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The Economic Worth of Cloud Computing Adoption: A Financial Analysis

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THE ECONOMIC WORTH OF CLOUD COMPUTING ADOPTION: A FINANCIAL ANALYSIS

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INTERNATIONAL BUSINESS DOCTORAL PROGRAM

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Dedication

I dedicate my dissertation work to my family and friends. A heartfelt of gratitude goes to my parents, Donna Edney and Clarence Todman Sr for their unwavering support. A special dedication goes to my children CeRelia and CeAra Donald; I thank you for staying by my side and being supportive during the process. To family members Maxie Nicholas and Veronica Phillips, your prayers and constant mentoring made the difference.

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THE ECONOMIC WORTH OF CLOUD COMPUTING ADOPTION: A FINANCIAL ANALYSIS

by

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DISSERTATION

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Abstract

Using resource based view theory and efficient market hypotheses as a basis, this study examined the impact of cloud computing adoption on the market value of the firm using an event study perspective and firm performance perspective. The study's population was chosen based on their participation on a US stock exchange. Using a sample of 139 cloud computing adoption announcements, I found that the announcement of cloud computing adoption is associated with negative abnormal market returns however the effect is not statistically significant. The trading volume showed a significant increase but this increase was not statistically significant. The risk, β, showed an increase but was not statistically significant. Last I investigated firm performance and derived the return on assets (ROA), return on sales (ROS) and selling general and administrative (SG&A) costs for the firms that adopted cloud computing. Expected were an increase in ROA and ROS and a decrease in SG&A. Rather, ROA and ROS both showed a decrease in value. The mean SG&A shows a decrease in the year after cloud computing adoption. I conclude with potential reasons for the findings . There were several limitations, lack of direct information from the firms, and a small sample size due to the lack of announcements. Despite, this study's results further acknowledge that cloud computing adoption does provide some financial impact onthe adopting firms.

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Chapter 1: Introduction

Cloud computing is a relatively new phenomenon (Ostermann, Iosup, Yigitbasi, Prodan, Fahringer, Epema, 2009) which provides an on demand service via a paradigm that uses outsourcing of computer resources. The use of cloud computing signals a change in the manner information systems are used to provide information technology needs of users. Cloud computing's ability to provide information systems services inexpensively while extending more computing services makes it attractive to customers but even more attractive to businesses (Marston, Li, Bandyopadhyay, Zhang, and Ghalsasi, 2011).

Information technology (IT) literature has been inundated with discussions on how cloud computing adoption benefits an organization (Velte, Velte, & Elsenpeter, 2009; Armbrust, Fox, Griffith, Joseph, Katz, Konswinski, Lee, Patterson, Rabkin, Stoica, & Zaharia, 2009b). There are, however, no studies that comprehensively examine the impact of cloud adoption announcements on adopting firms' valuation. Only three studies (Parameswaran, Venkatesan, Gupta, Sharman and Rao, 2011; Parameswaran, Venkatesan and Gupta, 2013; Huntgeburth, Forderer, Ebertin and Veit, 2013) empirically examined the impact of cloud adoption announcements on adopting firms' valuation in terms of abnormal returns. These studies have, however, failed to examine the impact of cloud adoption announcements on the adopting firms' valuation in a comprehensive manner in terms of the abnormal stock returns, abnormal trading volume, and abnormal risk. Previous studies have also failed to evaluate the financial performance of the firms that adopted cloud computing in terms of return on sales (ROS), return on assets (ROA) and selling general and administrative (SG&A) expenses. In the next section the problem statement for undertaking the present research is presented.

1.1 Problem Statement

The U. S. Government estimates that they will spend more than $7 billion by 2015 on cloud computing. Cloud computing users stem from individuals, to small businesses, to large corporations and, as noted earlier, governments (Kaufman, 2009). Even though there is an increase in the number of cloud adopters, (Avery, 2009) many businesses are reluctant to venture into cloud computing. I believe that one major reason for this reluctance is due to the fact that potential users are unaware of the financial benefits that cloud computing provides.

Empirical studies in the past have demonstrated a positive relationship between IT investments and market value (Im, Dow & Grover, 2001) and IT investments and firm performance (Brynjolfsson & Hitt, 2000; Bharadwaj, Bharadwaj, Konsynski, 1999). The present research will be the first of its kind to examine the benefits of Cloud computing, from the productivity and market value perspective. In a recent study, Zhang, Zhang, Chen and Huo (2010) succinctly state that cloud computing utilizes the vacant computer resources, increases the economic efficiency through improved utilizations and equipment energy consumption. This leads to the assumption that the adoption of cloud computing leads to financial benefits both internally and externally. The present research will lend a more definitive answer to whether the announcement of cloud computing adoption by a publicly traded company enhances the market value of the company.

The results of the present research will benefit both researchers and practitioners by demonstrating the impact of cloud computing on the business value of a publicly traded company. Previous studies have attempted to empirically assess the impact of cloud computing but these studies produced mixed results. Previous studies have also failed to conduct a comprehensive study in the area by including the changes in trading volume and risk. The

present research also uses the financial performance measures of firms to evaluate the impact of cloud computing adoption on the market value of the firms. The following section provides a general definition of cloud computing and looks at the different types of cloud computing architecture.

1.2 Cloud Computing Definitions

Many definitions of cloud computing exist (Broberg, Venugopal, & Buyya, 2008b). Most of the definitions appear to be centralized on a certain aspect of cloud technology. Based on what Broberg et al., (2008b) stated in the present research, cloud computing is defined as a service delivered to consumers via one point of access that meets most or all of their computing needs. Cloud computing consists of a platform that utilizes virtualized resources (Gong, Liu, Zhang, Chen, & Gong, 2010) that can be shared by both owners and users (Ercan, 2010). Designed to make better use of distributed computing resources, cloud computing promises reliable service and continuous availability (Broberg, Buyya, & Tari, 2008a; Broberg et al., 2008b) while allowing users to communicate with other users in order to obtain necessary information (Hayes, 2008; Nurmi, Wolski, Grzegorcyk, Obertelli, Soman, Yourseff, & Zagarodnov, 2008). Cloud computing can also be used as an alternative to grids and supercomputers (Ostermann et al., 2009).

Nurmi et al., (2008) states that cloud computing systems provide access to large amounts of data and computational resources focusing on infrastructure as a service (IaaS). The authors suggest Eucalyptus, an open software framework that provides an infrastructure environment. Eucalyptus is similar to Amazon EC2 API when observing cloud operation. API defines cloud, virtual data, public address, storage, and volume.

Cloud computing encompasses the network of systems available to the users and the datacenters that utilize the system (Armbrust, et al., 2010b). In general, the cloud consists of a data center where the provider is able to store the data in a centralized location (Kandukuri, Paturi, and Rakshit, 2009). Cloud computing reduces the costs of maintaining an IT infrastructure significantly by shifting the location of the infrastructure to a virtualized environment (Vaquero, Rodero-Merino, Caceres, Lindner, 2008). The adoption of the cloud can occur in multiple forms. A company can develop a cloud to cater to their existing customers or the company may also choose to join another company's cloud that is related to the business or service it provides.

Mell & Grance (2011) define cloud computing as a model for convenient on-demand network access to a shared pool of configurable computing resources such as storage, data and software. The architecture of cloud computing is dependent on the type of cloud models. In general four main types of cloud deployment models have been discussed in the literature: private, public, community and hybrid (Ramgovind, Eloff & Smith, 2010; Mell and Grance, 2011). These deployment models are further discussed in the following paragraphs.

1.2.1 Private Cloud

Private cloud is defined as a datacenter built to meet the internal needs of an organization. These types of cloud are usually not available to other organizations (Armbrust, Fox, Griffith, Joseph, Katz, Konwinski, Lee, Patterson, Rabkin, Stoica & Zaha, 2009a) and usually operated by an organization for an organization (Mell & Grance, 2011). Ramgovind et al (2010) explain that private cloud can also involve an agreement between organizations and cloud vendors that allow the organizations to utilize the cloud capabilities for private uses. Rimal, Choi, Lumb(2009)

state that using a private cloud allows a consumer to use the cloud provided by a vendor without the concerns of common networking restrictions such as network bandwidth, and privacy.

1.2.2 Public Cloud

The public cloud is referred to as a pay-as-you-go datacenter made available to the general public (Armbrust et al., 2009a). A public cloud is usually owned by a business that sells cloud services (Mell & Grance, 2011).

Public cloud comes in a couple of forms (Li, Yang, Kandula, & Zhang, 2010): primarily, the cloud environment is provided where a customer selects applications provided by the cloud or built by their own applications. Secondly, virtual systems are designed - where customers run applications inside the virtual machine.

1.2.3 Community Cloud

Community cloud, unlike the other cloud structures, grew out of a need to have more control over the cloud environment (Marinos & Briscoe, 2009). The idea is to create an environmental sustainability led by the organizations of under-utilized resources pooling together and forming a cloud community. The community cloud is formed by distributing the server functionality amongst a group of nodes provided by a set of cloud servers. This grouping is referred to as a virtual data center. In this environment the nodes fulfill all roles of cloud consumers, producers, and coordinators (Marinos, Briscoe, 2009).

Because the cloud community is not owned by a particular organization its lifespan is not dependent upon the success or failure of any organization. Due to its diversity, one would think that it is protected from failure but community clouds do fail. When the community cloud fails, the unaffected nodes are able to mobilize to another cloud and compensate for their failures.

1.2.4 Hybrid Cloud

Ramgovind et al., (2010) argue that a hybrid cloud is a private cloud linked to one or more external sources. Hybrid clouds are generally managed centrally (Ramgovind et al., 2010) and generally consist of multiple private or public clouds (Yan, Rong, & Zhao, 2009). Hybrid clouds utilize at least one private cloud and one public cloud in an effort to bring out a more secure environment and flexibility (Bittencourt & Madeira, 2011).

In a hybrid cloud environment, the public or private cloud involved is allowed to maintain its own entity, (Mell & Grance, 2011) but are bound together for technological or proprietary reasons. This relationship between the clouds allows for technology and application portability (Mell & Grance, 2011).

In the next section the purpose of the present research is provided.

1.3 Purpose of the Study

A recent stream of research has mainly focused on defining cloud computing; the purpose of the present research is to investigate the economic impact of adopting cloud computing by a publicly traded company and its future financial implications. The impact of cloud computing adoption announcements by a company was conducted in two phases: the first phase analyzed the impact of these adoption announcements on the abnormal returns, abnormal trading volume, and abnormal risk of the company. The second phase of the dissertation research analyzed the cloud adoption impact on the firm performance using return of assets (ROA), return on sales (ROS), along with selling goods and administrative costs (SG&A). The economic impact was observed shortly after a public announcement of launching cloud computing in a number of reputable online journals, newspapers, and/or computer articles.

1.4 Contribution

Given the importance of information systems to a firms' competitive success, it is critical to understand how cloud computing adoption affects the financial output of the firm. Prior research has long pursued the relationships between investments in information systems, strategic advantage, and firm performance (Chi, Holsapple, Srinivasan, 2007). Bharadwaj et al., (1999) and Hitt and Brynjolfsson, (1996) have both demonstrated that IT investments do in fact provide financial benefits. I intend to reinforce their findings using theoretical frameworks to explain how an IT investment can enhance a firm's performance. One particular study suggests that it is not easy to understand the relationship between IT and firm performance due to its inherent complexity (Bharadwaj, 2000). Fairbank, Labianca, Steensma and Metters (2006), suggest that micro-examinations of practices and procedures within firms needs to be investigated further. Following this lead, in this dissertation, I will argue that cloud computing does affect the financial output of a firm. My argument will be based on my research on the market value and the performance of the firm.

Answering the calls for research to examine the role of information systems in relation to competitive actions and firm performance (Ferrier, Holsapple, and Sabherwal, 2007), the present research will add to the limited research studies conducted on the financial impact of cloud computing. It is my hope that, the present dissertation research will help us understand the financial benefits and risks of cloud computing adoption. This proposition will allow firms to make an informed decision on whether to adopt or not adopt the cloud usage. If a firm decides to adopt cloud computing, it should be able to provide better IT services at a lower cost. The present research should shorten the research gap in cloud computing adoption area. IT professionals could use this research to assist decision makers with making an informed cloud

computing adoption decision. Researchers should also be able to use this study to further advance the cloud computing adoption research. Although this study is not the first to empirically investigate the market value of cloud computing adoption, it will be the first to investigate the firm's performance.

1.5 Dissertation Organization

The remainder of my dissertation research is organized as follows. Chapter 2 introduces the business literature on cloud computing. The literature review focuses on the business aspect of cloud computing. Multiple researches has conferred the importance of the business perspective on cloud computing studies and encouraged the development of more cloud computing business studies (Marston, et al., 2011; Chang, Bacigalupo, Wills, and Roure, 2010). This chapter reviews the present cloud computing business literature and then continues on to review IT within two major groups of literature: 1) event study and 2) firm performance.

Chapter 3 introduces the explanation of the two theories used in this study: resource based view and efficient market hypothesis. This is followed by the hypothesis development section which is grounded in literature.

Chapter 4 provides the financial methods used to analyze the impact of cloud computing adoption announcement on the market value of the adopting firm. Event-study analysis is used to investigate the stock price return, abnormal volume and abnormal risk of the firm. Return on sales (ROS), return on assets (ROA) and selling goods and administrative (SG&A) are used to evaluate the firm performance.

Results of the present research are provided and discussed in chapter 5. Chapter 6 presents the limitation of the dissertation research and provides conclusions for the study.

