Gordon Institute of Business Science
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The effects of merger and acquisition activity on the performance of listed innovation driven businesses: Insights from the pharmaceutical and biotechnological industries.

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ABSTRACT

An innovation deficit may exist due to cycles of Mergers and Acquisitions (M&A) as managers of innovation driven business use a strategy of buying growth at the expense of innovation. It is recognised that innovations are vital for economic growth and society depends on innovations from industries such as pharmaceutical and biotechnology as a matter of public health. Empirical studies exist that explain why companies engage in M&A and the impact thereof on company performance but with a non-specific industry focus. The impact of M&A on innovation driven businesses is less well documented. This identified a gap in the knowledge in this area and to address it, this research examined specifically the effects of M&A activity on innovation-driven businesses as proxied by the pharmaceutical and biotechnological industries.

A quantitative, causal design using a time series approach was employed for the research. Specifically event study methodology, which measured the impact of a specific event on the value of a company and a joint set of variables, was the main tool used for this research. Cumulative average abnormal returns (CAARs) were calculated to assess the impact of the M&A event on the value of the companies. An accounting study was used to determine abnormal operating financial performance. Parametric tests, non-parametric tests, and descriptive statistics were used to assess variables, namely research and development intensity, sales performance, and cost efficiency. Secondary company data used for the analysis such as data on the M&A transactions, stock prices, and data from company financial statements was sourced mainly from the Zephyr database. A sample of 35 transactions in the period 2005-2015 was selected based on purposive sampling.

Parametric (paired-sample t-tests, matched pairs t-tests, paired sample correlations) and non-metric tests (Wilcoxon Signed Rank Sum tests and the Friedman test) were performed at the 95% confidence interval. A bootstrapping technique was used to test the statistical significance of the results of the CAARs.

This research concluded that post the transaction the acquirers shareholders earn positive but statistically insignificant returns in the short-term; up to one year post the transaction the acquirers face a significant decline in research and development intensity and are less cost effective while the operating financial performance and sales performance, are not significantly impacted.

KEYWORDS

Innovation; Merger; Acquisition; Pharmaceuticals; Biotechnology; Performance

DECLARATION

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

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Tinashe Zigomo

09 November 2015

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CHAPTER 1: INTRODUCTION TO THE RESEARCH PROBLEM

1.1 Research Title

The effects of merger and acquisition activity on the performance of listed innovation driven businesses: Insights from the pharmaceutical and biotechnological industries.

1.2 Research Problem

According to leading industry analysts, concerns exist that the pharmaceutical industry in general may be facing an innovation deficit (Nature reviews, 2009). Malik (2009) argued that new drug approvals are far from the high levels witnessed in the mid-1990s. The World Health Organisation (2014) projected that by 2020 the global burden of disease and coupled with it the need for new treatments is set to rise significantly. The institution estimated that chronic diseases (diseases that affect humans on a long-lasting basis and can be controlled but not cured) will account for almost 75% of all mortality worldwide, a rise from 60% in 2001 (WHO, 2015). It is evident the trend of a rise in disease burden is contrasted to the decline in innovation in the sector.

According to Ritz and Bevins (2012), it is also recognised that innovations are engines of economic growth. A decline in innovation would thus plausibly negatively impact the growth of the global economy at large. For listed companies a further decline in innovation would prove to be even direr as it has been found that by the very virtue of transitioning to being a publicly traded entity, the company's internal innovation subsequently becomes less novel (Bernstein, 2015; Ferreira, Manso, & Silva, 2012).

Considering the trend of lagging innovation prospects, the response by many large companies in the sector has been to engage in mergers and acquisitions (M&A's) in an attempt to emerge from their dwindling prospects (Malik, 2009). On the contrary some authors such as Phillips and Zhdanov (2013) claimed that the motivation has been to gain research and development (R&D) synergies. Synergies, in the context of mergers and acquisitions are defined as the positive incremental gains that are associated with the union of two entities (Firer, Ross, Westerfield & Jordan 2012).

While the question on motive for M&A has been discussed in more detail, less has been said about the impact this activity has had on the afore mentioned pharmaceutical and biotechnological sector (LaMattina, 2011). While a wide body of literature exists on the traditional motives of M&A, relatively little literature is available on the effect of M&A activity on the innovation output of a company (Sevilir & Tian, 2012). Comanor and Scherer argued that the increased industry concentration that has been brought on by recent merger waves may have contributed to the overall declining rate of innovation (Comanor & Scherer, 2013).

According to Getz (2014) approximately 50% of all drugs undergoing clinical testing are being interrupted by different kinds of merger or acquisitive activities such as in-licensing deals, co-development agreements, joint ventures, asset swaps, and plain M&As. The result is that the drugs are taking significantly more time to develop which affects the innovation output (Getz, 2014). Hence attention is once again drawn to M&A activity and its impact thereof on the innovation driven sector. According to LaMattina (2011) waves of merger and acquisitions activity have beset the pharmaceutical and biotechnological (also referred to as pharma and biotech) industries over the recent past and current research argues that the main players in this industry are buying growth at the expense of innovation as they react to patent expiries, rising research and development costs, as well as stricter regulations (LaMattina, 2011).

Extensive research exists about the reasons for company engagement in M&A (Sheen, 2014). Research on the impact of M&A activity is generalised mainly on company performance without differentiation on the nature of the company (Kirchhoff & Schiereck, 2011). Some research has been conducted specifically on the determinants of M&A success of pharma and biotech industries (Kirchhoff & Schiereck, 2011). However, the impact of mergers and acquisitions on innovation is less well documented (LaMattina, 2011). This identifies a gap in the knowledge in this area.

Lastly, as confirmed by literature reviewed in Chapter 3, there are contradictory and inconclusive findings in current literature on the impact of M&A on innovation. These contradictory and inconclusive findings exist on various key performance indicators such as pre- and post- M&A research and development intensity, sales performance, cost efficiency, and operational performance.

The following section therefore elaborates further on the aims of this research in addressing the problems raised.

1.3 Research Aims

The main motivation of this research was to find answers to the question posed by Comanor and Scherer (2013) who questioned if the rising trend in mergers and acquisitions, which in itself may have been triggered in response to a lag in innovation, presented a self-defeating strategy that has only worsened the outcomes of the pharmaceutical and biotechnological industries?

The research aimed firstly to assess whether or not merger and acquisition activity in innovation-driven companies, as proxied by the pharmaceutical and biotechnological industries, has been successful from a shareholder perspective. Second the research aimed to better understand the impact of M&A activity on the operating performance of the acquiring company. Third the research aimed to improve the understanding of the impact of M&A activity on specific acquirer, target, and combined entity (acquirer post-deal/post-transaction) attributes, namely research and development intensity (innovation), sales performance, and cost efficiency.

The aims of the research, as stated in this section provide context for Chapter 2 which delves into the questions for which this research intends to find answers. These questions are coordinated to specific objectives. The terms deal, transaction and M&A event are used interchangeably throughout this research study.

1.4 Research Questions and Objectives

Saunders and Lewis (2012) described research objectives as clear, specific statements that essentially stipulate what the research process is seeking to achieve after the research has been conducted. The authors further articulated that the objectives of the research should naturally flow from the research questions and that they augment the questions by adding precision, and advise that researchers include both research questions and objectives (Saunders & Lewis, 2012). Therefore, this chapter develops the research questions and posits the objectives of this research from these questions.

Conflicting views exist on the impact of merger and acquisition activity on innovation-driven business. This is despite the large wave of acquisitive activity affecting businesses in pharmaceutical and biotechnological industries, especially in the last few years. The lack of consensus can in part be attributed to the argument that the impact of mergers and

acquisitions on innovation is less well documented (LaMattina, 2011). With innovations playing a key role in economic and human development as shall be revealed in the literature section, it is worthwhile to explore the gap in the literature regarding how such chronic merger and acquisition activity in innovation-driven industries such as pharmaceuticals and biotech impacts the businesses that operate in these industries.

The research study attempted to find answers to the following questions coordinated to specific objectives within the context of innovation driven businesses, as proxied by pharmaceutical and biotechnological companies:

Research question	Research Objective
1. Does the merger and acquisition activity negatively impact shareholder value?	a) To determine, based on abnormal share price returns and sample t-tests, the impact of M&A activity on shareholder value in the short term.
2. Is the operating financial performance of the acquiring company negatively impacted following the acquisitive activity?	b) To determine, based on abnormal operating cash flow return on assets and paired samples correlations, the pre- and post-merger and acquisition operating financial performance of the acquiring company in the period one year prior to the M&A transaction up to one year post transaction.
3. Does the overall research and development intensity of the acquiring company decline following the acquisitive activity?	c) To determine the correlation if any that exists between the pre- and post-deal research and development intensity of the acquiring company to gauge the influence of the merger and acquisition event. To determine the impact of the M&A event on acquirer research and development intensity in the period one year prior to the transaction up to one year post

	transaction.
4. Is the sales performance of the acquiring company improved by the acquisitive activity?	d) To determine the correlation if any that exists between the pre and post-deal sales performance of the acquiring company to gauge the influence of the merger and acquisition event. To determine the impact of the M&A event on the acquirer sales performance in the period one year prior to the transaction up to one year post transaction.
5. Is the cost efficiency of the acquiring company improved by the acquisitive activity?	e) To determine the relative pre-deal (pre-transaction) cost efficiency of the target and acquirer. To determine the impact of the M&A event on the cost efficiency of the acquiring company in the period one year prior to the transaction up to one year post transaction.

Due to resource and time constraints, not all aspects relating to this topic were covered in this research study. Hence the scope is clearly established in the following chapter.

1.5 Research Scope

The scope of this research was limited to acquisitions undertaken by pharmaceutical and biotechnological companies listed on major stock exchanges during the period from 2005 to 2015 year-to-date. The selected industries served as a proxy for the innovation-driven businesses.

It is worthwhile to note at this point that the reason why the pharmaceutical and biotechnological industries were selected as a proxy for innovation driven businesses is

further explained in Chapter 2. Furthermore, the reason for the selection of the time period from 2005 to 2015 is further explained in Chapter 4.

Chapter 1 identified a problem and elaborated on the objectives of this research in addressing that problem. It is important to further expand on the relevant theory concerning the subject of mergers and acquisitions and of innovation and to explore the linkages between the two areas. The following is a summary of the existing literature in support of the objectives and also includes literature describing the areas of innovation and mergers and acquisitions.

CHAPTER 2: LITERATURE REVIEW

Chapter 1 outlined the research problem providing justification for the need of the research leading in the aims and objectives of the research topic. Chapter 2 summarises the relevant theory base about innovation and mergers and acquisitions with a particular focus on the pharmaceutical and biotechnological industries, which serve as proxies for innovation-driven businesses for reasons, explained below.

The pharmaceutical (pharma) and biotechnological (biotech) industries were selected as proxies for innovation-driven businesses due to a number of factors.

- First, these industries consist of companies that fit the profile of innovation-driven business. According to Teece (2010) innovation driven businesses are characterised by a high dependence on intangible assets (patents and intellectual property), high investments or expenditure in research and development (R&D), high volatility or change, and high risk of failure in terms of ability to achieve breakthrough products or services that can be transformed into market success. These attributes are characteristic of pharmaceutical and biotechnological companies.
- Second the pharmaceutical and biotechnological industries depend on innovation as a driver for future success (Bharath, Manjula, & Vijaychand, 2011). This essentially means that if these companies do not innovate then they could potentially cease to exist.
- Third, it is worthwhile to note that currently four out of the ten most innovative companies in the world as published by Forbes, are pharmaceutical or biotechnological companies (Forbes, 2015).

Before the relevant theory concerning innovation can be discussed, it is important to establish the definition of innovations.

2.1 Innovations Defined

Innovation can be defined as the outcome when new and economically useful knowledge is produced, diffused across to an intended audience and used (Tidd & Bessant, 2011). The production of an innovation involves the research and development process of the

innovation from an idea to an actual product or service; the diffusion and use of an innovation involves the process whereby observers of an innovation adopt and/or imitate it (Tidd & Bessant, 2011).

Innovation occurs in a cycle which requires intentional effort and investment. The innovation cycle consists of three stages as presented in Figure 1, namely the 'invention' stage where a new idea or process is conceived, followed by the 'innovation' stage where the economic requirements of the idea are arranged and lastly the stage of 'sustained competitive advantage' where the innovation is continuously adapted to bring about sustained economic value to the owners (Ismail, 2015). Any breaks or interruptions to this cycle are disruptive to the process of innovation and can affect the output.

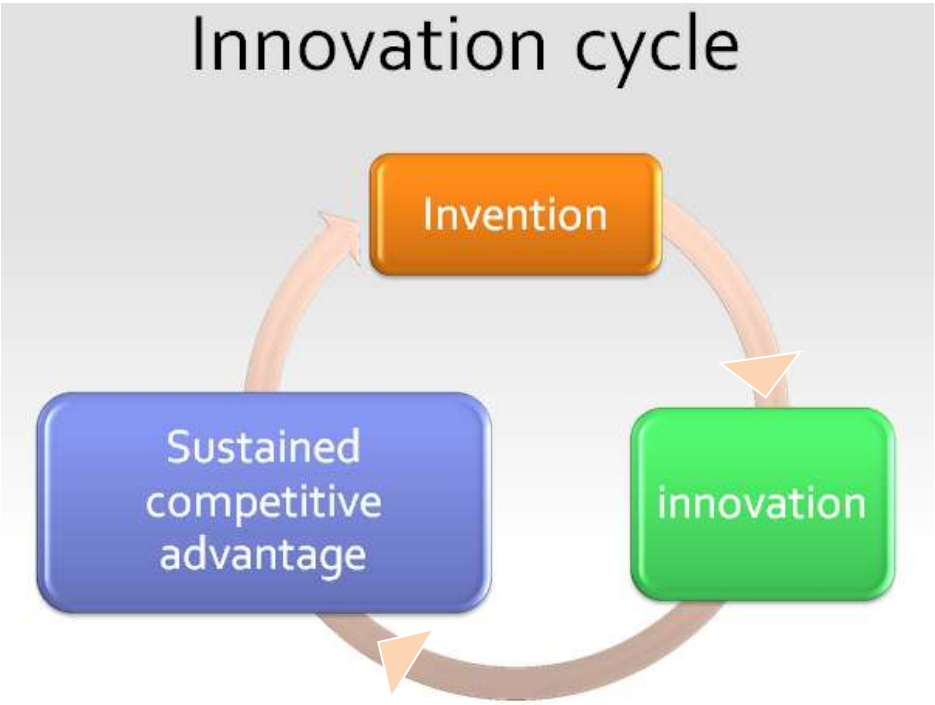


Figure 1: The Innovation Cycle

Innovations are not restricted to radical innovation or activities at the technological frontier. An innovation can be novel to the company, novel to the industry, or novel to the world (Ismail, 2015).

Within the pharma and biotech industries, innovations are developed through a comprehensive discovery process which is briefly described in the following section. The the discovery process is explained to illustrate the high levels of complexity of the innovation process in pharma and biotech as well as the high levels of investment required

in terms of finances and time. Understanding the tedious process involved in developing new pharmaceutical or biotechnological products is an important base towards understanding the impact of some of the commercial or strategic decisions, such as acquisitions, that could be made during the time a drug is in development.

2.1.1 Innovation in Pharma and Biotech: The drug discovery process

The process of innovation in pharma and biotech is commonly called research and development (R&D) or more specifically drug discovery (Bharath et al., 2011). Two main stages define the process by which drugs are produced, namely the pre-clinical (outside human use) and the clinical stage (use in humans) (Bharath et al., 2011). The process from the pre-clinical to the completion of the clinical stage and subsequent review and approval of the drug by a national health authority can take anywhere from four to ten years (FDA, 2015).

2.1.1.1 Pre-clinical stage drug discovery

The pre-clinical stage involves studies outside of human subjects and is a two-step process. The first step is focused on how the body and the disease or medical condition works by identifying and modelling the biological target within the body that is causing the problem. The second step is to identify a lead compound for initial testing in animals mainly based on the level of match between the biological target and the compounds available in a special library (Bharath et al., 2011).

After pre-clinical studies are completed, the drug has to be tested in humans through several phases of clinical trials.

2.1.1.2 Clinical stage drug discovery

According to the FDA (2015) during the clinical stage, studies (or trials), are done in people in three main phases, namely:

- Phase 1: Safety and dosage studies, which take several months.
- Phase 2: Efficacy and side effect studies, which take between one and two years.
- Phase 3: Continuation of efficacy with monitoring of side effects, which takes between one and four years.

Considering that the innovation time line is a long and tedious process, an interruption due to activities such as mergers and acquisitions could further prolong the development of the drug. This has recently been flagged as an area of concern as according to Getz (2014) approximately half of the drugs that are undergoing clinical testing are being interrupted by various (M&A) activities resulting in it taking significantly more time to develop these drugs.

Furthermore it is currently estimated that the average cost involved in developing each new drug ranges in literature from $800 million to $1.8 billion (United States dollars) over a 12 to 15 year time period (Bharath et al., 2011). Such a costly exercise may prove even more costly if/when disrupted. In view of the high cost involved in research and development, this may also influence decisions by companies to rather acquire other companies that have established product pipelines as opposed to investing in companies that are investigating their own new innovative products.

Now that innovation has been explained both broadly and within the context of pharma and biotech, it is important to establish the importance of innovations.

2.2 Importance of Innovations

2.2.1 Innovation and Business and Economic Growth

Ritz and Bevins (2012) argued that innovation is a key ingredient in the economic performance of a country, region, or global environment in order to prosper in the 21st Century.

Innovative products find their value in two ways; firstly in the extent to which new technology is incorporated into the product and secondly in the level to which the innovative product is able to fulfil key customer needs more effectively than the products that are currently existing (Sorescu, Chandy, & Prabhu, 2003). Pharmaceutical and biotechnological products meet these two criteria well as new molecules are discovered and developed through a process that incorporates the latest technologies with the final product being used to treat specific diseases or meet specific patient needs.

According to Tidd and Bessant (2011) and supported by Ritz and Bevins (2012) innovation and enterprise are core elements in the economic growth and development of nations. It can be argued that at the national economy level what carries weight is how the national systems are oriented towards innovation, including the existence of formal policy,

institutions and governance structures. However, according to the Tidd and Bessant (2011) it is also critical to consider the contribution of innovation to the economy at a micro level, in particular innovation in industries and companies and the entrepreneurship of individuals.

2.2.2 Innovation and Sustainability

While innovation is often presented as a major contributor to the degradation of the environment, through its association with increased economic growth and consumption, it is also recognised to be important in environmental sustainability (Tidd & Bessant, 2011). It is through innovation that industries have developed sustainable ways in which to conduct their business.

2.2.3 Innovation and Social Changes

Innovations have also been recognised as agents for social change in as far as the innovative products or solutions are able to positively impact the development of communities including but not limited to the health status and social welfare of the people, the environment in which the communities live in with a focus on sustainability, the community arts and culture, and the level of education and employment of the members of the community (Tidd & Bessant, 2011).

Having established the importance of innovation, awareness needs to be raised regarding the potential “innovation deficit” and what this means for the economy and for people.

2.3 The Innovation Deficit

An “innovation deficit”, also referred to as a “productivity gap” in some literature, can be described as a phenomena whereby the rate at which new innovations are being developed lags behind and fails to meet the demands of the population; these demands could include economic growth, public health, and technology (Drews & Rysner, 1996; Drews, 2003), to name a few.

According to Bharath et al. (2011) within pharma and biotech industries, the innovation deficit is evident, despite the fact that available basic biomedical knowledge has been rising at an exponential rate as propelled by academia through research. However, the

gap between the research desk or the laboratory and the eventual clinical application to benefit the patient appears to be expanding (Bharath et al., 2011).

Only one out of twelve drugs that enters clinical trials for development becomes a new drug approved by health authorities (Bharath et al., 2011). Malik (2009) argued that new drug approvals fall short from the highs witnessed in the mid-1990s. Furthermore, according to Malik (2009) the discovery of innovative drugs has dwindled to the point of concern as reflected by the much lower numbers of 'first-in-class' products to reach the market. 'First-in-Class' products refer to drugs which completely novel for the treatment of a condition and will, for example, will treat the medical condition using a new, often better, and unique mechanism of action (FDA, 2015). This signals a slow rate of innovation.

Of particular concern for the pharmaceutical and biotechnological industries is that even though a variety of approaches are being used for R&D, attrition rates with regard to new product development which contribute to an innovation deficit remain high during drug development (Bharath et al., 2011). This presents an even more concerning public health problem, as it is projected that the global burden of disease is set to rise, hence the need for treatments is set to increase (WHO, 2015).

To provide a balanced view, it is fair to state that the declining R&D productivity in the pharma and biotech industries can be attributed to other factors. For instance traditionally there has been a focus with much progress made in addressing simple disease targets, and now the focus has shifted to the more complex disease targets which cannot be addressed from a traditional chemistry perspective and furthermore the role of these complex disease targets in disease is not yet well understood (Barabási, Gulbahce, & Loscalzo, 2011).

Another factor that has led to the decline in R&D productivity is the high number of poor performing active substances that have to be withdrawn from development due to poor pharmacological properties, lack of appropriate bioavailability, poor pharmacokinetics, and high adverse effect profiles (Bharath et al., 2011).

Some estimates on drug development failures due to poor performing active substances go as high as approximately 50%. An estimated 30% of attrition is due to lack of efficacy while 12% of attrition is due to side effects (Kessel, 2011).

However, more appropriate to this study, it is also argued that approximately 8% of attrition in development is due to commercial reasons such as merger and acquisitions, and lack of

market potential (Bharath et al., 2011). Hence the question that this research study sought to answer is: Does M&A activity contribute to the innovation deficit? It is an aim of this research study to reveal how acquisitive behaviour among companies within the industry has contributed to the attrition in R&D productivity or intensity.

The theory base of innovations has been laid out and some linkages to M&A activity have been established. Now the theory base of mergers and acquisitions and further linkages to innovation are explored in the next section, commencing with the definition of M&As.

2.4 Mergers and Acquisitions Defined

According to Firer et al. (2012), a variety of terms describe the acquisition of one company by another. These include merger, acquisition, takeover, amalgamation, arrangement, combination, compromise, consolidation, reconstructions and absorption. This research study concentrated on the evaluation of the acquisition of one company by another by way of M&A, since these two types of activity constitute the most extensive option currently used by pharma and biotech to generate synergies (Kirchhoff & Schiereck, 2011).

A “merger” is defined as a type of transaction resulting in the combination of two companies. In most cases a new entity is formed in which the new shareholders essentially include all the shareholders of the prior individual companies (Firer et al., 2012).

An “acquisition” is defined as a type of transaction that results in an individual or company (known as an acquirer) gaining control over the management and assets of another company (known as the target). The process by which this happens can be by ownership of these assets or by indirect control of the management of the company, or by acquisition of the shares or majority thereof of the target (Firer et al., 2012).

An important difference between a merger and an acquisition is that in a merger, the size of the companies involved are equal or comparable, whereas in an acquisition a larger company, the acquirer, takes over the smaller company, the target (Bartlett, Beech, de Hart, de Jager, de Lange, Erasmus, & Van Rooyen, 2014). A scenario is also possible where a smaller company takes over a larger company and this is defined as a “reverse takeover” (Bartlett et al., 2014). For the purposes of this research study, the terms merger and acquisition are considered the same and are therefore used interchangeably referring

to the same principle as there is no evidence that the size of the acquirer relative to target has any bearing on value creation or destruction (Dobbs, Koller, & Huyett, 2010).

This research study focused on horizontal acquisitions of companies. These are basically acquisitions of companies within the same industry as the offeror or acquirer. This type of acquisition is often geographic in nature and accompanied by economies of scale. The companies in the industry compete with each other in their respective product markets (Firer et al, 2012).

According to Dobbs et al. (2010), in M&A and from the perspective of the acquirer, value is said to be created for shareholders when the difference between the value received and the price paid by the acquirer is positive. The “value received” by the acquirer is further defined as the targets intrinsic value plus a premium based on any performance improvements anticipated post the transaction. For the calculation of the intrinsic value the target is considered as a stand-alone entity managed by its former management team. Hence the “price paid” by the acquirer is the market value of the target company plus the premium that is required to convince the shareholders of the target to sell their shares (Dobbs et al., 2010).

Having defined what M&As are, the next step establishes the drivers of companies that engage in M&A activity. This is addressed in the following section.

2.5 Drivers of Mergers and Acquisitions in the Innovation industries

Bena and Li (2014) affirmed that the traditional driver of M&A activity has been potential “synergies”, and that many M&As are motivated by technology reasons where the acquirer sees value in technology gains. In the innovation space, current views are that the main drivers for M&As are as a tool to glide over patent expiries, spiralling R&D costs, and waning product pipelines which affect growth (Kirchhoff & Schiereck, 2011).These main drivers are further explained in the ensuing sections that follow.

2.5.1 Research and Development Cost-Cutting

At present the estimated average cost of drug discovery for each new drug ranges from approximately $800 million to $1.8 billion (United States dollars) over a 12 to 15 year time

period (Bharath et al., 2011). Significant variation exists in this estimate in both cost and time and this depends on a number of factors such as the nature of the disease being targeted, the drug type being developed, and the type and scope of the clinical trials that would be required to gain regulatory and marketing authorisation approval (Bharath et al., 2011). Whilst significant variations exist, developing a drug is still a costly process which would be a concern to the chief executive officer (CEO) and shareholders of a company.

2.5.2 Growth: Product Pipeline

According to Malik (2009) most pharmaceutical companies are currently faced with the problem of weak pipelines and based on a comparative examination of the number of new medicine approvals in recent years compared to the past the revelation was that drug approvals are significantly less than the high levels observed in the mid-1990s. However according to Phillips and Zhdanov (2013), weak pipelines may be a deliberate outcome of acquirers as large companies may decide in their strategy to outsource innovation by purchasing smaller innovative companies while conducting less R&D themselves.

It is also apparent that leading pharmaceutical companies depend on a relatively small portfolio of 'blockbuster' drugs for a large part of their revenues (Malik, 2009). By definition, a 'blockbuster' drug is one that generates more than US$ 1 billion in revenue annually (Khanna, 2012).

Large and dominant pharmaceutical companies are arguably more successful than smaller pharmaceutical companies in terms of the process of transforming their existing innovative breakthroughs into economic gains (Gorton, Kahl, & Rosen, 2009). Economic gains in this context refer to the successful marketing and sales of the innovation. Current trends have exposed that dominance in the pharmaceutical and biotechnological space is being achieved through merger and acquisition (M&A) activity (Getz, 2014).

2.5.3 Patent Expiries

A "patent cliff" currently looms over the pharma and biotech industries as a large number of the industries' big-name blockbuster drugs are due to lose their patent protection in the near future and once the drugs are off patent, stiff competition from sales of cheaper generic products will result in a sharp decrease in the big pharma revenues (Malik, 2009). This becomes an incentive to purchase further intellectual property through M&As.

2.5.4 Shift from Conventional Pharmaceuticals to Biotechnological Products

Another driver in the series of M&A activity particularly in pharma and biotech industries has been the shift in the science and technology in the industry from conventional pharmaceuticals to biological products.

Table 1: Big Pharma companies by revenues

#	Company	2014 ($m)	2013 ($m)	Growth ($m)	Growth (%)
1	Novartis	47101	47468	-367	-1
2	Pfizer	45708	47878	-2170	-5
3	Roche	39120	39163	-43	0
4	Sanofi	36437	37124	-687	-2
5	Merck & Co.	36042	37437	-1395	-4
6	Johnson & Johnson	32313	28125	4188	15
7	GlaxoSmithKline	29580	33330	-3750	-11
8	AstraZeneca	26095	25711	384	1
9	Gilead Sciences	24474	10804	13670	127
10	Takeda	20446	19158	1288	7
11	AbbVie	20207	18790	1417	8
12	Amgen	19327	18192	1135	6
13	Teva	18374	18308	66	0
14	Lilly	17266	20962	-3696	-18
15	Bristol-Myers Squibb	15879	16385	-506	-3
16	Bayer	15486	14854	632	4
17	Novo Nordisk	15329	14877	452	3
18	Astellas	14099	13508	591	4
19	Boehringer Ingelheim	13830	15789	-1959	-12
20	Actavis	13062	8678	4384	51
21	Otsuka	11308	11226	82	1
22	Daiichi Sankyo	10430	12067	-1637	-14
23	Biogen Idec	9398	6668	2730	41
24	Baxter	8831	8347	484	6
25	Merck KGaA	7678	8399	-721	-9

Source: PMLive (2015)

Malik (2009) attested to the fact that the world's top pharmaceutical companies, commonly referred to as Big Pharma, are increasingly investing in biotech companies in order to increase their product pipelines. Table 1 provides a list of the top 25 Big Pharma

companies by 2014 revenue data. Malik (2009) observed that in the past large companies typically focused on the discovery of small molecule drugs with simple composition and that are synthetic and chemical-based.

