Institutional Shareholders' Investment Horizons and Corporate IT Capability: An Empirical Evaluation of the U.S. Equity Market

André Schäfferling
Universität Bamberg



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Erstgutachter:	Prof. Dr. Tim Weitzel
Zweitgutachter:	Prof. Dr. Heinz-Theo Wagner
Mitglied der Promotionskommission:	Prof. Dr. Kai Fischbach
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Dedicated to my parents

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Zusammenfassung

Im März 2014 schrieb Laurence D. Fink, der Chef des weltgrößten Vermögensverwalters BlackRock, einen offenen Brief an die Vorstände und Verwaltungsräte der 500 größten U.S. Unternehmen. Er warnte eindringlich, nicht den zunehmend kurzfristigen Marktgegebenheiten zu folgen, sondern langfristig in den Erhalt und die Zukunft der Unternehmen zu investieren.

Dieses Beispiel ist nur eines von vielen, in denen institutionelle Investoren versuchen, Einfluss auf Unternehmen auszuüben. Vielfach steht für langfristig orientierte Investoren die Entwicklung der Unternehmen im Vordergrund, was Investitionen in Anlagevermögen, aber auch in immaterielle Vermögenswerte bedingt. Neben Investitionen in die Innovationsfähigkeit von Unternehmen und die Qualifizierung der Mitarbeiter steht auch die Informationstechnologie (IT) – die heutzutage in vielen Unternehmensbereichen eine kritische Rolle spielt – in vorderster Reihe (Porter 1992). Den langfristigen Investoren stehen jedoch kurzfristig orientierte Investoren oder Händler gegenüber, die hauptsächlich an der Steigerung der Unternehmensgewinne und damit an Kursänderungen interessiert sind (Ke and Petroni 2004; Yan and Zhang 2009). Diese Investoren scheuen nicht davor zurück, das Management unter Druck zu setzen, ihre kurzfristigen Markterwartungen auf Kosten einer nachhaltigen Entwicklung zu erfüllen. Die dadurch erzwungene Kurzsichtigkeit der Manager führt nicht selten dazu, dass zukünftige Investitionen und Budgets gekürzt werden, um – kurzfristig – gut dazustehen (Bushee 1998). Es zeigt sich also, dass die Heterogenität der Investoren sich unterschiedlich auf das Handeln der Unternehmensführung auswirkt (Chen et al. 2007; Gaspar et al. 2005).

Andererseits ist es für die Investoren von ebenso großer Bedeutung, die entsprechend ihrer Strategie vielversprechendsten Investitionsobjekte auszuwählen. Die bisherige Forschung hat gezeigt, dass die IT-Fähigkeiten von Unternehmen, also der innovative und effektive Einsatz von IT-bezogenen Ressourcen zur Unterstützung von unternehmensrelevanten Prozessen (Bharadwaj 2000; Ross et al. 1996), entscheidende Vorteile mit sich bringt (Kohli and Grover 2008; Masli et al. 2011a). So steht der effiziente IT-Einsatz nicht nur mit Wettbewerbsvorteilen (Dehning and Stratopoulos 2003), sondern auch mit überdurchschnittlichem finanziellen Erfolg (Masli et al. 2011b) und einer höheren Marktbewertung im Zusammenhang (Muhanna and Stoel 2010). Es liegt also nahe, dass sich Investoren der Vorzüge einer hohen Leistungsfähigkeit der IT bewusst sind und entsprechende Unternehmen im Fokus haben. Während die handelsorientierten Investoren an kurzfristigen, vor allem gewinnbezogenen Informationen interessiert sind (Yan and Zhang 2009), dürften für langfristig orientierte Investoren insbesondere auch weiche Erfolgsfaktoren wie die IT-Fähigkeiten von Unternehmen interessant sein.