Chapter 2: Literature Review

There is no doubt about the relevance of cloud computing in today's business world. This relevance is demonstrated by a large number of businesses that have adopted cloud computing. The relevance is further demonstrated by the economic investment made by companies that offer cloud computing. Previous research on cloud computing, as stated earlier, is limited in scope. While these studies provide a good definition of cloud computing and its architecture and its origin, they only briefly examine its value to a business.

This chapter of the dissertation starts by providing a number of cloud computing definitions and key features suggested by researchers and practitioners (see Section 2.1) and then provide the key features of the cloud (see Section 2.2). Since the present research is mainly on cloud computing, the present section of the dissertation research covers cloud computing literature (see Section 2.3). I will be conducting an event study in cloud computing, consequently my research covers the relevant literature on event studies in general and evaluates event studies conducted in the information systems area in particular (see Section 2.4). Since cloud computing is a type of information system, the present research uses event study methodology. This chapter also covers event studies conducted in the information systems area in general and event studies conducted in cloud computing in particular (see Section 2.5). These sections are thereby followed by a literature review on financial ratios. The last section of the chapter covers literature on information systems that utilized financial ratios.

2.1 Definition of Cloud Computing

NIST (Mell and Grance, 2011) has defined cloud computing as a model for convenient on demand network access to a shared pool of configurable computing resources such as networks, servers, storage spaces, applications, and services (Mell and Grance, 2011). It is the

demand for network access and computing resources that has driven the growth of cloud computing from the supply side point of view (Clarke, 2010). The lower cost for using cloud computing is due to its inexpensive architecture and compatibility with other systems (Low, Chen & Wu, 2011). The lack of complexity also played a major role in the growth of cloud computing.

Catteddu and Hogben (2009) defined cloud computing as an information technology (IT) system that provides an on demand service often based on distributed or virtualized computing technologies. Cloud computing is designed to make a better use of computing resources (Rimal, Choi and Lumb, 2009). The cloud promises reliable service and continuous availability (Broberg, et al., 2008a) while allowing users to communicate with other users in order to gain necessary information (Hayes, 2008; Nurmi et al., 2008).

Cloud computing encompasses a network of systems available to the users and the datacenters that provide the systems (Armbrust, et al., 2010a). Cloud computing can represent both a system and a type of application. The typical cloud consists of a data center where the provider is able to store the data in a centralized location (Kandukuri, Patur and Rakshit, 2009). Cloud computing is able to reduce the costs of IT maintenance by shifting the location of the computing infrastructure from a decentralized structure to a virtualized environment (Vaquero, et al., 2008).

Leimeister, Bohm, Riedl, Krcmar (2010) have summarized available definitions of cloud computing to come up with the following definition: The cloud is a dynamic provision of services on a network that is provided on demand and is priced according to the use. The authors also added that cloud computing is based on virtualized resources, applications, and data that is delivered via the internet.

2.2 Key Features of Cloud Computing

The key features of cloud computing include on demand service, user friendliness, relative advantage, complexity, and compatibility. On demand service refers to cloud computing's ability to deliver the right balance of productivity, collaboration, and innovation that lead to profitability (Boss, Malladi, Quan, Legregni, Hall, 2007). Buyya, Yeo, Venugopal, Broberg and Brandic (2009) stated that on demand service means being able to deliver computing resources anywhere anytime in the world independently of human interactions. One of the strongest assets of the cloud is its ability to provide a personal resource collection based on specific service level agreements to customers that can be accessed anytime and from anywhere (Buyya et al., 2009).

User friendliness characteristics of cloud computing refers to how simple it is to use the system. Vaquero, et al., (2008) suggested that the cloud growth is based on the cloud's ability to be user friendly. In a comparison to grid computing, the authors noted that this ability of the cloud to hide deployment details further lends to its ease of use. The author concludes by explaining that grids are complex, invasive and management intensive tools as opposed to cloud computing being a simple and externally managed system.

The relative advantage feature of the cloud refers to the value at which the technological result is perceived to be better than other technological approaches (Yang, Kankanhalli, Boon-Yuen and Lim, 2013). Most businesses prefer the cloud because it is easily generalizable and available on demand for use via the Internet resources. Relative advantage of the cloud leads to improved inter-business communication, better customer business relations, and efficient business interactions due to mobilized access to business information (Low et al., 2011). Low, et al., (2011) suggests that relative advantage is one of the reasons companies choose to adopt and

utilize the cloud. Empirically, Low et al., (2011) found that relative advantage was a major factor in the adoption of cloud computing.

Complexity is assumed to be present when the innovation being used is assumed to be difficult to understand (Yang et al., 2013). The complexity of a technology can serve as a barrier to adoption (Low et al., 2011). When tested empirically, Low et al., (2011) found complexity not a determining factor in cloud computing adoption. The cloud popularity also speaks to its ability to provide intricate systems without appearing to be too complex to the user (Vaquero et al., 2008, Zhang, Cheng and Boutaba, 2010).

Compatibility is the degree to which the technology used fits with the potential cloud computing adopter's values, previous business practices, current and future needs. Wang, Wang and Yang (2010) stated that compatibility is an essential factor for innovation adoption. A technology that is compatible is easily adoptable to the firms because this signifies that the adoption of the technology will not require major adjustments that involve time and money (Low et al., 2011).

In the following section, cloud computing research studies are reviewed and elaborated.

2.3 Cloud Computing Research

Research studies in cloud computing have been led mostly by cloud computing vendors. The literature therefore tends to stress the technical side of cloud computing (Leimester et al., 2010) more than the business value of cloud computing (Iyer and Henderson, 2010). A summary of these research studies are provided below.

Acknowledging the cloud's new role as a leading technology, Leimeister, et al., (2010) reviewed the existing definitions of cloud computing and provided a new comprehensive definition. Unlike the literature in the area which focuses on technical aspects, the authors

highlighted the business opportunities the cloud provides. They showed that, based on prior studies, cloud computing's success rests on its ability to be scalable to satisfy the user's needs and to be able to offer flexible pricing mechanism based on its usage. Referring to the cloud as an IT outsourcing model, Leimeister et al., (2010) state that cloud computing should provide on-demand service, online delivery of scalable IT services that utilizes virtual technology, and a pay-per-use pricing system. The authors also offer a conceptual picture of the factors that create a successful cloud computing system. These include a distributed computing infrastructure and applications services. This study was effective in extending the prevailing technical literature of business opportunities and demonstrating the need for understanding the business value of cloud computing.

Iyer and Henderson (2010) provide seven cloud computing capabilities and encourage IT leaders to use these capabilities to generate winning business strategies. These capabilities include: controlled interface, location independence, sourcing independence, ubiquitous access, virtual business environments, addressability and traceability, and rapid elasticity. Cloud computing's ability to be adjusted to meet the users' needs is what the authors referred to as controlled interface. Location independence addresses the cloud computing's ability to provide services and information resources from anywhere without paying attention to the originating location. Sourcing independence allows the firm to control access to services. Sourcing independence also gives the adopting firm the freedom to switch providers when necessary. The ability to provide any company data or service via a web browser is what the authors referred to as ubiquitous assets. The virtual business environment refers to cloud computing's ability to provide a suite of integrated applications and tools to complete a specific business task. Addressability and traceability refers to the data and resources made available to a business that

can be easily tracked. The ability to verify the history of usage of data and computing resources allow the company to comply with internal and external constraints. Rapid elasticity addresses the ability the customer has to rapidly change either up or down their amount of usage. Iyer and Henderson (2010) concludes by suggesting that the cloud should not be observed as only an IT cost saving venture, but also a business opportunity for collaboration that can improve innovation.

Marston, Li, Bandyopahyay, Zhang, and Ghalsasi (2011) examine the power of cloud computing from a business consumer's perspective using the strength, weakness, opportunities and threats (SWOT) analysis. The authors suggested that the strength of the cloud comes from its ability to handle a spike in usage, without incurring additional service costs. Another strength suggested was its ability to maintain lower IT costs. A major weakness of the cloud, according to the authors, was big businesses not being able to trust the cloud due to its infrastructure and security needs. Marston et al., (2011) concluded by stating that opportunities for cloud computing were numerous, one argument was that the cloud was a huge benefit to small businesses because it allowed the businesses to exploit high end applications.

Smaller companies benefit from shared computer resources that would normally be available only to large corporations. The ability to process at high speeds and the additional data usage are resources that the cloud makes available. Marston et al (2011) suggests that all of the computing resources do not share the same security or standard requirements. This poses a threat to large corporations that share vital information over the cloud. The authors state that regulation is needed for the cloud to succeed. The regulation would guarantee the standards that all the computing resources operate at the same level with regard to security and management.

In another study, Khan and Malluhi (2010) addressed the difficulties businesses face in trusting the cloud. Issues such as lack of transparency, lack of trust in cloud computing and diminishing control, plague businesses that adopt cloud. Lack of transparency, lack of trust, and diminishing control, Khan and Malluhi (2010) explained stem from the cloud computing architecture. Many vendors are concerned about the thought of critical data saved on multiple unknown resources. Because the cloud user does, not know where critical data is being stored, the lack of transparency becomes a major issue. Many businesses are uneasy with the thought of losing critical data to third parties. Often the third parties are located in various countries. The authors surmise that these security issues along with any other issues that evolve can be eliminated with better encryption techniques and better security practices (Khan and Malluhi, 2010).

Chang, DeRoure, Wills, and Walters (2011), observed the process necessary to achieve good cloud computing design, deployment, migration and services noting that these four factors lead to elevated business performance. First, addressing the many reasons why companies use cloud computing, the authors explain that measuring the business performance of cloud computing as in any other information technology is challenging. Organizational Sustainability Modeling (OSM) was suggested as a new way to quantitatively measure the business performance of cloud computing. The study looks at two case studies and review lessons learned from two companies' (SAP and Vodafone) adventures with adopting cloud computing to provide web services.

Cloud computing has already proven that its adoption has the ability to provide the adopting business IT value (Chang, Walters, and Wills, 2013). However, in order for a company to get the best use of cloud computing a business framework should be implemented. The

framework suggested by Chang, Walters, and Wills (2013) addresses the design, deployment, migrations, and services provided by the cloud. Empirically testing the framework, allowed for the authors to address strategic and operational issues with cloud computing implementation while proving that the framework suggested is versatile and productive to lead to a business' main goal of higher revenues and IT benefits (Chang, Walters, and Wills, 2013).

Sultan (2010) states that cloud computing will be used in education because implementation and maintenance costs of the cloud are low. The author showed that the cloud provided an opportunity for an institution to impart education in a more efficient manner. The use of the cloud, proved to be beneficial to the institution but concerns remain about control, performance, security, privacy, and reliability of the cloud.

Ercan (2010) also addressed how cloud computing can be a significant alternative for educational institutions. The cloud's ability to quickly and economically provide applications and platforms through the internet on demand makes life easier for students, administration, and faculty. The author added that cloud computing also add advantages to staff by taking away some of the responsibilities of maintenance at the university. Global platforms allow for the elimination of licenses, reduced costs, and less scalability. Ercan (2010) adds that there are disadvantages, however, based on the study presented.

Another cloud computing study that focused on education was a study conducted by Mousannif, Khalil and Kotsis (2013) that highlighted the potential benefits of cloud computing on educational institutions. The highlighted benefits include the ability of the cloud to provide student and staff with software and hardware resources needed to impart education. This includes providing researchers and postgraduates with the required special software and hardware needed to conduct research and deliver to web developers the developmental tools

needed to design, edit, and host web applications. The authors conclude by suggesting that educational institutions should build a private cloud and advertise its offerings to the students and staff.

Cloud computing calls for several technologies and architectures to work together to ensure that virtualization is operational. Mishra, Mathur, Jain and Rathore (2013) suggest that cloud's virtualized experience maintains accountability while removing control to a virtual environment which allows the sharing of work responsibility. The authors suggest that the virtualized experience allows users to share resources and operate in an online environment. The authors further state that because the cloud takes advantage of virtual resources it is exposed to new security issues. The authors put forth a cloud architecture that allows the cloud to operate in a secure environment. The authors conclude by stating that, despite the secure architecture, it is important for customers to take precaution to protect their data and computing resources in order to ensure that their cloud environment is secure.

Etro (2009) investigated the economic impact of gradually introducing cloud computing to business creation, employment, and competition in Europe. The author first examines if the use of cloud helps generate competition during the introduction of a business. This competition is expected to promote business development and profits. Etro (2009) used a dynamic stochastic general equilibrium model to prove that cloud computing indeed has a positive effect on business creation, GDP, and employment.

Human resources (HR) departments are often neglected due to lack of funds and lack of understanding of the benefits that HR provides to an organization. Datta, Islam, Mukheyee, and Kander (2012), suggest a cloud-based HR management application. If the business

acknowledges that the employee is an asset, then they should champion a technical system that compliments effective solutions, efficient working practices, and thorough HR analysis (Datta el al., 2012). The authors believe that a cloud-based HR management application would dedicate resources toward HR solutions. In conclusion, the authors determined that developing a cloud-based application specific to a business entity would allow the business more opportunity to grow in the HR area which should lead to an overall business growth.

Relocation of data, control of data loss, management of cloud systems are just some of the issues that Ercolani (2013) discusses in his research. The author suggests that one cannot understand the potentials of cloud computing in specific software as a service (SaaS) (a type of cloud computing software) without some working knowledge of the benefits provided by the software and the issues involved in delivering the software. The benefits provided include: easy to deploy, easy to maintain, and always functional, to name a few. The integrated top down selective analysis for adopting SaaS is also a benefit for the consumer considering the adoption of cloud computing. The analysis provides a check list of topics that focuses on when an adoption decision to be made on the type of the cloud and the cloud provider. The analysis uses a system of weight and rating, where the importance of the benefit or the issue is analyzed and scored. The author believes despite the fact that the analysis has not been empirically tested the evaluation that lends to efficient cloud computing adaptation.