According to Paul, Mytelka, Dunwiddie, Persinger, Munos, Lindborg and Schacht (2010) biotechnological companies, by contrast to pharmaceutical companies, are typically emerging companies with much less cash reserves but have the ability and expertise to develop new, often first-in-class, biological or novel chemical-based drugs that are cutting edge. Conventional pharmaceutical companies are not currently invested in these developments as they still considered difficult to produce on a large scale. Biologics or biotech medicines, are large, complex, protein based molecules, which are produced within living microorganisms or mammalian cells (FDA, 2015). Current trends show that the biotech market, with more advanced therapies, is growing at a much higher rate than the traditional pharmaceutical market (Malik, 2009).

As some of the various drivers of M&A activity have been laid out, the following section explores some of the available literature concerning the impact that M&A activity has had on companies.

2.6 Impact of Mergers and Acquisitions on Value Creation and Company Performance

The previous section illuminated some of the main drivers of merger and acquisition activity particularly within the context of pharma and biotech industries. This section examines some of the available literature on the impact that M&A has had on value creation and company performance.

As discussed in Chapter 2.4, M&As create value when the combined company cash flows are greater than they would have been without the transaction, and if the acquirer has not paid too much to the target's shareholders, then some of that value will accrue to the acquirer's shareholders (Dobbs et al., 2010).

According to McKinsey research of 1415 acquisitions from 1997 to 2009, the post-acquisition combined value of the acquirer and target increased by approximately four

percent on average (Dobbs et al., 2010). This is contrary to views that argue that M&As in the innovation space destroy value, and in addition disrupt productivity in companies, and harm R&D efforts (Sorescu et al., 2003).

Bruner (2004) concluded that the risks of M&As are no greater than the risks of any other projects and that there is a tendency to over-exaggerate the failure associated with M&As.

More current literature provides inconclusive evidence relating to the impact that M&A has in the innovation space as there are varying schools of thought. The focus of the available literature has mainly been on the impact of shareholder returns, operating financial performance, research and development intensity, sales performance and cost efficiency, hence these aspects are explained in more detail in the sections that follow.

2.6.1 Impact on Shareholder Value

2.6.1.1 Introduction

Shareholder value can be examined in two main stock market based ways namely shareholder returns and stock price performance (Papadakis & Thanos, 2010).

With regards to shareholder returns, most of the studies analysing the impact of M&A on shareholder returns use cumulative abnormal returns, are non-industry specific, and are not current (Kirchhoff & Schiereck, 2011). A majority of the dated studies reached the conclusion that following the M&A transactions, the shareholders of the acquiring companies receive slightly negative returns (Lyroudi, Lazaridis, & Subeniotis., 1999; Eckbo &Thorburn, 2000; and Kohers & Kohers, 2000).

In addition, results from more recent analyses conducted on the stock returns to shareholders of the acquiring companies supported the evidence that negative returns are experienced by acquirers post the M&A activity. For example Bartlett et al. (2014) assert that 40.7% of companies reported negative returns post an M&A event. Bartlett et al. (2014) also summarised findings from studies which concluded that returns to shareholders in the acquiring company were essentially zero (i.e. no more than the required return earned by the investors). Ahern (2014) also concluded that returns post an M&A are insignificant as acquirer shareholders do not receive higher than normal gains from holding stock in the acquiring companies that grow by way of acquisitions.

As the goal of a company should always be to maximise shareholder returns, the summary of studies described in the preceding paragraphs implies that the M&A activity has a

negative impact on the acquirer, specifically as measured by acquirer shareholder returns. On the contrary, other studies conclude that the target companies usually profit from substantial value gains from the union with the acquirer (Bruner, 2002).

A substantial amount of research is also available that favours positive outcomes for the combined entity (acquirer plus target) essentially providing the consensus view that the shareholder value effects are significantly positive (Bruner, 2002). The main driver for the positive outcomes for the combined entity is the target's positive value effect, however in terms of magnitude the value accrued to the target remains higher than the gains of the combined entity stocks (Andrade, Mitchell, & Stafford, 2001; Bruner, 2002). This essentially means that the while overall value may have been created, this is largely driven by the value accrued to the target shareholders who earn a premium on their stockholding during the acquisition and it can be assumed that acquirers still do not gain much.

Again in support of better outcomes for combined entities, post-merger combined returns (acquirer and target) also turned out positive in most of the studies as examined by Bruner (2004), hence entrenching the view that M&As indeed create value for the shareholders in the combined company. More relevant to this study, Kirchhoff & Schiereck (2011) conducted a study on the elements that determine M&A success in pharma and biotech. The authors found that shareholders of the acquiring companies earned slightly negative but statistically insignificant abnormal returns. Targets realized high gains, signalling a re-distribution of wealth from acquirers to targets during the transaction (Kirchhoff & Schiereck, 2011).

With regards to stock price performance, conflicting arguments exist in the literature. Some empirical studies that examined the reaction of capital markets to M&A transaction announcements found that the average deal when value-weighted actually lowers the acquirer's stock price between one and three percent (Dobbs et al., 2010). Concerning stock price values, it was revealed from empirical studies that the stock value of the target company shareholders increased significantly at about 30% over market returns immediately following an acquisition announcement (Bartlett et al., 2014).

Studies that have examined the impact of M&A on shareholder returns have traditionally been event studies divided into periods ranging from short to long term. The event study methodology is discussed further in Chapter 2.7.1. In the following sub-sections, a summary of the findings of some of the short term and long term studies is discussed.

2.6.1.2 Findings of Short-term studies

According to Andrade et al. (2001) short-term event studies provide the most statistically reliable evidence on the ability of M&A to generate or erode wealth and value for shareholders. Cumulate average abnormal stock returns (CAARs), which show the market's to the announcement of the M&A transaction, are calculated based on the assumption that in the short-term, stock prices will adjust quickly in an efficient market (Andrade et al., 2001).

Event windows are explained in detail in Chapter 2.7.1. The most commonly relied upon event windows in short term studies as according to Andrade et al. (2001) include the three day [-1;+1] windows that immediately surround the announcement of the M&A transaction, as well as windows with a slightly longer period which begin a few days prior to the announcement and end at the completion of the M&A transaction. Event windows are often denoted by the notation [-x;+y] where -x = time in days before the announcement of the transaction and +y = time in days after the announcement of the transaction. The announcement date is day zero.

A summary of event studies with short term event windows of up to 10 days that reported negative short-term share price returns to acquirers are depicted in Table 2.

From Table 2, significantly negative returns (as shown by a double asterisk in the table) were depicted in 12 of the 17 studies reported on. When filtered for statistical significance the highest short-term [-4;+1] cumulative abnormal returns (CARs) of -4.64% were reported in a study conducted by Houston, James, & Ryngaert (2001, as cited in Bruner, 2002) where 27 transactions were evaluated in the period 1985 to 1996. The lowest statistically short-term [-1;0] CARs of -0.80% were reported in a study conducted by Jennings & Mazzeo (1991, as cited in Bruner, 2002) where 352 transactions were evaluated that occurred during the period 1979 to 1984.

Table 2: Short-term event studies with negative CARs

Study	Cumulative Abnormal Returns	Sample Size	Sample Period	Event Window (Days)
Dodd (1980)	-1.09%** -1.24%	60 66	1970 - 1977	(-1,0)
Asquith, Bruner, Mullins (1987)	-0.85%**	343	1973 - 1983	(-1,0)
Varaiya, Ferris (1987)	-2.15%**	96	1974 - 1983	(-1,0)
Morck, Schleifer, Vishny (1990)	-0.70%	326	1975 - 1987	(-1,1)
Franks, Harris, Titman (1991)	-1.45%	399	1975 - 1984	(-5,5)
Servaes (1991)	-1.07%**	384	1972 - 1987	(-1, close)
Jennings, Mazzeo (1991)	-0.8%**	352	1979 - 1985	(-1,0)
Bannerjee, Owers (1992)	-3.3%**	57	1978 - 1987	(-1,0)
Byrd, Hickman (1992)	-1.2%**	128	1980 - 1987	(-1,0)
Healy, Palepu, Ruback (1992)	-2.2%	50	1979 - 1984	(-5,5)
Kaplan, Weisbach (1992)	-1.49%**	271	1971 - 1982	(-5,5)
Berkovitch, Narayanan (1993)	-$10m	330	1963 - 1988	(-5,5)
Sirrower (1994)	-2.3%**	168	1979 - 1990	(-1,1)
Mulherin, Boone (2000)	-0.37%	281	1990 - 1999	(-1,1)
Mitchell, Stafford (2000)	-0.14%** -0.07%	366 366	1961 - 1993	(-1,0)
Walker (2000)	-0.84%** -0.77%	278 278	1980 - 1996	(-2,2)
Houston, James, Ryngaert (2001)	-4.64% **(1985-90) -2.61% (1991-96) -3.47%** (all)	27 37 64	1985 - 1996	(-4,1)
** Considered to be statistically significant				

Source: Bruner (2002)

A summary of event studies that reported zero or positive share price returns to acquirers in the short-term are depicted in Table 3.

Table 3: Short term event studies with zero or positive CARs

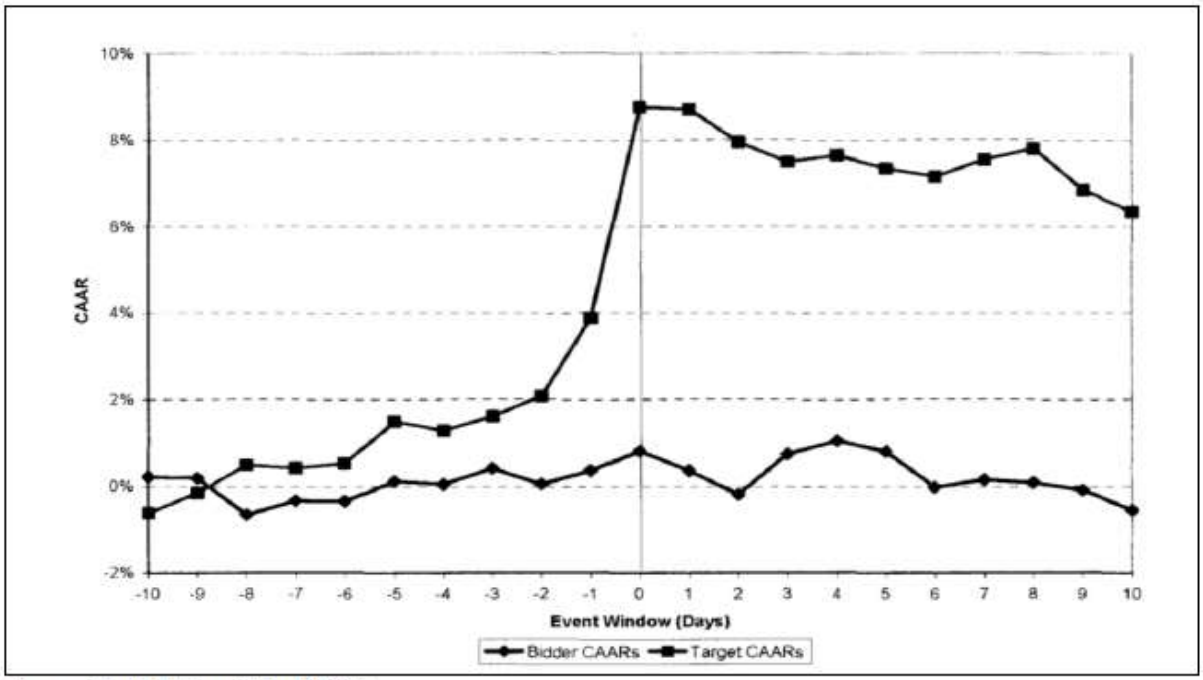
Study	Cumulative Abnormal Returns	Sample Size	Sample Period	Event Window (Days)
Dodd, Ruback (1977)	+2.83% ** +0.58%	124 48	1958 - 1978	(0,0)
Kummer, Hoffmeister (1978)	+5.20%**	17	1956 - 1970	(0,0)
Bradley, Desai, Kim (1982)	+2.35%**	161	1962 - 1980	(-10,+10)
Asquith (1983)	+0.20% +0.50%	196 89	1962 - 1976	(-1,0)
Eckbo (1983)	+0.07% +1.20%**	102 57	1963 - 1978	(-1,0)
Dennis, McConnell (1986)	-0.12% (-1,0) +3.24% (-6,+6)**	90	1962 - 1980	(-1,0)
Bradley, Desai, Kim (1988)	+1%**	236	1963 - 1984	(-5,5)
Jarrell, Poulsen (1989)	+0.92%**	461	1963 - 1986	(-5,5)
Lang, Stulz, Walklling (1989)	0%	87	1968 - 1986	(-5,5)
Loderer, Martin (1990)	+1.72%** (1966-68) +0.57%** (1968-80) -0.07% (1981-84)	970 3401 801	1966 - 1984	(-5,0)
Smith, Kim (1994)	+0.50% -0.23%	177	1980 - 1986	(-5,5) (-1,0)
Lyroudi, Lazardis, Subeniotis (1999)	0%	50	1989 - 1991	(-5,5)
Mulherin (2000)	+0.85%**	161	1962 - 1997	(-1,0)
Kohers and Kohers (2000)	1.37% **(cash deals) 1.09%** (stock) 1.26% (whole sample)	961 673 1634	1987 - 1996	(0,1)
** Considered to be statistically significant				

Source: Bruner (2002)

From Table 3, significantly positive returns (as shown by a double asterisk in the table) were depicted in 10 of the 14 studies that reported positive cumulative abnormal return. Filtered for statistical significance, the highest short-term [0;0] CARs of +5.20% were reported in a study conducted by Kummer & Hoffmeister (1978, as cited in Bruner, 2002) where 17 transactions were evaluated in the period 1956 to 1970. The lowest short-term [-5;0] CARs of +0.57% were reported in a study conducted by Loderer & Martin (1980, as cited in Bruner, 2002) in which 3401 transactions were evaluated between 1968 and 1980.

A research study that examined the short-term effects of M&A on the share price returns (CAARs – cumulated average abnormal returns) of the acquirer was conducted in South

Africa on companies listed on the Johannesburg Stock Exchange (JSE) by Mushidzi & Ward (2004). A summary of the findings are presented in Fig 2. From Fig 2, a [-10;+10] event window was constructed and from the CAARs presented in the figure it is revealed that the acquirer lost approximately an average of 0.55% whilst the target gained approximately an average of 6.33% (Mushidzi & Ward, 2004). This further entrenches the empirical evidence that acquirers tend not to benefit as much as targets in terms of stock returns.



Source: Mushidzhi and Ward (2004)

Figure 2: JSE CAARs - Acquirer and Target

2.6.1.3 Findings of Long-term studies

According to Papadakis & Thanos (2010) long-term studies examine the returns over event windows ranging from a few months to years post the completion of the transaction. Bruner (2002) reported on 11 long-term studies in which the event window ranged from 356 -1250 days. From the findings, 8 of the11 studies showed statistically significant negative returns ranging from -18% to -4%.

Confounding effects such as the influence of deal financing methods, the amount of assets employed, varying accounting treatments, as well as industry specific and economic factors tended to mar the results of the long-term studies (Bruner, 2002). As such, for this study a short event window was selected. The use of a short window is further substantiated by

Song, Kueh, Abdul Rahman, & Chu (2011) who were of the view that it is challenging to adequately filter out confounding effects in the longer term.

2.6.1.4 Conclusion on shareholder value

In conclusion, to evaluate the proportion of deals that create value if any for the acquiring company's shareholders, research was conducted by McKinsey that examined the reaction of the stock market to an acquisition within the short-term window of a few days around its announcement. It was found a third of acquisitions created value, one-third did not create value with some even eroding value, and in a final third of the analysis the empirical results were inconclusive (Dobbs et al., 2010). To further validate this observation, further research post-announcement of the acquisitions has also revealed that the initial market reactions persist on average and are able to accurately indicate future performance (Dobbs et al., 2010).

On the contrary, most studies conducted on target companies have concluded that the target companies usually profit from substantial value gains from the union (Eckbo & Thorburn, 2000; Bruner, 2002).

Some evidence suggests that a large portion of M&As, approximately half or more, fail to achieve their intended outcome (Krug, 2009). This is an alarming amount. Furthermore, about half of all acquired companies tend to be divested by the parent within five years post-acquisition, which is similarly a significant proportion (Krug, 2009). This is confirmation once again that many companies and their shareholders do not realise the anticipated synergies that they may have thought existed at the time a decision was made to go for the acquisition. The best option often sought by these companies is to rather purge the failed entity and in the process value is then completely destroyed.

According to empirical research conducted by Kirchhoff & Schiereck (2011) on the elements that determine the success of M&A in pharma and biotech, specific elements help determine the outcome of abnormal returns of the combined entities, acquirers, and targets as summarised in Table 4. In essence the stock market reacts positively to the acquisition if these elements are present (Kirchhoff & Schiereck, 2011).

Table 4: Summary of determinants of abnormal returns in combined entity, acquirer, and target

Combined entity	Acquirer	Target
• If the stocks of the acquirer had been underperforming the benchmark, or industry or market index during the estimation period; • If the acquirer has a low R&D intensity (i.e. ratio of R&D expenses to sales); and • If the target's cash flows are relatively high.	These are generally comparable to the determinant mentioned for the combined entity but more specifically include: • If the acquirer has outperformed their benchmark recently; • If the acquirer has a low R&D intensity; and • If the acquirer takes over targets with relatively high cash flows.	• If the target has a smaller market value compared to its acquirer. • If the target is taken over by an acquirer with increased operational costs.
Source: Kirchhoff & Schiereck (2011)		

2.6.2 Impact on Operating financial Performance

Many research studies on the impact of M&A on operating financial performance exist, but most have a non-industry focus. The focus of these studies is on a plethora of accounting measures which include cash flow return on assets (ROA), return on equity (ROE), return on sales (ROS), earnings per share, and operating margins (Andrade et al., 2001).

Some findings from these research studies revealed that traditional accounting measures as mentioned in the paragraph above are generally not improved following an acquisition (Krug, 2009). Alternatively, Smit and Ward (2007) in a study of South African domestic M&A's that had a post-event window of two years reported that the acquiring companies' average post-acquisition cash-flow return on tangible assets showed positive but insignificant improvement. A more recent study conducted by Halfar (2011) in which the long run effects of M&A activity on the operating financial performance of acquiring companies was measured, found that M&A's destroyed value in the initial two years from the date of announcement of the transaction. However from the third year onwards this trend was reversed.

On the contrary, similar studies to the Halfar (2011) study have reported statistically insignificant improvements in the financial performance (Krug, 2009), while other studies reported statistically significant positive performance (Healy, Palepu, and Ruback, 1992; Ghosh, 2002). In addition some studies have shown mixed results depending on the

specific operating performance aspect measured. For example, a study by Gugler, Mueller, Yurtoglu, and Zulehner, (2003), reported significant increases in a measure of profitability but negative effects in a measure on sales; while Mantravadi and Reddy (2007), reported significant increases in a measure of profitability and decreases in a measure of the return on net assets.

More aligned to the scope of this research, and contradictory to the findings of the Gugler et al. (2003) and Mantravadi and Reddy (2007) studies, a study conducted in the pharmaceutical industry in India demonstrated that M&As did not have any significant impact on the profitability of the combined entity in the long run (Mishra & Chandra, 2010).

A summary of the results reviewed by Bruner (2002) on the operating financial performance of companies involved in M&A's is presented in Table 5 which shows that of 15 studies that were conducted between 1977 and 2001, eight of the studies reflected either an increase or no significant change in the operating financial performance post-acquisition. The remaining seven studies however showed a decline in operating financial performance post-acquisition.

From Table 5, it is clear that ROA, operating cash flow returns, ROE, and ROS were the pre-dominant measures used to assess financial performance.

Table 5: Findings from operating financial performance studies

Author	Sample period	Sample size	Measure	Findings
Meeks (1977)	1964 - 1972	233	Return on assets	ROA declined in post-merger years.
Salter and Weinhold (1979)	Unknown	16	Return on equity	ROE and ROA significantly lower than that for the New York Stock Exchange.
Mueller (1980)	1962-1972	287	Return on equity, Return on assets, Return on sales.	Firms engaging in merger activity were less profitable.
Mueller (1985)	1950-1992	100	Market share	Firms involved in mergers and acquisitions suffered significant losses.
Ravenscraft and Scherer (1987)	1950-1977	471	Return on assets	Negative relationship between operating ROA and tender offer activity.
Ravenscraft and Scherer (1987)	1950-1977	471	Return on assets	Declines in return on assets for target companies.
Herman and Lowenstein (1988)	1977 – 1983	56	Return on capital	Return on capital for acquirers increased post-merger.
Seth (1990)	1962 – 1979	102	Value of equity	Increase in equity value and cash flows as a result of operational synergies post-acquisition
Healy, Palepu and Ruback (1992)	1979 – 1984	50	Asset turnover Operating cash flow margin	Merged firms showed significant abnormal improvement in asset productivity. No significant increases in cash flow.
Chatterjee and Meeks (1996)	1977 – 1990	144	Profitability returns	Pre 1985 – no significant increases in profitability returns post-merger. Post 1985 – significant increases in profitability returns post-merger.
Dickerson, Gibson and Tsakalotos (1997)	1948 – 1977	144	Return on assets	Post-acquisition ROA for acquirers is lower than for non-acquirers for the first five years.
Healy, Palepu and Ruback (1997)	1979 to 1984	50	Operating cash flow returns	Mergers and acquisitions resulted in a zero net present value based on operating cash flows.
Parrino and Harris (1999)	1982-1987	197	Operating cash flow return	Significant increase in operating cash flow return post-merger.
Parrino and Harris (2001)	1982-1987	197	Operating cash flow	Significant increase in operating cash flow return post-merger.
Gosh (2001)	1981 to 1995	315	Return on assets Operating cash flow	No change in return on assets post-acquisition. Cash flows increased significantly for cash based acquisitions.

Source: Bruner (2002)

From the divergent empirical results presented in Table 5, it is therefore recognised that studies that use accounting-based measures have inconsistent results. This presents an opportunity to contribute to consensus on the topic of operating financial performance and M&A.

2.6.3 Impact on Research and Development Intensity/Innovation Productivity

Kirchhoff & Schiereck (2011) define R&D intensity as a metric calculated by finding the ratio of the R&D costs to the sales with a higher intensity viewed positively based on the assumption that generally, higher investments in R&D are rewarded by innovations and ultimately by better performance. Typically in the pharma and biotech industry, innovation

through R&D is a critical success factor to maintain product and patent pipeline and in order to guarantee future revenue and cash flow streams, therefore historically R&D investment has been a major driver of M&A activity in these industries (Kirchhoff & Schiereck, 2011).

It is recognised that there are limitations to considering R&D as a substitute for innovation. This limitation has however been addressed by studies that have turned to other market-based measures, such as announcements of new products or pipeline counts (Teece, 2010). However the link between R&D spend and product announcements was partly explored by Boldrin and Levine (2013) who found that at the industry level, there is a strong correlation between R&D expenditure and new product announcements but this relationship weakens at the individual company level.

One study conducted on the United States pharmaceutical industry compared the number of new drugs discovered to the discovering company's R&D spend (Tidd & Bessant, 2011). The outcome of the study was the discovery of a non-linear (convex) relationship between drugs discovered and the R&D costs which supports the assertion that innovation and R&D are not necessarily correlated.

Various ratios have thus been developed to link innovation and R&D costs. The ratio of R&D cost to value added has been used is research as a proxy for innovation productivity (Tidd & Bessant, 2011). This is because there could be high expenditure with not much value added and hence identical R&D expenditures in different industries may have diverging outcomes in terms of value added (Tidd & Bessant, 2011). Furthermore there is variation in the R&D thresholds for different industries as some industries are more capital-intensive than others (Tidd & Bessant, 2011).

More difficult to measure is the impact of R&D on the stock market as a measure of prior financial market efficiency needs to be established before setting up a testable hypothesis. Clearer is the establishment that there is no relationship between R&D costs and the market value of the company the majority of industries with the exception of the pharmaceutical industry (Griliches, Hall, & Pakes, 1991). In contrast, product announcements have a positive effect on the share price and ultimately market capitalisation of the acquiring company (Chaney, Devinney, & Winer, 1992).

Tidd (2012) conducted a study examined how innovation and performance are linked with a sample of 40 companies representing five different sectors. With regards to the

performance metric linked to R&D, Analysis of the data confirmed that R&D costs as a proportion of sales (R&D intensity), had a significant positive effect on the value added, and on the number of new product announcements made (Tidd, 2012). The linkages established between R&D intensity, value added, and new product announcements are important because it gives rise to concerns over the company's performance if a company's R&D intensity declines.

The results of the Tidd (2012) study also suggested that the financial markets under-value expenditure on R&D, but value R&D efficiency. When ratios of new products introduced to the absolute R&D were calculated and used as a metric that stood for research efficiency, it was found that the research efficiency was viewed well by the market as shown by a significant positive effect on the market-to-book value (Tidd, 2012).

At least two conflicting views exist regarding the impact of M&A activity on research and development. Phillips and Zhdanov (2013) argued that when a market is actively acquisitive this has an overall positive influence on all companies' large or small to innovate and conduct R&D. The authors further expanded their argument to include that successful innovation in an industry is what makes companies attractive acquisition targets, and the potential for strategic M&As is in itself a key driver for companies to continue to increase R&D spend (Phillips & Zhdanov, 2013).

On the contrary, Getz (2014) argued that M&A activity actually has a negative influence on R&D productivity and results in pharmaceutical or biotechnological breakthroughs taking significantly more time to develop. Prior to this argument, Comanor and Scherer (2013) had already stated that the companies that have relied on M&As tend to lag behind those that have not and suggested that M&As are not an effective way to promote an innovation culture or remedy a deficit of innovation. Aligned to Comanor and Scherer's and further validated by Getz's argument, Seru (2013) concluded that post the acquisition the acquiring company innovates less with evidence that larger companies conduct less R&D per unit of the company size; the author emphasized this point by accusing the acquirer of "stifling" innovation. From these conflicting views, it is worth investigating the impact of M&A activity on R&D productivity further.

2.6.4 Impact on Sales Performance

Kirchhoff & Schiereck (2011) define sales performance as a metric calculated by the ratio of sales or operating revenue to the total assets and the aim is for this ratio to be as high

as possible indicating strong operating revenue in comparison to the company's assets. The authors acknowledge sales performance as one of the key signifiers of success for companies operating in the pharma and biotech industries and the assumption is that executives would be motivated by the prospect of increased revenues when they make decisions to grow through acquisitions (Kirchhoff & Schiereck, 2011). Whether the anticipated growth in sales performance is realised post the deal is a subject under debate.

Sheen (2014) and Hoberg and Phillips (2010) found, in the authors investigation of the impact of M&A on product sales as measured in terms of market share changes, that there was no significant market share change for a product after the M&A. Sheen (2014) also found that it was only in instances where companies stated specifically beforehand that sales growth was a goal in the M&A announcement that the combined entity market share increased. This finding is in direct contradicts Sorescu et al.'s (2007) argument, as they conducted an event study which found that there was a positive influence on sales performance as a result of the M&A.

While this data was not industry specific, it still presents a contradiction in findings that needs clarification and this industry specific research study intended to illuminate this aspect.

Empirical evidence from an industry specific study conducted on the effects of M&A in operating revenue/sales efficiency conducted in the context of the banking industry found that revenue efficiency did not improve after the merger (Kamarudin, 2014). Another study conducted on M&A within the Chinese banking sector found similar findings in that there was an insignificant increase in the banks revenue efficiency following the M&A transaction (Ariff & Can, 2008).

2.6.5 Impact on Cost Efficiency

Kirchhoff & Schiereck (2011) define cost efficiency as metric that is calculated by the ratio of the operating costs to the total company assets and the aim is for this value to be as low as possible indicating low operating costs compared to the company's assets. In the pharma and biotech industry it is recognized that in the face of escalating R&D costs invariably cost synergies would be critical drivers for M&A transactions as both acquirers and targets can use cost synergies to achieve economies of scale and thereby respond to

rising research and development as well as marketing costs through the combination of their respective individual efforts (Kirchhoff & Schiereck, 2011).