Die vorliegende kumulative Dissertation verfolgt daher die zentrale Frage, inwiefern und in welchem Ausmaß ein Zusammenhang zwischen der Eigentümerstruktur von Unternehmen und ihren IT-Fähigkeiten besteht. Hierbei wird insbesondere der Anlagehorizont von institutionellen Investoren betrachtet. Zur Untersuchung der Forschungsfrage baut die Arbeit auf den Erkenntnissen und Theorien der bisherigen Forschung in diesen beiden Bereichen auf. Dazu wird

die IT-Wertschöpfungsliteratur herangezogen und mit der Kapitalmarktforschung zu Eigentümerstrukturen und institutionellen Investoren verknüpft.

Die empirischen Analysen basieren auf der Kombination von drei zentralen Datenquellen, die IT-bezogene Informationen, Eigentümerdaten und Finanzkennzahlen enthalten. Auf Grund der Verfügbarkeit entsprechender Daten sind die Auswertungen auf U.S.-Unternehmen und den Zeitraum von 1997 bis 2013 begrenzt. Die angewendeten statistischen Verfahren stammen aus der multivariaten Statistik (siehe Field 2009) und den ökonometrischen Methoden der Paneldatenanalyse (Wooldridge 2010).

Die Forschungsergebnisse zum Einfluss institutioneller Investoren auf die Entwicklung des unternehmensweiten IT-Leistungsvermögens zeigen, dass Unternehmen, die erkennbar hohe IT-Fähigkeiten aufweisen, in den Vorjahren durch deutlich langfristiger orientierte Investoren gekennzeichnet sind. Bei der Untersuchung von Veränderungen im Zeitablauf ergibt sich ein ähnliches Bild. So erhöht eine Veränderung der Eigentümerstruktur hin zu langfristig orientierten Investoren die Wahrscheinlichkeit, dass ein Unternehmen in den folgenden Jahren eine herausragende IT-Leistungsfähigkeit entwickelt.

Die Analyse der umgekehrten Auswirkung der IT-Leistungsfähigkeit auf die Eigentümerstruktur zeigen ähnliche Resultate. Unternehmen mit ausgeprägtem Leistungsvermögen werden von institutionellen Investoren mit deutlich längerem Anlagehorizont gehalten. Langzeitanalysen zeigen, dass die kontinuierliche positive Außenwahrnehmung oder Reputation hinsichtlich der IT-Leistungsfähigkeit eines Unternehmens mit einer Veränderung der Eigentümerstruktur in Richtung langfristig orientierter Investoren einhergeht. Die Ergebnisse unterstützen somit die vermuteten Auswirkungen des IT-Leistungsvermögens auf den Kapitalmarkt. Durch die zukunftsorientierte Ausrichtung von Unternehmensaktivitäten werden insbesondere langfristige Investoren angezogen, die dem Unternehmen länger die Treue halten (Bushee 2004).

Mit der Untersuchung der Zusammenhänge zwischen der Eigentümerstruktur und der IT-Leistungsfähigkeit von Unternehmen schlägt diese Arbeit eine Brücke zwischen den beiden angesprochenen Forschungsbereichen und findet neue Aspekte im Beziehungsgeflecht zwischen Unternehmen und Investoren. Zum einen zeigt sich bei der Betrachtung von organisationalen Fähigkeiten, hier insbesondere der IT-Leistungsfähigkeit, dass die Eigentümerstruktur ein relevanter Einflussfaktor ist. Bisherige Ergebnisse zur Innovationsfähigkeit von Unternehmen (Bushee 1998; David et al. 2001) lassen sich somit auf den IT-Kontext übertragen. Zum anderen wird deutlich, dass eine hohe IT-Leistungsfähigkeit von Unternehmen nicht nur firmenintern Vorteile mit sich bringt, sondern sich neben der Marktbewertung (siehe Muhanna and Stoel 2010) auch in der Eigentümerstruktur niederschlägt. Langfristig orientierte Investoren beeinflussen nicht nur die zukünftige Entwicklung der IT eines Unternehmens positiv, sondern werden umgekehrt auch von solchen Unternehmen angezogen, deren IT sich in der Vergangenheit erfolgreich entwickelt hat.