Enterprise Resource Planning (ERP) has carved its way into industry as a universally accepted solution to achieve integrated enterprise information systems. Parthasarathy (2013) states that it is logical for ERP to be cloud based for cloud based systems allow customers to focus on the business task while being able to obtain all needed IT functions as a service. Parthasarathy (2013), in a book chapter, discusses the issues related to ERP and cloud ERP

systems from three perspectives: organizational, business, and technological. The author first examines organizational issues by discussing the change in architecture. Stating there is no need for the organization to build browsers and storage areas as before, now most of the tasks are done by the cloud. The business aspect is addressed by strategy and innovation, where Parthasarathy (2013) explains that the business must now assume the responsibility for understanding the business possibilities in cloud computing and use as the best strategy. The technological issues such as maintenance of hardware, demonstrating how the use of the cloud shifts the responsibilities of maintenance from the business IT support team, to the cloud. The object was to assist top management with deciphering the best options for deploying cloud-based ERP computing systems. This was done by reflecting over means for minimizing risks and taking advantage of the benefits. Parthasarathy (2013) summarized a case study that demonstrated how a cloud-based ERP can be implemented and maintained efficiently.

2.4 Event Study Research in Information Systems

Event studies have been used extensively in information systems literature to evaluate the efficiency and effectiveness of information systems investments. Stock market reactions to topics such as IT outsourcing, IT investments, information security and privacy breaches, adoption of enterprise resource planning (ERP) are just a few areas that researchers have investigated. This section of the present research reviews event studies from information systems literature in general. This is followed by a discussion of two studies that evaluated the impact of cloud computing on the market value of firms (Parameswaran, et. al., 2011; Huntgeburth et al., 2013).

Garg, Curtis, and Halper (2003) identified information security breaches on 49 publicly traded businesses and conducted an event study to assess the financial impact of these breaches

on the market value of the breached firms. The authors found that, using a 2-day and a 3-day event window resulted in overall the negative market reaction to these breaches. More specifically, Garg et al., (2003) found that security incident costs companies between 17 and 28 million dollars per incidents. The authors further divided the data by the type of industry. The authors found that the market reacted differently to different types of industry.

Campbell, Gordon, Loeb, and Zhou (2003) conducted an event study using 3-day event window [-1, 0, +1] on US publicly traded firms. The security breaches were posted on newspapers. Unlike Garg et al., (2003), Campbell et al., (2003) did not find a significant market reaction to the security breaches. The authors, however, did find a highly significant negative effect due to security breaches that were caused by unauthorized access to confidential data, this proves that investors view security breaches more severely than other breaches.

Hovav and D'Arcy (2004), using a sample of 186 virus attack announcements, examined whether these attacks had an effect on the market value of a firm. Using varying event windows, [0, 0], [0, 1], [0, 5], the authors found that virus attacks did not yield negative abnormal returns. The authors concluded by suggesting that further research is needed to explain the risk associated with security breaches.

Acquisti, Friedman, and Telang (2006) investigated privacy breaches impact had on the market value of the firm. The authors defined a privacy breach as hacking, stolen or lost equipment, and poor data handling processes. The Acquisti et al., (2006) study extended the breach studies area by investigating the impact on the market value of the firm based on the type of industry, channel of the announcement, severity of the breach, and the size and type of the firm. Using a one day event window, the authors found a significant negative impact of data

breaches on a firm. The abnormal returns increased in magnitude on the days following the breaches and eventually decreased and lost statistical significance.

Konchitchki and O'Leary (2011) summarized different types of event study methodologies used in the past and suggested techniques that can be used in future event studies in information systems. The authors found that most studies used LexisNexis as the source for the announcements, utilizing an event window of [-1, +1], and had varying sizes for the number of announcements. The authors also noted that the longer the event window was, the more difficult it was to ensure the market influence was due to the event. The authors concluded that overall event studies have made a significant contribution to the information systems research area.

Hayes, Hunton, and Reck (2001) studied the impact the enterprise resource planning (ERP) systems adoption announcements had on the market value of 91 firms that adopted ERP systems. Using different event windows, the authors found that overall there was a significant impact on the market value of the firm due to these announcements. The authors divided the firms into small and large groups and found that the impact was greater for smaller firms (Hayes et al., (2001). This study demonstrates the importance of using the firm size as a factor in the event study research.

Jeong and Stylianou (2008), along the same lines, examined the impact that applications service provider (ASP) adoptions may have on the market value of the firms. The authors examined 268 ASP adoption announcements between 1998 and 2007, using a three-day event window [-1, 0, +1] and found that the market reacted positively to these announcements. The authors further determined that the market reacted differently based on the firm size, industry, and ASP vendor status. ASP adoptions were, for example found to affect the larger firms more

than the smaller firms. The ASP announcements also weighed heavily on the market for IT and healthcare industry firms. In addition the authors also found positive significance for firms announcing adoption of ASP with market leading vendors.

Jeong and Lu (2008), in a similar study, examined the impact of radio frequency identification (RFID) investment announcements on the market value of 128 firms. The study utilized a 6 year data collection period (January 2001 – December 2006) and a three-day event window of [-1, 0, +1]. The market showed positive returns for early adopters of RFID. These results demonstrated the importance of reviewing new technology continuously and evaluating the benefits and risk in relation to the firm.

Defond, Konchitchki, Mcmullen and O'Leary (2010) explained that prior research studies that investigated the business value of knowledge management had yielded ambiguous results. The authors investigated the impact of knowledge management on business value by using winners of the "Most Admired Knowledge Enterprise" (MAKE) award. Defond et al., (2010) used a 5-day event window observing 2 days before the event and 2 days after the event [-2,-1, 0,+1,+2]. The authors found that there was a positive market reaction for MAKE winners.

2.5 Event Studies on Cloud Computing

Unlike other technologies, the impact of cloud computing has not yet been fully explored. Cloud computing adopters cite a number of benefits including business agility and cost savings for adopting the cloud, but empirical evidence to verify these claims are lacking. There have only been three studies (Parameswaran, et al., 2011; Parameswaran, et al., 2012; Huntgeburth, et al., 2013) that examined the market value of cloud announcements on publicly traded companies, these studies are discussed below.

Parameswaran, Venkatesan, Gupta, Sharman, & Rao (2011) conducted an event study using businesses that adopted cloud computing to validate aforementioned assertions. More specifically, the authors assessed the impact of cloud computing announcements on the market value of the firms that adopted the cloud using 383 cloud computing announcements obtained from the adopter's press releases and news websites. Multiple event windows were used, (-1,1), (-1,2), (-1,3), (-1,4), (-1,0), (0,+1), (0,+2), (0,+3), to conduct this research. The authors found a significant and positive impact of cloud computing announcements by these firms when the vendors' and adopter's cloud data were examined collectively. A positive impact of vendors' announcements was also found on adopters' market value. The cloud computing announcements of adopters, however, did not significantly impact the stock prices of the adopters in the short run using, the smaller event windows.

Building on their previous study, Parameswaran, et al., (2012), explores the impact of cloud computing security announcements on the market value of firms. Using 214 cloud security announcements and multiple event windows, (-1,0), (0,+1), (0,+2), (0,+3), the authors found that even positive cloud computing security announcements generated a negative impact on the market value of the adopting firms.

Huntgeburth, et al., (2013) investigates whether the use of cloud computing actually improves the financial outcome of a firm. More specifically, the study reviews factors that lead to the success of cloud computing, adoption on firm value, firm size, industry type, innovativeness, strategic intent, and innovation timing. The event study methodology was used to analyze the impact of 65 cloud computing deployment announcements. The results showed, with an event window of [-1, +1], significant abnormal returns on the aforementioned factors between the years 2008-2010. In conclusion, Huntgeburth et al., (2013) recommended a

research that would investigate the financial impact of cloud computing using a different methodology such as return on assets (ROA).

As can be seen from the antecedent paragraph, the results from the event studies are mixed. Because of the mixed results and following the suggestion put forth by Huntgeburth et al., (2013), the present research investigates the impact of cloud computing on firm performance. In the next section of the dissertation research, firm performance is also discussed, and this is followed by a review of firm performance in the information systems literature.

2.6 Firm Performance

The performance of a firm has long been used as a measure of the firm's market value. Defined as the outputs or results of a firm as measured against its intended outputs, firm performance consists of different measures such as financial firm performance and market firm performance. The present research focuses on financial performance.

The motivation behind examining the performance of a firm that adapted cloud computing is to argue that the adoption of cloud computing positively affects firm performance. This positive affect can lead to the enhancement of the business and the creation of new business opportunities. The impact of cloud computing announcements on financial measures will assist managers and investors with financial information needed to make sound business decisions. The present research uses return on assets (ROA), return on sales (ROS), and selling goods and administration (SG&A) to measure internal performance of a company after it has made the cloud computing adoption announcement.

According to recent research by the US government, the cost of using cloud computing is two-thirds less than the cost to use any other IT infrastructure (Alford & Morton, 2010). For this

reason alone, multiple firms have chosen to enter the world of cloud computing with hopes of improving the service delivered to their customers while improving their financial outlook.

In the next section of the dissertation, research studies that used firm performance as a measure to determine if technology plays an important role in improving this performance are discussed.

2.7 Firm Performance in Information Systems

Business value stems from the correlation of the impact of IT investment on firm performance (Melville, Kraemer & Gurbaxani, 2004). Significant progress has been made that shows that IT investments have a strong impact on firm performance (Brynjolfsson, 1993; Brynjolfsson and Hitt, 1998; Edvinsson and Malone 1997). Multiple studies have utilized resource based view as a theoretical framework to investigate the IS and firm performance relationship (Barney, 1991; Barua, Konana, Whinston, & Yin, 2004; Bharadwaj, 2000; Sambamurthy, Bharadwaj, and Grover, 2003; Wernerfelt, 1984). Others have used theories such as knowledge based view (Grant, 1996; Kearns and Sabherwal, 2007) and the concept of fit from information process theory (Kim et al., 2006). In this section of the literature review, studies that use resource based view and demonstrate how the use of IS improves a firm's performance are discussed.

A firm's resources can include multiple items, assets, and capabilities, as well as knowledge. In a recent study, Barney (1991) used resource based view of the firm to suggest that firms can achieve competitive advantage using its resources. Barney introduced four indicators of resources: valuable, rare, not easily imitated, and usable across the firm. These attributes, according to Barney (1991), afford a firm a competitive advantage, at least for a period of time. The firm then becomes responsible for sustaining the competitive advantage for

longer periods by protecting its resources from its competition. Barney (1991) introduces and tests a model using the attributes stated above against several firms' resources, testing sustainable competitive advantages. Barney's (1991) model suggested that an IS investment that is valuable and rare, not easily imitable and usable across the firm can lead to improved firm performance. The present research argues that the ability of cloud computing to provide information systems at a low cost, with limited resources needed from the firm, will serve as a resource to the adopting firm.

Wernerfelt (1995) stated that the resource based view is a useful tool for viewing the resources of a firm. However, the resources will have to be clearly defined. The author also noted that values of resources change. It is therefore, extremely important to study the effects of different resources. Once the resources are valued, Wernerfelt (1995) predicts it would be easier for firms to have different strategies on different resources and it will assist in showing the differences between firms.

One of the most compelling information systems research studies was conducted by Hitt and Brynjolfsson (1996). The study dubbed the productivity paradox and examined the controversy between IS business value and firm performance. The authors attempted to model the right practice to use when determining IT business value by examining the relationship between IT stock and profitability ratios. The ratios used were return on assets (ROA) and return on equity (ROE). The positive results of ROA implied that benefit to firm performance was demonstrated along with an increase in consumer surplus. No relation was however, demonstrated, between IT stock and ROE.

Tam (1998) extended the Hitt and Brynjolfson (1996) study by examining the relationship between IT stock and profitability ratios in four newly industrialized Asian countries

(Hong Kong, Malaysia, Singapore, and Taiwan). The affect was measured using ROA, ROE and return on sales (ROS). The authors found a positive relationship for ROE and IT stock in Taiwan while a negative relationship was demonstrated between IT stock and ROS in Hong Kong. Tam (1998) demonstrated through his research that IT investments affect firm performance across national boundaries.

Another study that examined financial performance using a resource based view was conducted by Bharadwaj (2000). In this study, Bharadwaj (2000) posed that IT becomes a resource when it is observed as a capability. In order to assess the relationship between IT capability and firm performance, the author used a matched-sample comparison method to calculate the average ROA. This method required the pairing of firms of the same industry and size with the assumption that operating performance is different in different industry. The results validate that firms with high IT capability perform better than similar firms in a similar industry using a variety of profit and cost-based measures (Bharadwaj, 2000).

Poston and Grabski (2000) examined the effect of ERP on a firm's performance. The authors used various financial ratios such as SG&A and cost of goods sales (COGS). They found increases in SG&A and COGS sales the year after ERP implementation and a decrease in COGS three years after ERP implementation. They also found a significant increase in costs as a percentage of revenue but a decrease in the number of employees as a percentage of revenue the year after the implementation of ERP.