Sheen (2014) posited that if two manufacturing plants are reduced to one, as would happen due to synergies during M&A, then the merged companies cut costs and lower prices. However in instances where the nature of the M&A involves diversifying a portfolio, then there are no cost synergies. Further in an environment where competition is very high companies may already be operating at their peak efficiency, this may leave less room for further cost reductions due to M&A (Sheen, 2014).

The cost efficiency of the target relative to the acquirer is also an important factor to consider. In their study conducted on the M&A success factors in the pharmaceutical and biotechnological industries, Kirchhoff and Schiereck (2011) hypothesised that if the target is significantly less cost efficient than the acquirer, then the transaction is likely to be more successful as measured by a positive stock market response. The authors cited research conducted in 2002 that provided empirical support for this argument which was based on the banking industry (Banerjee & Cooperman, 2000, as cited in Kirchhoff & Schiereck, 2011) The authors further cited research conducted in 1992 which also showed that the wider the cost efficiency gap between target and acquirer then the more likely the transaction will be a success from a stock market perspective (Hawawini & Swary, 1992, as cited in Kirchhoff & Schiereck, 2011).

The outcome of the multiple regressions in the study conducted by Kirchhoff & Schiereck (2011) suggests that in the pharma and biotech industries, stock markets do not strongly believe in cost synergies as a motivation for a successful transaction. The same study however showed in the univariate analyses that there was a tendency of the stock markets to react positively to transactions in which the acquirer and target had a more negative or low cost efficiency. Kamarudin (2014) in a study conducted on mergers and acquisitions within the banking sector in Malaysia found that cost efficiency of the acquirer increased following the M&A event.

This section explored some of the existing literature on the impact of M&As on companies. The next sections focus on summarising some of the theory that analyses how an assessment can be made on the impact of the M&A activity on the companies involved.

2.7 Measuring Abnormal Share Price Returns and Performance

Different methods are available that enable measurement of the impact of M&A on company performance as described in the preceding section. This section describes some of the main methods that can be utilised, and in addition provides more detail about the methods that were used in this research study.

Four main methods are generally used to evaluate the effect that an M&A transaction has had on a company, namely (Krug, 2009):

- Using event studies perform an analysis of the stock market returns to the shareholders of one or more of the following entities post the M&A announcement:
  - the target company,
  - the acquiring company,
  - the combined company
- Using accounting studies perform an analysis of target, acquirer, or combined company performance after the M&A using one or more accounting measures such as ROA.
- Conducting case studies of specific transactions to gain more in depth analysis.
- Conducting surveys of the executives or other key people involved in the M&A.

2.7.1 Measuring abnormal share price returns - Event study methodology

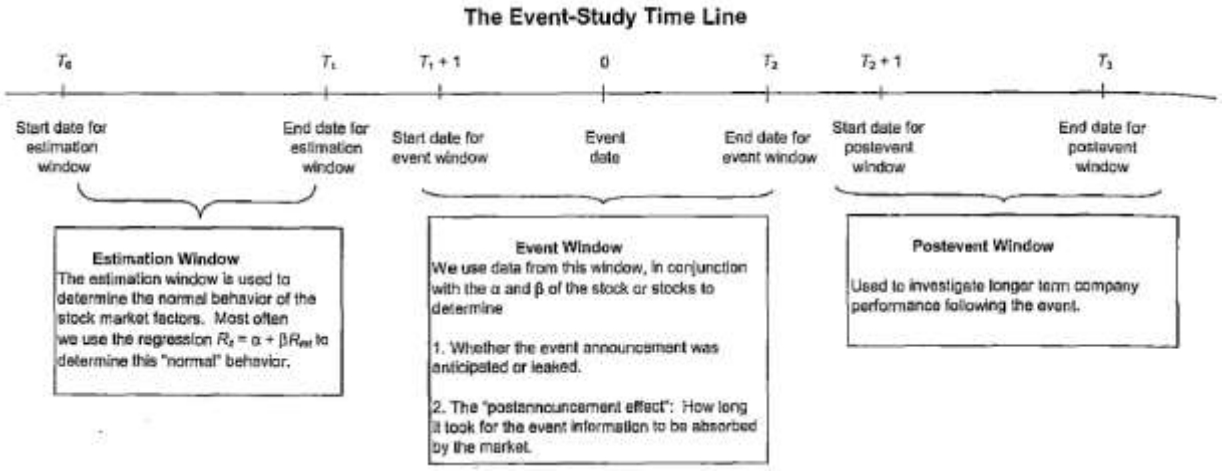
An event study within the context of corporate finance refers to a time series based methodology used in an attempt to determine the effects of a specific event in a capital market or in the ordinary life cycle of a company on its stock market performance (Mushidzi & Ward, 2004). The event-study methodology is able to separate company-specific events from market- and industry specific events. The methodology is able to assess whether or not an event or announcement has caused an abnormal movement in the share price of a company. The underlying assumption of event studies is that the market is efficient and unbiased, and that share prices quickly and accurately incorporate the economic impact of the information contained in the event (Mushidzi & Ward, 2004).

The use of event study methodology is well documented as a tool used to determine statistically significant differences between actual returns on share prices of the acquiring

companies and the expected returns over the event window (Mushidzi & Ward, 2004; Mackinlay, 1997). This calculation is termed the cumulative average abnormal returns (CAAR) (Mushidzi & Ward, 2004). The cumulative average abnormal returns (CAAR) are calculated from the sum of the difference between a stock's actual return and its expected return over a particular time period, which is known as the event window. One of the problems experienced with event studies is that the daily abnormal returns can be relatively small. This can make it very difficult to determine whether there is any significant difference from zero. Hence accumulating the daily returns into Cumulative Average Abnormal Returns (CAARs) helps to overcome this problem (Ward & Muller 2010).

The timing sequence of an event window can best be illustrated by the timeline line in Figure 3. The length of the estimation window is shown in Figure 3 as T_0 to T_1. The event itself occurs at time 0 for example the public announcement of the M&A transaction, and the event window is represented as $T_1 + 1$ to T_2.The length of the post-event window is shown as $T_2 + 1$ to T_3 (Ahern, 2009). The event window is sometime called the control period.

Figure 3: The Event-Study Time Line



In the context of M&A and its impact on the stock market, an event is usually defined as the point in time when the announcement of the M&A is made. Hence in short-term event studies the *event window* is a period starting a few stock market trading days before the actual event day. As far as the length of the event window is concerned, this is often centered on the announcement date and is generally three, five, or ten days long (Bremer, Buchanan & English, 2011). This research study used a five day event window.

The *post-event window* is generally used for the post-transaction assessment of a company's performance can be as short as one month and as long as several years (Kothari & Warner, 2006).

The *estimation window* is also used to determine what can be considered as the normal behaviour of a stock's return and for it to be meaningful the usual length is approximately 252 calendar days which is the same as one calendar year (Ward & Muller 2010). The normal behaviour being assessed is normally with respect to a market or industry index. If this length of data is not available then it is still necessary to have a minimum of 126 observations (Ward & Muller 2010). If less than 126 observations are available in the estimation window, it is possible that the parameters of the market model will not indicate the true stock price movements, and thus the relationship between the stock returns and the market returns remain undetermined (Ward & Muller 2010). The selected estimation window is presumably a period that reflects the stock's normal price movements (Ward & Muller 2010).

The most common model used for determining stock price performance under "normal" circumstances is the market model, which is essentially a regression of the stock returns and the returns of the market index (Ward & Muller 2010). The equation below illustrates the market model for a stock *i* which can be expressed as:

$$r_{it} = \alpha_i + \beta_i r_{Mt}$$

Where r_{it} and r_{Mt} are equal to the stock and the market return on day *t.* The coefficients α_i and β_i are estimated by running an ordinary least-square regression over the *estimation window* (Fama, & French, 1996).

The most common criteria for selecting market and industry indexes are whether the company is listed on a stock exchange and whether any restrictions are imposed by data availability. In general, the market index should be a broad-based value-weighted index or a float (Ward & Muller 2010).

Kirchhoff and Schiereck (2011) argued that in order to reach a clear conclusion concerning whether or not an M&A event in the pharma and biotech industries had an impact on value, then M&A transactions need to be examined based on the combined entity returns. A company's expected returns can be determined by a variety of methods, however according to Mushidzi and Ward (2004) the most common are the:

- Mean Adjusted Model, where the average share price returns during the period of normalcy, i.e. during the estimation period, are used;
- Market Model, where the expected share price returns are assumed to subscribe to the classic capital asset pricing model as shown in the equation above and are based on the risk (beta) of the acquiring company relative to the market;
- Market Adjusted Model, which was used for this study and is mainly suited to short-term event studies, where the share price returns during the event window are based on the expectation that the acquiring company will generate the same returns as the rest of the market or industry as guided by an index;
- Control Portfolio Model, where a portfolio is constructed consisting of control companies and the share price returns are based on the portfolio returns over the event window.

Using these methods helps mitigate the potential weaknesses of event studies as raised by Aktas, de Bodt and Cousin (2007). The authors raised the concern that the results are sensitive to or have a risk of contamination from confounding factors.

The advantage of using the event study methodology lies in the fact that it is time-independent, hence the results of many companies experiencing a similar event at different times can have their results aggregated (Ahern, 2009).

According to Smit and Ward (2007), whilst the Market Models mentioned above are valid, arguments have been raised against their use which can be considered persuasive. The inherent weaknesses of the market models include the fact that share prices fluctuate constantly and do not necessarily reflect a linear trend, especially in the case of illiquid shares and another weakness is that past share price performance is not always a good predictor of expected returns. Their use should therefore be limited to short-term studies for short event windows for example, event windows of up to seven days.

Therefore in accordance with Smit and Ward (2007) the most robust model for use in determining expected returns tends to be the Control Portfolio Model, especially for longer term studies. Smit and Ward (2007) stated, that the control portfolio itself can be built based on a number of different criteria particularly:

a) The industry of the acquiring company's;
b) Other companies of similar size;
c) Other companies with a similar price to book ratio; or

d) Other companies with similar price to earnings ratio.

2.7.1.1 Market Adjusted Model

As explained briefly in Chapter 2.7.1, the Market Adjusted Model is a method used where the share price returns are based on the expectation that the acquiring company will generate the same returns as the rest of the market during the event window.

The expected return on the share is the return that would have occurred without the event (i.e. if the market increased on a specific day it would be expected that the share would also increase), whereas the abnormal return relates to the unexpected return, on account of the information in the event (Smit & Ward, 2007).

Hence to measure expected (normal) returns a benchmark or control group, typically the market index, such as the all share index or specific industry index for industry studies would be selected. Therefore with the market model it is assumed that the expected returns on a share on a specific date would be equivalent to the return of the index on that date as shown by the equation below (Smit & Ward, 2007):

$$E(Rit)=Rmt$$

Where (Rit) is the expected return on security I at time t and Rmt is the return on the market on day t.

An example of an industry index that is used to peg performance in the pharmaceutical industry is the NYSE Arca Pharmaceutical Index which is designed to represent a cross-section of widely held, highly capitalised companies in the pharmaceutical industry. In its calculation the index is weighted on the market-capitalisation of the companies it represents using the United States stock exchange primary market prices for component securities, and current outstanding shares (NYSE, 2014).

Of particular interest is that the companies selected for the index are involved in various phases of the development, production, and marketing of pharmaceutical and biotechnological products. The value of the index is tracked in real time and is published at 15 second intervals through a platform called the Consolidated Tape Association's Network B and/or through a platform called the NYSE Euronext Global Index Feed under the ticker symbol "DRG" (NYSE, 2014). The values of the index are readily available on the internet via a link on the New York Stock Exchange official website.

2.7.2 Measuring operating financial performance

To measure whether the operating financial performance of acquiring companies improves or declines after large acquisitions, a similar approach to standard event study methodology can be used. This method involves calculating operating financial performance using cash flow return on assets (Healy et al., 1992). Healy et al. (1992) and Healy and Palepu (1997) proposed that cash flow should be used rather than other accounting measures because of the differences in accounting treatment. In addition, the authors argued that assets must be used to scale performance in order to allow comparison across time and companies.

A more recent assessment by Papadakis and Thanos (2010) also supports the use of cash flow return on assets and claim that this is the most widely used measure for calculating the operating financial performance in M&A. The authors argue that the cash flow return on assets are less influenced by the increasing or decreasing estimation bias that is as a result of bargaining power changes and/or leverage during M&A's.

Operating cash flows were succinctly defined by both Ghosh (2001) and Healy et al. (1992) as sales minus cost of goods sold, minus selling and administrative expenses, plus depreciation and goodwill amortisation.

According to Smit & Ward (2007), Equation 7 is applied to calculate abnormal cash flow returns on assets for the years prior to the M&A (note equation numbers are allocated in Chapter 4 hence the equation number provided in this section is as per chapter 4 allocation)

$$\mathrm{ACRAa+t,y} = (\mathrm{CFa,y} + \mathrm{CFt,y}) \div (\mathrm{Aa,y} + \mathrm{At,y}) - \mathrm{ICFAy} \qquad \textbf{(Equation 7)}$$

Where:

ACRAa+t,y = the abnormal cash flow return on assets for the acquiring company a, and the target company t, for year y (before the acquisition, combined on a pro forma basis:

CFa,y = the operating cash flow for the acquiring company a for year y (before the acquisition);

CFt,y = the operating cash flow for the target company t for year y (before the acquisition);

Aa,y = the assets of the acquiring company a, at the end of year y (before acquisition);

At,y = the assets of the target company t, at the end of year y (before acquisition);

ICFAy = the median industry cash flow return on assets for year y (before the acquisition) (Smit & Ward, 2007)

Whilst equation 8 is used to calculate the ACRA post the M&A.

$$\mathrm{ACRAc,y} = (\mathrm{CFc,y}) \div (\mathrm{Ac,y}) - \mathrm{ICFAy} \qquad \textbf{(Equation 8)}$$

Where:

ACRAc,y = the abnormal cash flow for the combined entity c, for year y (after the acquisition):

CFc,y = the operating cash flow for the combined company c for year y (after the acquisition);

Ac,y = the assets of the combined company c, at the end of year y (after acquisition);

ICFAy = the median industry cash flow return on assets for year y (after the acquisition) (Smit & Ward, 2007)

2.7.3 Measuring acquirer and target specific attributes

Finally, in addition to the CAAR and operating financial performance evaluations, a comprehensive evaluation also includes an analysis of the potential result of the M&A activity on a variety of target specific and acquirer specific attributes (Kirchhoff & Schiereck, 2011). The specific attributes relevant to this research are R&D intensity, sales performance and cost efficiency.

Concerning R&D intensity, several analyses assessed the ratio of R&D investments or expenditure to operating revenues (sales) as a measure of the extent of research intensity and assumed that on average, the larger the investment in R&D the higher the reward in terms of innovations and ultimately in terms of overall company performance (Kirchhoff & Schiereck, 2011).

Concerning sales performance, Kirchhoff and Schiereck (2011) mention the metric called sales performance which is calculated by finding the operating revenue to total assets ratio in a pre-defined time around the M&A transaction. According to the two authors, the operating revenue to total assets ratio provides some information about a company's overall sales power.

With respect to cost efficiency, Kirchhoff and Schiereck (2011) analysed the operational costs of the target, acquiring, and combined company over a set period of time as a ratio to the total assets over the same period to conclude on the overall impact of the M&A event on the acquiring company cost efficiency.

2.8 Conclusion

To conclude this chapter, it is evident that current views concerning the impact of mergers and acquisitions on innovation-driven business are inconclusive and at times contradictory. Furthermore, it has been revealed that most studies on the topic of M&A have been non-industry specific.

The summary of literature provided raises awareness of the innovation deficit and the importance of innovations in terms of economic growth and, in the context of pharma and biotech industries, to public health and wellbeing. Simultaneously, the concept of this innovation deficit was linked to M&A activity as a potential cause.

This presents a problem that is deemed worthwhile to investigate further, to understand more clearly the impact of M&As in this highly radical and challenging innovative space. Furthermore, the gaps in the available literature present an opportunity to contribute to a more conclusive position on the topic of M&A and its impact on innovation, specifically in the pharma and biotech industries.

CHAPTER 3: RESEARCH QUESTIONS AND HYPOTHESES

In the literature summary, the relevant theory base concerning mergers and acquisitions and the innovation-driven businesses as proxied by the pharma and biotech industries was discussed. It was found that most literature divulging the impact of merger and acquisition activity is quite broad and does not specify the nature of business, e.g.: as innovation driven or otherwise.

The current literature on the impact of merger and acquisition activity on innovation is sparse and contradictory. Therefore this research study attempted to add to the body of knowledge in the area of merger and acquisitions and innovation, particularly the impact thereof. In the process, the research sought to illuminate the contradictory findings of current research on the topic of mergers and acquisition and innovation and possibly contribute to consensus on the topic.

The primary tool in this research was the event study methodology which measured the impact of a specific event on the value of a company and a joint set of variables. Using merger and acquisition data and company data from financial statements, various companies listed on a range of stock exchanges were studied as justified in Chapter 4. An accounting study was used for the determination of abnormal operating financial performance, and parametric and non-parametric tests and descriptive statistics were used to assess other key variables.

Considering the above introduction to this chapter, the researcher sought to find answers to five main research questions. The research questions and the explanation of how the researcher intended to answer each one are outlined below.

3.1 Research Question 1: Does the merger and acquisition activity negatively impact acquirer shareholder value?

First t-tests were used to assess the stock price performance of the acquirer from one day prior to the announcement of the transaction/deal up to three days after announcement of the transaction/deal, described as t [-1:+3] where t = time in days. As discussed in Chapter

2, short event windows are still valid for interpretation of future company performance as initial market reactions are persistent on average and indicate future performance quite accurately (Dobbs et al., 2010).

Second, the hypothesis that shareholders of the acquiring companies earn negative cumulative abnormal returns over the short term was tested.

Hypothesis 1: The null hypothesis states that shareholders of acquiring companies zero cumulative abnormal returns over the short-term of up to three days ($CAAR_{ST}$) following the announcement of an acquisition.

The alternative hypothesis states that shareholders of acquiring companies do not earn zero cumulative abnormal returns over the short-term of up to three days ($CAAR_{ST}$) following the completion of an acquisition.

H_0: $CAAR_{ST} = 0$

H_A: $CAAR_{ST} \neq 0$

3.2 Research Question 2: Is the operating financial performance of the acquiring company negatively impacted following the acquisitive activity?

Paired t-tests were used to compare the abnormal cash flow return on assets pre- and post-deal. The duration in scope was one year pre- and post-transaction.

Second, the hypothesis that abnormal cash flow return on assets are impacted by the M&A event was tested. The event window of one year pre- and post-transaction is comprehensively explained in Chapter 4.1.

Hypothesis 2a: The null hypothesis states that the abnormal operating cash flow return on assets one year after an acquisition ($ACRA_{post}$) does not exceed the abnormal operating cash flow return on assets one year prior to such acquisition ($ACRA_{pre}$). \

The alternative hypothesis states that the abnormal operating cash flow return on assets one year after the acquisition ($ACRA_{post}$) exceeds the abnormal operating cash flow return on assets one year prior to such acquisition ($ACRA_{pre}$).

H_0: $ACRA_{post} - ACRA_{pre} \leq 0$

H_A: $ACRA_{post} - ACRA_{pre} > 0$

Hypothesis 2b: The null hypothesis states that the post-deal abnormal cash flow return on assets ($ACRA_{post}$) are correlated to the pre-deal abnormal cash flow return on assets ($ACRA_{pre}$).

The alternate hypothesis states that the post-deal abnormal cash flow return on assets ($ACRA_{post}$) and the pre-deal abnormal cash flow return on assets ($ACRA_{pre}$) are correlated.

H_0: $ACRA_{post}/ACRA_{pre} \neq 1$

H_A: $ACRA_{post}/ACRA_{pre} = 1$

3.3 Research Question 3: Is the overall research and development intensity of the acquiring company negatively impacted following the acquisitive activity?

Paired samples statistics were used to compare pre- and post- M&A research and development intensity. T-test paired sample correlations were then performed to find correlations of R&D intensity pre and post the M&A event. The duration in scope is one year pre- and post-transaction.

Second, the hypothesis that research and development intensity is impacted by the M&A event was tested.

Hypothesis 3a: The null hypothesis states that the post-deal research and development intensity (RDi_{post}) does not exceed the pre-deal research and development intensity (RDi_{pre}).

The alternate hypothesis states that post-deal research and development intensity (RDi_{post}) exceeds the pre-deal research and development (RDi_{pre}) .The duration in scope is one year pre- and post-transaction.

H_0: $RDi_{post} – RDi_{pre} \leq 0$

H_A: $RDi_{post} - RDi_{pre} > 0$

Hypothesis 3b: The null hypothesis states that the post-deal research and development intensity (RDi_{post}) is not correlated to the pre-deal (RDi_{pre}).

The alternate hypothesis states that post-deal research and development intensity (RDi_{post}) and the pre-deal RDi_{pre} are correlated. The duration in scope is one year pre- and post-transaction.

H_0: $RDi_{post}/RDi_{pre} \neq 1$

H_A: $RDi_{post}/RDi_{pre} = 1$

3.4 Research Question 4: Is the sales performance of the acquiring company negatively impacted by the acquisitive activity?

Paired sample statistics were used to compare pre- and post- M&A sales performance. The duration in scope is one year pre- and post-transaction. T-test paired sample correlations were then performed to find correlations of sales performance pre- and post-the M&A event.

Second, the hypothesis that the sales performance of the acquirer is impacted by the M&A event was tested. The duration in scope is one year pre- and post-transaction.

Hypothesis 4a: The null hypothesis states that post -deal sales performance (SP_{post}) does not exceed the pre-deal sales performance.

The alternate hypothesis states that post-deal sales performance (SP_{post}) exceeds the pre-deal sales performance (SP_{pre}). The duration in scope is one year pre- and post-transaction.

H_0: $SP_{post} - SP_{pre} \leq 0$

H_A: $SP_{post} - SP_{pre} > 0$

Hypothesis 4b: The null hypothesis states that the post-deal sales performance (SP_{post}) is not correlated to the pre-deal sales performance (SP_{pre}).

The alternate hypothesis states that post-deal sales performance (SP_{post}) and the pre-deal sales performance (SP_{pre}) are correlated. The duration in scope is one year pre- and post-transaction.

H_0: $SP_{post}/SP_{pre} \neq 1$

H_A: $SP_{post}/SP_{pre} = 1$

3.5 Research Question 5: Is the cost efficiency of the acquiring company negatively impacted by the acquisitive activity?

Paired sample statistics were used to compare pre- and post- M&A cost efficiency. T-test paired sample correlations were then performed to find correlations of cost efficiency to the M&A event. The duration in scope is one year pre- and post-transaction.

Second, the hypotheses that the cost efficiency is impacted by the M&A event were tested.

Hypothesis 5a: The null hypothesis states that the post-deal cost efficiency (CE_{post}) does not exceed the pre-deal acquirer cost efficiency (CE_{Apre}).

The alternate hypothesis states that the post-deal cost efficiency (CE_{post}) exceeds the pre-deal acquirer cost efficiency (CE_{Apre}). The duration in scope is one year pre- and post-transaction.

H_0: $CE_{post} - CE_{Apre} \leq 0$

H_A: $CE_{post} - CE_{Apre} > 0$

Hypothesis 5b*:* The null hypothesis states that the post-deal cost efficiency (CE_{post}) does not exceed the pre-deal target cost efficiency (CE_{Tpre}).

The alternate hypothesis states that the post-deal cost efficiency (CE_{post}) exceeds the pre-deal target cost efficiency (CE_{Tpre}). The duration in scope is one year pre- and post-transaction.

H_0: $CE_{post} - CE_{Tpre} \leq 0$

H_A: $CE_{post} - CE_{Tpre} > 0$

***Hypothesis 5c**:* The null hypothesis states that the relative pre-deal cost efficiency (target relative to acquirer) (CE_{Tpre} / CE_{Tpost}) is not the same.

The alternate hypothesis states that the relative pre-deal cost efficiency (target relative to acquirer) (CE_{Tpre} / CE_{Tpost}) is the same. The duration in scope is one year pre- and post-transaction.

H_0: $CE_{Tpre}/CE_{Apre} \neq 1$

H_A: $CE_{Tpre}/CE_{Apre} = 1$

In general, to facilitate the discussion of the results obtained in Chapter 6, some descriptive statistics were performed on the sample. These descriptive statistics are described in Chapter 4 and are presented in Chapter 5. The descriptive statistics included an explanation of the population and sample size; the annual classification of the deals throughout the review period in terms of the announcement and completion dates; the value of the acquiring companies in the sample, the value of the deals in relation to the value of the acquiring companies; the price to book ratios of the acquirers; the acquirer and target geographies; the acquirer stock exchange listing and the deal types.

In conclusion, the research hypotheses contained in this chapter attempted to address the themes and motivations raised by the research problem, questions, and objectives and the literature review in Chapter 2. Chapter 4 motivates and details the research study design and the methodologies that were used in investigating and finding answers to the research questions and hypotheses raised.

CHAPTER 4: RESEARCH METHODOLOGY AND DESIGN

The preceding Chapter 3 contained the research hypotheses raised by the research questions and objectives and the literature summary. In this chapter the unit of analysis, the population of relevance and the sampling method and sample size are defined. The chapter furthermore discusses the research design and methodologies used in order to arrive at conclusions and observations with respect to the hypotheses raised. Lastly the limitations of the research are identified.

4.1 Methodology Selection

A quantitative, causal design using a time series approach was employed for the research (Saunders & Lewis, 2012). The research was quantitative as it dealt mainly with numerical data in the form of stock market and financial data (Saunders & Lewis, 2012). The time series approach was selected because of access to data over time and the researcher did not have full control over the treatment exposure or influence of extraneous variables (Zikmund, 2008). As historic records and documented information from a database were used this meant the adoption of an archival research strategy (Saunders & Lewis, 2012).

As explained in the literature review, the event study methodology (which follows a time series approach as depicted above) was considered to be the most appropriate methodology in assessing the stock market reaction to the M&A event and it was adopted on that basis. The use of a short event window of five days was employed in this study. This was substantiated by Song et al. (2011) who were of the view that it is challenging to adequately filter out confounding effects in the longer event windows. According to Bremer et al. (2011) short-term event studies in contrast to long term studies are employed to assess the impact of changes in company organisation, financial structure and performance over a period of days, ranging from three to seven.

Depending on the event, the post-event window can be as short as one month and as long as several years (Ward & Muller 2010). This study analysed company data in a post event window of up to one year post the M&A event as data for this period was readily available and comprehensive from the selected database.

Also arising from the literature review, an accounting study was adopted with respect to calculating operating financial performance pre- and post-merger.

Variables such as research and development intensity, sales performance, and cost efficiency, were analysed from a combination of descriptive statistics and regression analysis.

In this study, the independent variable was the M&A event as depicted by abnormal share price returns. Dependent variables included the post deal stock returns, post deal cash flow return on assets and pre-determined target-specific attributes and acquirer-specific attributes as discussed in the literature, namely R&D intensity, sales performance, and cost efficiency.

4.2 Unit of Analysis

The unit of analysis was a single listed acquisition transaction in the pharma and biotech industries during the period from 2005 to 2015 year-to- date. A ten year period was selected because the researcher considered this long enough to capture a large enough pool of M&A activity within the scope of this research.

The selected time period was based on the assumption that due to the current wave of M&A activity a large volume of data would be found within this time period. Furthermore, the proposed timeline took into account the analysis of data up to one year post-M&A as stated in Chapter 4.1.

4.3 Population

The population of relevance consisted of all acquisitions undertaken by pharmaceutical and biotechnological companies listed on major stock exchanges during the period from 2005 to 2015 year-to-date as explained in Chapter 4.2.

The initial filter for acquisition size had only included acquisitions where the size of the transaction was greater than or equal to 20% of the acquirers' market capitalisation. The point of reference for this size filter had been the Johannesburg Stock Exchange listings requirements which classify a large acquisition using the 20% cut off market as stipulated above and these are formally referred to as category 1 and 2 type transactions. However

due to research data limitations, the size filter was expanded to include all acquisitions regardless of size of the transaction as a proportion of market capitalisation of the acquiring company. The potential risk of the removal of the size filter was that some transactions in the sample may have been too small to make any meaningful and measurable impact on the variables being tested in this research.

The population of relevance was extracted from a global database of mergers and acquisitions called Zephyr; and this constituted the sampling frame. Zephyr is available through Bureau van Dijk. The 'Zephyr' database contains up-to-date and historical data on financial deals worldwide and can be filtered, amongst other attributes, by industry, timeline, and geography. The database also contains individual company historical data including comprehensive information from the company financial statements. The database, which was developed 10 years ago, boasts up to 30% more data on deals than other standard databases currently available on the market. This database constituted the sampling frame for all transactions.