Der Dialog mit den Kapitalmärkten stellt für die Unternehmensleitung einen wesentlichen Bestandteil ihrer Arbeit dar (Bushee 2004). Durch die gezielte Informationsverbreitung können langfristige Investoren gewonnen werden, die umgekehrt einen erheblichen Einfluss auf die zukünftige Entwicklung der Unternehmen nehmen. Die Erkenntnisse der vorliegenden Arbeit fügen dem eine weitere Facette hinzu. Das Management sollte die IT-Aktivitäten des

Unternehmens ihrer Bedeutung entsprechend in seiner Informationspolitik herausstellen. Investoren wie auch Finanzanalysten auf der anderen Seite sollten die Entwicklung der IT-Leistungsfähigkeit der Unternehmen aufmerksam verfolgen und die damit einhergehenden Vorteile für zukünftige Perioden in ihre Überlegungen einbeziehen.

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Introductory Paper

Institutional Shareholders' Investment Horizons and Corporate IT Capability: An Empirical Evaluation of the U.S. Equity Market

André Schäfferling
German Graduate School of Management and Law

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1 Introduction

1.1 Motivation and Objective of the Thesis

In March 2014, Laurence D. Fink, CEO and Chairman of BlackRock, sent a letter to every chairman and chief executive officer (CEO) in the S&P 500 encouraging them to focus on long-term growth strategies instead of cutting capital expenditures or even increasing debt for share buybacks and dividend payments. BlackRock – the world's largest and probably most influential investment company with $4.324 trillion in assets under management at the end of 2013[1] – owns on average 4.08 percent of each company in the S&P 500[2]. Mr. Fink not only appealed to the executives, he implicitly criticized the increasing short-term dynamics in financial markets and the absence of long-term investors. Short-term and activist investors impose pressure on public firms at the cost of future growth (e.g. Gillan and Starks 2007). Carl Icahn, a well-known activist investor, opposes Laurence Fink on how to best spend corporate earnings but fully agrees on the need for more investor involvement. On his website he calls the recent awakening of passive institutional stockholders "a watershed moment for stockholder participation"[3].

This debate reflects one of many facets of institutional investors. These investors differ in their strategies, investment behavior and expectations and so does their interaction with companies. It is well known that companies need to invest in tangible and intangible assets such as research and development (R&D), information systems, and employee training to stay competitive (Lev 2001; Porter 1992). Larry Fink particularly advised managers to make those investments that will sustain growth. These investments include information technology (IT) and the IT workforce, two well-known assets that drive future profits and long-term competitiveness (Porter 1992; Ross et al. 1996). Research shows that "strategic advantage results to organizations that can exploit IT functionality on a continuous basis" (Bharadwaj et al. 1999a, p. 383) which is commonly referred to as a firm's IT capability (Bharadwaj 2000). While some long-term oriented investors such as BlackRock encourage these investments, others seek short-term profits and pursue different interests. In general, IT is viewed as a strategic asset and "firms that do not demonstrate their commitment to IT through appropriate investments could be questioned or penalized by their institutional shareholders" (Ravichandran et al. 2009b, p. 681). Can it therefore be expected that institutional investors exert influence on the development and constant renewal of IT capability in the firms they hold investments in?

At the same time, institutional investors have to decide which companies they want to invest in. The IT business value literature provides broad evidence of the benefits associated with IT (Kohli and Grover 2008; Masli et al. 2011a). Whereas some investors prefer to trade based on earnings related information (Ke and Petroni 2004; Yan and Zhang 2009), others seek long-term investments and have an interest in intangible assets (Chen et al. 2007). Companies that have

[1] Retreived from: BlackRock 2013 annual Form 10-K, filed on 2014-02-28, http://www.sec.gov/Archives/edgar/data/1364742/000119312514076587/d641151d10k.htm (last accessed 01.05.2014)

[2] Based on own calculations of equity holdings reported by BlackRock via Form 13F (see 3.1.2 for more details on equity holdings data). Minimum 1.33 percent, maximum 8.91 percent and value weighted average 3.87 percent.

[3] http://www.shareholderssquaretable.com/a-watershed-moment-for-stockholder-participation/ (last accessed 01.05.2014)

developed a continuous IT capability and are recognized for their efforts should thus attract certain types of investors. A firm's ownership structure, which is composed of different types of investors such as short- and long-term oriented institutional investors, should reflect the existence of strategic and intangible assets, such as IT capability.