Dehning and Stratopoulos (2002) used ROA, ROS, and an efficient measure total asset turnover (TAX) to evaluate the relationship between IT enabled strategies and these profitability and efficiency ratios. Stratopoulos and Dehning (2000) in an earlier study found that the center on wealth and philanthropy (CWP) 100 companies that implement an IT-enabled strategy have

an accounting advantage against their competitors. The authors argue that this advantage is only demonstrated with the correct evaluation. More specifically, the study found that CWP100 companies have higher ROA and TAX for all 7 years, while ROS is higher for 4 years out of the 7 years.

Ravichandran and Lertwongsatien (2005) used resource-based view to decipher the reason why some companies reap better success in business performance due to IT investments than others. The authors' assumption is that firm performance can be explained by how effective the firm uses IT to meet its core needs. Using 129 firms based in the U.S., Ravichandran and Lertwonsatien (2005) suggest that IT assets could have direct effect on firm performance using RBV. To prove this the authors propose a model that uses RBV and interrelates IS resources, IS capabilities, as well as IT support for core responsibilities and firm performance. Ravichandran and Lertwongsatien (2005) used rate of return ratios such as return on assets (ROA) and return on sales (ROS) as indicators of operating performance. The result is a conceptual foundation that yielded a 10% variance for ROA and linked IS activities to firm performance. The authors closed by encouraging the development of future studies to empirically test the model from a resource based perspective (Ravichandran and Lertwongsatien, 2005).

Dewan, Shi & Gurbaxani (2007) empirically demonstrate that IT investments are considerably more risky than non-IT capital investments and that IT investment are linked to a substantial premium. The authors, using return on equity (ROE), show that roughly 30% of the gross return on IT investment corresponds to risk premium. The authors' evaluation suggests new insights into the value derived from making IT investments. Dewan, Shi & Gurbaxani (2007) suggest that managers should evaluate the value of IT investments at a delayed rate.

While prior information systems research has shown a positive relationship between information systems in general and firm performance, the present dissertation research focuses on a specific type of information system namely cloud computing. By testing the relationship between cloud computing adoption and firm performance, the present research focuses on the impact of cloud computing on the performance of a firm.

In summary, companies have adopted the cloud with the hope of reducing the cost of the company IT while increasing the business performance globally. The research on the impact of adopting cloud computing as can be seen from the aforementioned discussion are not conclusive and, as such, have not been very helpful to academia or industry. The present research using an event study provides a more definitive answer to the question of whether the cloud computing announcements by a company enhance its market value. It is understood that two event studies have already been conducted in the cloud adoption area but these studies are not comprehensive in the sense that they do not include abnormal trading volume and abnormal risk nor do these use ROS, or SG&A. It is expected that, inclusion of these ratios will provide comprehensive insights into the impact of cloud computing adoption announcements by a publicly traded company on the market value of the company.

In the next section, a theoretical framework and hypotheses for the present research are provided.

Chapter 3: Theoretical Framework and Hypothesis Development

The last five years have seen a great increase in cloud computing investments. Globally companies have adopted the cloud with hopes of improving the effectiveness of the companies while reducing the cost of conducting business performance. It is important for us, as such, to ascertain whether there is a benefit from adopting cloud computing using appropriate theory and literature support.

This dissertation research uses the performance of a firm, which has long been used as a measure of the firm's market value. The motivation behind examining the performance of a firm that adapted cloud computing is to scrutinize the value effects that the cloud computing investment brings in to the firm. In the next section, a theoretical framework for the present research, using resource based view (RBV) and efficient market hypotheses (EMH), is provided.

3.1. Resource Based View

The resource based view (RBV) of the firm is influenced by the ground breaking work of Penrose (1959). Penrose (1959) posed that the reason why firms diversify across industries is because they have excess resources that they can use in the production of related products. Therefore, multi-product firms can benefit from a less costly practice of using one resource to generate two or more product lines. Willig (1979), in a later study, added that the excess capacity either come from sharing a resource or from human capital.

The resource argument was redefined by Teece (1980). Teece (1980) stated that, in the case of market imperfection, the use of resources to produce multiple products within a firm provides the firm competitive advantage. In a perfect scenario industrial diversification would not be more beneficial to a firm that produces a single product. Market failures such as these are results of poor use of resources, such as poor contracts and lack of organizational knowledge.

The items that are considered intangible assets are not easily replaceable. Teece (1980), however, noted that imperfect tradability is a characteristic that makes a resource a source of a firm's sustained competitive advantage. The resource also qualifies for being strategic to a firm (Amit and Schoemaker, 1993). This strategic asset can be referred to as a set of difficult to trade and imitate resources that provide a firm's competitive advantage

RBV is derived from the strategic management theories, organizational economic theories, and the industrial economic viewpoint. Strategic management requires the firm specific strategies to gain competitive advantage. RBV combines all three types of aforementioned theories to develop a generalizable theory that can lead to the growth and development of a firm (Mahoney and Panidan, 1992).

RBV lends to the idea of gaining superior financial performance based on a firm resources or capabilities. Although it is believed that IT is instrumental in a firm's growth and survival, it still has not been proven that IT is linked to firm performance. Bharadwaj (2000), however, explains that case studies and evidence prove that IT is a key factor in making a firm successful. Bharadwaj (2000) empirically investigated firm performance based on the use of IT as a capability and determined that IT capability significantly impacts firm performance.

RBV posits that a conventional firm's resource becomes the knowledge of the employees and the common practices of the firm (Subramani and Walden, 2001). Despite the considerable challenges conventional firms experience when posed with the opportunity to use the Internet to gain a competitive advantage (Subramani and Walden, 2001), literature suggests that the internet has served as a resource to many businesses.

The first known RBV study was in the field of strategy management. Wernerfelt (1984) discusses dualistic reasoning economics. The premise of this study was to demonstrate that it is

possible to restate a theory developed for one discipline with concepts and ideas developed from another discipline. Wernerfelt (1984) attempts to develop a theory of competitive advantage based on the firm resources. The approach to developing a theory of competitive advantage in the work assumes that a firms profit is in its strategic use of its resources (Wernerfelt, 1984). The primary contribution was noting that competitive advantage based on resources is earned when a firm's resources are governed strategically.

If the resources are viewed as capabilities, then the firm's use of the resources become its competencies; IT can then be examined as a broader functional capability (Bharadwaj, 2000). Various IT studies have demonstrated how IT resources deliver competitive advantage. Mata, Fuerst, and Barney (1995) pose that managerial IT skills can be used as a resource and eventually lead to sustained competitive advantage. Another study, an example of IT being used as a resource, was conducted by Chatfield and Bjorn-Andersen (1997). The authors used a case study to investigate an organizational system used for Japan Airlines. The study observes that the system is a physical resource and that the system's users are human capital resources.

The present research applies RBV to better understand how companies can use cloud computing to gain competitive advantage and financial profit. The primary role of an information system is to create business value. Thus an IT that has the ability to create competitive advantage and help a firm gain financial profit will be looked at favorably. As mentioned earlier, cloud computing allows easy deployment, access to large amounts of data, and access to computational resources. This makes cloud computing a resource for both the provider and the consumers. These are also understood as the means cloud computing uses to obtain financial gains that lead to a competitive advantage.

RBV emphasizes the use of internal sources to garner competitive advantage and create new opportunities. Cloud computing can be and should be considered a crucial internal source. This makes RBV a good theoretical basis for understanding the financial effects of adopting cloud computing. The next couple of paragraphs show how other researchers have applied RBV to use existing IT capabilities to gain financial advantage.

RBV views strategy as the capability of firms that enable them to generate a sustainable competitive advantage (see figure 3-1). Borrowed from the strategy literature, RBV suggests that the ability of a firm to earn a profit depends on two factors: the attractiveness of the industry the firm is in and the firm's ability to gain the competitive advantage over rivals (Grant, 1991). Bharadwaj (2000) suggests that firms compete on the basis of unique firm resources. The resources are generally valuable and difficult to imitate; however, the resources must be used towards achieving the business strategy. The difference in strategy is what leads to the firm being able to gain the competitive advantage (Barney, 1991).

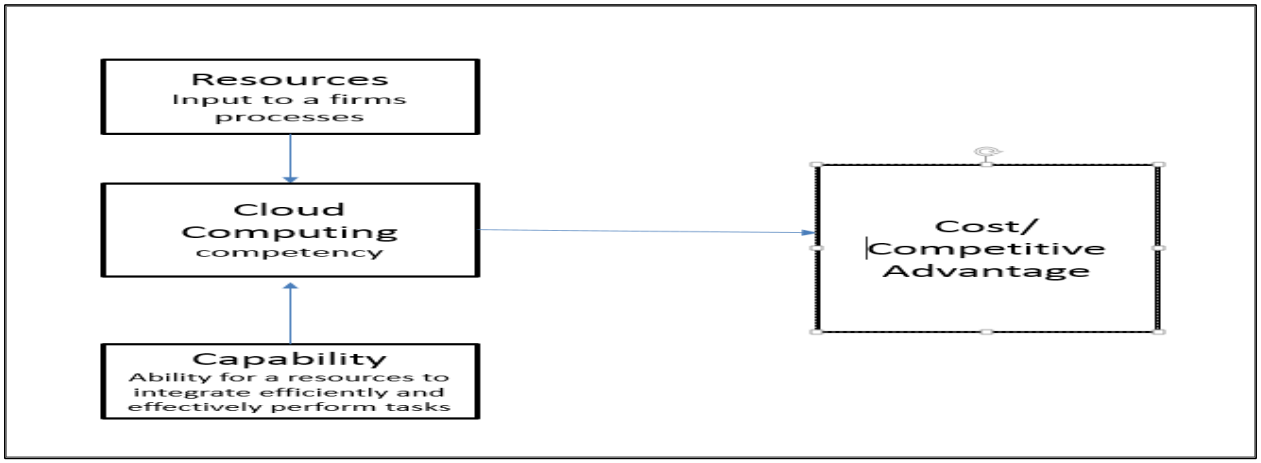

Figure 3-1: Resource Based View

RBV encourages the use of IT and processes affiliated with IT to demonstrate how the resource can be used effectively to create business value. The present research uses the event

study methodology to measure business value. The next section of the present research discusses Efficient Market Hypothesis, a theory commonly used with the event study.

3.2 Efficient Market Hypothesis

Fama &French (1996) posit that there are firm characteristics that are related to average returns on common stocks, and the one factor model does not take care of these. Fama &French (1993, 1996, and 2004) argue, therefore, that the expected returns of a firm should also consider the firm size and the firm value. The authors claim that the inclusion of these two additional factors to the original one-factor market model will better account for the variability of firm returns.

The firm size is operationalized using the market capitalization of the firm, and the firm value is measured by the book to market ratio of the firm. In the present research, the Fama and French three-factor model is used to provide a more robust testing for the hypotheses.

$$r = R_f + \beta_3(K_m - R_f) + b_s * SMB + b_v * HML + \alpha$$

Where r = return

$\boldsymbol{R_f = is\ the\ risk\ free\ return\ rate}$

$\boldsymbol{K_m = is\ the\ return\ of\ the\ whole\ stock\ market}$

$\boldsymbol{\beta_3 = the\ three\ factor\ \beta}$

SMB = Small Minus Big
HML = High Minus Low

Equation 3-1

Hypothesis 1 states that the stock market reaction to a publicly announced adoption of cloud computing will result in positive cumulative abnormal returns. The hypothesis draws on the market adjusted model and the Fama-French three-factor model. The efficient market hypotheses, was used as the theoretical rationale for this hypothesis. The model is provided next followed by the literature support.

Efficient market hypotheses (EMH) hypothesize that the prices of securities reflect all known information about the stock. Market participants can, however, interpret the information differently as such price fluctuations are random and may occur at any time. Fama (1965) argues that in an efficient market there exist many informed investors who will make informed decisions based on present and future expected events.

EMH is the foundation for event study analysis. The event study's main focus is to test a null hypothesis that theorizes that markets are efficient, as stated by Fama (1970), and to examine the impact of a specific event on the market value of a firm (Binder, 1998). The impact of the specific event is commonly referred to as the abnormal return. The next section discusses abnormal returns.

Market Adjusted Returns

The impact of cloud computing adoption on the market value of a firm is measured by abnormal returns. There are three common procedures used to calculate abnormal returns: mean adjusted, market adjusted and the market model. The market model is the most commonly used procedure. The market model controls the historical relationship between the abnormal returns for a firm, with the daily abnormal return. The market adjusted returns are the difference between the firm's abnormal returns and the daily abnormal return. Though different in execution, the statistical results provided by mean adjusted and market adjusted model are often similar (Agrawal & Kamakura 1995). Market adjusted returns are easier to compute and, therefore, used by a growing number of studies.

The market model is based on the Capital Asset Pricing Model (CAPM). The estimation of expected return uses Ordinary Least Squares (OLS) regression. OLS is used on all the companies included in the present research. Equation 3-2 shows the daily returns where the

dependent variable is the return for stock (i) at time (t) and the independent variable is the market index for the same time (t).

$$\boldsymbol{R_{i,t}} = \boldsymbol{\alpha_i} + \boldsymbol{\beta_i R_{m,t}} + \boldsymbol{e_{i,t}}$$

where $\boldsymbol{R_{i,t}}$ is the return for firm i on day t,
$\boldsymbol{R_{m,t}}$ is the return on the market portfolio on day t,
α and β are parameters in the model and
$\boldsymbol{e_{i,t}}$ is the error term.

Equation 3-2

Fama & French Theory

Early evidence of stock price fluctuations was understood to be occasional instances of price behavior, where certain fluctuations followed certain predictable paths (Kendall 1953). Fama (1965) introduced the idea of randomness to stock price and market value. With a better understanding of price randomization, Fama (1970) produced a comprehensive review of the theory and evidence of efficient market hypothesis.