Missing data for the attributes required for analysis, as set out in the hypotheses stated in Chapter 3, were further collected by accessing the Zephyr database under the tab for company information. Under this tab a comprehensive set of historical information derived from financial statements was revealed, upon entering the names of the required companies.

Any additional secondary company data completely missing from Zephyr was further sourced form from the Y charts database. Y Charts is an investment research data service touted to be equivalent to a web-based version of a Bloomberg terminal, which is a trusted data source. To validate the use of Zephyr and Y Charts, random financial statement data was extracted from the databases and compared to the actual financial statements of the selected companies. Pharmaceutical and Biotechnological companies served as proxies for innovative businesses since, as justified in the literature reviewed, they fit the profile of such a business.

4.4 Sampling

The sampling technique initially preferred was probability based, stratified, and disproportionate (Saunders & Lewis, 2012). However the population resulted in being limited in size due to data acquisition constraints. The sample was therefore selected

based on purposive sampling (non-probability sampling). This essentially meant that all the companies meeting the selection criteria mentioned in Chapter 4.5 and having all available data were selected for analysis. The researcher was aware that this method of sampling possibly introduced sampling bias and that the sample would not necessarily be a true representation of the entire population (Saunders & Lewis, 2012).

A sample of 35 companies that suited the selection criteria described in Chapter 4.5 was selected which allows for sufficient statistical inferences to be made.

4.5 Data Collection Process

The relevant M&A events were identified as described in Chapter 4.2. A sample of at least 30 events was required for sufficient statistical inference. Eventually, as mentioned in Chapter 4.4, a sample of 35 events/transactions was used based on the sampling technique and criteria described in Chapter 4.4.

Certain selection criteria were defined for inclusion of a transaction into this study, particularly:

- The merger or acquisition transaction was in the pharmaceutical or biotechnological industries in the period from 2005 to 2015. Only horizontal transactions were considered with both the acquirer and target being in the same industry.
- The acquirer was classified as a pharmaceutical or biotech company (as justified in Chapter 2, these serve as proxies for innovation driven business);
- Both acquirer and target were publicly listed entities on either the Johannesburg, New York, or other major stock exchange with significant pharma/biotech representation;
- The status of the transaction was “complete”;
- Variable data required for analysis related to the merger or acquisition transaction and variable data from annual financial statements had to be available, including information from statements of financial position, statements of comprehensive income, and statements of cash flows.

Exchange rates:

- A specific exchange rate at the time of the deal was determined automatically by the database used during the event period defined. The database allowed for values to be displayed in a number of different currencies and South African rand was an available option.
- For accuracy and consistency, the exchange rates were further validated by randomly cross- checking with the XE currency convertor available online, via the XE website. XE is a globally trusted currency authority, and XE.com ranks among the top 400 sites in the world for e-commerce.

Sources of secondary data:

- As explained in Chapter 4.3 the transactions were identified through the use of the 'Zephyr' database which contains extensive M&A transaction data as well as extensive company data. Missing data were further sourced from the Y Charts database.
- Index data on the NYSE Arca Pharmaceuticals Index was sourced from the Yahoo finance webpage as this data was real time and also contained historical data of more than 10 years.

4.6 Data Analysis Process

4.6.1 Introduction

Initially general descriptive statistics were performed on the sample to facilitate the discussion of the results in Chapter 6. The descriptive statistics included a description of the population and sample size; the annual classification of the deals throughout the review period in terms of the announcement and completion dates; the value of the acquiring companies in the sample, the value of the deals in relation to the value of the acquiring companies; the price to book ratios of the acquirers; the acquirer and target geographies; the acquirer stock exchange listing and the deal type.

It was then determined whether or not the selected merger and acquisition (M&A) transaction was successful in terms of shareholder return. This was measured using the standard event study methodology. The event study was constructed on the basis of cumulated average abnormal returns, which were calculated by finding the difference between the actual observed stock returns and the theoretical expected returns, averaging

them for each day in the event window, and accumulating them across the event window. A five day event window was used t [-1;+3] as justified in Chapter 2.7.1 and 4.1, and defined around the date of announcement of the M&A event (Kirchhoff & Schiereck, 2011). The results were tested for significance using a variety of parametric and non-parametric tests which further explained in the following sections (Kirchhoff & Schiereck, 2011).

Further evaluation of the M&A event was conducted by measuring the operating financial performance in an accounting study that used the measure of the company operating cash-flows, expressed as a return on assets, with an adjustment for industry performance over an event period defined as the estimation window and the post event window (Healy, Palepu, and Ruback, 1992). The event period over which the accounting study was performed was from one year prior to the deal up to one year post-deal. The one-year duration is explained in Chapter 4.1. Operating cash-flow was calculated as sales minus cost of goods sold minus selling and administrative expenses plus non-cash items, such as depreciation and amortisation (Gosh, 2001).

Lastly multiple parametric and non-parametric tests were used to measure the joint impact of M&A events on a set of variables of the acquirers, their targets, as well as the merged entities as well as any existing interdependence between them. Two classes of factors to explain the impact of the M&A activity were used. These were target-specific attributes, and acquirer-specific attributes (Kirchhoff & Schiereck, 2011). The target and acquirer variables, as measured by a specific key performance indicators (KPI), included research and development intensity, sales performance, and cost efficiency (Kirchhoff & Schiereck, 2011).

For each hypothesis mentioned in Chapter 3 a series of tests were conducted as necessary. Namely T-tests, Wilcoxon Signed Rank Sum tests or the Friedman test, and Paired sample correlations were used for the pre-acquisition and post-acquisition variables to test for statistically significant differences of means within the prescribed event windows at the 5% level of significance (Wegner, 2012). Statistical analyses were completed using the SPSS software package.

4.6.2 Calculating Abnormal Returns

To test Hypothesis 1, the cumulated abnormal returns were calculated. The Adjusted Market Model described in Chapter 2.7.1 and 2.7.1.1 was the specific methodology used to calculate abnormal returns based on the following justification.

- The event window was short enough (5 days) as supported by literature (see Chapter 2.7.1) to assume confounding factors would not negatively affect the results.
- An industry index was found which catered specifically for pharmaceuticals and with historical data covering the period being analysed.

The following steps in the analysis process were followed:

a) Acquirer share price data were collected for each of the sample members from the Zephyr database for the event window defined as t [-1;+3] which means an event window was constructed from one day prior to announcement of the transaction up to 3 days post announcement of the transaction.
b) The announcement date was the date stated as the announcement date in the Zephyr database.
c) Across the five days in the event window, daily equal-weighted indices were formulated for each of the share prices and these were calculated from the log returns of the stocks in terms of the following Equation 1.

Rit = log [Pit/Pit-1] **(Equation 1)**

Where:

Rit = the equal weighted share return for security i for day t; and

Pit = the equal weighted share value of security i at the end of day t.

With reference to Ward and Muller (2010):

d) As per the Adjusted Market model methodology, the expected returns for each stock were considered as equivalent to the returns experienced by the industry index on each day within the defined event (see Equation 2).

$(Rit)=Rmt$ **(Equation 2)**

Where (Rit) is the expected return on security I at time t and

Rmt is the return on the market on day t.

e) The NYSE (New York stock exchange) Arca Pharmaceutical Index performance data were collected for each date in the event window for each of the sample

members. The percentage change in the index from the previous day was the same as the return for the index and this was assumed to be the expected return on the day for each security. The index real-time and historical data were readily available on the internet using Yahoo finance and had historical data exceeding 10 years. Since 60% of the companies in the sample were listed on the NYSE a decision was made by the researcher to use this index for the entire sample as a proxy.

f) Once the expected returns were calculated (as described in Equation 2), the abnormal return for each share price on each day in the 5 day event window was calculated. This was calculated in terms of Equation 3 as the difference between the actual return for that share price for that day less the expected return for that for that day as calculated based on the industry index:

$ARit = Rit - E(Rit)$ **(Equation 3)**

Where:

ARit = the abnormal return of stock i in period t;

E(Rit) = the expected share price return of stock i in period t determined in terms of Equation 2;

Rit = actual return of stock i in period t

g) After calculating the daily AR for each selection in the sample, the daily average abnormal return (AAR_{it}) for the whole sample was calculated using the formula in equation 4.

$$AARk,l = \frac{1}{n}\sum_{i=k}^{l} ARi,k,l$$

(Equation 4)

Where:

AARk,l = the daily average abnormal return for the sample on the day t=K to t=L. K and L represent the start and end of the event period under study.

ARi,k,l = abnormal return for security i for day t=K to t=L, as defined in Equation 3.

n = the number of firms in the sample on specified day t.

h) The daily Average Abnormal Returns were then accumulated to obtain Cumulative Abnormal Returns for each selection for each event window, with reference to the following equation:

$$\mathrm{CAARi,k,l} = \sum_{t=k}^{l} \mathrm{AARkl} \qquad \textbf{(Equation 5)}$$

Where:

CAARi,k,l = the cumulative abnormal return for security i for the period from t = k to t = l; and

AARkl = the average abnormal return for security i for day K to L defined as the event period as calculated in Equation 4.

i) After the CAARs had been calculated, one- and two tailed t-tests were conducted at the 5% level of significance for the purposes of testing the hypotheses and answering the research questions stated in Chapter 3.

j) Statistical inferences were based on the result of a “bootstrap” of the CAAR. Since the abnormal returns had been accumulated, it was not expected that the distribution of CAARs at any point in time would necessarily be normal. And so for the purposes of testing for significance a “bootstrap” distribution was constructed using a Monte Carlo analysis. In statistics, bootstrapping can refer to any test or metric that relies on random sampling with replacement. Bootstrapping enables measures of accuracy to be assigned to sample estimates and these measures can be defined in terms of attributes such as bias, prediction error, variance, confidence intervals, or some other such measure (Ward & Muller, 2010). For this research study a confidence interval was selected as the assigned measure of accuracy.

4.6.3 Calculating the Cash Flow Return on Assets

To test Hypothesis 2 an accounting study was used that measured the companies’ operating cash-flows return on assets, with an adjustment made for industry performance over the event period of five days (Healy et al., 1997). Due to data availability, an estimation window of one year pre- the transaction and a post-event window of one year post-transaction was selected for the accounting study, both of which meet the minimum

criteria for validity as periods for analysis as explained in Chapter 2.7.1. According to Healy et al., (1997) when the above mentioned technique is used in measuring financial performance the results are more robust than other measures as this method can overcome confounding factors such as the influence of different accounting treatments, different deal financing methods, the level of assets used as well as industry and economic factors.

Gosh (2001) used an approach whereby pre- and post-acquisition performance of companies involved in the merger or acquisition were compared to matched companies. As mentioned in Chapter 4.6.1, the author defined operating cash-flow in the form of a formula described as the outcome of sales or operating revenue minus cost of goods sold (COGS) minus selling and administrative expenses (S&A) plus non-cash items, such as depreciation and amortisation (Depr and Amort). This is now also commonly referred to as earnings before interest taxes depreciation and amortisation (EBITDA). This is represented in Equation 6 below:

$$\boldsymbol{CashFlow} = (\boldsymbol{Sales} - \boldsymbol{COGS}) - \boldsymbol{S\&A} + (\boldsymbol{Depr.} + \boldsymbol{Amort}) \qquad \textbf{(Equation 6)}$$

According to the methodology used by Smit and Ward (2007):

a) The abnormal cash flow return on assets was calculated by first finding the cash flow return on assets for each individual transaction and comparing it to the industry median cash flow return on assets for the acquiring company's industry sector, namely pharmaceuticals. As a note, the whole sample was assumed to be a representation of the industry hence ICFA was based on sample median cash flows and total assets.
b) Equation 7 was used to calculate abnormal cash flow return on assets in the event window preceding the announcement of the merger or acquisition.

$$\mathrm{ACRAa+t,y} = (\mathrm{CFa,y} + \mathrm{CFt,y}) \div (\mathrm{Aa,y} + \mathrm{At,y}) - \mathrm{ICFAy} \qquad \textbf{(Equation 7)}$$

Where:

ACRAa+t,y = the abnormal cash flow return on assets for the acquiring company a, and the target company t, for year y (before the acquisition, combined on a pro forma basis;

CFa,y = the operating cash flow for the acquiring company a for year y (before the acquisition);

CFt,y = the operating cash flow for the target company t for year y (before the acquisition);

Aa,y = the assets of the acquiring company a, at the end of year y (before acquisition);

At,y = the assets of the target company t, at the end of year y (before acquisition);

ICFAy = the median industry cash flow return on assets for year y (before the acquisition) (Smit & Ward, 2007)

c) Equation 8 was used to calculate abnormal cash flow return on assets in the event window post the announcement of the merger or acquisition.

$$\mathrm{ACRAc,y} = (\mathrm{CFc,y}) \div (\mathrm{Ac,y}) - \mathrm{ICFAy} \qquad \textbf{(Equation 8)}$$

Where:

ACRAc,y = the abnormal cash flow for the combined entity c, for year y (after the acquisition):

CFc,y = the operating cash flow for the combined company c for year y (after the acquisition);

Ac,y = the assets of the combined company c, at the end of year y (after acquisition);

ICFAy = the median industry cash flow return on assets for year y (after the acquisition) (Smit & Ward, 2007).

4.6.4 Calculating the Acquirer and Target Specific Attributes

4.6.4.1 R&D intensity

To test Hypothesis 3 the R&D intensity was measured; this was determined by the ratio of R&D to sales/operating revenue. It was calculated by dividing the R&D costs one year prior to the transaction by the sales/operating revenue in one year prior to transaction (ptt) and comparing it to the value obtained by dividing the R&D costs one year post transaction by the sales/operating revenue one year post transaction (pt) thus finding the correlation to the M&A event (Kirchhoff & Schiereck, 2011). The general formula for calculation of R&D intensity is represented by Equation 9.

$$RDi = RDc \div OR \qquad \textbf{(Equation 9)}$$

Where:

RD_i = Research and development intensity

RD_c = Research and development costs

OR = Operating revenue

The research and development costs and sales/operating revenue amounts were collected from the historical company statements of comprehensive income. Calculating research intensity is based on the assumption that on an average, higher investments or expenditures in R&D are rewarded by innovations and ultimately by higher performance (Kirchhoff & Schiereck, 2011). This assumption was also validated by other research to be true as presented in Chapter 2.6.3.

4.6.4.2 Sales performance

To test Hypothesis 4 the sales performance was measured; this was determined by the ratio of the sales/operating revenue to the total company assets. It was calculated by dividing the sales one year prior to transaction (ptt) by the total assets one year prior to transaction (ptt) and comparing it to the value obtained by dividing the sales/operating revenue one year post transaction (pt) by the total assets one year post transaction (Kirchhoff & Schiereck, 2011). The general formula for calculation of sales performance is represented by Equation 10.

$$SP = OR/TA \qquad \textbf{(Equation 10)}$$

Where:

SP = Sales performance

OR = Operating revenue

TA = Total assets

The sales/operating revenue to total company assets ratio is intended to provide some insights into the company's overall sales power and its trend over time (Kirchhoff & Schiereck, 2011).

4.6.4.3 Cost efficiency and Relative cost efficiency

- To test Hypothesis 5a the post-deal cost efficiency (CE_{post}) was compared to the pre-deal acquirer cost efficiency ($CE_{a,pre}$). The post-deal cost efficiency was calculated by dividing the operational costs of the combined company one year post-deal ($OC_{a,post}$) by the total assets of the combined company one year post-deal ($TA_{a,post}$).

- The pre-deal acquirer cost efficiency was calculated by dividing the operational costs of the acquirer one year pre-deal ($OC_{a,pre}$) by the total assets of the acquirer one year pre-deal ($TA_{a,pre}$). The formulas for these calculations are displayed in Equations 11(a) and 11(b).

$$\text{CEpost} = (\text{OCa, post}) \div (\text{TAa, post}) \qquad \textbf{(Equation 11(a))}$$

Where:

CE_{post} = Post-deal cost efficiency

$OC_{a,post}$ = Operational costs of combined company post-deal

$TA_{a,post}$ = Total assets of combined company post-deal

$$\text{CEa, pre} = (\text{OCa, pre}) \div (\text{TAa, pre}) \qquad \textbf{(Equation 11(b))}$$

Where:

$CE_{a,pre}$ = Pre-deal acquirer cost efficiency

$OC_{a,pre}$ = Operational costs of acquirer pre-deal

$TA_{a,pre}$ = Total assets of acquirer pre-deal

- To test Hypothesis 5b the post-deal cost efficiency (CE_{post}) was compared to the pre-deal target cost efficiency ($CE_{t,pre}$). The post-deal cost efficiency was calculated as per Equation 11(a) by dividing the operational costs of the combined company one year post-deal ($OC_{a,post}$) by the total assets of the combined company one year post-deal ($TA_{a,post}$).
- The pre-deal target cost efficiency was calculated by dividing the operational costs of the target one year pre-deal ($OC_{t,pre}$) by the total assets of the combined company one year pre-deal ($TA_{t,pre}$) The formula for this calculation is displayed in Equation 12.

$$\text{CEt, pre} = (\text{OCt, pre}) \div (\text{TAt, pre}) \qquad \textbf{(Equation 12)}$$

Where:

$CE_{t,pre}$ = Pre-deal target cost efficiency

$OC_{t,pre}$ = Operational costs of target pre-deal

$TA_{a,pt}$ = Total assets of target pre-deal

- To test Hypothesis 5c the relative cost efficiency was measured; this was determined by the ratio of cost efficiency of the target to the acquirer and finding the correlation to the M&A event. The ratio was calculated by initially dividing the operational costs of the target one year pre-deal ($OC_{t,pre}$) by the total assets of the target one year pre-deal ($TA_{t,pre}$) and then dividing this by the result obtained when the operational costs of the acquirer one year pre-deal ($OC_{a,pre}$) are divided by the total assets of the acquirer one year pre-deal ($TA_{a,pre}$) (Kirchhoff & Schiereck, 2011). The formula for the relative cost efficiency is provided in Equation 13.

$$RCE = \left[\frac{OCt,pre}{TAt,pre}\right] \div \left[\frac{OCa,pre}{TAa,pre}\right] \qquad \textbf{Equation 13}$$

Where;

RCE = Relative cost efficiency

$OC_{t,pre}$ = Operational costs of target one year prior to transaction

$TA_{t,pre}$ = Total Assets of target one year prior to transaction

$OC_{a,pre}$ = Operational costs of acquirer one year prior to transaction

$TA_{a,pre}$ = Total Assets of acquirer one year prior to transaction

4.7 Limitations

The research methodology had inter alia, the following limitations:

- Only the impact of acquisitions undertaken in the period from 2005 to 2015 year-to-date (as justified in Chapter 1.5) were reviewed and had a sample size of only 35 transactions. Whilst statistical inferences on the population could still be made, the time period selected, short event window, and sample size bring about a limitation in that the research findings may not be representative of the population of all acquisitions conducted in all time;
- The research methodology focused only on acquisitions by companies listed on selected stock exchanges (as described in Chapter 4.4) with major pharma and

biotech industry representation and were therefore not representative of acquisitions by unlisted companies or companies listed on other stock exchanges;

- The use of an adjusted market model for the calculation of CAAR's is based on the assumption that markets are efficient and ignores the potential impact of confounding factors such as the influence of deal financing methods, the amount of assets employed, varying accounting treatments, as well as industry specific and economic factors. While this limitation may have been mitigated by the use of a very short event window, it is recognized that a control portfolio method may have been more robust.
- In the calculation of the ICFA an assumption was made that the sample was a true representation of the industry and this may not have been the case based on the sampling technique eventually chosen.
- The context of the research was limited to two related sectors, pharma and biotech, and ignored the possibility that acquisitions in innovation-driven businesses may be value-creating in some innovation industry sectors and value-destructing in other innovation industry sectors over different time periods;
- It considered the impact of M&As on innovation-driven businesses only within the limited range of variables that were measured, i.e. abnormal returns, average operating cash flows, research and development intensity, sales performance, and cost efficiency. Other variables that may be influential were not included in this study due to data and time constraints.
- It used the Adjusted Market Model method using an index of companies listed on the NYSE as a proxy for the calculation of abnormal returns. Even though 60% of the companies in the sample were listed on the NYSE, the remaining companies may not have been truly represented by the same index.
- The sampling technique eventually employed was non-probability based which may have introduced sampling bias.

CHAPTER 5: RESULTS

5.1 Description of the sample obtained

5.1.1 Introduction

The sample obtained consisted of 35 merger and acquisition transactions that occurred in the pharmaceutical and biotechnological industries in the period from 2005 to 2015. All transactions were marked as complete. Most transactions were completed between 2010 and 2015 (71%). Time to completion of the transactions from the date of announcement ranged from zero to eight months. Some of the descriptive statistics of the sample are summarised in Table 6.

Table 6: Summary of Descriptive Statistics

Attribute	**Value**			
Population size	884			
Population start date	01-Jan-2005			
Population end date	31-Jul-2015			
Sample size	35			
Number of acquisitions per year (by completion and announcement date)	Completion		Announcement	
Year	Number of deals	%	Number of deals	%
2005	2	5.7	2	5.7
2006	2	5.7	2	5.7
2007	4	11.4	4	11.4
2008	0	0.0	1	2.9
2009	2	5.7	2	5.7
2010	2	5.7	3	8.6
2011	6	17.1	4	11.4
2012	3	8.6	3	8.6
2013	3	8.6	4	11.4
2014	7	20.0	10	28.6
2015	4	11.4	0	0.0
Deal size				
Minimum (mill ZAR)	8.190			

Attribute	Value
Maximum (mill ZAR)	186553.750
Mean	21300.289
Std. Deviation	46362.633
Skewness	2.573
Acquirer Market capitalisation	
Minimum (mill ZAR)	100.822
Maximum (mill ZAR)	2201915.000
Mean	387742.586
Std. Deviation	585801.947
Skewness	1.796
Deal value as percentage of market capitalisation of acquirer	
Minimum %	0.026
Maximum %	106.662
Mean	13.539
Std. Deviation	22.298
Skewness	2.724
Acquirer Price to Book value ratio	
Minimum %	0.000
Maximum %	16.240
Mean	4.050
Std. Deviation	3.234
Skewness	2.046

As shown in Table 6:

The initial population size obtained from the Zephyr database consisted of 884 transactions. Deal sizes ranged from R8.190 to R186 553.750 million Rand (ZAR) with the data positively skewed in its distribution (skewness was 2.573, which is greater than +1 hence substantially skewed) (Wegner, 2012).

The value of the acquiring companies as shown by market capitalisation, ranged from R100.822 to R2 201 915.000 million Rand (ZAR) with the data positively skewed in its distribution (skewness was 1.796 which is greater than +1, hence substantially skewed).

Acquirer price to book value ratio ranged from zero to 16.240 with the data positively skewed in its distribution (skewness was 2.046 which is greater than +1 hence substantially skewed).

The dates of announcement of the transactions ranged from July 2005 to Dec 2014 and dates of completion of the transaction ranged from August 2005 until March 2015. The majority of the deals had their announcement and completion dates in 2014 (20% and 28.6% respectively). The majority of the deals were also announced and completed in the last five years (from 2010 to 2015) (71.4% and 68.6% respectively).

5.1.2 Company Geographic Data

Acquirers were from Africa, Asia, Europe, and America as shown in Figure 4. Chinese companies had the highest representation in the sample with 20%, followed by companies from Great Britain and the United States with 17% and 14% respectively (Table 7).

Even though South Africa had a frequency of three for acquirer country of origin this was the same company, Aspen Pharmacare, which was the acquirer in three of the transactions within the sample. In terms of region, European companies had the highest frequency representing a combined total of 48.5% of acquirers in the sample of transactions.

Figure 4 Acquirer country of origin

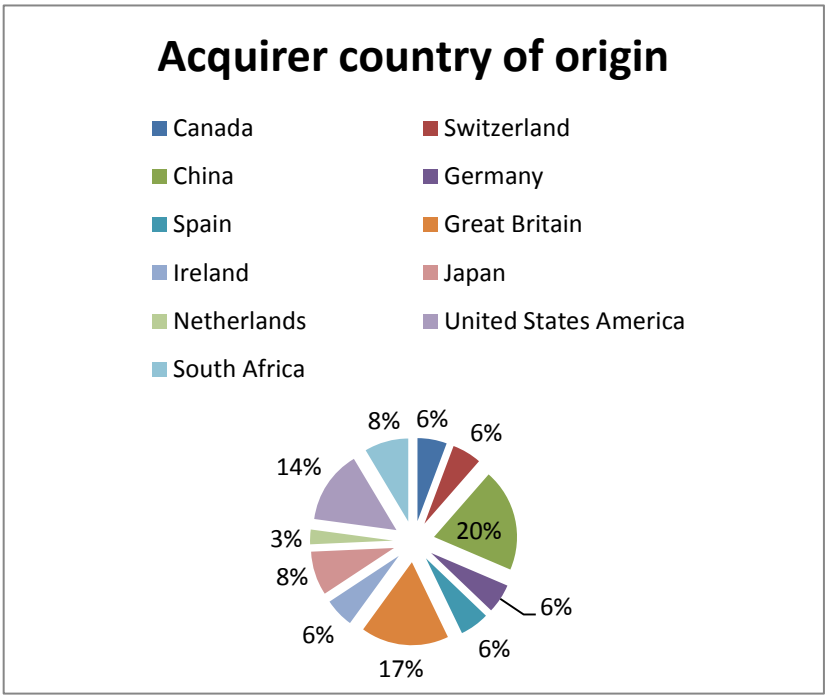


Table 7: Acquirer country of origin

	Frequency	Percent
Canada	2	5.7
Switzerland	2	5.7
China	7	20.0
Germany	2	5.7
Spain	2	5.7
Great Britain	6	17.1
Ireland	2	5.7
Japan	3	8.6
Netherlands	1	2.9
United States America	5	14.3
South Africa	3	8.6
Total	35	100.0

Targets were from South America, Asia, North America, and Europe as shown in Figure 5. Companies from the United States and China had the highest representation as targets having approximately 23% representation each. This was followed by companies from Great Britain with approximately 15% representation (Table 8).

In terms of region, European companies had the highest frequency representing a combined total of 37.3% of targets in the sample of transactions. Asia followed with 31.5% of the targets being Asian companies.