The primary objective of this thesis is the theoretical, conceptual, and empirical analysis of the relationship between a firm's IT capability and its ownership structure. Institutional investors nowadays represent the largest fraction of corporate shareholders. On the one hand, they are attracted by and invest based on certain information. On the other hand, they influence executives and corporate decision making. This dissertation is positioned at the interface of information systems (IS) and accounting research to contribute to the understanding of this relationship. Combining research on IT business value and firm ownership, the general research question of this thesis is as follows:

RQ: What is the relationship between a firm's IT capability and its ownership structure?

1.2 Structure of the Thesis

This cumulative doctoral thesis is composed of seven individual research papers that can be assigned to three major thematic parts within the research context presented above. Figure 1 provides an overview of the structure of the dissertation and a contextualization of the single papers.

The first part is related to the IT capability concept and its measurement. **Paper I** reviews the literature to identify research on antecedents and outcomes of IT capability. **Paper II** represents a new measurement approach for IT capability based on content analysis techniques for unstructured documents. The second and third part both cover the empirical analysis of the relationship between firms' IT capability and ownership structure. **Paper III** and **Paper IV** present empirical studies of the influence of institutional investors on the development of IT capability of companies they hold. Whereas **Paper III** conducts several cross-sectional group comparisons to analyze whether differences in investor orientation and IT capability are related, **Paper IV** uses a longitudinal approach to investigate changes in the ownership structure and subsequent indications of IT capability. The third thematic part of the thesis examines the capital market implication of both IT capability and IT capability reputation from different perspectives. **Paper V** studies the differences between companies in terms of their shareholders' investment horizon. **Paper VI** and **Paper VII** both implement a longitudinal approach. Paper VI compares different groups of companies and their change in IT capability over two five-year periods. In contrast, **Paper VII** looks deeper into a panel of companies that have been characterized as having notable IT capability at least once, and investigates whether changes in the ownership structure are related to previous changes in firms' IT capability reputation.