The development of EMH led to Fama & French (1996) postulating that there are firm characteristics that are also related to average returns on common stocks. Fama & French (1993, 1996, 2004) suggest that the expected stock returns of a firm should also consider the size of the firm and the firm value in order to better reflect the market. The authors claim that inclusion of these two factors to the original one-factor market model better explain the variability of the firm returns. The firm size is operationalized using the market capitalization of the firm and firm value by the book-to-market ratio of the firm. In the present research, the Fama and French three-factor model is used for estimating abnormal returns. The Fama-French 3-factor model is used in the present research because it has shown in the past to provide a more robust testing of the hypotheses.

Abnormal Returns

A minimum of 255 days were used for the estimation window. The estimation window begins 255 days just prior to the day before the event window [-1, 0, 1]. All 99 firms used in this study have the 255 days of return data as required. Both market adjusted and Fama-French 3-factor models were used to calculate the abnormal return. The Center for Research in Security Prices (CRSP) database was used to obtain the return data which is used as the daily return and value-weighted index which is used as the market index. After the regression analysis is estimated, the abnormal returns are calculated by subtracting expected returns from the observed returns.

$$AR_{i,t} = R_{i,t} - (\alpha_i - \beta_i R_{m,t})$$

where $\boldsymbol{AR_{i,t}}$ is the abnormal is return for firm i on day t.
$\boldsymbol{R_{i,t}}$ is the return for firm i on day t.
$\boldsymbol{R_{m,t}}$ is the return on the market portfolio on day t.
$\boldsymbol{\alpha_i}$ and $\boldsymbol{\beta_i}$ are the parameters estimated in the model.

Equation 3-3

Cumulative Abnormal Return

To manage fluctuation due to leakage, cumulative abnormal returns (CAR) were employed. CAR is the sum of all abnormal returns over the time period used for the event study. The CAR allows the researcher to observe the stock movement for the event period and evaluate how the stock movement is responding to the event (news). Due to information being dispersed over a multi-day period, the abnormal returns may occur over a multi-day period. This means

the cumulative abnormal return (CAR) must account for the idea that the information may not be provided instantaneously. The following model was used to compute the CAR:

$$CAR = \sum_{t}^{t+n} AR_{i,t}$$

where CAR = cumulative abnormal return
$\boldsymbol{AR_{i,t}}$ is the abnormal return for firm i on day t.

Equation 3-4

The CARs are estimated using the market model. The CAPM model, borrowed from Fama & French (2004), is affiliated with abnormal returns. The method used to calculate the abnormal trading volume was provided by Beaver (1968)'s seminal study, which is based on the valuation theory. This is discussed in the next section.

Abnormal Trading Volume

Beaver (1968) derived the idea that investors' reactions to earning announcements are reflected in the trading volume movements of common stocks. Other studies, Kiger (1972) and Foster (1973) shared the same sentiment. Morse (1980) study used both abnormal returns and abnormal trading volume, and stated that this is an important practice because sometimes the price and volume reactions may differ.

Kim and Verrecchia (1991) study examined whether an announcement can affect trading volume and found that trading volume is proportional to the absolute price change and to the measure of precision across traders. Noting that the price change reflects the average change in trader's beliefs due to an announcement where trading volume reflects the trader's reactions. Though they state that an announcement is due to have a large impact on returns, due to the reflection on the trader's belief, Kim and Verrecchia (1991) do acknowledge that it has power on the volume due to the trader's reflections (Kim, O., & Verrecchia, R. E., 1991).

The event study is also used to calculate abnormal trading volume (Chae, 2005). The steps discussed for identifying valid announcement dates are applicable for measuring abnormal volumes. In order to derive the abnormal volume, the present research used the formula shown in Equation 3-5 suggested by Yun and Kim (2010). Yun and Kim (2010) scaled the event daily volume by the average pre-event daily volume. If trading volume in the event period is considered normal, the ratio should equal to one. The following equations were used in order to estimate trading volume (Yun and Kim, 2010):

$$During - Event_{volume,i} = \frac{\sum_{t=-1}^{t=-1} trading\ volume_{i,t}}{3}$$

$$Pre - Event_{volume,i} = \frac{\sum_{t=-255}^{t=-2} trading\ volume_{i,t}}{3}$$

$$Volume_{ratio,i} = \frac{During - event_{volume,i}}{Pre - event_{volume,i}}$$

Equation 3-5

Abnormal Risk

Beta changes are used in the finance and accounting literature as a measure of risk shifts (Patton & Verardo, 2009; Yun & Kim, 2010). This section discusses the process used to estimate the risk incurred as a result of a cloud computing adoption announcement. It is assumed that risk would be higher for firm's announcing cloud computing adoptions as suggested by a number of authors. Subashini and Kavitha (2011), for example, stated that cloud computing risks data being exposed to a number of vulnerabilities. Haeberlen (2010) is concerned about the lack of accountability in cloud computing and recommended the use of a third party for privacy audits. Xiao and Xiao (2013) have identified a number of security and privacy attributes that could be problematic for cloud computing.

Beta changes were calculated using a similar process as explained in the abnormal returns section (see 3.2). A one factor model is employed to estimate the firm's beta 120 days before the one day pre-event day. The same model is used to estimate the beta for 120 days after the one day post-event day. The post event beta is divided by the pre-event beta producing a ratio that should be equal to one if the event had no impact on the risk of the firm.

$$\beta_{ratio,i} = \frac{\beta_{post,i}}{\beta_{pre,i}}$$

where β= Risk
Post = after the event
Pre = before the event

Equation 3-6

Measuring Firm Performance

A key way to understand firm performance is through financial statement analysis. Financial statement analysis uses traditional accounting measures. The present research uses three financial performance ratios to measure firm performance: return on assets (ROA), return on sales (ROS) and selling general and administrative (SG&A). These ratios are used to assess the impact of cloud computing adoption on the financial health of a company. The profitability ratios (ROA, ROS) measures a company's ability to earn a profit relative to its sales investment and equity. In this study, the focus is on whether the investment in computing impacts the profitability ratios. Each of these ratios discussed, ROA, ROS and SG&A are discussed further below.

ROA is often used as a measure of firm performance (Bharadwaj, 2000; Hitt and Brynjolfsson, 1996). ROA is accepted as a common view of operational measure of the efficiency of a firm, and a manner in which to examine the profitable use of its total asset base (Ansoff, 1965; Dess & Robinson, 1984). ROA was selected because it has been proposed that

the use of cloud computing provides improved efficiency, productivity that eventually leads to profitability.

$$\boldsymbol{ROA} = \frac{\boldsymbol{Net\ Income}}{\boldsymbol{Total\ Assets}}$$

Equation 3-7

Return on Sales (ROS), represents a firm's operating profit margin. ROS is often used to evaluate a company's operational efficiency or profitability. ROS is also referred to as income per dollar of sales.

$$\boldsymbol{ROS} = \frac{\boldsymbol{Net\ Income\ (before\ Interest\ and\ Tax)}}{\boldsymbol{Sales}}$$

Equation 3-8

The SG&A ratio is a cost ratio. Cost ratios attempt to examine the relationship between the cost and the benefits of a proposed project. SG&A produces information about the future firm performance. SG&A is directly reported on a firm's income statement and is the sum of all direct and indirect selling expenses. In the present research, there is an interest in the change in SG&A of a company that adopted cloud computing. This is because of this adoption, the company is expected to make more sales of goods and services at a lower cost. The performance before the adoption and the performance after the adoption were used, in the present research, to determine if the firm performance had changed.

3.3 Hypotheses Development

The hypotheses are developed based on the aforementioned theories and literature reviews. Figure 3-2 shows what is believed to be the impact of cloud computing announcements on the market value of the firm.

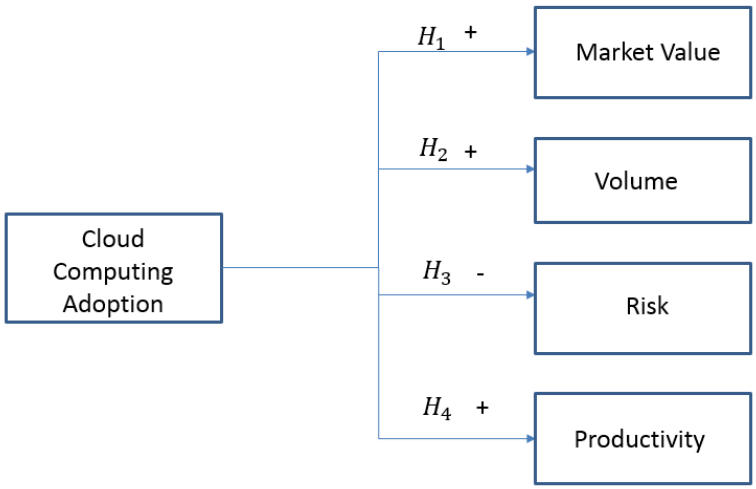

Figure 3-2: Hypothesis development

Hendricks, Singhal, and Stratman (2007) investigated the financial effects of investments in enterprise resource planning (ERP), supply chain management (SCM) and customer relationship management (CRM) on the firms returns. Their goal was to determine whether the use of enterprise systems did bring in profitability to the firm implementing the system. Using 186 announcements, the authors' study yielded mixed results. ERP showed positive abnormal returns, however early adopters of ERP gained more profit than laggards. SCM showed a positive stock return as well. In contrast CRM showed no significant increase in stocks returns. In conclusion, this study demonstrated that the capability for improved profit did not only lie with the enterprise system but also lied with the operational practices of the firm (Hendricks, et al., 2007).

Using the resource-based view, Park, Mezias, and Song (2004) conducted an event study to assess how alliances with e-commerce firms affect firm values in an emerging business sector. The authors explain that forming an alliance with an e-commerce business can enhance a firm's

available resources because it provides the firm with additional opportunities to satisfy customers. For this reason, the study uses alliance strategies as resources and RBV to examine with the effects on ecommerce firms business value. Using four different event windows (-1, 0, +1), (-1, 0), (0, +1), (-1, +1), the authors evaluated 272 alliances of sixty-nine e-commerce firms. Park, Mezias and Song (2004), hypothesized and concluded that alliance strategies significantly and positively affect firm value of e-commerce firms.

Another event study conducted by Uhlenbruck, Hitt, and Semadeni (2006) examined the change in the market value of firms acquiring Internet firms. Uhlenbruck et al., (2006) hypothesized that acquisitions made by offline firms of internet firms and the acquisition of Internet firms by other Internet firms lead to market valuation in a positive manner. It was assumed that acquisitions of online firms create the potential for complimentary resource exchange between the merging firms. Also that online firm can enhance their market value by acquiring other online firms. RBV and organizational learning theory was used to conduct this event study. The authors found that the acquisition of an online firm as an introduction of new technology lead to positive stock market returns.

Based on the aforementioned discussions of the relevant literature, the following hypothesis is proposed:

H_1: Publicly announced cloud computing adoption by a company listed on one of the U.S. Stock exchanges will result in positive abnormal returns.

Abnormal Trading Volume

Most studies are focused on the stock market and how it has impacted stock prices with very little focus on trading volume (Bamber, 1987). Trading volume can also be used as a means for determining investors' reactions to information and can reflect the investors' behavior or trading activity. Some argue that observing the trading volume is a more precise measure than

stock prices. Kim and Verrechia (2001), for example, argue that a firm's stock returns are dependent on trading volume and considering trading activity will, therefore, provide a better understanding of a stock's valuation. Multiple studies have investigated the impact of an event on trading volume. In this section a brief summary of Chatterjee, Pacini and Sambamurthy (2002), Nicholas-Donald, Matus, Ryu and Mahmood (2011) and Joseph, Wintoki and Zhang (2011) studies are provided.

Chatterjee, Pacini, and Sambamurthy (2002) used the event study methodology to investigate whether IT infrastructure announcements create market value and trading volume. The study used 112 of this type of announcements and a five-day event window. Chatterjee et al., (2002) empirically examined, using announcements from the early 1990s, the business effects of specific IT infrastructure investment announcements on the market value and trading volume of business firms. The authors hypothesized and concluded that IT infrastructure investment announcements did create significant market value and significant increases in trading volume.

Nicholas-Donald, Matus, Ryu and Mahmood (2011) observed the impact of privacy breach announcement on trading volume. The authors used the Yadav (1992) method to calculate the abnormal trading volume. The authors derived the trading volume, using an event window of [-1, 0,1]. The trading volume for the event window was compared to the post-event period, and an increase in trading volume was observed.

Another event study that examined trading volume was conducted by Joseph, Wintoki and Zhang (2011). In this study, the authors' examined the ability of online ticker searches to predict abnormal stock returns and abnormal trading volumes. Using a sample of 470 firms,

stemming from events occurring within 2005-2008, the authors found that online search intensity reliably predicts abnormal stock returns and abnormal trading volume.

Based on the aforementioned discussions of the relevant literature, the following hypothesis is proposed:

H_2: Publicly announced cloud computing adoption by a company listed on one of the US stock exchanges will result in positive trading volumes.

Risk

Finance literature and information systems (IS) literature demonstrates that abnormal trading risk is also affiliated with financial market earnings. In a recent study, Nicholas-Donald, Matus, Ryu, & Mahmood, (2011) empirically investigated the impact that publicly announced privacy breaches have on the market value of the firms affected. Using a three-day event window [-1, 0, +1], the authors found that the risk factor did increase by 4% on the event day.