Figure 5: Target country of origin

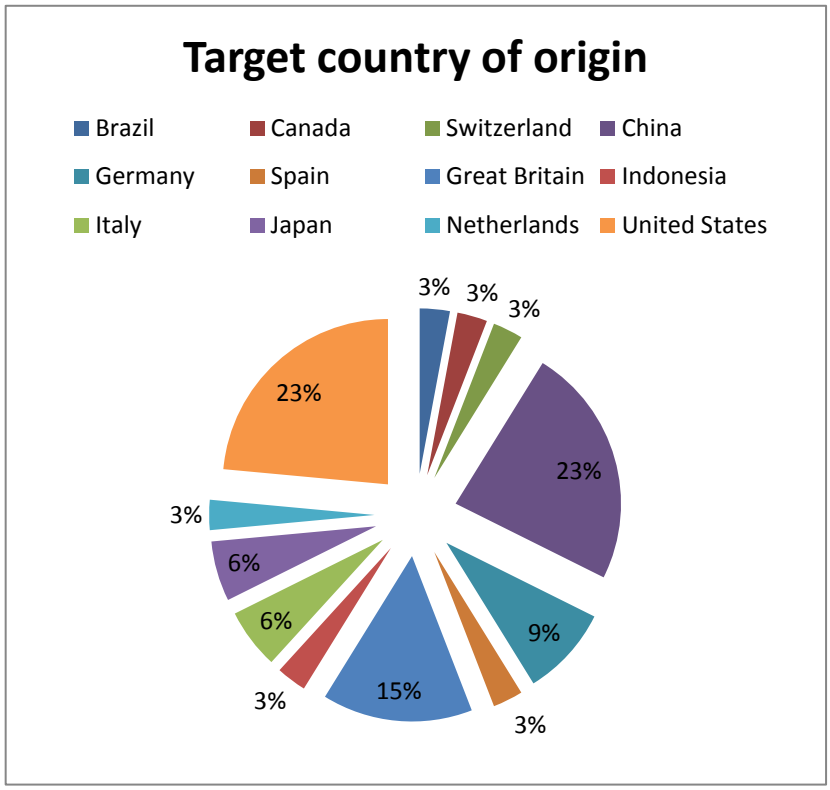


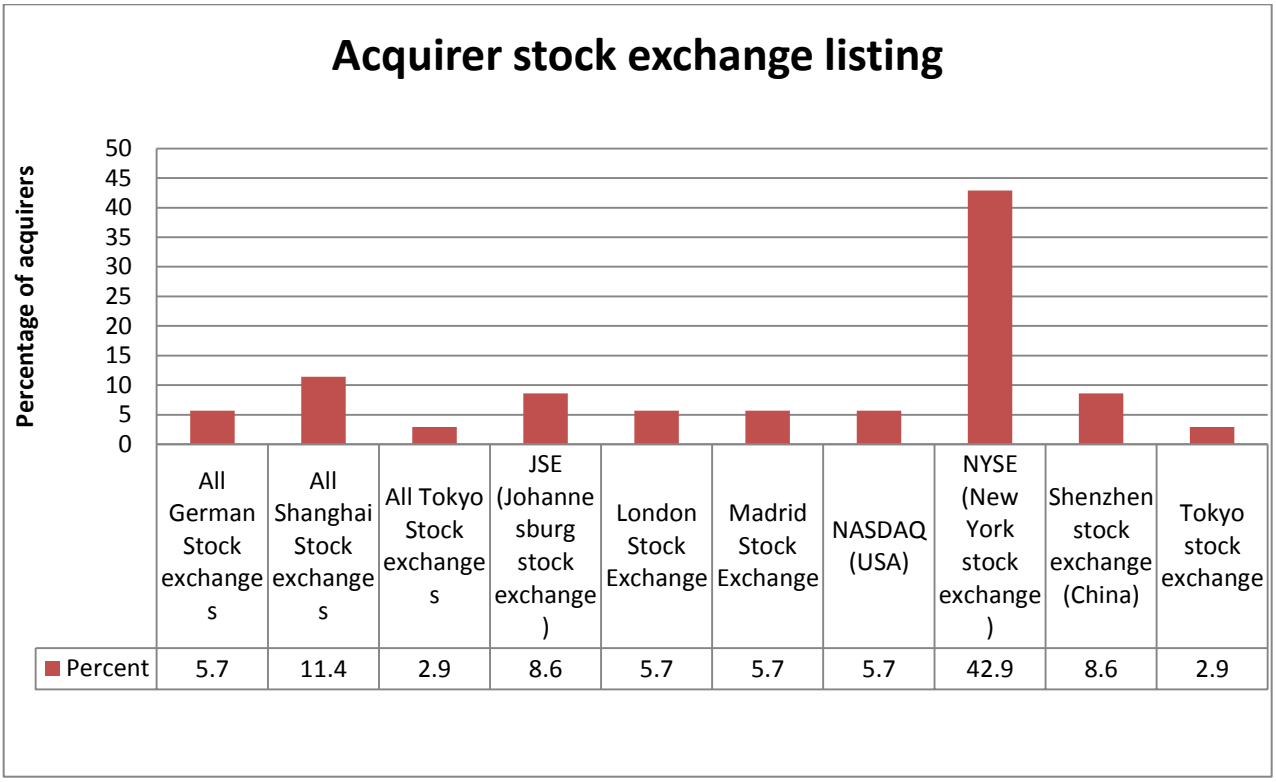
Table 8: Target country of origin

	Frequency	Percent
Brazil	1	2.9
Canada	1	2.9
Switzerland	1	2.9
China	8	22.9
Germany	3	8.6
Spain	1	2.9
Great Britain	5	14.3
Indonesia	1	2.9
Italy	2	5.7
Japan	2	5.7
Netherlands	1	2.9
United States	8	22.9
Total	35	100

5.1.3 Company Stock Exchange Listing

As shown in Figure 6, the majority of acquirers were listed on an American stock exchange i.e. either the New York Stock Exchange (NYSE) (42.9%) or the NASDAQ (5.7%). Another large representation was from acquirers listed on Chinese stock exchanges namely the Shanghai Stock Exchange (11.4%) and the Shenzhen (8.6%) stock exchanges. Acquirers listed on the Johannesburg Stock Exchange constituted 8.6% of the transactions in the sample.

Figure 6: Acquirer stock exchange listing



5.1.4 Transaction Types and Size

Most of the transactions (60%) represented a 100% acquisition as shown in Figure 7 and Table 9.

The value of the deals as a percentage of market capitalisations of the acquiring companies ranged from 0.026% to 106.662%, with the data positively skewed in its distribution (skewness was 2.724 which is greater than +1 hence substantially skewed) (Table 6, section 5.1.1).

Figure 7 Deal type

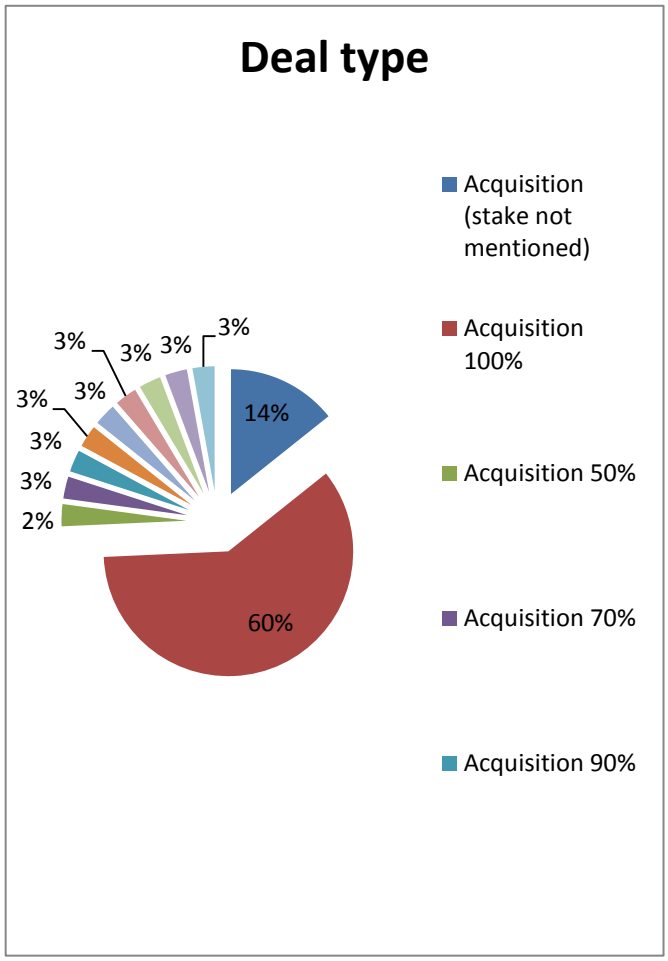


Table 9: Deal Type Scores

	Frequency	Percent
Acquisition (stake not mentioned)	5	14.3
Acquisition 100%	21	60.0
Acquisition 50%	1	2.9
Acquisition 70%	1	2.9
Acquisition 90%	1	2.9
Acquisition 97.97%	1	2.9
Acquisition 99%	1	2.9
Acquisition increased from 45% to 60%	1	2.9
Acquisition increased from 49% to 85%	1	2.9
Acquisition increased from 54.794% to 62.794%	1	2.9
Acquisition unknown remaining stake %	1	2.9
Total	35	100.0

5.2 Results on Reliability and Validity of the Data

A sample of 35 was large enough to assume normality of data. As described by the central limit theorem the arithmetic mean of a sufficiently large sample of observations meeting certain criteria will be approximately normally distributed (Wegner, 2012). Hence parametric tests, which assume a normal distribution, were performed to test the various hypotheses.

However due to the non-probability based sampling method that had been employed, and due to the substantial skewness in the data presented in Table 6, Chapter 5.1 and in Appendix 3 (Table 19), a Kolmogorov Smirnov normality test was conducted to confirm normality of data (Wegner, 2012). The results of the Kolmogorov Smirnov test for the key attributes are displayed in Appendix 4 (Table 20).

From Appendix 4 (Table 20) a large proportion of the *p* values indicated that many attributes were not normally distributed, hence non-parametric tests were performed as additional tests to the parametric tests to ensure more accurate statistical inferences could be made. Namely these non-parametric tests were the Wilcoxon signed-rank test and the Sign test. The results of the Wilcoxon signed-rank test were generally preferred as this test is considered to be a stronger test to the Sign test due to its ability to use both signs and rank.

5.3 Statistical Results per Hypothesis

All tests in the study were performed at $\alpha = 0.05$ (95% confidence interval) (Wegner, 2012).

5.3.1 Research Question 1: Does the merger and acquisition activity negatively impact acquirer shareholder value?

5.3.1.1 Paired t-test results on Acquirer stock price performance

Table 10: Stock price paired sample t-tests

Acquirer Stock price (ZAR)	Paired Samples Statistics	
	Mean	SD
One day prior to announcement	309.084	360.499
At announcement	309.922	339.975
One day after announcement	340.859	375.118
Two days after announcement	343.751	379.148
Three days after announcement	346.951	383.922

Figure 8 and Table 10 showed the acquirer stock price performance at four specific time points. These are namely at 1 day prior to announcement of the deal; one day after the announcement of the deal; two days after the announcement of the deal; and three days after the announcement of the deal.

Generally, the majority of the acquiring company stock prices showed an upward trend that continued to rise from one day prior to announcement of the deal up until three days after announcement of the deal. The stock price paired sample statistics presented in Table 10 support this analysis where the mean stock price increased on each day in the five day event window from 309.084 ZAR one day prior to announcement to 346.922 ZAR three days after announcement.

Figure 8: Stock price performance –t [-1;+3]

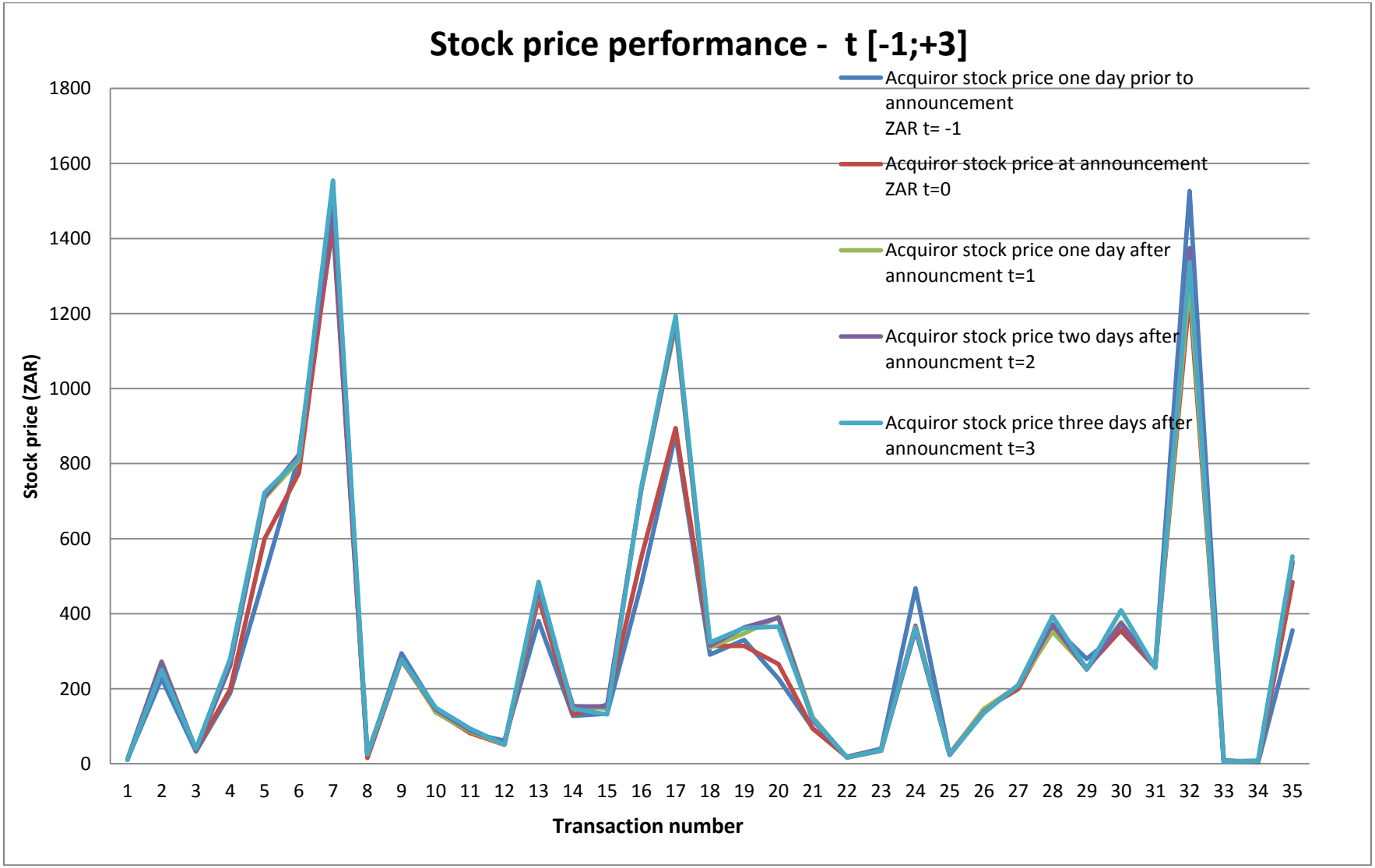


Table 11: CAAR t-tests and bootstrap

Day	Log AAR	CAAR	5% bootstrap interval	95% bootstrap interval	*p*-value	Comment on result
-1	N/A	N/A	N/A	N/A	N/A	Impact of day -1 experienced on day 0
0	-0.08%	0.00%	0	0		
1	8.25%	8.52%	-49.87	58.39	0.500	Insignificant
2	-0.19%	8.31%	-6.46	17.68	0.184	Insignificant
3	0.84%	9.22%	-0.42	13.45	0.058	Insignificant (Significant at α= 0.01)

5.3.1.2 Hypothesis 1 results

Hypothesis 1: The null hypothesis stated that shareholders of acquiring companies earn zero cumulative abnormal returns over the short-term of up to three days ($CAAR_{ST}$) following the announcement of an acquisition.

The alternative hypothesis stated that shareholders of acquiring companies do not earn zero cumulative abnormal returns over the short term of up to three days ($CAAR_{ST}$) following the completion of an acquisition.

H_0: $CAAR_{ST} = 0$

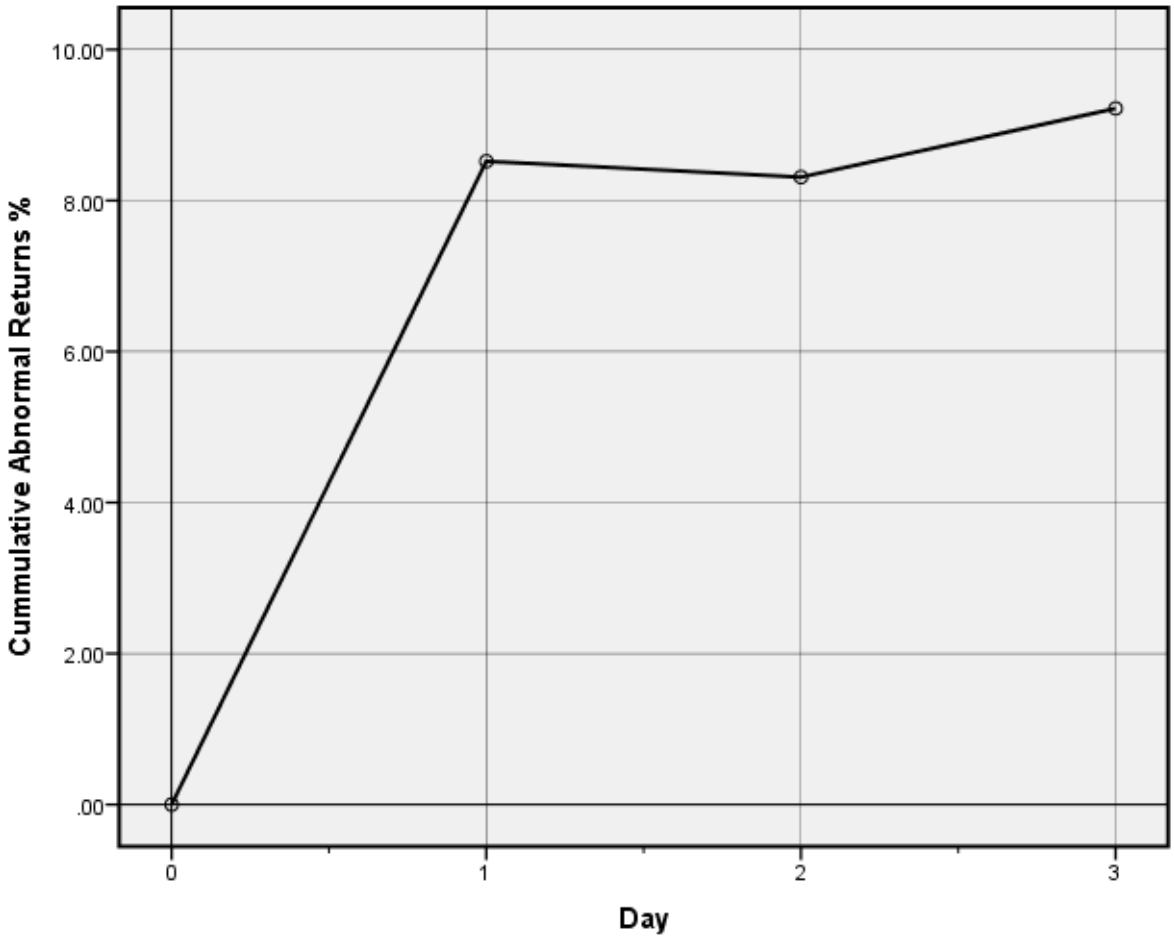
H_A: $CAAR_{ST} \neq 0$

- The results of the bootstrapped t-tests on the $CAAR_{ST}$ (Table 11 and Appendix 5) showed that the average cumulative abnormal returns in the short-term of up to three days, whilst positive, are insignificant (p=0.058).
- High positive values of $CAAR_{ST}$ (>8%) were witnessed (Figure 9), although these are not statistically significant.
- A non-parametric test (Wilcoxon signed ranks test, see Table 12) was also performed on the $CAAR_{ST}$ for Day 0 to 4 and still found the CAAR insignificant (p=0.109).
- Null hypothesis is retained

Table 12: CAAR Wilcoxon Signed Rank test

Null hypothesis	Test	*p*-value	Decision
The median of CAAR equals 0.00	One sample Wilcoxon Signed Rank test	0.109	Retain the null hypothesis

Figure 9: CAAR plot



5.3.2 Research Question 2: Is the operating financial performance of the acquiring company negatively impacted following the acquisitive activity?

Table 13: Abnormal cash flow returns on assets t-tests

ACRA	Paired Samples Statistics		Paired Samples Correlations		Parametric and Non-parametric tests	
	Mean	SD	Correlation coefficient	(p-value)	Matched pairs t-test (*p*-value)	Wilcoxon sign rank test (*p*-value)
Pre-deal	-0.0014	0.115	0.729	≈ 0.000	0.434	0.756
Post-deal	-0.0127	0.115				

5.3.2.1 Paired t-test results on abnormal cash flow return on assets

The values of the means presented in Table 13 (-0.0014; -0.0127) showed that the pre- and post-deal abnormal cash flow return on assets are both negative and the values are both close to zero.

5.3.2.2 Hypothesis 2 results

Hypothesis 2a: The null hypothesis stated that the abnormal operating cash flow return on assets one year after an acquisition ($ACRA_{post}$) does not exceed the abnormal operating cash flow return on assets one year prior to such acquisition ($ACRA_{pre}$).

The alternative hypothesis stated that the abnormal operating cash flow return on assets one year after the acquisition ($ACRA_{post}$) exceeds the abnormal operating cash flow return on assets one year prior to such acquisition ($ACRA_{pre}$).

H_0: $ACRA_{post} - ACRA_{pre} \leq 0$

H_A: $ACRA_{post} - ACRA_{pre} > 0$

- The results of the matched pair's t-test showed that there was no significant difference between the pre- and post-deal abnormal cash flow return on assets (ACRA) (p= 0.434). Hence the M&A event did not significantly affect the ACRA.
- The results of the Wilcoxon sign rank test confirmed that there was no significant difference between the pre- and post-deal abnormal cash flow return on assets (ACRA) (p= 0.756). Hence the M&A event did not significantly affect the ACRA.
- The null hypothesis is therefore retained.

Hypothesis 2b: The null hypothesis stated that the post-deal abnormal cash flow return on assets ($ACRA_{post}$) are correlated to the pre-deal abnormal cash flow return on assets ($ACRA_{pre}$).

The alternate hypothesis stated that the post-deal abnormal cash flow return on assets ($ACRA_{post}$) and the pre-deal abnormal cash flow return on assets ($ACRA_{pre}$) are correlated.

H_0: $ACRA_{post}/ACRA_{pre} \neq 1$

H_A: $ACRA_{post}/ACRA_{pre} = 1$

- The results of the paired samples correlations showed that the pre- and post-deal ACRAs were significantly positively correlated ($p \approx 0.000$) with a high correlation coefficient of 0.729.
- The null hypothesis is therefore rejected

5.3.3 Research Question 3: Is the overall research and development intensity of the acquiring company negatively impacted following the acquisitive activity?

Table 14: R&D Intensity t-tests

RDi	**Paired Samples Statistics**		**Paired Samples Correlations**		**Parametric and Non-parametric tests**	
	Mean	SD	Statistic	(*p*-value)	Matched pairs t-test (*p*-value)	Wilcoxon sign rank test (*p*-value)
Pre-deal	0.292	1.357	1.000	0.000	0.107	0.005
Post-deal	0.263	1.259				

5.3.3.1 Paired t-test results on research and development intensity

The values of the means presented in Table 14 (0.292; 0.263) showed that the pre- and post-deal research and development intensity (RDi) were both positive with the pre-deal mean being higher.

Data were treated by removing one outlier as illustrated in Figure 10. This was done to prevent the outlier from biasing the results of the tests (specifically, the acquirer in question was Bayer AG pharmaceuticals, whose RDi figures were much higher than all other sample members and was therefore removed from the paired t-test results). However it was found the outcome of the t-test did not change significantly. Figure 11 shows the RDi data after treatment of the outlier. The data become more visible and meaningful as a result.

Figure 10: R&D intensity before treatment

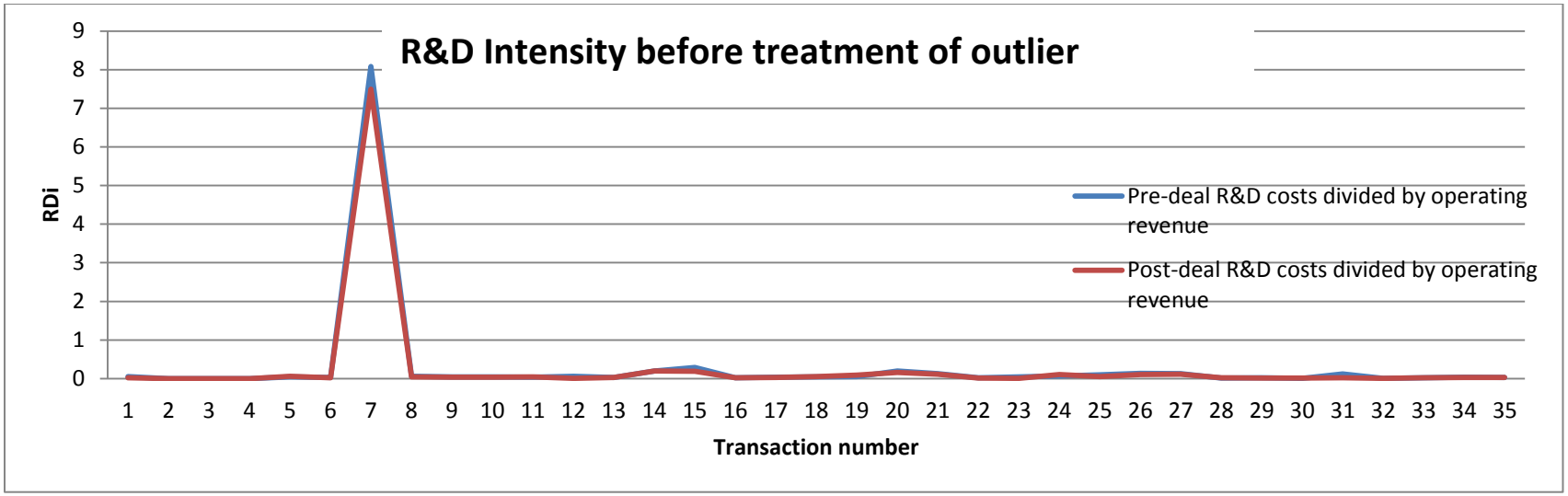
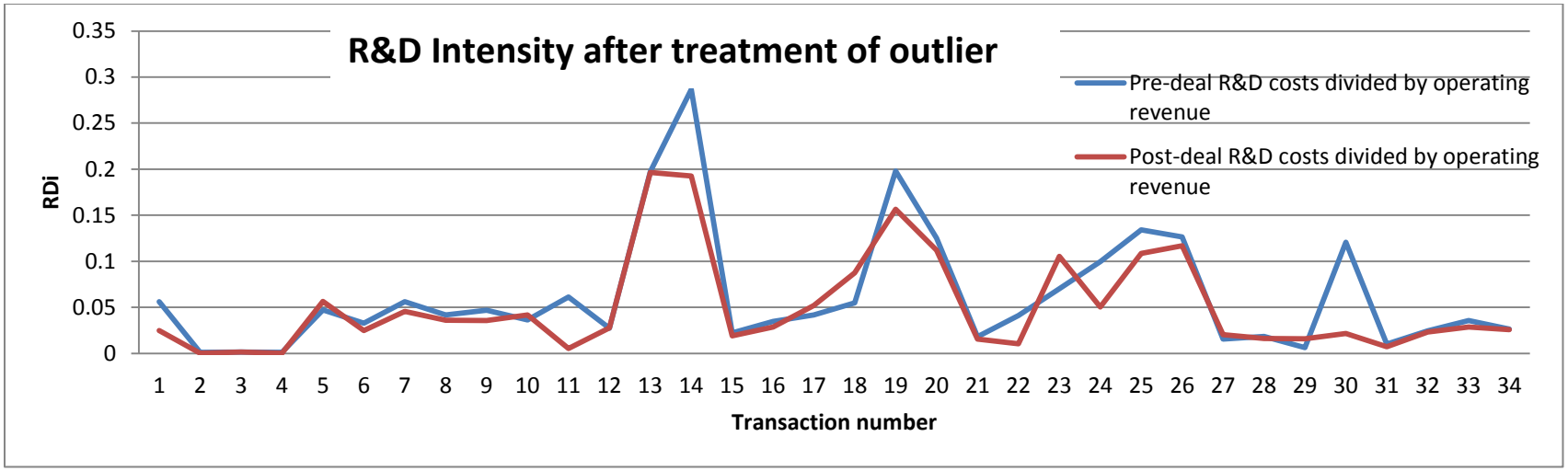


Figure 11: R&D intensity after treatment



5.3.3.2 Hypothesis 3 results

Hypothesis 3a: The null hypothesis stated that the post -deal research and development intensity (RDi_{post}) do not exceed the pre-deal research and development intensity (RDi_{pre}).

The alternate hypothesis stated that post-deal research and development intensity (RDi_{post}) exceeds the pre-deal research and development (RDi_{pre}).

H_0: $RDi_{post} - RDi_{pre} \leq 0$

H_A: $RDi_{post} - RDi_{pre} > 0$

- The results of the matched pair's t-test showed that there was no significant difference between the pre- and post-deal research and development intensity (RDi) (p= 0.107). Hence the M&A event did not significantly affect the RDi.
- The results of the Wilcoxon sign rank test however showed that there was a significant difference between the pre- and post-deal research and development intensity (RDi) (p= 0.005). The null hypothesis cannot be rejected and is retained. Hence the post-deal RDi was significantly less than the pre-deal RDi.
- As explained in Chapter 5.3 for this study, in the event of a contradiction between the parametric and the non-parametric test, the result of the non-parametric test was used.

Hypothesis 3b: The null hypothesis stated that the post-deal research and development intensity (RDi_{post}) is not correlated to the pre-deal (RDi_{pre}).

The alternate hypothesis stated that post-deal research and development intensity (RDi_{post}) and the pre-deal RDi_{pre} are correlated. The duration in scope is one year pre- and post-transaction.

