
[42] Liu, D.; Pu, X. & Schramm, M. E. (2016), 'Stock Market Response to Strategic Technical Alliances between Drug and Biotechnology Firms', Journal of Product Innovation Management.
[43] Martynov, A. & Martynov, A. (2017), 'Alliance portfolios and firm performance: the moderating role of firms' strategic positioning', Journal of Strategy and Management 10(2), 206--226.
[44] Mirza, S. A. & Javed, A. (2013), 'Determinants of financial performance of a firm: case of Pakistani Stock Market', Journal of economics and International Finance 5(2), 43.
[45] Mishra, A.; Wilson, C. & Williams, R. (2009), 'Factors affecting financial performance of new and beginning farmers', Agricultural Finance Review 69(2), 160--179.
[46] Mohamad, N. E. A. B. & Saad, N. B. M. (2010), 'Working capital management: The effect of market valuation and profitability in Malaysia', International Journal of Business and Management 5(11), 140.
[47] Mohr, J. & Spekman, R. (1994), 'Characteristics of partnership success: partnership attributes, communication behavior, and conflict resolution techniques', Strategic management journal 15(2), 135--152.
[48] Mowery, D. C.; Oxley, J. E. & Silverman, B. S. (1996), 'Strategic alliances and interfirm knowledge transfer', Strategic management journal 17(S2), 77--91.
[49] Niesten, E. & Jolink, A. (2015), 'The impact of alliance management capabilities on alliance attributes and performance: a literature review', International Journal of Management Reviews 17(1), 69--100.
[50] Niosi, J. (2003), 'Alliances are not enough explaining rapid growth in biotechnology firms', Research policy 32(5), 737--750.
[51] Osborn, R. N. & Hagedoorn, J. (1997), 'The institutionalization and evolutionary dynamics of inter-organizational alliances and networks', Academy of Management Journal 40(2), 261--278.
[52] Oswald, S. L. & Jahera, J. S. (1991), 'The influence of ownership on performance: An empirical study', Strategic Management Journal 12(4), 321--326.
[53] Pangarkar, N. & Wu, J. (2013), 'Alliance formation, partner diversity, and performance of Singapore startups', Asia Pacific Journal of Management 30(3), 791--807.
[54] Parmigiani, A. & Rivera-Santos, M. (2011), 'Clearing a path through the forest: A meta-review of inter-organizational relationships', Journal of Management 37(4), 1108--1136.
[55] Reuer, M.; Zollo, J. J. & Singh, H. (2002), 'Inter-organizational routines and performance in strategic alliances', Organization Science 13(6), 701--713.
[56] Rothaermel, F. T. & Boeker, W. (2008), 'Old technology meets new technology: Complementarities, similarities, and alliance formation', Strategic Management Journal 29(1), 47--77.
[57] Rothaermel, F. T. & Deeds, D. L. (2004), 'Exploration and exploitation alliances in biotechnology: A

system of new product development', Strategic management journal 25(3), 201--221.
[58] Schilke, O. & Lumineau, F. (2016), 'The double-edged effect of contracts on alliance performance', Journal of Management, 0149206316655872.
[59] Stuart, T. E. (2000), 'Inter-organizational alliances and the performance of firms: A study of growth and innovation rates in a high-technology industry', Strategic management journal, 791--811.
[60] Tailab, M. (2014), 'Analyzing Factors Effecting Profitability of Non-Financial US Firms', Res. J. Finance Account 5, 17--26.
[61] Tyebjee, T. & Hardin, J. (2004), 'Biotech–pharma alliances: Strategies, structures and financing', Journal of commercial biotechnology 10(4), 329--339.
[62] Wang, Y. & Rajagopalan, N. (2015), 'Alliance capabilities: review and research agenda', Journal of management 41(1), 236--260.
[63] Wuyts, S.; Dutta, S. & Stremersch, S. (2004), 'Portfolios of interfirm agreements in technology-intensive markets: Consequences for innovation and profitability', Journal of marketing 68(2), 88--100.
[64] Yamakawa, Y.; Yang, H. & Lin, Z. J. (2011), 'Exploration versus exploitation in alliance ortfolio: Performance implications of organizational, strategic, and environmental fit', Research Policy 40(2), 287--296.