Ball and Kothari (1991) examined abnormal returns and risks in the days surrounding earnings announcements. The authors determined that evaluating risk will be dependent on the firm and the type of event study being conducted. It is often difficult to determine what factors affect the returns or risk (Ball and Kothari, 1991). When observing risk, timing becomes very important; noting that good news is often announced early and bad news late. Another important factor Ball and Kothari (1991) introduce in the equation is firm size. Firm size generally denotes how much information is provided. Once timing and firm size are accounted for, authors suggest examining correlations carefully in order to avoid risk misestimating. Multiple event windows were used. The authors determined that the type of announcement and the size of the firm made a significant difference in the abnormal return and the abnormal risk.

Patton and Verardo (2009) investigated the beta on the event day using firm specific news announcements. The sample consisted of 810 companies listed on the S&P 500 index from

January 1995 to December 2006. The authors used the panel regression approach across the entire sample of stocks, to estimate the change in betas. The authors found evidence of statistically significant change in risk due to firm specific news.

Yun and Kim (2010) also evaluated the change in betas due to inclusions or deletions of stocks in the KOSPI 200 index. The authors identified 2,777 regular changes of stocks. Yun and Kim (2010) evaluated the abnormal returns, abnormal volume and changes in beta. To calculate beta Yun and Kim used a method (a univariate model) from Barberis, Shleifer, & Wurgler (2005) study to calculate beta. The authors found a statistically significant increase in daily betas. Yun and Kim (2010) concluded that the increase was due to addition of stocks or the deletion of the company from the KOSPI 200 index.

Based on the aforementioned discussions of the relevant literature, the following hypothesis is proposed:

H_3: Publicly announced cloud computing adoption by a company listed on one of the U.S. stock exchanges will result in a negative significant change in risk.

Information Technology and Productivity

The use of the Internet has been understood to decrease the cost of doing business (Bharadwaj, Bharadwaj & Konsynski, 1999) by making employees more productive and, at the same time, allowing customers to place their orders during their leisure time. Other features that generate an increase in productivity include a more efficient and improved quality of customer service at a lower cost (Brynjolfsson, Hitt,2000).

Case studies in the economic literature show evidence that Information Technology (IT) and firm performance are tied together (Brynjolfsson, Hitt, 2000). However, earlier empirical studies have failed to show positive results from the use of IT (Brynjolfsson, Hitt, 2000). Later

studies that examined the use of IT and the firm level performance did show a positive increase in the market value of the firm (Brynjolfsson and Hitt, 1996).

Lee and Miller (1999) viewed the human element as a vital resource and built their argument for commitment to employees being an effective strategy using RBV. The authors analyzed 129 Korean firms and found that ROA was positively influenced by the increased interaction with and commitment to employees.

Hitt, Hoskisson, & Kim (1997) study used international diversification as a resource and demonstrated the importance of monitoring financial performance when considering different types of international diversification such as product diversification. The authors used 295 firms and found that international diversification could lead to competitive advantage by examining the return on assets (ROA). Obtaining the data from Compustat, Hitt et al., (1997) performed a regression on the ROA ratio and found that international diversification had a positive relationship with firm performance. The study determined that initially there is a positive relationship but eventually the relationship levels off and becomes negative if international diversification increases. In conclusion, the authors using RBV determined that international diversification is essential for competitive advantage but it requires adequate management in order for the firm to maintain competitive advantage.

Poston and Grabski (2000) examined the financial effects of ERP adoption using firm performance. The authors used SG&A and COGS to measure firm performance. Poston and Grabski, found a significant increase in costs. This increase was observed in both SG&A and COGS in the year after ERP implementation.

Bharadwaj (2000) observed the difference between IT firm performance when looking at IT's capability as a resource as opposed to observing an IT investment. In order to assess the

relationship, Bharadwaj (2000) used a match-sample comparison method. The results show an increase in ROA in both cases but IT capability performs better than IT as a resource in similar industries.

Cloud computing mainly results in resource savings and has a direct impact on the firm production. Hence, I hypothesize:

H_4: Investments in Cloud computing adoptions by publicly traded firms lead to improvements in financial performance as measured by return on assets (ROA), return on sales (ROS) and selling general and administrative (SG&A) ratios.

The next section of the present research explains the methods used to conduct the event study and firm performance analysis referred to by the hypotheses.

Chapter 4: Methodology

This chapter provides the steps taken to evaluate the financial impact of the cloud computing announcements. The first section (4.1), the data section, describes and analyzes the data used to evaluate the market value of cloud computing adoption. The second section (4.2) provides a detailed description of the step taken to complete the analysis described in chapter three. In section 4.3, the present research explains why the event window of [-1, 0, +1] was chosen and used for this study. The last section (4.4) describes the steps taken to analyze the firm performance ratios.

4.1 DATA SELECTION

Cloud computing adoption event, as stated earlier, is defined as the public announcement of the adoption of cloud computing by an intending publicly traded company. The sample of events for this research consists of companies found on a U.S. Stock exchange, NASDAQ, NYSE, or AMEX. The present research used all cloud computing adoption announcements made by the publicly traded companies between January 1, 2008 and December 31, 2013.

Events for this study were collected by conducting a search on Google search database. The Google site serves as a public website that allows the user to search via keywords. The keywords used for the present search include “launch cloud computing” and “adopt cloud computing”. Additional keywords that were related to the type of cloud launched were also used: platform as a service (Paas), infrastructure as a service (Iaas), and software as a service (Saas). Figure 4.1 shows the data procurement count by year.

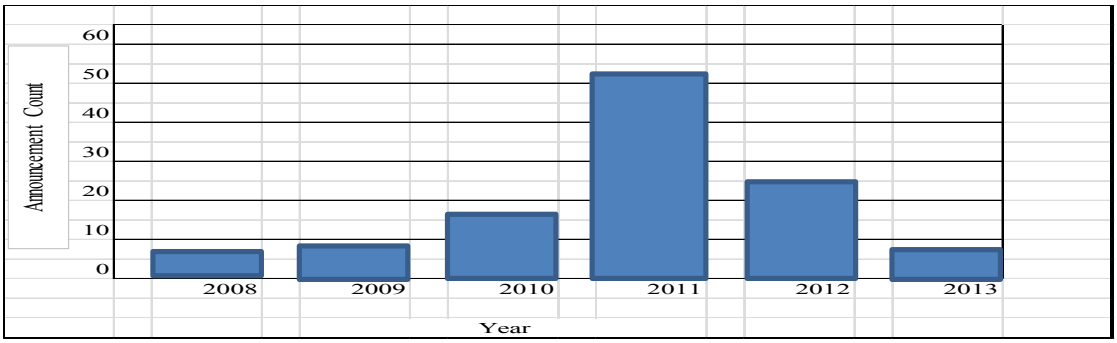

Figure 4-1 Cloud Computing Announcements

All the articles were scanned to assure that the article stated that the company was going to adopt cloud computing within the month of the announcement. The results were limited specifically to online news articles. The search results were filtered based on the following criteria:

1) The event must be published in an article that is of newspaper form and that is highly regarded as sources of information technology news.
2) The event must be associated with a publicly traded company that was listed on NASDAQ, AMEX or NYSE.

The search and screening process yielded 134 findings, ten were eliminated due to conflicting event dates with other major occurrences. An additional twelve events were eliminated because the article referred to a company that was not publicly traded. Once the firm is included in the sample, it is assured that the firm returns are available in the Center for Research in Security Prices (CRSP) database. The goal was to be consistent with the common practices for event searches conducted in other event studies. The process resulted in 112 events of cloud computing adoption announcements during the aforementioned period. Appendix A provides the list of publicly traded companies used in the present research.

4.2 EVENT STUDY METHODOLOGY

Well accepted, the event study methodology has been widely used in finance, accounting, strategy, marketing, and information systems. Event study methodology measures the impact that an unanticipated event has on the expected profitability or risk of a firm due to the event. Based on the underlying theory, efficient market hypotheses, event study poses that all information about a firm is distributed equally. The event study also assumes that the price of a security reflects future cash flow and also reflects all the information available about a firm's current and future earning potential. It is understood, for the aforementioned reason, that a firm's stock price is a reliable indicator of a firm's value.

The event methodology has two main purposes, the first, is to test Efficient Market Hypothesis (EMH). If abnormal returns exist following an event, then EMH will be affected. Second, it is used to assess the magnitude of an event's impact. The present research considers the adoption of cloud computing as a major corporate event.

The event study methodology examines the price of a security after an event and compares it to its pre-event price. The results reflect the unbiased estimated financial value of the event. The standard event study methodology was used to find out whether cloud computing announcements had an impact on the firm's value in terms of abnormal return, abnormal volume, abnormal risk and firm performance.

Most of the prior research studies, at least in the information systems area, used a single-factor market model to estimate abnormal returns. In order to demonstrate robustness, the present research uses the Fama-French multi-factor model. The daily return data is obtained from the Center for Research in Security Prices (CRSP) and the research utilized a market model estimation period for beta of 255 days: a financial year. In the present analysis, cumulative

abnormal returns (CARs) around the cloud computing announcement dates for the event window are accumulated, in attempts to capture pre-day, day of, and post-day abnormal returns.

The information systems (IS) literature has welcomed the use of event studies since the early 2000s' (Roztocki & Weistroffer, 2008). Konchitchki and O'Leary (2011) noted that event studies in the IS area are usually based on adoption, implementation, purchase, or use of information technology. The goal of most of the IS studies was to justify the costs and benefits that a technology offers. Konchitchki and O'Leary (2011) noted that these studies also evaluate the financial benefits derived by a firm that implements a chosen technology.

The motivation behind investigating the impact of cloud computing implementation announcements on the announcing firms came from prior event studies conducted in the IS area. It is understood that it may be impossible to measure the direct impact of cloud computing adoption on a firm's future profit. The present research can, however, investigate whether a decision to adopt cloud computing is viewed as worthwhile by investors during the event window. When an announcement is made about a cloud computing adoption by a firm, investors make independent decisions on the future profit potential of the firm. The investor's decision is then reflected in the firm's stock returns. Binder's (1998) study states that in order for event studies to be used, the empirical return in the period of interest must be determined, a model framework for normal returns must be produced, and then the two compared to determine if there are significant differences. This allows the present research to evaluate the financial impact of measuring the abnormal returns of a firm's announcement to adopt cloud computing.
Below is the outline for the basic steps used to conduct the event study:

1) Step1: The event definition: Cloud computing announcements were determined as the event of interest. Due to the fact that cloud computing is a relatively new technology, the time period was limited to the last seven years.
2) Step 2: Event Selection: Once cloud computing adoption was selected as the event of interest, a Google search was conducted. A sample of 115 announcements was found. Announcements with no date or found not to be from a credible source were discarded.
3) Step 3: Normal and abnormal returns: In order to demonstrate the impact of the cloud computing adoption, an abnormal return was derived using SAS (version 9.3). This return is the post return of the security over the event window minus the normal return of the firm over the event window. The normal return assumes the event has not taken place. The two most popular choices for abnormal returns are mean return model and market model. The mean return model assumes that the mean return of a security is constant throughout the time. The market model, most commonly used, assumes that there is a relationship between the market return and the security return. The market model return is therefore used for the present research.
4) Step 4: Estimation Procedure: The estimation window is needed to determine the normal performance model. This is done by using the period just prior to the event window as the estimation window.
5) Step 5: Testing procedure: Once the normal performance model has been determined, the abnormal returns are calculated. A framework for testing the abnormal returns is then developed. The abnormal returns for individual firms are aggregated.
6) Step 6: Empirical results: The results are presented following the experimental design. The diagnostics are presented as well. The results are explained and displayed.

7) Step 7: Interpretation, Discussion and Conclusion: The empirical results should provide some insight on how cloud computing adoption announcements affect security prices.

4.3 Event window

In an effort to eliminate confounding events, a short event window is usually preferred [-1, 0, +1] (please see Figure 4-2). Confounding events such as mergers, or stock splits, may influence abnormal returns during the event window. McWilliams and Siegel (1997) argue that long event windows reduce the power of the event being studied and can lead to false inferences about the significance of the event. It has also been argued that a short event window shows the significance of the event. In the present research an event window that I felt captured the effect of the cloud computing adoption event was selected. Information about the announcement can be leaked before the event; to estimate for that occurrence the event window covers a day before the event. Information may also be delayed in delivery, to estimate for that occurrence the event window has an additional day after the event in order to observe information leaked late.

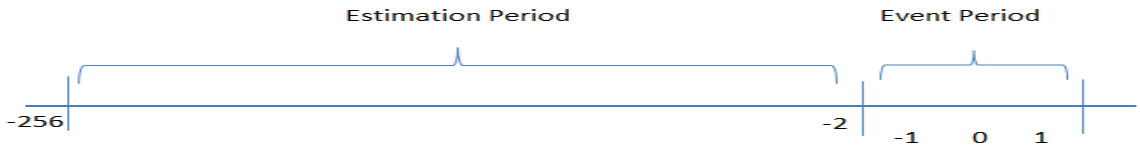

Figure 4-2: Event Window

4.4 Firm Performance

The present research used only cloud computing adopting firms, for which at least three years of financial data was available on Computstat. This reduced the size of the research sample from 168 to 142. Performance results for 3 years were collected for each of the 142 companies from Compustat. The objective of this aspect of the study is to determine whether firms with high IT capability (e.g. cloud computing) experience higher profit and better business

performance along with lower costs. In order to evaluate the impact of cloud computing adoption the present research compares means between the year prior to the cloud adoption and the year following the cloud adoption. The event window in this aspect of the study differs as it addresses, one year prior to the event (t-1), the year of the event (t0) and the year after the event (t+1).