H_0: $RDi_{post}/RDi_{pre} \neq 1$

H_A: $RDi_{post}/RDi_{pre} = 1$

- The results of the paired samples correlations showed that the pre- and post-deal RDi's were significantly positively correlated ($p \approx 0.000$) with the highest achievable positive correlation coefficient of 1.000.
- The null hypothesis is rejected

5.3.4 Research Question 4: Is the sales performance of the acquiring company negatively impacted by the acquisitive activity?

Table 15: Sales performance t-test

SP	Paired Samples Statistics		Paired Samples Correlations		Parametric and Non-parametric tests	
	Mean	SD	Statistic	(*p*-value)	Matched pairs t-test (*p*-value)	Wilcoxon sign rank test (*p*-value)
Pre-deal	0.573	0.285	0.903	0.000	0.903	0.451
Post-deal	0.554	0.265				

5.3.4.1 Paired t-test results on sales performance

The values of the means presented in Table 15 (0.573; 0.554) showed that the pre- and post-deal sales performance (SP) was both positive and that the values are very close to each other. Figure 12 also shows that the sales performance values were close to each other and in some instances there was no noticeable difference.

5.3.4.2 Hypothesis 4 results

Hypothesis 4a: The null hypothesis stated that post-deal sales performance (SP_{post}) does not exceed the pre-deal sales performance (SP_{pre}).

The alternate hypothesis stated that post-deal sales performance (SP_{post}) exceeds the pre-deal sales performance (SP_{pre}).

H_0: $SP_{post} - SP_{pre} \leq 0$

H_A: $SP_{post} - SP_{pre} > 0$

- The results of the matched pair's t-test showed that there is no significant difference between the pre- and post-deal sales performance (SP) (p= 0.903). Hence the M&A event did not significantly affect the SP.
- The results of the Wilcoxon sign rank test confirmed that there was no significant difference between the pre and post-deal sales performance (SP) (p= 0.451).
- The null hypothesis is therefore retained.

Hypothesis 4b: The null hypothesis stated that the post-deal sales performance (SP_{post}) is not correlated to the pre-deal sales performance (SP_{pre}).

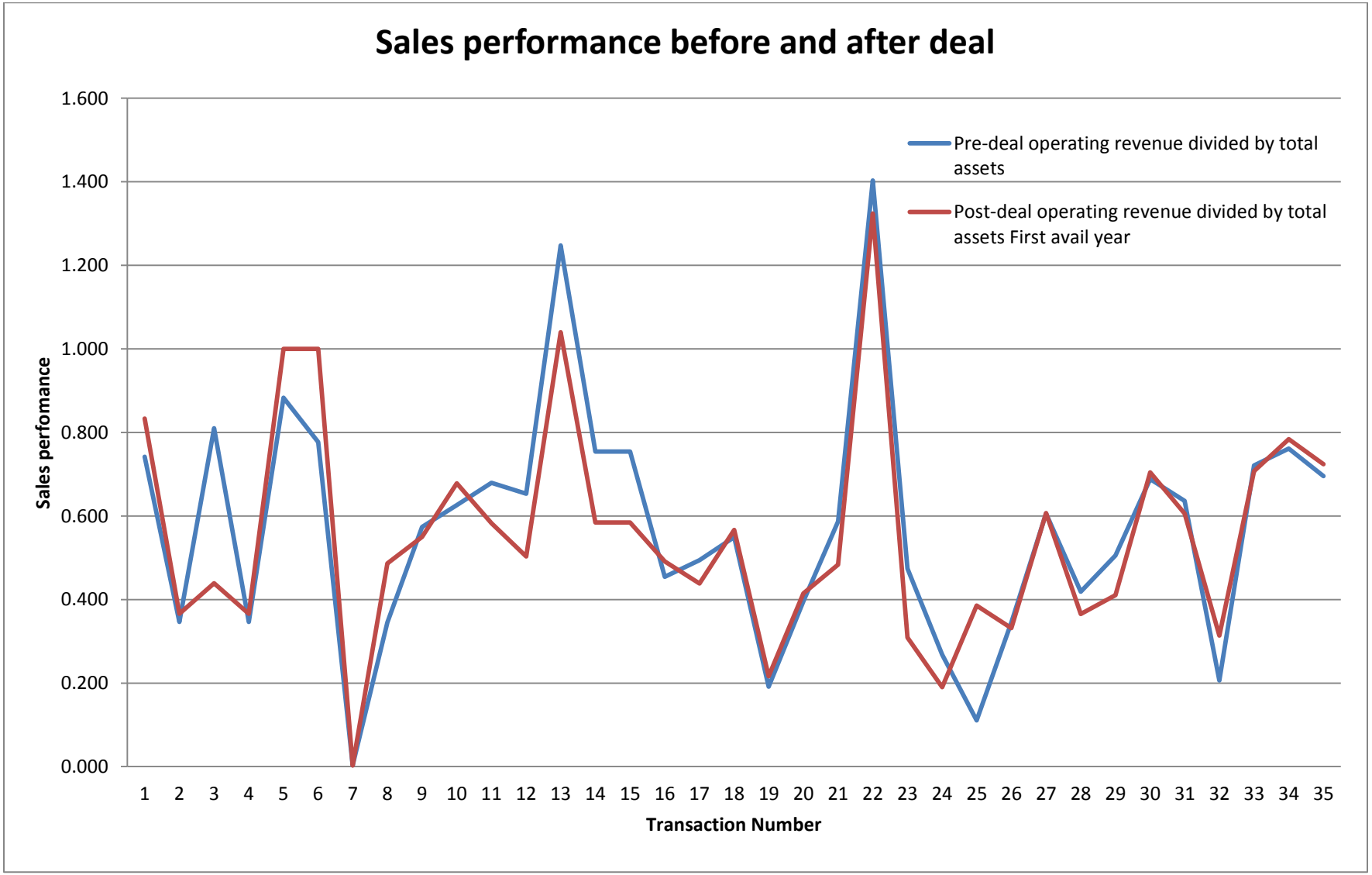
The alternate hypothesis stated that post-deal sales performance (SP_{post}) and the pre-deal sales performance (SP_{pre}) are correlated. The duration in scope is one year pre- and post-transaction.

H_0: $SP_{post}/SP_{pre} \neq 1$

H_A: $SP_{post}/SP_{pre} = 1$

- The results of the paired samples correlations showed that the pre- and post-deal SP's were significantly positively correlated ($p \approx 0.000$) with a very high positive correlation coefficient of 0.903. The null hypothesis is therefore rejected.

Figure 12: Sales performance before and after deal



5.3.5 Research Question 5: Is the cost efficiency of the acquiring company negatively impacted by the acquisitive activity?

Table 16: Cost efficiency t-tests

CE		Paired Samples Statistics		Parametric and Non-parametric tests		
		Mean	SD	Matched pairs t-test (*p*-value)	Friedman test	
Hypothesis 5a	Pre-deal (acquirer)	0.258	0.174	0.416		
	Post-deal	0.277	0.265		N	35
Hypothesis 5b	Pre-deal (target)	0.151	0.343	0.073	Chi-Square	26.800
	Post-deal	0.277	0.265		P value	.000
Hypothesis 5c	Pre–deal (target)	0.151	0.343	0.078		
	Pre-deal (acquirer)	0.258	0.174			

5.3.5.1 Paired t-test results on cost efficiency

The values of the means presented in Table 16 showed that the values of pre- and post-deal cost efficiencies (CEs) were all positive. The mean acquirer's cost efficiencies were closer in value to each other pre-and post-deal (0.258; 0.277) with the post-deal mean cost efficiency value being slightly higher. A larger difference existed between the mean pre-deal target cost efficiencies and the post-deal values (0.151; 0.277) with the post-deal mean being higher. A larger difference also existed between the pre-deal target and acquirer's mean cost efficiencies (0.151; 0.258) with the pre-deal acquirer mean cost efficiencies being higher. Figure 13 also shows pre-deal target values being the lowest and post-deal values as the highest

5.3.5.2 Hypothesis 5 results

Hypothesis 5a: The null hypothesis states that the post-deal cost efficiency (CE_{post}) does not exceed the pre-deal acquirer cost efficiency (CE_{Apre}).

The alternate hypothesis states that the post-deal cost efficiency (CE_{post}) exceeds the pre-deal acquirer cost efficiency (CE_{Apre}).

H_0: $CE_{post} - CE_{Apre} \leq 0$

H_A: $CE_{post} - CE_{Apre} > 0$

- The results of the matched pair's t-test showed that there is no significant difference between the pre- and post-deal acquirer cost efficiency (CE) (p= 0.416).

Hypothesis 5b: The null hypothesis states that the post-deal cost efficiency (CE_{post}) does not exceed the pre-deal target cost efficiency (CE_{Tpre}).

The alternate hypothesis states that the post-deal cost efficiency (CE_{post}) exceeds the pre-deal target cost efficiency (CE_{Tpre}).

H_0: $CE_{post} - CE_{Tpre} \leq 0$

H_A: $CE_{post} - CE_{Tpre} > 0$

- The results of the matched pair's t-test showed that at α=0.05 there is no significant difference between the pre-deal target and post-deal acquirer cost efficiency (CE) (p= 0.073)..

Hypothesis 5c: The null hypothesis stated that the relative pre-deal cost efficiency (target relative to acquirer) (CE_{Tpre} / CE_{Tpost}) is not the same.

The alternate hypothesis stated that the relative pre-deal cost efficiency (target relative to acquirer) (CE_{Tpre} / CE_{Tpost}) is the same. The duration in scope is one year pre- and post-transaction.

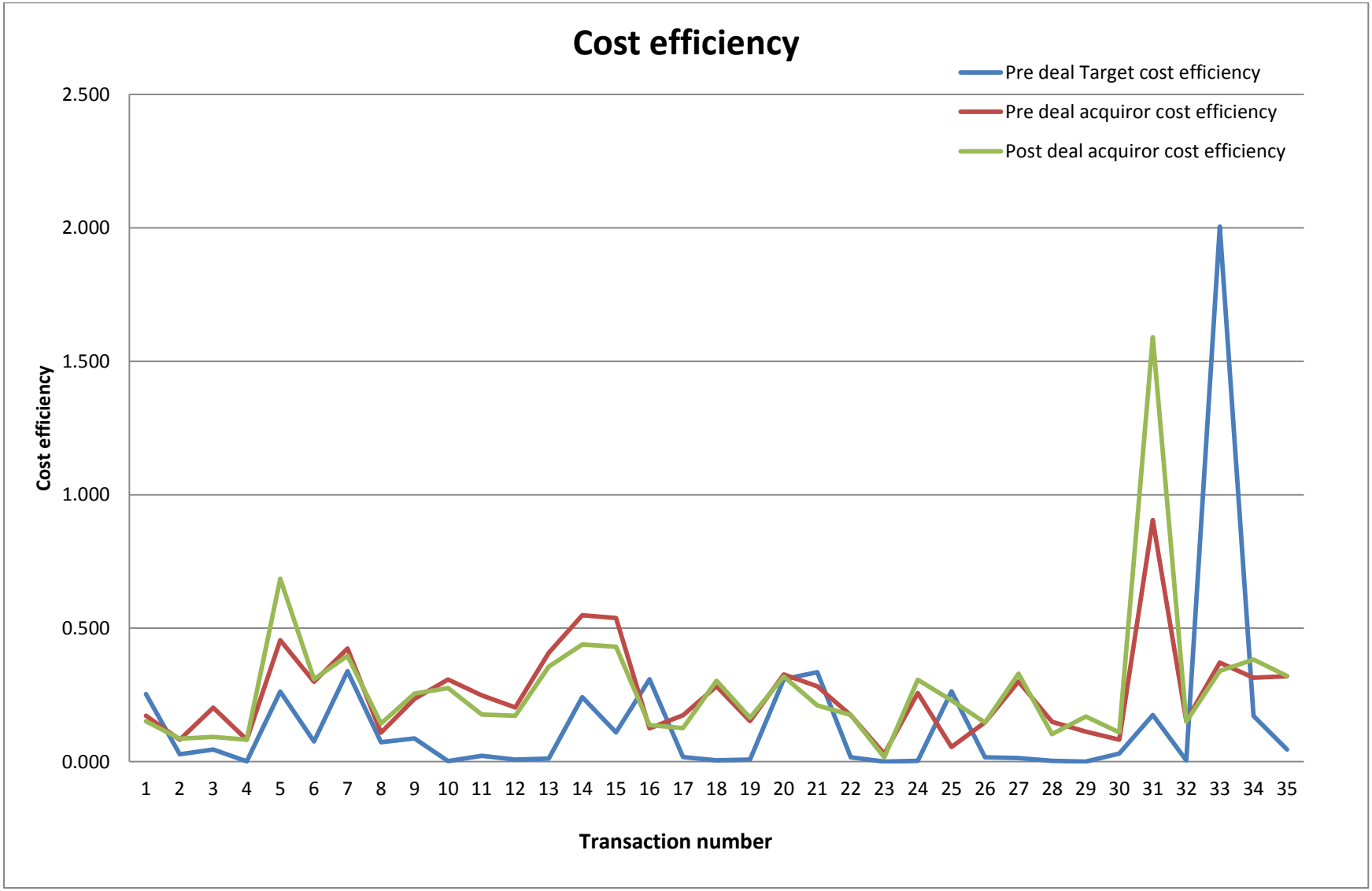
H_0: $CE_{Tpre}/CE_{Apre} \neq 1$

H_A: $CE_{Tpre}/CE_{Apre} = 1$

- The results of the matched pair's t-test showed that at α=0.05 there is no significant difference between the pre-deal target and the pre-deal acquirer cost efficiency (CE) (p= 0.078).

In contrast, a non-parametric Friedman test of differences among repeated measures was conducted and rendered a Chi-square value of 26.800 which was significant at p<0.05. This showed that the differences in the pre- and post-deal cost efficiencies were in fact statistically significant. Null hypotheses 5a, 5b and 5c are therefore retained.

Figure 13: Cost efficiency



This concludes the presentation of results from this research study that covered all the research questions posed in Chapter 3. Chapter 6 provides a discussion of the results obtained and presented in Chapter 5 in light of the literature base covered in Chapter 2.

CHAPTER 6: DISCUSSION

6.1 Introduction

In Chapter 1, the main motivation of this research study was explained as finding answers to a question that asked if the rising trend in mergers and acquisitions, which may have been triggered in response to a lag in innovation, presented a self-defeating strategy that has only made the pharmaceutical and biotechnological industries outcomes worse? (Comanor & Scherer, 2013)

While the question on motives for M&A was comprehensively discussed in literature that was reviewed, it was discovered that less has been said about the impact this activity has had on innovation driven-businesses such as pharmaceutical and biotechnological businesses (LaMattina, 2011). Also more specifically, there has been relatively little research on the effect of M&A activity on the innovation output of a company (Sevilir & Tian, 2012).

Chapter 2 further built a case for the need for this research study by discussing the importance of innovation, the phenomenon of the “innovation deficit”, and provided some of the contributors that have led to the occurrence of this phenomenon. Chapter 2 also emphasised that the current views concerning the impact of mergers and acquisitions on innovation driven business are inconclusive and at times contradictory in existing literature. This presented an opportunity to contribute to consensus on the topic.

From the above motivation, the researcher laid out the research aims in Chapter 1.3. In summary, these aims sought to assess whether or not merger and acquisition activity in innovation driven companies, as proxied by the pharmaceutical and biotechnological industries, has been successful from a shareholder perspective. Second, the research aimed to better understand the impact of merger and acquisition activity on the operating performance of the acquiring company.

Third, the research aimed to gain a more profound understanding of the impact of merger and acquisition activity on specific acquirer, target, and combined entity (acquirer post-deal) specific attributes, namely research and development intensity (innovation), sales performance, and cost efficiency.

These aims generated five overarching research questions that were described in detail in Chapter 3, for which tests were performed and results were collated in Chapter 5. The following sections present a discussion of the results for each research question by referring to the literature base covered in Chapter 2. The results were mainly concurrent with literature but there were some new findings that contradicted the existing literature.

Chapter 6 concludes with a summary of the findings made in this research and how the study has contributed to the existing body of knowledge on the topic of M&As, specifically the contribution to the understanding of the impact of M&A's on innovation-driven businesses as proxied by pharmaceutical and biotechnological companies.

6.2 Discussion of sample obtained

The 35 transactions selected for this research are described in more detail in Appendix 2. As shown in Appendix 2, a majority of the companies sampled qualified as big pharma companies and are listed in the top 25 global pharma companies by global sales shown in Table 1 Chapter 2.5.4 (PMLive, 2015).

Both acquirer and target were either pharmaceutical or biotechnological companies or both. The initial filter in the Zephyr database was set to pick only from these two sectors however it was not possible to further to be specify what the core focus of each acquirer or target was (i.e. as conventional pharmaceuticals or just biotechnological or both). Due to the two industry similarities as presented in Chapter 2.1.1, this did not present any problems for the analysis.

Table 6 in Chapter 5.1.1 and Appendix 3 detailed the sample descriptive statistics. It was noted that several data attributes were highly dispersed substantially skewed hence this justified the use on non-parametric tests in addition to the parametric tests which are prone to break down when data is substantially skewed (Wegner, 2012).

Acquiring companies from China, Great Britain and the United States dominated the sample (20%, 17%, and 14% representation respectively) (Figure 4 and Table 7, Chapter 5.1.2). Targets were mainly from China and Great Britain (23% and 15%). Of interest, the only African company to appear was the South African pharmaceutical company Aspen with three transactions in which it was the acquirer over the period selected. Regionally, European companies dominated the sample as acquirers and targets (48.5% and 37.3% respectively)

while Asian companies (mostly Chinese) (28.6% and 31.5% respectively) (Figure 5 and Table 8, Chapter 5.1.2).

While the majority of companies in the sample may have been European, the most represented stock exchange listing was American (NYSE 42.9%, and NASDAQ 5.7%). This alludes to a better performing pharmaceutical market in the United States. Asian stock exchange listings followed closely dominated by the Shanghai (11.4%) and Shenzhen (8.6%) stock exchanges which are both Chinese (Figure 6, Chapter 5.1.3). This is a possible signifier of China's emergence as a major player in the innovation industries such as pharma and biotech.

The majority of the transactions were acquisitions, ranging from a 50% to a 100% stake in the target company. 60% of the transactions were 100% acquisitions of the targets. However in 14% of the transactions the acquired stake was not mentioned. This made it easier for the post deal data to be gathered as essentially the acquirer retained its name and assimilated the target into its financial data.

6.3 Research Question 1: Does the merger and acquisition activity negatively impact acquirer shareholder value?

In Chapter 2.6.1, shareholder value was defined in two main ways: in terms of stock price performance and also in terms of the stock returns over a set period of time (Papadakis & Thanos, 2010). Research Question 1 sought to answer the question: "Does the merger and acquisition activity negatively impact acquirer shareholder value?" The answer to this question was found in two main ways.

6.3.1 Stock Price Performance

First, the data on stock price performance over the five day window was plotted graphically and in addition t-tests were performed. Figure 8 in Chapter 5.3.1.1 showed the acquirer stock price performance at four specific time points. These were namely at one day prior to announcement of the deal; one day after the announcement of the deal; two days after the announcement of the deal; and three days after the announcement of the deal.

A finding from this study was that the majority of the acquiring company stock prices showed an upward trend that continued to rise from one day prior to announcement of the deal up until three days after announcement of the deal.

The stock price paired sample statistics presented in Table 10, Chapter 5.3.1.1 also supported the analysis of a rising trend in stock price throughout the event window, with a mean stock price that showed an increase in value on each day of the five day event window from 309.084 ZAR one day prior to announcement to 346.922 ZAR three days after announcement. This represented an average 12% increase in the stock price over the period under examination.

The rise in stock price values of the acquirer over the event window in itself was an unexpected occurrence as empirical studies that have examined the reaction of capital markets to M&A announcements found that the value-weighted average deal actually lowered the acquirer's stock price between one and three percent (Dobbs et al., 2010). Hence rising acquirer stock prices post-deal could be considered as an industry specific occurrence.

The explanation for the contradicting occurrence could be that in the pharmaceutical and biotechnological sectors, which are currently riddled by waning product pipelines and patent expiries, the markets generally have positive views towards acquirers that are growing through acquisitions. Acquisitions in these sectors would typically mean pipeline protection and injections of new intellectual property which would ultimately help secure future cash flows as argued by Kirchhoff & Schiereck (2011). Hence there is a tendency to reward such a growth strategy through active investment in the acquirer when the deals are announced.

Rising stock prices during an M&A event window is often an occurrence associated with the target and not the acquirer. As discussed in the literature, empirical evidence concerning stock price values revealed that the stock value of the target company shareholders increases significantly at about 30% over market returns immediately following an acquisition announcement (Bartlett et al., 2014).

6.3.2 Cumulative Abnormal Average Returns

Second, to answer the research question on the impact on the shareholder value, the cumulated abnormal average returns were calculated and bootstrapped t-tests were performed as explained in Chapter 4.6.2 to enable statistical inferences to be made.

The results of the bootstrapped t-tests on the average cumulative abnormal returns (CAARs) (Table 11, Chapter 5.3.1.2) showed that the CAARs during the event window [-1; +3], whilst positive, was statistically insignificant (p=0.058). Furthermore in addition to the parametric tests, a non-parametric test (Wilcoxon signed ranks test, see Table 12, Chapter 5.3.1.2) was also performed on the $CAAR_{ST}$ for Day 0 to 4 and as a confirmatory analysis also found the CAAR insignificant (p=0.109).This finding confirmed the view of some the more recent studies which concluded that shareholders do not receive higher than normal gains from holding stock in acquiring companies that grow through acquisition (Ahern, 2014).

The positive CAAR values obtained in this research study are also in agreement with most of the studies examined by Bruner (2004) in which post-merger combined returns (acquirer and target) were also positive, hence further entrenching Bruner's view that M&As do create value for the shareholders in the combined company.

However, it was observed that the positive CAAR obtained in this study contradicted the results from a recent analysis done by Bartlett et al. (2014) who conducted a study on the stock returns to shareholders of acquiring companies and found that 40.7% reported negative returns. A majority of older studies conducted over a decade ago also concluded that following acquisitive activity, the shareholder value of the acquiring companies is slightly negative (Lyroudi et al., 1999; Eckbo & Thorburn, 2000; Kohers & Kohers, 2000).

The observation of positive cumulative abnormal returns in this study could be considered to be an industry specific occurrence. As explained in Chapter 2.5.4, the science in the pharmaceutical and biotechnological space is moving away from the traditional small molecule pharmaceuticals towards the more effective and lucrative biological products. It was revealed in Chapter 2.5.4 that according to Malik (2009) the world's leading pharmaceutical companies, commonly referred to as Big Pharma, are increasingly investing in biotech companies in order to increase their product pipelines.

Investors can therefore be expected to perceive this rising trend of M&As favourably as biological products tend to be more lucrative than the traditional pharmaceutical products. As markets tend to be driven by sentiment it appears that this favourable perception is rewarded by positive abnormal returns. This positive stock market reaction, as explained in the above subchapter 6.2.1 is supported by the argument raised by Kirchhoff & Schiereck (2011) that acquisitions in the pharmaceutical and biotechnological sectors would typically mean pipeline protection and injections of new intellectual property which would ultimately help secure future cash flows.

Although it was noted that high positive values of $CAAR_{ST}$ (>8%) were witnessed in this study (Figure 9, Chapter 5.3.1), the other reason why they could not be considered as significantly positive was because of the use of only a small set of 2, 3, and 4 observations to create a sample of 500 observations for the bootstrap estimates.

A question may arise as to whether or not the analysis of stock price performance or stock returns over such a short period of time as a five day window could be a reliable basis for commentary on future company performance. In this regard, Dobbs et al. (2010) summarized evidence from research done by McKinsey which found that post announcement of acquisitions the initial market reactions are persistent on average and indicate future performance quite accurately.

In conclusion, this study found that the merger and acquisition activity had a positive but statistically insignificant impact on the acquirer's shareholder value. This result was mainly shown by the outcome of the bootstrapped t-tests on the short term CAARs which turned out as statistically insignificant (p=0.058) and further supported by the outcome of the Wilcoxon signed ranks test performed on the short term CAARs and which also found the CAARs insignificant (p=0.109). The null hypothesis was retained.

6.4 Research Question 2: Is the operating financial performance of the acquiring company negatively impacted following the acquisitive activity?

In this research study, the operating financial performance was defined and measured in terms of abnormal cash flow return on assets which is the most widely used measure as justified in Chapter's 2.7.2 and 4.6.3 (Papadakis & Thanos, 2010). Research Question 2 sought to answer the question "is the operating financial performance of the acquiring company negatively impacted following the acquisitive activity?" The answer to this question was found by initially calculating the abnormal cash flow return on assets (ACRAs) one year pre- and post-deal using the formulas described in Equations 7 and 8 (Chapter's 2.7.2 and 4.6.3) and then a barrage of tests were performed to validate the results.

Paired sample t-tests were conducted to help the researcher describe the mean pre and post deal ACRAs obtained. Hypothesis 2a and 2b were then tested by conducting the Matched pairs t-test and Wilcoxon signed ranks test for hypothesis 2a and the Paired samples

correlations for hypothesis 2b respectively (Chapter 5.3.2.2). Inferences in response to Research Question 2 were drawn from the results of all of these tests.

The values of the means presented in Table 13, Chapter 5.3.2 (-0.0014; -0.0127) showed that the pre- and post-deal abnormal cash flow return on assets (ACRA) were both negative and the values were both close to zero. The occurrence of negative pre-deal ACRAs could be considered as a logical instigator for the deals to have occurred in the first place as acquirers would have been seeking ways in which the financial fortunes of the company could be turned around. However, the post-deal ACRAs were slightly more negative than the pre-deal ACRA alluding to even poorer financial performance of the acquirers post deal. This outcome further validates the findings of Krug (2009) who provided evidence that suggested that a large portion of M&As, approximately half or more, fail to achieve their intended outcome.

The results of the matched pair's t-test showed that there was no significant difference between the pre- and post-deal abnormal cash flow return on assets (ACRA) (p= 0.434). Hence the M&A event did not significantly affect the ACRAs. The results of the Wilcoxon sign rank test further confirmed that there is no significant difference between the pre- and post-deal abnormal cash flow return on assets (ACRA) (p= 0.756). This once again confirmed that the M&A event did not significantly affect the ACRAs.

This study therefore showed that the one year post acquisition abnormal cash flow return on assets showed a negative but insignificant decline, which translates to a negative but insignificant impact on the acquiring company's (combined entity) operating financial performance. These results were consistent with a study conducted by Krug (2009) who also reported a negative though insignificant effect on financial performance post the M&A transaction.

However these results were contrary to Smit and Ward's (2007) study which reported that the average post-acquisition acquiring companies' cash-flow return on tangible assets showed positive but also insignificant improvement. The difference between this research study and the Smit and Ward (2007) study is that the post-event window was one year in this study and two years in the Smit and Ward study. This may indicate that post one year from the acquisition the operating financial performance tends to improve even though the values are still insignificant at two years post the event, and this is sufficient motivation to conduct the study over a longer post event window. The result obtained in this research study is also

contrary to other older studies conducted by Healy et al. (1992) and Ghosh (2002) which reported significant positive performance post the deal.

Of interest to note is that all the other studies reported in the preceding paragraph were not industry specific. It can therefore be plausibly concluded that the findings on operating financial performance in this study may be more of an industry-specific occurrence. Therefore managers and shareholders of pharmaceutical or biotechnological businesses need to be aware that the operating financial performance of the business in the short term of one year post an M&A transaction may be negatively affected but to an insignificant extent. These short term negative effects may in part be explained by the post-merger integration activities which in pharma and biotech may involve an interruption of the innovation cycle as explained in Chapter 2.1.

The results of the paired samples' correlations showed that the pre- and post-deal acquirer ACRAs were significantly positively correlated ($p \approx 0.000$) with a high correlation coefficient of 0.729. Hence as the ACRAs tended to increase or decline pre-deal, the same tendency was similar post-deal. This leads to the conclusion that the financial performance of the acquirer tends to follow the same trend in the short term of up to one year post-deal as it did pre-deal.

In conclusion, this research study found that one year post the acquisitive activity, the operating financial performance of the acquiring company as measured by the abnormal cash flow return on assets was not significantly impacted though the values were negative. Null hypothesis 2a is therefore retained. This research study also found that in fact the operating financial performance in the period of one year post the acquisitive activity tended to merely follow the pre-deal trend. Null hypothesis 2b is therefore rejected.

6.5 Research Question 3: Is the overall research and development intensity of the acquiring company negatively impacted following the acquisitive activity?