Chapter 5: Results

Chapter four of the present research described the sample highlighting key characteristics of the data and the process used for the selected research methodologies. Chapter 5 provides findings from the use of the aforementioned research methodologies. Section 5.4.2 more specifically, provides the descriptive statistics of the final sample. This is followed by the two different analyses that have been conducted: event study and firm performance methods. The first analysis followed the traditional event study market adjusted model to evaluate the abnormal return, abnormal volume, and abnormal risk (section 5.3). The second analysis, in order to derive the firm performance, used ROA, ROS and SG&A (section 5.4).

5.1 Research Objectives

The research objectives were to determine:

1) Whether there were observable stock market behaviors that indicated that investors believe that cloud computing adoption is positive using stock market returns and firm performance.
2) Whether the announcement of cloud computing has led to abnormal trading behavior as displayed by abnormal trading volume and abnormal risk.
3) Whether the announcement of cloud computing adoption led to an increase in business assets.

The following sections put forward the results pertaining to the public announcement of cloud computing adoption. Section 5.2 provides the descriptive statistics of the firms that announced cloud computing adoptions. Section 5.3 shows the event study results for the publicly announced cloud computing adoptions. Section 5.4 observes the financial effects using return on assets (ROA).

5.2 DESCRIPTIVE STATISTICS

As noted in section 3.2, the data for the study was obtained from the Center for Research in security prices database. The data obtained consisted of firms that made a cloud computing adoption announcement during the test period of January 2008 to December 2013. The data consisted of 135 companies for which abnormal returns were calculated.

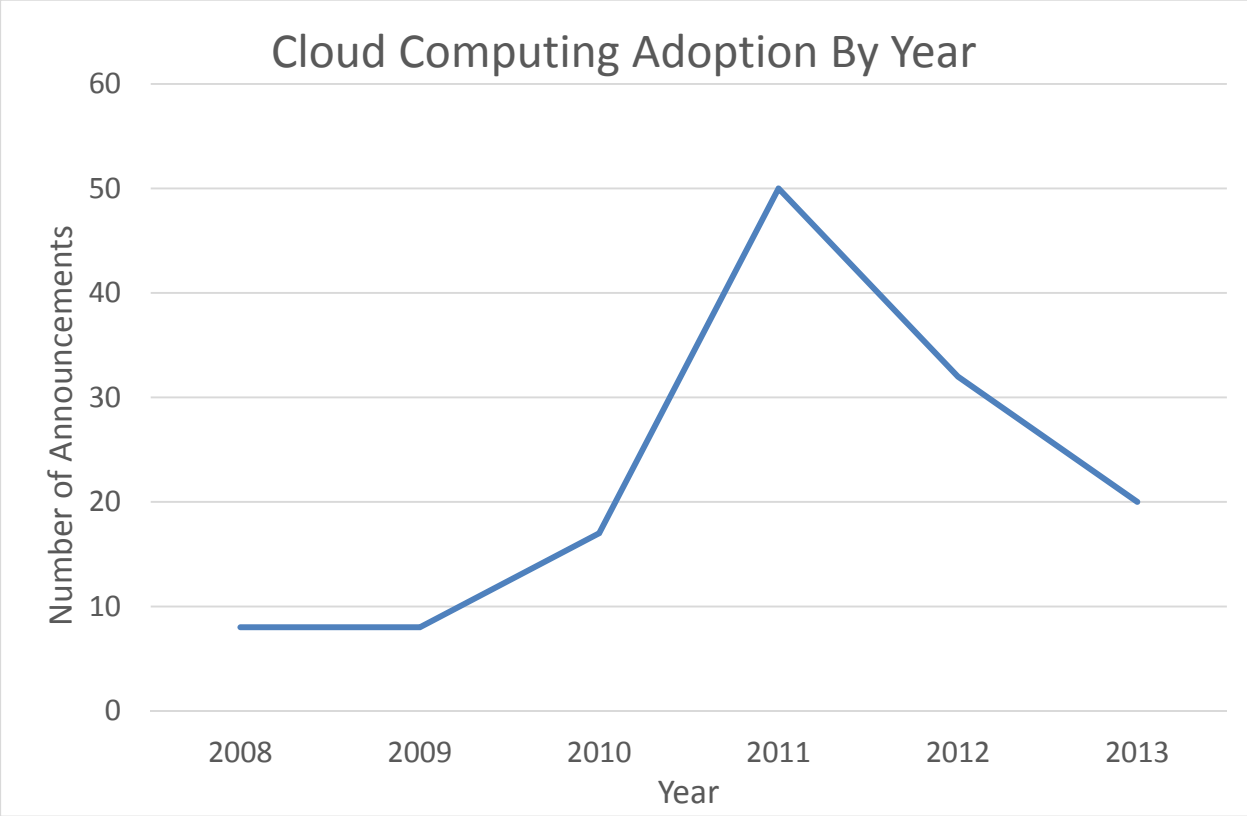

Figure 5-1: Chart of Cloud Computing Adoptions by Year

The chart above (Figure 5-1) shows the number of announcements per calendar year. The chart shows the slow growth in cloud computing adoption announcements with a peak in cloud computing adoption announcements in the year 2011 and a decrease from then on.

Table 5-1: Descriptive Statistics

N	Mean	Std Dev	Minimum	Maximum
135	.0109	.110	-0.1501	1.1887

Table 5-1 presents the descriptive statistics of the sample data (the CARs, as described in the next section). The lowest value of the abnormal return was -.1501 and the highest return was 1.1997, producing a mean of -.0109.

The results indicate that overall, the abnormal returns responded in a positive manner to cloud computing adoption. In the following sections the statistical results of the event study and the firm performance analysis are presented. The first section, 5.3 addresses the event study.

5.3 Event Study

A simple market adjusted model was used to investigate the announcement returns. Brown and Warner (1985) show that this simple methodology is capable of picking up announcement returns. Abnormal returns were calculated using the event window of [-1, 0, 1].

5.3.1 Hypothesis 1

Table 5-2 reports the results of the event study and reveals that cloud computing adoption, in particular, shows no evidence of a positive (or negative) effect on the market value of firms, because of two reasons. Although, the mean CAR is negative (-0.01087, or -1.08%), the level of significance indicates that it is not different from zero.

Table 5-2: The Means Test for the Cumulative Abnormal Returns

N	Mean	Std Dev	t-value	P Value
135	-0.01087	.1099	1.15	.25

This result indicates that the stock market does not value investments in cloud computing as a positive or negative venture. Alternatively, the announcement of cloud computing has no informational value to investors, as this may not be deemed to be new information (e.g., stock market participants already incorporated their expectations in the stock price, prior to the announcement).

5.3.2 Hypothesis 2

Event studies do not focus only on stock price effects, but often examine changes in other variables such as trading volume (Kothari & Warner, 2006) and trading risk. In this section, I explore the effects that cloud computing announcements have on abnormal trading volume. The present research, to evaluate the abnormal trading volume used the technique based on the work of Beneish & Whaley (2002) and Yun & Kim (2010) for each of the announcements. Pellicer & Rees (1999) explain that due to market efficiency, trading volume can increase due to rapid information dissemination. The method used in the present research uses a pre-event window of 253 days and compares it to the event window [-1, 0, 1].

In order to confirm the relationship between trading volume and cloud computing adoption announcements, the trading volume prior to the event day is observed (see Table 5-3). The results show that that a publicly traded company that announced the launching of cloud computing experience a significantly higher trading volume. Abnormal trading volume for cloud computing adoption is reported in Table 5-3. The evaluation produced a positive abnormal trading volume on the event day. Trading volume appears to retreat back to normal levels approximately five days after the event.

There are 135 independent firm announcements. Abnormal volume is not significantly different at the announcement period, when compared with the pre-period, at conventional

significance levels. The mean volume ratio is 2.29, however this is not different in significant manner from the expected value of 1 (i.e., if there were no differences in average daily volumes we would expect the average daily volume in the pre period to be equal to the average daily volume during the event window and, thus, have a value of 1).

The results suggest that announcements of cloud computing adoption are not linked to abnormal trading volume activity. In the next section, I investigate the risk associated with cloud computing announcements.

Table5-3: Abnormal Trading Volume

N	*Mean*	*T stat*	*(p-value)*
135	2.294	0.98	.33

5.3.3 Hypothesis 3

The risks (betas) were calculated by observing the changes between the pre and post-betas. Pre and post betas were calculated using 120 trading days surrounding the event announcement day. The ratio of the test results are shown in Table 5-4. The betas (β) are estimated by simply regressing daily returns on the market return. I use (-121, -1) as the pre period and (2, 122) as the post period and then calculate a simple ratio of these two values. If there is a difference, the ratio should be different from 1.

Table 5-4 below provides the results from the analysis. The results show that the mean beta ratio equals 0.99. Not surprising, this is not statistically different from 1. This implies that there does not appear to be a change in beta (or risk), from before till after the announcement of cloud adoption.

Table 5-4: Abnormal Risk

N	*Mean*	*Std Dev*	*T Stat*	*P Value*
135	.9916	.042	-0.20	.84

5.3.4 Hypothesis 4

The main reason for adopting cloud computing is because it has the ability to improve firm performance. In an attempt to validate this assertion, the evaluation process was taken a step further by investigating the impact of adoption announcements on firm performance. The objective is to verify if the literature, as reviewed in Chapter 2, is accurate in stating that cloud computing adoption will increase a firm's ability to meet the needs of its customers in a more efficient manner. In order to investigate the profitability aspect of investments in cloud computing, following the literature, the present research uses Return on Assets (ROA, defined as NI / AT, from Compustat), Return on Sales (ROS, NI / SALE, from Compustat), and selling General and Administrative (SG&A) ratios. Because mean accounting ratios are seriously affected by outliers, I focus my analysis on medians. In addition to showing the median values for years -1, 0 (the year of the announcement), 1, I also show median differences, to investigate whether performance has changed, relative to year -1.

Table 5-5: Firm Performance Descriptive Statistics

	Year Prior	Year of		Year After	
	Median	Median	Difference	Median	Difference
ROA	5.45%	5.72%	1.26%	5.89%	0.25
ROS	4.12%	4.59%	0.60%	4.33%	0.09%
SG&A	31.01%	30.17%	-0.24%	32.13%	-0.24%

Table 5-5 shows the results of this performance analysis. It appears that in the year of adoption ROS and ROA increase. Specifically, the median ROS was 5.45% in the year prior and 5.72% in the year of adoption. The median increase is 1.26% and this is significant at the 1 percent level. However, there is no significant increase in the year after adoption (relative to year -1). ROA exhibits a similar pattern. Notably, there is a median increase from year -1 to year 0 (0.60%), but not thereafter. When I investigate SG&A, I do not find significant changes relative to year -1. Overall, this suggests that there may be some improvement in performance, but this is short lived. The results show positive mean differences, signifying a positive effect based on cloud computing adoption announcements. The lack of significance demonstrates that there is a positive change in firm performance rate, although not significant. This contradicts the idea of significant increased firm performance due to cloud computing adoption announcements.

These results are discussed in details in Chapter 6 along with the limitations of the study. Chapter 6 also provides a conclusion that is generated as a result of the findings of the study.

Chapter 6: Discussion and Conclusion

In this chapter I discuss the results of the financial analysis of the two basic research questions: 1) Does the market show reactions to the announcement of cloud computing adoptions (as measured by abnormal returns, abnormal volume and abnormal risk)? 2) Does the adoption of cloud computing lead to internal financial benefits (as measured by ROA, ROS. and SG&A)? In this section a discussion of the financial analysis used in this study are broken down by findings and explained. The analysis and methods were explained in chapter 4. The results were provided in chapter 5. All data analysis were performed using SAS.

6.1 Discussion

There are three major findings in this study: The results of the present research show that overall cloud computing adoption announcement made by a publicly-traded company included in the research is associated with a negative abnormal return but this effect is not statistically significant. Second, the companies enjoy significant trading volume increase on the launching day of cloud computing but it levels off at the end of the event window. Third, the abnormal risk for companies that made the cloud computing adoption announcements is not significant either. Fourth, in the year of adoption ROS and ROA increase. An in-depth description of the results are provided in the following paragraphs.

6.1.1 Hypothesis 1

The present study was conducted on the impact of cloud computing announcements made by publicly-traded companies listed on NASDAQ and NYSE. The CAR was examined along with the daily changes in share price to determine mean abnormal return. The descriptive statistics provided in Chapter 5 (section 5.2) demonstrate that returns are higher on the day of and the day following the announcement. The regression results demonstrate that cloud

computing announcements are associated with negative abnormal returns with a mean CAR of -0.01087 with a standard deviation of .1099 during the event window [-1, 0, +1]. The results of the present research show that cloud computing adoption announcement by a publicly-traded firm have a negative effect on its market value, but this effect is not statistically significant. This increase is in line with Ferstl, Utz and Wimmer (2012) study that evaluated the financial effects of the Fukushima-Daiichi disaster on selected nuclear and alternative energy stocks. The authors found that the disaster yielded losses however the negative CAR results were not statistically significant.

Austin's (1993) study conducted a research on the private values of patents and found that though the firms gained excess returns due to the patents however the results were not statistically significant. Uhlenbruck, Hitt, and Semadeni (2006) predicted and observed that acquisitions made by offline firms acquiring other offline firms lead to positive abnormal returns although the results were not statistically significant. Other studies that experienced a negative abnormal return from announcements in the information systems area were conducted by Dos Santos, Pfeffers and Mauer (1993) and Campbell, Gordon, Loeb and Zhou (2003). These researchers, however, find their results to be negative and not significant.