In this research study, research and development intensity was defined and measured in terms of the ratio of the R&D costs to the sales based on the validated assumption that on average, higher investments or expenditures in R&D are rewarded by more innovations and ultimately by higher company performance (Kirchhoff & Schiereck, 2011). Research

Question 3 sought to answer the question “is the overall research and development intensity of the acquiring company negatively impacted following the acquisitive activity?”

The answer to this question was found by initially calculating the one year pre and post-deal research and development intensities (RDi) using Equation 9 as described in Chapter 4.6.4.1. A series of tests were then conducted to validate the results. Paired sample t-tests were conducted to help the researcher describe the mean pre- and post-deal RDis obtained. Hypothesis 3a and 3b were then tested by conducting the Matched pairs t-test and Wilcoxon signed ranks test for hypothesis 3a and the Paired samples correlations for hypothesis 3b respectively (Chapter 5.3.3.2). Inferences in response to Research Question 3 were drawn from the results of all of these tests.

The values of the means presented in Table 14, Chapter 5.3.3 (0.292; 0.263) showed that the pre- and post-deal RDis were positive with the pre-deal mean being higher than the post-deal mean. This result alluded to a decline in research and development intensity post deal which was further tested through a matched pair’s t-test.

The results of the Matched pair’s t-test showed that there was no significant difference between the pre- and post-deal research and development intensity (RDi) (p= 0.107). Hence statistically this meant that according to the parametric tests the M&A event did not significantly affect the RDi.

The results of the Wilcoxon sign rank test however contradicted the outcome of the Matched pair’s t-test and showed that in fact there was a significant difference between the pre- and post-deal research and development intensity (RDi) (p= 0.005). Hence the post-deal RDi was significantly less than the pre-deal RDi. In terms of Research Question 3, this result meant that according to non-parametric tests, R&D intensity declined following the acquisitive activity. As explained in Chapter 5.3, in the event of a contradiction between the parametric and the non-parametric tests in this research study, the results of the non-parametric test would be used for drawing inferences.

These results are aligned to the work done by Seru (2013) who concluded that post the acquisition the acquiring company innovates less with empirical data that showed that the larger companies conducted less amounts of R&D per unit of the company size. The results are also aligned to the assertion by Getz (2014) who argued that M&A activity actually has a negative impact on R&D productivity. Getz (2014) explained that the result of this declined

R&D productivity is that pharmaceutical or biotechnological breakthroughs take significantly more time to develop.

The results however contradicted the work of Phillips and Zhdanov (2013) who argued that when a market is actively acquisitive this has an overall positive impact on all companies in an industry regardless of size and all are motivated to innovate and conduct R&D. However, Phillips and Zhdanov's assertion was based on the assumption that innovation is being led particularly by the smaller companies in an industry. The authors argued that instead of conducting R&D in-house, larger companies can optimally outsource R&D investment to smaller companies and then simply use their larger cash reserves to acquire those that are successful at innovating and fit the strategic goals of the large company (Phillips & Zhdanov, 2013).

According to Phillips and Zhdanov (2013), smaller companies that successfully innovate become more attractive as acquisition targets and are therefore motivated to continue to spend on R&D. The end result would be an overall rise in R&D productivity.

The difference between this research study and the argument raised by Phillips and Zhdanov is that Phillips and Zhdanov's assertion is based on an indirect measurement of overall R&D intensity/productivity with the target companies being the main drivers of R&D, while this research study focused on the acquirer being the direct driver of overall R&D intensity/productivity and measured the direct overall R&D intensity/productivity of the acquirer before and after the M&A transaction.

The significance of the result of this study to managers and shareholders of acquiring pharmaceutical and biotechnological companies is that they need to be become increasingly aware that they are potentially buying growth at the expense of the company's and the overall industry's R&D productivity. It therefore becomes the responsibility of the acquirers to ensure that as they outsource R&D from smaller companies, they also need to motivate these companies to continue to innovate so that product pipelines can continue to grow.

The decline in R&D intensity post-acquisition itself can be explained by rapid cost-cutting undertaken by managers of the combined company post the acquisition. As explained in Chapter 2.5.1, at present the estimated average cost involved in the drug discovery process for each new drug ranges from $800 million to $1.8 billion (United States dollars) over a 12 to 15 year time period (Bharath et al., 2011). Considering this enormous cost, it is logical for acquiring companies to undergo a portfolio optimisation process in which decisions are made

to cut certain products under development. This decision would be aligned to the company's overall strategy.

The finding in this research regarding a decline in R&D intensity also gives weight to the phenomena of the "innovation deficit" or "productivity gap" raised in Chapter 2.3. A decrease in R&D intensity can be expected to be accompanied by an increase in the attrition rate with regard to new product development, which according to Bharath et al. (2011), contributes to an innovation deficit. This brings with it economic and public health concerns as raised in Chapter 1.2.

As mentioned in Chapter 2.6.3, it is recognised that there are limitations of analysing R&D and patents as surrogates for innovation and R&D spend or patents do not necessarily equate to output in terms of marketed products (Teece, 2010). That being said, there is value in using R&D spend as a proxy for innovation output as often companies with a high R&D spend tend to have a higher innovation output (Tidd, 2012).

From Chapter 2.6.3 it was revealed that Tidd (2012) conducted a study of the relationship between innovation and performance that examined 40 companies, representing five different sectors. Analysis of the data from the Tidd study confirmed that expenditure on R&D, as a proportion of sales, has a significant positive effect not only on value added due to a positive market reaction to this metric, but also on the number of new product announcements made as shown by direct positive correlations between the metric and new product announcements (Tidd, 2012). This suggests that R&D contributes both to increasing the number of new products introduced as well as the organisations' value.

The results of the paired samples correlations showed that the pre- and post-deal RDi's are significantly positively correlated ($p \approx 0.000$) with the highest achievable positive correlation coefficient of 1.000. Hence as RDi tended to increase or decline pre-deal, the same tendency was similar post-deal. This leads to the conclusion that the acquirer's R&D intensity/productivity followed the same or similar trends before and after the transaction. Hence, in terms of Research Question 3 this means that an acquirer that had been decreasing R&D (decreased R&D intensity) continued to do so after the transaction.

In conclusion, based on the non-parametric test specifically the Wilcoxon sign rank test, this research study found that one year post acquisition the research and development intensity of acquiring companies significantly declines from the pre-deal values. Furthermore, the pre- and post-deal acquirer research and development intensities are significantly correlated

suggesting the M&A event is an accelerator of the acquirers declining research and development intensity. Therefore null hypotheses 3a is retained and 3b is rejected.

6.6 Research Question 4: Is the sales performance of the acquiring company negatively impacted by the acquisitive activity?

In this research study, sales performance was defined and measured in terms of the ratio of the sales or operating revenue to the total assets and the higher the value of this ratio, the better the sales performance of the company (Kirchhoff & Schiereck, 2011). Research Question 4 sought to answer the question "is the sales performance of the acquiring company negatively impacted following the acquisitive activity?"

The answer to this question was found by initially calculating the one year pre and post-deal sales performance (SP) using Equation 10 as described in Chapter 4.6.4.2. A series of tests were then conducted to validate the results. Paired sample t-tests were conducted to help the researcher describe the mean pre- and post-deal SPs obtained. Hypothesis 4a and 4b were then tested by conducting the Matched pairs t-test and Wilcoxon signed ranks test for hypothesis 4a and the Paired samples correlations for hypothesis 4b respectively (Chapter 5.3.4.2). Inferences in response to Research Question 4 were drawn from the results of all of these tests.

The values of the means presented in Table 15, Chapter 5.3.4 (0.573; 0.554) showed that the pre- and post-deal sales performances (SP) were both positive indicating the operating revenues were generally higher than the total assets of the company both pre- and post-acquisition. The mean values were also very close to each other with the post-deal mean value being slightly less than the pre-deal value.

The results of the matched pair's t-test showed that there was no significant difference between the pre- and post-deal sales performance (SP) (p= 0.903). Hence the M&A event did not significantly affect the SP. The results of the Wilcoxon sign rank test confirmed that there was no significant difference between the pre- and post-deal sales performance (SP) (p= 0.451).

This study therefore showed that one year after the deal, there was no change in the sales performance of the acquirer. This confirms the research done by Sheen (2014) who found

that, when investigating the effect of M&A on product revenues/sales as assessed by market share changes, there was no overall significant change in market share for a product after the M&A transaction. Sheen (2014) also found that the combined acquirer and target market share only increased when companies stated sales growth as a goal in the merger announcement.

The result are however in contradiction with the non-industry-specific study conducted by Sorescu et al. (2007) who found that there was a positive influence on sales performance as a result of the M&A.

No improvement in the sales performance may indicate that the M&A transaction did not live up to the anticipated outcome. This is possible, as according to Krug (2009) some evidence suggests that a large portion of M&As, approximately half or more, fail to achieve their intended outcome.

The stagnation in sales performance may be an indication that the complete effects of the M&A transaction have not been realised due to post-merger integration activities. The lack of significant change in the sales performance may also be an indication that the post-event window selected was may have been too short to reveal any real impact of the M&A on this metric.

The results of the paired samples correlations showed that the pre- and post-deal sales performance were significantly positively correlated ($p \approx 0.000$) with a very high positive correlation coefficient of 0.903. Hence as sales performance tended to increase or decline pre-deal, the same tendency was similar post-deal.

In conclusion, this research study found that one year post acquisition the sales performance of acquiring companies is not significantly impacted. Furthermore, the pre- and post-deal acquirer sales performances are significantly positively correlated suggesting that sales performance merely followed the same trends post-deal as it had done pre-deal. Null hypotheses 4a is retained while 4b is rejected.

6.7 Research Question 5: Is the cost efficiency of the acquiring company negatively impacted by the acquisitive activity?

In this research study, cost efficiency was defined and measured in terms of the ratio of the operating costs to the total assets (Kirchhoff & Schiereck, 2011). An important note is that the lower the value of this ratio (or the more it tends towards zero) then the more cost efficient company becomes. Research Question 5 sought to answer the question "is the cost efficiency of the acquiring company negatively impacted following the acquisitive activity?"

The answer to this question was found by initially calculating the one year pre-deal cost efficiencies (CEs) of the target and acquirer using Equation 11b and 12 and the one year post-deal deal CEs of the acquirer (combined entity) using Equation 11a as described in Chapter 4.6.4.3. A series of tests were then conducted to validate the results. Paired sample t-tests were conducted to help the researcher describe the mean pre- and post-deal CEs obtained.

Hypothesis 5a, 5b, and 5c were then tested by conducting the matched pair's t-test and the Friedman test (Chapter 5.3.5). Inferences in response to Research Question 4 were drawn from the results of all of these tests.

The values of the means presented in Table 16, Chapter 5.3.5 showed that the pre- and post-deal cost efficiencies (CEs) were all positive; meaning on average the companies had higher operational costs compared to the total assets. The mean acquirer's cost efficiencies were closer in value to each other pre-and post-deal (0.258; 0.277) with the post-deal (combined entity) mean CE being slightly higher. The interpretation is that post-deal the acquirer showed signs of being less cost-efficient in its operation's than it had been pre-deal.

A larger difference existed between the mean pre-deal target cost efficiencies and the post-deal (combined entity) values (0.151; 0.277) with the post-deal mean being higher. This meant on average the target company pre the deal was more cost efficient than the combined company after the deal. A larger difference also existed between the pre-deal target's and acquirer's mean cost efficiencies (0.151; 0.258) with the pre-deal acquirer's mean cost efficiency value being higher. This meant that the acquirers were on average less cost efficient than the targets to begin with.

The results of an initial matched pair's t-test comparing acquirer CEs pre- and post-deal showed that there was no significant difference between the pre- and post-deal acquirer's cost efficiency (CE) (p= 0.416). The results of a second matched pair's t-test comparing target and post deal acquirer further showed that there was no significant difference between the pre-deal target and post-deal acquirer's (combined company) cost efficiency (CE) (p= 0.073). The results of a final matched pair's t-test comparing pre-deal target and acquirer CEs (relative cost efficiency) showed that there was no significant difference between the pre-deal target and the pre-deal acquirer cost efficiency (CE) (p= 0.078).

In contrast, a non-parametric Friedman test of differences among repeated measures was conducted and rendered a Chi-square value of 26.800 which was significant at p<0.05. This showed that the differences between the pre- and post-deal cost efficiencies were in fact statistically significant. Once again as explained in Chapter 5.3 for this research study in the event of a contradiction between the parametric and the non-parametric test, the results of the non-parametric test were used for drawing inferences. The results of the Friedman test alludes to a decline in the acquiring company cost efficiency one year post the deal and this may signal a failure to achieve the relevant cost synergies that may have been anticipated by the acquisition.

As mentioned in Chapter 2, in the innovation space, current views argue that the main drivers for M&As are as a tool to glide over escalating research and development (R&D) costs, as well as patent expiries, and waning product pipelines which affect growth (Kirchhoff & Schiereck, 2011). Therefore it would make sense to conclude that declining cost efficiencies would be a negative outcome of the transaction for the acquiring companies.

Lastly, this study also showed that there was a significant difference between the pre-deal target's and acquirer's cost efficiencies. Relative to the targets, the acquirers had significantly higher values for cost efficiencies to begin with. The interpretation however is that the acquirers were in fact less cost efficient than the targets to begin with. The acquirers may have anticipated to make technology gains from the acquisition which would have positively impacted cost efficiency as motivated by Bena and Li (2014), but perhaps these technology gains were not fully realised.

As explained in Chapter 2, the relative cost efficiency of target to acquirer is important to consider in that if the target is significantly less cost efficient than the acquirer, the market sentiment tends to be more positive towards the transaction and the market reaction tends to be better than a scenario where the acquirer is more cost efficient than the target (Kirchhoff

& Schiereck (2011). Hence within the context of this research study, this finding concerning relative cost efficiencies can help explain the occurrence of insignificant abnormal returns as found for Research Question 1. Based on the nearly zero post-deal returns found in this research study, it can be assumed that the market may have established that the targets were in fact significantly more cost efficient than the acquirer which is the opposite of what is required for the transaction to be successfully evaluated by the market.

In conclusion, based on the results of the Friedman test, this research study found that there was a significant decline in the cost efficiency of the acquirer one year after the M&A event (i.e. the combined company was less cost efficient than the pre-deal acquiring company had been). In addition this research study found that compared to the target's cost efficiencies before the acquisition, the combined company was also significantly less cost efficient. Lastly, this research study also found that pre-deal the acquirers were relatively less cost efficient than the targets. Hence based on the Friedman test results, null hypotheses 5a, 5b and 5c are therefore retained

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6.8 Summary of findings

Table 17: Summary of findings

Research Question	Summary of Hypotheses tested and outcome	Conclusion	Commentary (findings and themes)
1 Does the merger and acquisition activity negatively impact acquirer shareholder value?	*Hypothesis 1* H_0: $CAAR_{ST}$ =0 H_A: $CAAR_{ST} \neq 0$ ➢ Retain H_0	- The merger and acquisition activity had a positive but statistically insignificant impact on the acquirer's shareholder value	- Insignificant abnormal returns post an M&A event are an expected occurrence from the majority of the literature. - Positive abnormal returns were an unexpected occurrence as the majority of literature point towards negative returns. This may allude to industry specific dynamics and add to the body of knowledge on the impact of M&A on shareholder returns.
2 Is the operating financial performance of the acquiring company negatively impacted following the acquisitive activity?	*Hypothesis 2* 2a: H_0: $ACRA_{post} - ACRA_{pre} \leq 0$ H_A: $ACRA_{post} - ACRA_{pre} > 0$ ➢ Retain H_0 2b: H_0: $ACRA_{post}/ACRA_{pre} \neq 1$ H_A: $ACRA_{post}/ACRA_{pre} = 1$ ➢ Reject H_0	- One year post the acquisitive activity, the operating financial performance of the acquiring company was not significantly impacted though the values were negative.	- The operating financial performance in the period of one year post the acquisitive activity tended to merely follow the pre-deal trend as shown by the high correlation coefficient. - The negative ACRA values were consistent with some literature however contradicted the majority of literature in which positive ACRAs were. - These findings may signify an industry specific occurrence and add to the body of knowledge on the impact of M&A on company operating financial performance.
3 Is the overall research and development intensity of the acquiring company negatively impacted following the acquisitive activity?	*Hypothesis 3* 3a: H_0: $RDi_{post} - RDi_{pre} \leq 0$ H_A: $RDi_{post} - RDi_{pre} > 0$ ➢ Retain H_0	- One year post the acquisition the research and development intensity of the acquiring companies significantly declined from the pre-deal values.	- This finding gives weight to the innovation deficit argument raised in the literature. - The M&A event may have been an accelerator of the acquirer's already declining research and development intensity based on the high correlation

Research Question	Summary of Hypotheses tested and outcome	Conclusion	Commentary (findings and themes)
	3b: H_0: $RDi_{post}/RDi_{pre} \neq 1$ H_A: $RDi_{post}/RDi_{pre} = 1$ ➢ Reject H_0		between pre- and post-deal R&D intensities.
4 Is the sales performance of the acquiring company negatively impacted by the acquisitive activity?	*Hypothesis 4* 4a: H_0: $SP_{post} - SP_{pre} \leq 0$ H_A: $SP_{post} - SP_{pre} > 0$ ➢ Retain H_0 4b: H_0: $SP_{post}/SP_{pre} \neq 1$ H_A: $SP_{post}/SP_{pre} = 1$ ➢ Reject H_0	- One year post the acquisition the sales performance of the acquiring company was not significantly impacted.	- This finding was consistent with existing literature hence leading to an argument that sales synergies should not be a major motivator in M&A strategy. - Sales performance merely followed the same trends post-deal as it had done pre-deal.
5 Is the cost efficiency of the acquiring company negatively impacted by the acquisitive activity?	*Hypothesis 5* 5a: H_0: $CE_{post} - CE_{Apre} \leq 0$ H_A: $CE_{post} - CE_{Apre} > 0$ ➢ Retain H_0 5b : H_0: $CE_{post} - CE_{Tpre} \leq 0$ H_A: $CE_{post} - CE_{Tpre} > 0$ ➢ Retain H_0 5c : H_0: $CE_{Tpre}/CE_{Apre} \neq 1$ H_A: $CE_{Tpre}/CE_{Apre} = 1$ ➢ Retain H_0	- There was a significant decline in the cost efficiency of the acquirer one year after the M&A event (i.e. the combined company was less cost efficient than the pre-deal acquiring company had been).	- The higher operating costs in relation to assets did not translate to a better sales performance nor did it result in significantly higher investment in R&D as shown by a decline in R&D intensity - The targets were more cost effective before the acquisition, than the combined company after the acquisition - Before the deal, the acquirers were relatively less cost efficient than the targets.

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Table 17 above provides a summary the findings and the themes that emerged in this research study and that were discussed in detail in Chapter 6. From this summary, the overall conclusions and key contributions of this research study will emerge and will be presented in Chapter 7 which is dedicated to providing the conclusion on the research.

CHAPTER 7: CONCLUSIONS

The purpose of this research study was to find the answer to the broad question: “Has the rising trend in mergers and acquisitions, which may have been triggered in response to a lag in innovation, presented a self-defeating strategy that has only made the pharmaceutical and biotechnological industries outcomes worse?”, as presented in Chapter 1. From this broad question, five research questions were formulated as stated in Chapter 3, and using the methodology described in Chapter 4 results were obtained, collated, analysed and presented in Chapter 5. Chapter 6 provided a discussion of the results by referring to the literature presented in Chapter 2. A comprehensive and tabulated summary of the findings is captures in Table 17, Chapter 6.8.

In Chapter 7, the entire efforts of this research are summarised by emphasising the principal findings and delineating the contribution that the research has made to the existing body of knowledge in the field of mergers and acquisitions. Based on the outcome of this research, recommendations have been made for various stakeholders. The limitations of this research are also presented and based on the researcher’s experience of this research; suggestions are made for future research.

7.1 Principal Findings

7.1.1 Impact of M&A on Shareholder Returns

This study showed that shareholders of acquiring companies earn positive but statistically insignificant returns in the short-term post M&A activity. Hence in conclusion, mergers and acquisitions in innovation driven businesses as proxied by pharma and biotech do not significantly impact shareholder returns in the short term.

7.1.2 Impact of M&A on Operating financial Performance

This study showed that one year post acquisition the acquirer’s abnormal cash flow return on assets showed a negative but statistically insignificant change. Hence in conclusion, mergers and acquisitions in innovation driven businesses as proxied by pharma and biotech do not significantly impact the operating financial performance of the acquirer in the post event window of up to one year.

7.1.3 Impact of M&A on Research and Development Activity

This study showed that there is a significant decline in acquirer's R&D intensity one year post acquisition. Hence in conclusion, mergers and acquisitions in innovation driven businesses as proxied by pharma and biotech have a significant negative impact on the research and development intensity of the acquiring company in the post event window of up to one year.

7.1.4 Impact of M&A on Sales Performance

This study showed that one year post the deal, there was no change in the sales performance of the acquirer. Hence in conclusion, mergers and acquisitions in innovation driven businesses as proxied by pharma and biotech do not significantly impact the sales performance of the acquiring company in the post event window of up to one year.

7.1.5 Impact of M&A on Cost Efficiency

This study showed that one year post the deal, the combined company acquirer plus target was less cost efficient than the pre-deal acquiring company had been. It was also revealed that acquirers were on average more cost efficient than the targets to begin with. Hence in conclusion mergers and acquisitions in innovation driven businesses as proxied by pharma and biotech significantly impact the cost efficiency of the acquiring company make it less cost efficient in the post event window of up to one year.

In conclusion, the broad question asked in this research as posed by Comanor and Scherer (2013) was if the rising trend in mergers and acquisitions, which may have been triggered in response to a lag in innovation, presented a self-defeating strategy that has only made the pharmaceutical and biotechnological industries outcomes worse?

Based on the empirical evidence presented in this research report, this researcher concludes that if the intent of the mergers and acquisition activity in the pharmaceutical and biotechnological industries is to increase shareholder returns, improve on financial performance or cost efficiencies, or increase sales performance then it appears that M&A could very well be a self-defeating strategy. The results of this research study are carefully summarised again in the model presented in Figure 14. The figure clearly shows that post the M&A event, some of the key metrics that drive the performance of pharma and biotech as measured in this research study either decline or do not improve.

Other ways of achieving the necessary outcomes for the business need to be investigated. Furthermore based on the empirical evidence presented regarding the decline in acquirer R&D intensity post the transaction, it also appears that M&A may actually perpetuate the lag in innovation which may culminate into dried up product pipelines, risk public health, and jeopardize the future cash flows and the very existence of the companies operating in this industry.

7.1.6 Summary of Contribution

This study has contributed to the body of knowledge on mergers and acquisitions in the following ways:

- A major finding in this research study was that there was a decline in acquirer's R&D intensity post the M&A activity. This finding gives weight to the assertion that M&A has had a negative impact on overall R&D productivity and may be a significant contributor to the phenomena of the innovation deficit as explained in literature.
- The outcome of this research study concerning the impact of M&A on shareholder returns as shown by positive though statistically insignificant returns shed light led on an industry specific occurrence that was different from the consensus view in literature where returns were mainly negative though still statistically insignificant.
- The outcome of this research study concerning the impact of M&A on operating financial performance, also gave insights to an industry specific phenomena as shown by the occurrence of negative though statistically insignificant cash flow return on assets where the majority of studies showed positive though still statistically insignificant values.
- The outcome of this research study concerning the impact of M&A on cost effectiveness of the acquirer has further added to the literature the achievement of cost synergies through M&A by revealing that cost efficiencies are not necessarily achieved post the M&A transaction and that the acquirer may even end up worse off.
- Lastly, the research study addressed the gap identified in the literature regarding the impact of mergers and acquisitions on innovation-driven businesses which was found to be less well documented. The existing body of literature has been valuably expanded.

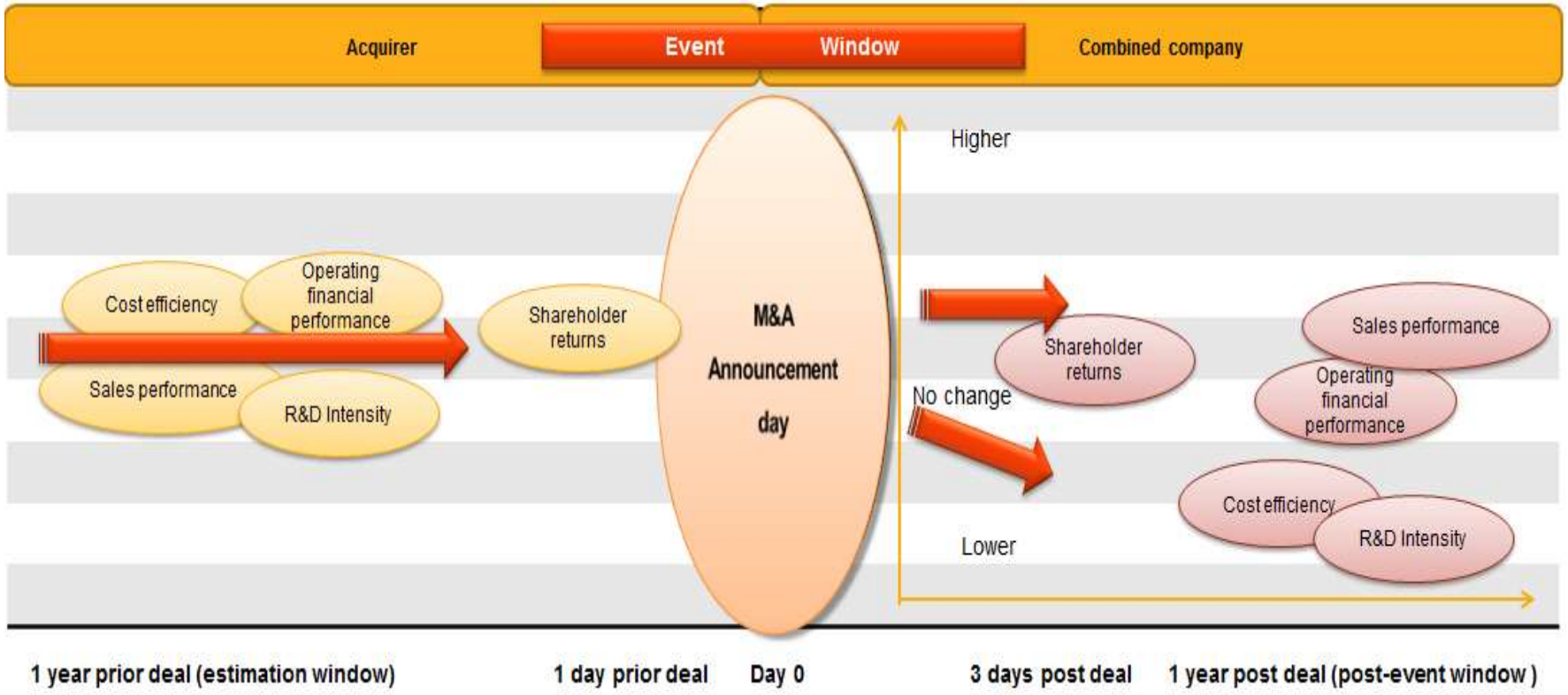

Figure 14: Model of Effects of M&A on Pharma and Biotech

7.2 Recommendations

7.2.1 Recommendations for Managers

Managers of innovation driven businesses are confronted with a tough challenge. In the face of rising R&D costs, patent expiries, and weakening product pipelines, engaging in M&A may seem like a suitable approach to continue to grow their businesses and increase shareholder value. However empirical results show that the intended outcomes may not be realised.

Therefore when deciding on motivations for M&As, managers of pharmaceutical or biotechnological businesses need to be aware that the shareholder returns are not significantly impacted by the transactions. Furthermore, it needs to be realised that the operating financial performance of the business after an M&A transaction may be negatively affected, albeit to an insignificant extent. Sales performance and cost-efficiencies are also likely not to significantly improve in the short-term of up to one year post the transaction.

Managers of pharmaceutical or biotechnological businesses also need to become increasingly aware that they are potentially buying growth at the expense of the company's and the overall industry's R&D productivity. It therefore becomes the responsibility of the acquirers to ensure that as they outsource R&D from smaller companies then they also need to motivate these companies to continue to innovate so that product pipelines can continue to grow.

7.2.2 Recommendations for Shareholders

Shareholders of acquiring pharmaceutical or biotechnological businesses also need to be aware that though the abnormal returns following an acquisition may be positive, the values are insignificant. Hence a decision to support an acquisition needs to be based on more sound strategy as presented by the managers of the business with a comprehensive analysis of anticipated synergies or outcomes.