6.1.2 Hypothesis 2

This section of the chapter, discusses the results obtained for Hypothesis 2 that investigates the impact of cloud computing adoption announcements on the trading volume. As stated earlier, it appears that a positive and significant increase in trading volume was found on the launching day of cloud computing but this increase retreats back to normal level at the end of the event window.

This is in line with Chatterjee, Pacini, and Sambamurthy (2002), Nicholas-Donald, Matus, Ryu and Mahmood (2011), and Joseph, Wintoki and Zhang (2011) who found that volume is affected positively by public announcements of infrastructure investment, privacy breach, and online ticker search intensity, respectively.

6.1.3 Hypothesis 3

Third, the risk, using beta was found to be high but it was not statistically significant. The change in risk was tested by analyzing the changes between pre and post beta. This demonstrated that investors, contrary to what most of the literature in the area stated, did not view cloud computing adoption as a risky business for the adopting firm.

These results are in line with the results obtained by some prior research studies and not in concordance with other studies. Nicholas-Donald, et al., (2011) found, for example, a significant decrease in abnormal risk. The results of the present research are, however, not aligned with studies conducted by Patton and Verardo (2009), Ball and Kothari (1991), and Yun and Kim, (2010). All of these studies found a positive and significant increase in abnormal risk caused by an event. The present dissertation research is the first study that investigates the risk change due to cloud computing adoption.

6.1.4 Hypothesis 4

Researchers have used financial ratios as a powerful tool for evaluating firm performance (Delen, Kuzey, and Uyar, 2013). Firm performance evaluations allow researchers the opportunity to employ the amounts observed on financial statements, using financial ratio, to deduce meaningful results. Financial ratios are used to analyze the financial health of a company; they are used, as in this study, to do comparisons across companies or to measure firm performance of different size and types of companies (Beaver, 1968).

To measure the firm performance of a publicly traded company, as stated earlier, the present research uses ROA, ROS, and SG&A. The objective was to evaluate the impact of cloud computing adoption on the performance of a company that adopted the use of cloud.

ROA is used often as a tool for measuring firm performance. ROA indicates how a company uses its asset to gain profitability. In addition ROA demonstrates how profitable a firm is.

Research studies on the impact of ROA on firm performance are, however, not as clear. Dess and Robinson (1984), Chi and Lin (2011), Hitt, Hoskisson, and Kim (1997), and Bharadwaj et al., (1999), on one hand, found that firm activities and events do positively affect the firm performance in terms of ROA.

Burton, Lauridsen and Obel (2002), on the other hand, found that the implementation of technology that does not best fit an organization lead to diminished firm performance. Fry (1982), and Woodward, Dawson, Wedderbum (1965) found that the type of technology along with the organizational characteristics become an important part in explaining why there is a decrease in firm performance. There is, therefore, a need for further research on this topic in the area. The ROA of the firms that adopted cloud computing, as stated earlier, were expected to increase on the benefits that cloud computing provides. Rather, a decrease in ROA is observed after the adoption of cloud computing.

The next variable used for evaluating firm performance is ROS. ROS demonstrates the amount of profit a firm makes after paying for wage, raw, materials, etc. ROS was used in the present research because the literature in the area demonstrates that cloud computing allows a firm to do more with less. The results on ROS showed a decrease in ROS from the year prior to the year after the adoption of cloud computing but this decrease was not significant. Hammond

and Slocum (1996) found that the ROS increased due to a firm's reputation. Boubakri and Cosset (1998) study used ROS as a measure of profitability for firms that were newly privatized. Boubakri and Cosset (1998) found significant increases in profitability.

SG&A was the last financial ratio used in the present research. SG&A is a cost ratio that reflects the sum of all direct and indirect selling expenses and all general and administrative expenses of a firm. SG&A can consists of payroll costs, salaries, travel expenses etc. Based on the benefits cloud computing should provide the SG&A should be lower, for the cost of doing business should significantly decrease. The mean SG&A of the present research shows a decrease in the year after cloud computing adoption, which is what is expected. Similar studies that evaluated firm performance and observed an increase in SG&A include, Thatcher and Oliver (2001) who looked at technology investments and Dehning and Richardson (2002) who observed returns on investment in information technology. Below I discuss the limitations of the present research.

6.2 Limitations

A limitation of the present study was the small size of the sample. A larger sample could have possibly provided better results especially for the risk or volume analysis. Another limitation of the study was that it was limited to only the publicly traded firms in the United States. Multiple cloud computing adoption announcements were found for firms not publicly traded. This also influenced the sample size.

There is evidence in finance literature that due to dividend changes, mergers and acquisitions, the performance of firms is not always consistent with stock market returns. The latter performance of firms is not always the same as the initial performance due to an announcement (Das, Sen, and Sengupta, 1998). Time is a limitation, due to the newness of cloud

computing. Based on the observation of the results it is believed that it would take another two years to see a significant benefit in the adoption of cloud computing. Another limitation was that it was limited to only the lack of profit information to estimate the return on assets. Approximately 40% of the companies lack sufficient information to estimate the ROA. .

6.3 Conclusion

The present research scrutinized the relationship between cloud computing adoption announcements by publicly traded companies and the stock market reactions to these announcements along with the firms' performance. The results show on both types of assessments cloud computing impact is mixed on the firms' profitability.

The event study method used in the present research supports the idea that adoption of cloud computing does impact the market value of the adopting firms but these impacts are mixed as stated in Chapter 5. The key features affiliated with cloud computing, such as lower startup costs, less training required, ease of governance, and ease of maintenance appears to impact the financial outlook of the firm but most of these impacts are not significant. The findings of the present research coincide with prior research studies by Paramerswaran, et al (2011) and Parameswaran, et al, (2012) who did not find significant impact on the stock prices of the cloud adopters. Huntegeburth, et al., 2013) did, however, find significant abnormal returns due to cloud computing deployment announcements. The present research, obviously had failed to agree with Huntegeburth, et al's assessment in this regard.

The present research moved the cloud computing impact research area further by evaluating the financial impacts on the companies that adopted cloud computing using ROA, ROS, and SG&A ratios. Huntgeburth, et al. (2013) suggested the idea of using these ratios but did not empirically tested their hypothesis.

The ROA of the firms that adopted cloud computing, as stated earlier, were expected to increase on the benefits that cloud computing provides. Rather, a decrease in ROA was observed after the adoption of cloud computing. As stated earlier, results also showed a decrease in ROS from the year prior to the year after the adoption of cloud computing but this decrease was not significant. The mean SG&A of the present research shows a decrease in the year after cloud computing adoption. This is what is expected.

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Appendix

Appendix A

Name	Event	PermNo
1-800 FLOWERS.COM, Inc.	5-Nov-12	87162
1st Source Corporation	28-Jun-11	36346
3D Systems Corporation	24-Jul-12	78664
3M Company	20-May-11	22592
8x8 Inc	29-Nov-11	85177
Abbott Laboratories	27-Apr-09	20482
Accenture plc.	20-Sep-11	89071
Adobe Systems Incorporated	3-Oct-11	75510
ADTRAN, Inc.	10-Jan-13	80791
Advanced Micro Devices, Inc.	8-Jan-13	61241
Altair Nanotechnologies Inc.	19-Dec-11	84596
Amazon.com, Inc.	15-Jun-10	84788
Amdocs Limited	29-Oct-12	86144
Ancestry.com Inc.	5-Jan-12	79466
Apple Inc.	13-Jun-11	14593
Arrow Electronics, Inc.	17-May-11	20217
ATandT Inc.	29-Nov-11	66093
Autodesk, Inc.	29-Nov-11	85631
Baidu, Inc.	26-Mar-12	90857
Bank of the Ozarks	28-May-10	85198
Barclays PLC	10-Jan-13	69761
Barnes and Noble, Inc.	25-Sep-12	79667
Best Buy Co., Inc.	23-Jun-11	85914
BMC Software, Inc.	7-Dec-10	65496
Boeing Company (The)	2-Jun-11	19561
Brightcove Inc.	15-Nov-12	13260
Brocade Communications Systems, Inc.	5-Nov-12	86881

CardioNet, Inc.	27-Feb-12	92587
CarMax Inc	9-Jun-08	89508
Celadon Group, Inc.	29-Sep-11	80113
CenturyLink, Inc.	15-Jul-11	60599
Cisco Systems, Inc.	1-Jul-09	76076
Citigroup Inc.	16-May-12	70519
Citrix Systems, Inc.	26-Feb-10	82686
Coca-Cola Company (The)	16-Jun-11	11308
Computer Sciences Corporation	19-Oct-11	40125
Continental Resources, Inc.	3-Apr-12	86765
CoreSite Realty Corporation	25-Sep-12	12093
Cousins Properties Incorporated	10-Jan-13	27511
Cray Inc	2-Mar-10	82287
Dell Inc.	18-Jul-11	11081
Digital Intelligence Systems, LLC	29-Nov-12	
DISH Network Corporation	29-Mar-12	81696
EMC Corporation	1-Jun-11	10147
Equinix, Inc.	31-Mar-11	89617
Ericsson	23-Sep-11	33452
Exa Corporation	12-Dec-11	13454
First Trust	27-Jun-11	90306
Fusion-io, Inc.	13-Dec-10	12865
Gap, Inc. (The)	15-Jan-13	59010
Golub Capital BDC, Inc.	10-Oct-11	93352
Google Inc.	9-May-11	90319
Groupon, Inc.	19-Jan-11	13108
Hewlett-Packard Company	29-Jul-08	27828
Informatica Corporation	25-Jul-12	86830
Ingram Micro Inc.	15-Aug-11	84168
Intel Corporation	29-Jul-08	59328

Interactive Intelligence Group, Inc.	19-Oct-11	87264
International Business Machines Corporation	7-Feb-08	12490
InterXion Holding N.V.	3-Jun-11	72541
Jamba, Inc.	11-Feb-08	90795
JPMorgan Chase Bank N A London Branch	27-Oct-10	42896
Konami Corporation	31-Aug-11	89510
Korea Telecom Corporation	6-Oct-10	86869
KVH Industries, Inc.	30-Apr-10	83390
Lawson Software	25-Apr-10	89271
Leapfrog Enterprises Inc	10-Jan-13	89471
Lockheed Martin Corporation	27-Oct-10	21178
Logitech International S.A.	22-Sep-11	84621
Marriot International	27-Oct-10	79764
McKesson Corporation	5-Apr-10	81061
Merge Healthcare Incorporated.	28-Nov-11	85739
MetroPCS Communications, Inc.	29-Aug-10	91937
Microsoft Corporation	8-Mar-09	10107
Mitel Networks Corporation	26-Mar-12	93354
Morgan Stanley	25-Jul-08	80206
NASDAQ Premium Income and Growth Fund Inc.	25-Sep-12	91745
NetApp, Inc.	16-May-11	82598
Netlist, Inc.	16-Nov-09	91616
Netsuite Inc	2-Feb-11	92491
Nippon Telegraph and Telephone Corporation	20-Jan-11	80863
Pervasive Software Inc.	24-Jul-12	85395
Philippine Long Distance Telephone Company	25-Aug-11	38607
Polaris Industries Inc.	18-Aug-11	
Polycom, Inc.	18-Jan-12	83405
QLT Inc.	8-Jun-10	78688
Quanta Services, Inc.	5-May-10	62631

Rackspace Hosting, Inc	31-Mar-11	92765
Radware Ltd.	14-Dec-11	87251
RealNetworks, Inc.	20-Dec-10	85576
Red Hat, Inc.	25-Apr-11	87184
Salesforce.com Inc	12-Oct-09	90215
SAP AG	11-Dec-09	89382
Sprint Nextel Corporation	15-Aug-11	39087
Telecom Italia S.P.A.	23-Dec-11	81782
Telefonica SA	13-Dec-11	75049
The Management Network Group, Inc.	30-Aug-11	87424
Towers Watson and Co	25-Sep-12	10119
UBS AG	5-Oct-11	88239
UnitedHealth Group Incorporated	14-Feb-12	92655
URS Corporation	12-Oct-11	50278
Verizon Communications Inc.	27-Jan-11	65875
Virgin Media Inc.	28-Sep-11	89644
Vmware, Inc.	3-Nov-09	92257
Wal-Mart Stores, Inc.	13-Mar-12	55976
Walt Disney Company (The)	23-Feb-12	26403
Washington Trust Bancorp, Inc.	23-Aug-11	11397
Westell Technologies, Inc.	8-Jun-11	82762
WEX Inc.	26-Nov-12	90569
Wipro Limited	22-Nov-11	88683
WMS Industries Inc.	17-May-11	64135
Xerox Corporation	7-Dec-11	27983
Yahoo! Inc.	29-Jul-08	83435
Yongye International, Inc.	9-Oct-09	93048
Zipcar, Inc.	3-Sep-09	12700
Zoom Technologies, Inc.	22-Aug-12	77011
Zynga Inc.	11-Aug-11	13169

Vita

Aurelia Nicholas-Donald earned her Bachelor of Science degree in Computer Science from Fayetteville State University in 1994. She received her Master of Science degree in Management Information Systems in 1998 from Bowie State University. In between degrees, Dr. Nicholas-Donald obtained her A+ and Network+ certifications. In 2010, she joined the doctoral program in Information Systems at The University of Texas at El Paso.

Dr. Nicholas-Donald has been the recipient of the Ph.D. student teacher of the year award as well as the recipient of the Virgin Islands Scholarship Grant.

Dr. Nicholas-Donald worked as a research associate and assistant instructor for the Accounting and Information Systems department.

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This dissertation was typed by Aurelia Nicholas-Donald