Shareholders also need to realise that the operating financial performance of the business after an M&A transaction may be negatively affected, but to an insignificant extent. Hence they should avoid making impulsive decisions on the stocks of these companies based on poor financial results in the period following an acquisition, as this may further negatively impact the performance of these companies.

7.2.3 Recommendations for Policy Makers

The finding in this research study affirmed that there is a decline in acquirer R&D intensity post M&A transactions. This has a potential impact on the economic performance of countries and in this specific case of pharmaceuticals and biotechnology, has a potential impact on public health. Policy makers need to be aware of the innovation deficit and its causes and should regulate M&A in innovation-driven businesses more strategically. A suggestion would be to develop regulation that mandates acquirers of innovation-driven businesses to motivate how they intend to continue to foster innovation post-acquisition.

7.2.4 Recommendations for Academics

Considering the findings in this research study that there is a decline in acquirer R&D intensity following M&A activity, academics in high growth innovative fields such as biotechnology information technology, renewable energy, engineering, etc. and academics in fields of commerce, economics and policy need to delve deeper into the impact that this is having on innovation productivity, economic performance, and the society at large.

7.3 Limitations of the Research

The research had the following limitations

- The research only focused on companies in the pharmaceutical and biotechnological industries. These industries were meant to serve as proxies for all other innovation-driven business as defined in Chapter 2. However the limitation is that it is possible that the other innovation-driven business in different industries e.g. information technology, renewable energy, engineering, etc…, would be impacted differently by merger and acquisition activity.
- Due to data availability limitations for all variables required for analysis, the sample used in the research resulted in being comprised of 35 companies. Though this is a suitable sample size for making statistical inferences, this sample may be considered a relatively small sample size to draw more comprehensive conclusions' for the entire population.
- Due to time and resource constraints, only a limited range of variables were studied in this research to make conclusions on the impact of mergers and acquisitions on the business. Though the variables selected are considered important in the

evaluation of impact, there are larger number of variables that may have provided a more inclusive picture of the problem under investigation.

- The evaluation only analysed a limited time frame. A more long-term study may have provided a better outlook for companies engaging in merger and acquisitions activities.
- When examining the impact of the merger and acquisition activity, the study only focused on the quantitative aspects. Other aspects such as the impact on organisational culture, staff turnover, productivity, and strategy were not considered.
- The research did not take into consideration the size of the deal in relation to the value or market capitalisation of the acquirer. Other research done on the impact of merger and acquisition activity on company performance shows that significant impact is usually revealed when the value of the deal is significant. Some research places significant values at approximately 20% of the market capitalisation.

7.4 Suggestions for Future Research

The following are suggestions for future research:

- It is considered worthwhile to include a more comprehensive set of innovation-driven businesses from multiple industries to provide a more accurate assessment of how mergers and acquisitions have impacted the innovation driven businesses. The study ideally should consist of a larger sample size.
- It would also be worthwhile to augment the quantitative study of variables selected in this research by conducting case studies which delve deeper into various aspects. For example, when investigating research and development it would be interesting to determine which role the specific kind of research plays or what factors help successfully exploit the knowledge of the target.
- Future research can assess some of the qualitative aspects of how mergers and acquisitions have impacted these businesses, e.g.: organisational culture, productivity, and company strategy. This can be done through employee interviews.
- In future a similar study can be conducted with more emphasis on large deals in which the impact can be more clearly seen in the company metrics.
- Other studies can also expand the variables examined to assess impact beyond CAARs, ACRAs, R&D intensity, Sales performance, and Cost efficiency.

- There is also scope for a study that examines the post-merger and acquisition effects of large acquisitions on innovation driven businesses over a wider event window.

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APPENDICES

Appendix 1: Consistency Matrix

TITLE: The effects of merger and acquisition activity on the performance of listed innovation driven businesses: insights from the pharmaceutical and biotechnological industries.

PROPOSITIONS/ QUESTIONS/ HYPOTHESES	LITERATURE REVIEW	DATA COLLECTION TOOL	ANALYSIS
Research question 1 Does the merger and acquisition activity negatively impact acquirer shareholder value?	Kirchhoff & Schiereck, 2011	Event study constructed on information from Zephyr database	CAAR analysis
Research question 2 Is the operating financial performance of the acquiring company negatively impacted following the acquisitive activity?	Smit and Ward, 2007	Event study constructed on information from Zephyr database	Abnormal operating cash flow return on assets
Research question 3 Is the overall research and development intensity of the acquiring company negatively	Phillips and Zhdanov (2013) Seru (2013) Comanor and Scherer (2013)	Event study constructed on information from Zephyr database; Financial statements	Parametric and non-parametric tests, Descriptive statistics

PROPOSITIONS/ QUESTIONS/ HYPOTHESES	LITERATURE REVIEW	DATA COLLECTION TOOL	ANALYSIS
impacted following the acquisitive activity?			
Research question 4 Is the sales performance of the acquiring company negatively impacted by the acquisitive activity?	Sheen (2014) Sorescu et al. (2007)	Event study constructed on information from Zephyr database; Financial statements	Parametric and non-parametric tests, Descriptive statistics
Research question 5 Is the cost efficiency of the acquiring company negatively impacted by the acquisitive activity?	Sheen (2014)	Event study constructed on information from Zephyr database; Financial statements	Parametric and non-parametric tests, Descriptive statistics

Appendix 2: Sample selected

Table 18: Summary of sample selected

Deal Number	Acquirer name	Stock Exchange	Acquirer country code	Target name	Announced date	Completed date	Target country code	Deal type	Deal status	Market Capitalization ZAR mill	Acquirer Price to Book value ratio	deal value as % mkt cap	Deal value mil ZAR
1907017078	APELOA CO., LTD	SHENZHEN SE (CHINA)	CN	ZHEJIANG APELOA KANGYU DRUG CO., LTD	13/02/2012	24/12/2012	CN	Acquisition	Completed	3 004.05	1.65	43.74	1 314.08
1601486705	ASPEN PHARMACARE HOLDINGS LTD	JSE	ZA	GLAXOSMITHKLINE PLC'S ARIXTRA & FRAXIPARINE DRUG BRANDS	30/09/2013	31/12/2013		Acquisition	Completed	103 500.00	5.49	11.68	12 093.10
598105	ASPEN PHARMACARE HOLDINGS LTD	JSE	ZA	STRIDES LATINA	21/11/2007	21/11/2007	BR	Acquisition 50%	Completed	34 422.00	3.20	2.99	1 029.28
1601443051	ASPEN PHARMACARE HOLDINGS LTD	JSE	ZA	MSD NL 8 NV	27/06/2013	01/10/2013	NL	Acquisition 100%	Completed	103 500.00	4.48	0.47	488.67
1909039575	ASTRAZENECA PLC	NYSE	GB	BRISTOL-MYERS SQUIBB COMPANY AND ASTRAZENECA PLC'S DIABETES JOINT VENTURE	19/12/2013	01/02/2014	GB	Acquisition unknown remaining stake %	Completed	760 000.00	3.03	6.33	48104.45
1909129700	ASTRAZENECA PLC	NYSE	GB	ALMIRALL SA'S RESPIRATORY FRANCHISE BUSINESS	30/07/2014	03/11/2014	ES	Acquisition 100%	Completed	967 368.40	4.28	2.39	23160.38

Deal Number	Acquirer name	Stock Exchange	Acquirer country code	Target name	Announced date	Completed date	Target country code	Deal type	Deal status	Market Capitalization ZAR mill	Acquirer Price to Book value ratio	deal value as % mkt cap	Deal value mil ZAR
1909099328	BAYER AG	All German Stock exchanges	DE	MERCK & COMPANY INC.'S CONSUMER HEALTH BUSINESS	06/05/2014	01/10/2014	DE	Acquisition 100%	Completed	1 210 748.20	4.06	13.23	160236.7
653228	BEIJING TIANTAN BIOLOGICAL PRODUCTS CORPORATION LTD	All SHANGHAI Stock exchanges	CN	CHENGDU RONGSHENG PHARMACEUTICALS CO., LTD	23/06/2008	21/01/2010	CN	Acquisition 90%	Completed	1 844.81	1.90	33.96	626.49
1909095619	GLAXOSMITHKLINE PLC	NYSE	GB	NOVARTIS AG'S VACCINE BUSINESS	22/04/2014	02/03/2015	CH	Acquisition 100%	Completed	1 433 404.00	12.25	5.73	82200.25
1601092105	GLAXOSMITHKLINE PLC	NYSE	GB	BRISTOL-MYERS SQUIBB COMPANY'S MIDDLE EAST BRANDED GENERICS BUSINESS	02/07/2009	02/07/2009	GB	Acquisition 100%	Completed	701 653.00	7.41	0.03	179.34
1601225281	HIKMA PHARMACEUTICALS PLC	London Stock Exchange	GB	BAXTER INTERNATIONAL INC.'S US GENERIC INJECTABLES BUSINESS	29/10/2010	03/05/2011	US	Acquisition 100%	Completed	18 493.00	4.77	4.00	739.90
508634	HIKMA PHARMACEUTICALS PLC	London Stock Exchange	GB	RIBOSEPHARM GMBH	22/01/2007	26/01/2007	DE	Acquisition 100%	Completed	17 780.80	4.77	1.81	322.71

Deal Number	Acquirer name	Stock Exchange	Acquirer country code	Target name	Announced date	Completed date	Target country code	Deal type	Deal status	Market Capitalization ZAR mill	Acquirer Price to Book value ratio	deal value as % mkt cap	Deal value mil ZAR
418815	JOHNSON & JOHNSON	NYSE	US	PFIZER CONSUMER HEALTHCARE	26/06/2006	20/12/2006	IT	Acquisition 100%	Completed	1 341 703.70	4.32	8.71	116805.9
556677	LABORATORIOS ALMIRALL SA	Madrid Stock Exchange	ES	HERMAL KURT HERRMAN GMBH & CO. OHG	16/07/2007	03/09/2007	DE	Acquisition 100%	Completed	21 739.60	0.00	16.91	3 675.09
582392	LABORATORIOS ALMIRALL SA	Madrid Stock Exchange	ES	SHIRE PLC'S NON-CORE PRODUCT PORTFOLIO	08/10/2007	19/12/2007	GB	Acquisition 100%	Completed	26 199.70	0.00	5.63	1 474.00
1909124314	MYLAN NV	NASDAQ	NL	ABBOTT LABORATORIES INC.'S NON-US DEVELOPED MARKETS SPECIALITY AND BRANDED GENERICS BUSINESS IN EUROPE	14/07/2014	27/02/2015	US	Acquisition 100%	Completed	204 574.00	5.54	34.27	70101.57
1909095884	NOVARTIS AG	NYSE	CH	GLAXOSMITHKLINE PLC'S ONCOLOGY PRODUCTS UNIT	22/04/2014	02/03/2015	GB	Acquisition 100%	Completed	2 201 915.00	2.95	8.47	186553.8
309748	NOVARTIS AG	NYSE	CH	BRISTOL-MYERS SQUIBB COMPANY'S US AND CANADIAN CONSUMER MEDICINES BUSINESS	14/07/2005	31/08/2005	US	Acquisition 100%	Completed	722 580.60	3.75	0.59	4293.3

Deal Number	Acquirer name	Stock Exchange	Acquirer country code	Target name	Announced date	Completed date	Target country code	Deal type	Deal status	Market Capitalization ZAR mill	Acquirer Price to Book value ratio	deal value as % mkt cap	Deal value mil ZAR
1909129473	PFIZER INC.	NYSE	US	BAXTER INTERNATIONAL INC.'S COMMERCIAL VACCINES BUSINESS	30/07/2014	01/12/2014	US	Acquisition	Completed	1 927 052.60	2.50	0.37	7039.86
1601314942	SALIX PHARMACEUTICALS LTD	NASDAQ	US	OCEANA THERAPEUTICS INC.	08/11/2011	20/12/2011	US	Acquisition 100%	Completed	13 069.72	5.70	19.26	2 517.35
1909121390	SANTEN PHARMACEUTICAL CO., LTD	All Tokyo Stock exchanges	JP	MERCK & COMPANY INC.'S OPHTHALMOLOGY BUSINESS IN JAPAN	13/05/2014	02/06/2014	JP	Acquisition	Completed	14 441.76	2.07	43.93	6343.77
1603038721	SHANGHAI PHARMACEUTICAL CO., LTD	All SHANGHAI Stock exchanges	CN	SHANGHAI ZHONGXI PHARMACEUTICAL CO., LTD	02/02/2010	11/02/2010	CN	Acquisition 100%	Completed	39 062.50	1.41	7.10	2 774.81
1633041360	SHENZHEN HEPALINK PHARMACEUTICAL CO., LTD	SHENZHEN SE (CHINA)	CN	CHENGDU HAITONG PHARMACEUTICAL CO., LTD	30/07/2011	10/09/2011	CN	Acquisition increased from 49% to 85%	Completed	2 659.00	2.53	0.31	8.19
1909246880	STADA ARZNEIMITTEL AG	All German Stock exchanges	DE	INTERNIS PHARMACEUTICALS LTD	19/12/2014	19/12/2014	GB	Acquisition 100%	Completed	223 067.58	1.52	0.40	887.00
1633107365	STAIDSON (BEIJING) BIOPHARMACEUTICALS CO., LTD	SHENZHEN SE (CHINA)	CN	BEIJING NUOWEIKANG MEDICAL TECHNOLOGY CO., LTD	05/09/2012	29/11/2012	CN	Acquisition 100%	Completed	100.82	5.05	63.20	63.72

Deal Number	Acquirer name	Stock Exchange	Acquirer country code	Target name	Announced date	Completed date	Target country code	Deal type	Deal status	Market Capitalization ZAR mill	Acquirer Price to Book value ratio	deal value as % mkt cap	Deal value mil ZAR
1601114337	TAISHO PHARMACEUTICAL CO., LTD	Tokyo SE	JP	BRISTOL-MYERS SQUIBB INDONESIA TBK, PT	15/09/2009	02/11/2009	ID	Acquisition 97.97%	Completed	32 064.00	1.05	3.80	1 219.83
1907004014	TAISHO PHARMACEUTICAL CO., LTD	NYSE	JP	BIOFERMIN PHARMACEUTICAL CO., LTD	31/07/2013	31/07/2013	JP	Acquisition increased from 54.794% to 62.794%	Completed	48 850.05	1.00	0.57	278.75
1601225004	TEVA PHARMACEUTICAL INDUSTRIES LTD	NYSE	IL	THÉRAMEX SPA	28/10/2010	05/01/2011	IT	Acquisition	Completed	328 750.00	2.19	0.72	2 352.98
429822	TEVA PHARMACEUTICAL INDUSTRIES LTD	NYSE	IL	TIANJIN HUALIDA BIOTECHNOLOGY PHARMACEUTICAL CO., LTD	13/03/2006	30/03/2006	CN	Acquisition increased from 45% to 60%	Completed	165 375.00	3.38	0.03	54.26
1601263007	VALEANT PHARMACEUTICALS INTERNATIONAL INC.	NYSE	CA	DERMIK LABORATORIES INC.	11/07/2011	19/12/2011	US	Acquisition 100%	Completed	106 081.00	3.31	3.33	3 537.30
1909213997	VALEANT PHARMACEUTICALS INTERNATIONAL INC.	NYSE	US	QLT INC.'S VISUDYNE BUSINESS	24/09/2012	24/09/2012	CA	Acquisition 100%	Completed	140 500.00	5.83	0.78	1095.67
1909116893	VALEANT PHARMACEUTICALS INTERNATIONAL INC.	NYSE	CA	ECR PHARMACEUTICALS COMPANY INC.	20/06/2014	20/06/2014	US	Acquisition 100%	Completed	419 255.00	8.45	0.11	440.96

Deal Number	Acquirer name	Stock Exchange	Acquirer country code	Target name	Announced date	Completed date	Target country code	Deal type	Deal status	Market Capitalization ZAR mill	Acquirer Price to Book value ratio	deal value as % mkt cap	Deal value mil ZAR
1633046159	ZHEJIANG CONBA PHARMACEUTICAL CO., LTD	All SHANGHAI Stock exchanges	CN	ZHEJIANG CONBA CHINESE MEDICINE CO., LTD	15/09/2011	16/12/2011	CN	Acquisition 99%	Completed	486.62	3.96	106.66	519.04
390445	ZHEJIANG CONBA PHARMACEUTICAL CO., LTD	All SHANGHAI Stock exchanges	CN	PHYTOWAY INC.	27/09/2005	15/10/2005	CN	Acquisition 70%	Completed	106.02	1.70	21.07	22.34
1909168221	ZOETIS INC.	NYSE	US	ABBOTT ANIMAL HEALTH INC.'S ANIMAL HEALTH ASSETS	17/11/2014	10/02/2015	US	Acquisition 100%	Completed	235 638.00	16.24	1.25	2 955.34

Appendix 3: Comprehensive sample descriptive statistics

Table 19: Comprehensive sample descriptive statistics

Sample Descriptive Statistics

	N	Min	Max	Mean	Std. Deviation	Skewness	
						Statistic	Std. Error
Acquirer Price to Book value ratio	35	.000	16.240	4.05000	3.234310	2.046	.398
Acquirer R&D Costs one year post transaction mill ZAR	35	7.000	34138.298	5188.94184	8493.759611	1.944	.398
Acquirer R&D Costs one year prior transaction mill ZAR	35	5.000	25111.111	4435.69720	6825.343546	1.587	.398
Acquirer stock price 1 week after completion ZAR	35	6.052	1489.016	343.75107	379.148195	1.744	.398
Acquirer stock price 3 months prior to announcement ZAR	35	3.800	1526.551	309.08416	360.499639	2.199	.398
Acquirer stock price 4 weeks after completion ZAR	35	6.268	1554.281	346.95092	383.922439	1.759	.398
Acquirer stock price after completion ZAR	35	6.638	1533.631	340.85856	375.118084	1.766	.398
Acquirer stock price prior to announcement ZAR	35	4.100	1450.068	309.92182	339.975160	1.911	.398
Deal value mil ZAR	35	8.190	186553.750	21300.28886	46362.633334	2.573	.398
deal value as % mkt cap	35	.026	106.662	13.53850	22.298215	2.724	.398
DSM BIOLOGIC	35	1	356	92.29	91.284	1.471	.398
Final stake (%)	35	50.000	100.000	94.70754	12.986479	-2.502	.398
Market Capitalization ZAR mill	35	100.821528 7	2201915.000000	387742.58630743 8	585801.9471752190	1.796	.398
operational costs of Acquirer one year post acquisition mil ZAR	35	142.959	295638.298	60547.09550	92360.058939	1.439	.398
operational costs of Acquirer one year prior acquisition mil ZAR	35	90.306	265454.545	52359.27051	82044.841852	1.532	.398
operational costs of target one year prior to acquisition mil ZAR	35	.853	30746.858	2969.73214	6687.149834	3.031	.398
Post deal Acquirer operating costs divided by total assets	35	.017	1.590	.27671	.265211	3.806	.398
Post-deal Acquirer operating cash flow mil ZAR First avail. yr	35	-4076.0546077	174893.6170213	21055.175029614	38832.3191599124	2.708	.398
Post-deal Acquirer operating cash flow divided by total assets (first avail yr)	35	-.006	.702	.11336	.114999	4.100	.398
Post-deal Acquirer operating revenue/turnover mil ZAR First avail. yr	35	782.750	936125.000	128199.32256	219338.950004	2.211	.398
Post-deal Acquirer total assets mil ZAR First avail. yr	35	1486.6618705	2134360.000000	265607.486076816	481462.8085901360	2.838	.398
Post-deal industry operating cash flow return on assets (first avail yr)	35	.1260908	.1260908	.126090788	.0000000000	.	.
Post-deal operating revenue divided by total assets First avail year	35	.003	1.324	.55396	.265194	.785	.398
Post-deal R&D costs divided by operating revenue	35	.000	7.494	.26304	1.259219	5.900	.398
Pre deal Acquirer operating costs divided by total assets	35	.030	.906	.25807	.173598	1.691	.398
Pre deal Target operating costs divided by total assets	35	.000	2.004	.15119	.342762	4.907	.398

Pre-deal Acquirer operating cash flow divided by total assets (first avail yr)	35	-.008	.578	.12742	.104316	2.607	.398
Pre-deal Acquirer operating cash flow mil ZAR Last avail. yr	35	-4161.5662429	180840.5390022	22464.670069738	40830.3354848320	2.412	.398
Pre-deal Acquirer operating revenue/turnover mil ZAR Last avail. yr	35	180.397	722790.835	105168.03642	177378.341950	2.032	.398
Pre-deal Acquirer total assets mil ZAR Last avail. yr	35	954.6267	1738393.9394	222382.275716	397354.4115586	2.703	.398
Pre-deal industry operating cash flow return on assets (first avail yr)	35	.1260908	.1260908	.126090788	.0000000000	.	.
Pre-deal operating revenue divided by total assets	35	.003068	1.403377	.57294644	.284538570	.659	.398
Pre-deal R&D costs divided by operating revenue	35	.001	8.085	.29155	1.357494	5.895	.398
Pre-deal target operating cash flow mil ZAR Last avail. yr	35	-107.453983 9	87122.6362142	3531.136005529	14874.8287429583	5.538	.398
Pre-deal target operating cash flow divided by total assets (first avail yr)	35	-.042	1.081	.10189	.214949	3.274	.398
Pre-deal target total assets mil ZAR Last avail. yr	35	216.478	1226420.650	92999.74596	283006.572652	3.882	.398
Stock price for market capitalisation calculation	35	7.871	1450.068	315.57423	344.754205	1.830	.398
Time to Completion (months)	35	0	18	3.00	3.963	2.087	.398
Valid N (listwise)	35						

Appendix 4: Data normality tests

Table 20: Results of the Kolmogorov Smirnov test for data normality

Attributes	Normal Parameters[a,] Std. Deviation[b]	Test Statistic	Asymp. Sig. (2-tailed)
Abnormal cash flow for combined entity 1 year after	.11500	.269	.000[c]
Abnormal cash flow return on assets for acquirer and target 1 year prior	.11488	.261	.000[c]
Acquirer Price to Book value ratio	3.234310	.177	.007[c]
Acquirer R& D Costs one year post transaction mill ZAR	8493.759611	.366	.000[c]
Acquirer R& D Costs one year prior transaction mill ZAR	6825.343546	.356	.000[c]
Acquirer stock price 1 week after completion ZAR	379.148195	.223	.000[c]
Acquirer stock price 3 months prior to announcement ZAR	360.499639	.222	.000[c]
Acquirer stock price 4 weeks after completion ZAR	383.922439	.207	.001[c]
Acquirer stock price after completion ZAR	375.118084	.218	.000[c]
Acquirer stock price prior to announcement ZAR	339.975160	.203	.001[c]
Completed date	1137.27572	.133	.125[c]
Deal Number	795765547.234	.383	.000[c]
Deal value mil ZAR	46362.633334	.392	.000[c]
deal value as % mkt cap	22.298215	.272	.000[c]
DSM BIOLOGIC	91.284	.159	.026[c]
Final stake (%)	12.986479	.430	.000[c]
Market Capitalization ZAR mill	585801.9471752	.288	.000[c]
operational costs of acquirer one year post acquisition mil ZAR	92360.058939	.336	.000[c]
operational costs of acquirer one year prior acquisition mil ZAR	82044.841852	.334	.000[c]
operational costs of target one year prior to acquisition mil ZAR	6687.149834	.371	.000[c]
Post-deal acquirer operating costs divided by total assets	.265211	.213	.000[c]
Post-deal acquirer operating cash flow mil ZAR First avail. yr.	38832.31915991	.309	.000[c]
Post-deal acquirer operating cash flow divided by total assets (first avail yr.)	.114999	.269	.000[c]
Post-deal acquirer operating revenue/turnover mil ZAR First avail. yr.	219338.950004	.316	.000[c]
Post-deal acquirer total assets mil ZAR First avail. yr.	481462.8085901	.292	.000[c]
Post-deal industry operating cash flow return on assets (first avail yr.)	.0000000048	.500	.000[c]
Post-deal operating revenue divided by total assets First avail year	.265194	.135	.108[c]
Post-deal R & amp; D costs divided by operating revenue	1.259219	.493	.000[c]
Pre-deal acquirer operating costs divided by total assets	.173598	.146	.056[c]

Attributes	Normal Parameters[a,] Std. Deviation [b]	Test Statistic	Asymp. Sig. (2-tailed)
Pre-deal Target operating costs divided by total assets	.342762	.330	.000[c]
Pre-deal acquirer operating cash flow divided by total assets (first avail yr.)	.104316	.202	.001[c]
Pre-deal acquirer operating cash flow mil ZAR Last avail. yr.	40830.33548483	.302	.000[c]
Pre-deal acquirer operating revenue/turnover rmil ZAR Last avail. yr.	177378.341950	.322	.000[c]
Pre-deal acquirer total assets mil ZAR Last avail. yr.	397354.4115586	.295	.000[c]
Pre-deal industry operating cash flow return on assets (first avail yr.)	.0000000048	.500	.000[c]
Pre-deal operating revenue divided by total assets	.284538570	.122	.200[c,d]
Pre-deal R & amp; D costs divided by operating revenue	1.357494	.473	.000[c]
Pre-deal target operating cash flow mil ZAR Last avail. yr.	14874.82874296	.463	.000[c]
Pre-deal target operating cash flow divided by total assets (first avail yr.)	.214949	.296	.000[c]
Pre-deal target total assets mil ZAR Last avail. yr.	283006.572652	.401	.000[c]
Share Return for portfolio at t=0	.135462	.115	.200[c,d]
Share Return for portfolio at t=1	.18329	.247	.000[c]
Share Return for portfolio at t=2	.18007	.180	.005[c]
Share Return for portfolio at t=3	.18178	.166	.016[c]
Stock price for market capitalisation calculation	344.754205	.211	.000[c]
Time to Completion (months)	3.963	.225	.000[c]
Weighted Acquirer stock price 1 week after completion ZAR	271.38501	.329	.000[c]
Weighted Acquirer stock price 3 months prior to announcement ZAR	262.88615	.262	.000[c]
Weighted Acquirer stock price 4 weeks after completion ZAR	276.19216	.333	.000[c]
Weighted Acquirer stock price after completion ZAR	266.09218	.326	.000[c]
Weighted Acquirer stock price prior to announcement ZAR	256.62987	.255	.000[c]
Weighted Share Return for portfolio at t=0	.04149	.369	.000[c]
Weighted Share Return for portfolio at t=1	.07521	.270	.000[c]
Weighted Share Return for portfolio at t=4	.06372	.277	.000[c]
Weighted Share Return for portfolio at t=completion	.08326	.279	.000[c]

Appendix 5: Bootstrap T-tests

Table 21: Bootstrap sample statistics

One-Sample Statistics

			Bootstrap[b]			
					95% Confidence Interval	
		Statistic	Bias	Std. Error	Lower	Upper
Cummulative Abnormal Returns	N	4				
	Mean	6.5125	.0126	1.8602	2.1300	8.9925
	Std. Deviation	4.35906	-1.15158	1.98102	.10500	5.12906
	Std. Error Mean	2.17953				

b. Unless otherwise noted, bootstrap results are based on 1500 bootstrap samples

Table 22: CAAR one sample test

One-Sample Test[a]

	Test Value = 0					
					95% Confidence Interval of the Difference	
	T	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Cummulative Abnormal Returns	2.988	3	.058	6.51250	-.4237	13.4487

a. No statistics are computed for one or more split files

Table 23: Bootstrap for CAAR one sample test

Bootstrap for One-Sample Test

		Bootstrap[a]				
					95% Confidence Interval	
	Mean Difference	Bias	Std. Error	Sig. (2-tailed)	Lower	Upper
Cummulative Abnormal Returns	6.51250	.01759[b]	1.80393[b]	.309[b]	2.13000[b]	8.99250[b]

a. Unless otherwise noted, bootstrap results are based on 1500 bootstrap samples

b. Based on 1476 samples

Appendix 6: Ethics Clearance Letter

(Please find attached on the next page)

Gordon Institute of Business Science
University of Pretoria

Dear Tinashe Zigomo

Protocol Number: **Temp2015-01331**

Title: **The impact of merger and acquisition activity on listed innovation driven businesses; insights from the pharmaceutical and biotechnological industries**

Please be advised that your application for Ethical Clearance has been APPROVED.

You are therefore allowed to continue collecting your data.

We wish you everything of the best for the rest of the project.

Kind Regards,

GIBS Ethics Administrator