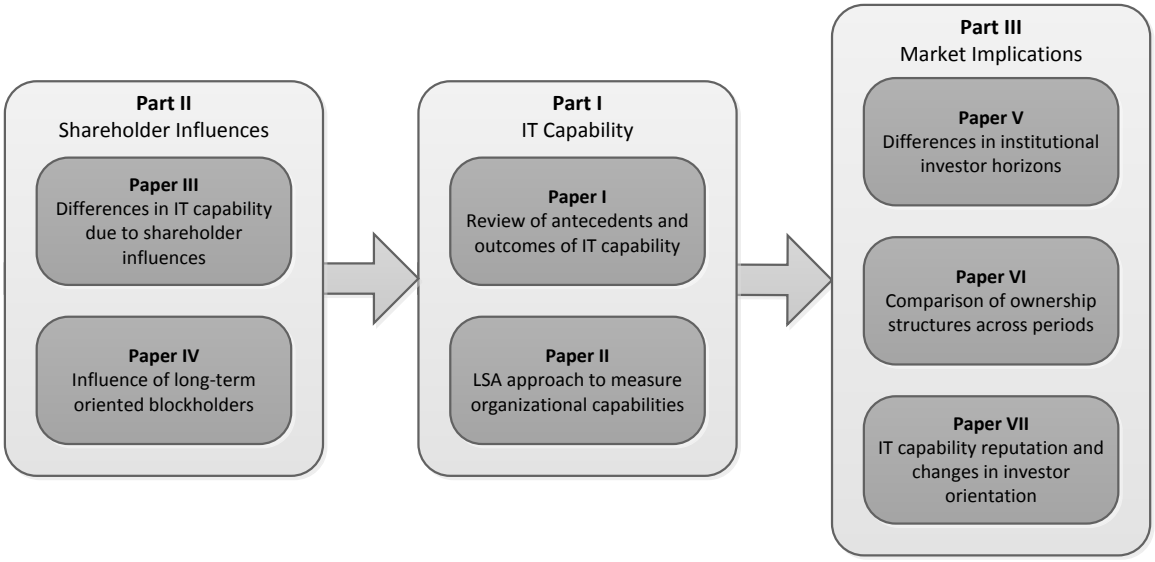


Figure 1. Structure of the thesis

This introductory paper summarizes the individual parts of this cumulative dissertation and is structured as follows. The next section introduces the relevant theoretical foundations and related research of the thesis. Section 3 explains the data sources and applied research methods used to study the research questions raised in the different papers. Section 4 presents the main results of each paper of the thesis, followed by the theoretical contributions and managerial implications in Section 5. Sections 6 and 7 discuss the limitations of the thesis and areas for further research. Finally, Section 8 contains a concluding summary.

2 Theoretical Foundations and Related Research

This section introduces the theoretical foundations and related research concerning the relationship between institutional investors and IT capability. The first two sub-sections summarize the central concepts of this thesis, namely IT capability from the IS literature (2.1) and institutional ownership from accounting and finance research (2.2). The following two sub-sections (2.3 and 2.4) discuss how and why these concepts are linked.

2.1 IT Capability and IT Capability Reputation

In early publications, researchers referred to IT capability in terms of either technological (Sabherwal and Kirs 1994) or managerial capabilities (Sambamurthy and Zmud 1997). Subsequent studies integrated these unilateral perspectives into a multidimensional concept composed of technological, human, and organizational aspects (e.g. Bharadwaj et al. 1999a; Bharadwaj 2000; Ross et al. 1996). Table 1 compares some conceptualizations of IT capability applied in the literature. The interaction of central elements like IT infrastructure, human IT resources, and IT business partnerships enables firms “to sustain IT innovation and respond to changing market conditions through focused IT applications” (Bharadwaj et al. 1999a, p. 381). Based on seminar work by Bharadwaj (2000, p. 171), IT capability is commonly understood as a firm’s ability “to mobilize and deploy IT-based resources in combination or co-present with other resources and capabilities”. Although some researchers have used different terms like IS capabilities (Feeny and Willcocks 1998; Ravichandran and Lertwongsatien 2005) and IT

competence (Sambamurthy et al. 2003), the central idea of finding innovative and effective ways to ensure optimal IT support of business operations remains the same.

The concept of IT capability is an integral part of the broader research stream on the business value of IT (Kohli and Grover 2008) and follows the principles of the resource based view (Bharadwaj 2000; Dehning and Stratopoulos 2003). The resource based view (RBV) attributes strategic benefits to organizations that have control over assets and capabilities that are valuable, rare, hard to imitate, and not substitutable by other resources (Barney 1991). Researchers have identified several IT related resources that meet these requirements and are part of an organizational IT capability (Mata et al. 1995; Wade and Hulland 2004).

Bharadwaj (2000) and later studies provide versatile evidence of the benefits and business value created by companies that succeed in developing such an IT capability. These benefits primarily include superior performance, competitive advantages, and innovation success. Paper I provides a detailed literature review on IT capability, its antecedents and its outcomes.

Recent research shifted from considering firm-internal IT capability (which is hardly measureable in all its facets) to studying firms' external IT capability reputation (Lim et al. 2013). The authors argue that IT executives are engaged in creating external legitimacy and public recognition for their IT capability by sending signals regarding IT strategy implementation or IT innovations to external stakeholders. IT executives who succeed in attracting public recognition are more likely to stay within the firm and further sustain their firm's reputation for IT capability.

Related but separate streams of literature cover IT investments respectively IT expenditures (see Lim et al. (2011) for a meta-analysis), IT-enabled capabilities (e.g. Joshi et al. 2010), and IT productivity (e.g. Tambe and Hitt 2012). A common criticism of solely studying IT investments is that they do not necessarily result in the development of IT capability, which often has long lead times (Tanriverdi et al. 2010) and is path-dependent (Lim et al. 2012a). Studies investigating the effects of IT capability and IT expenditures jointly conclude that only the former is significantly related to the benefits mentioned above (Aral and Weill 2007; Muhanna and Stoel 2010). Due to the unavailability of information about IT expenditures and insights from previous research, this thesis is focused on IT capability.

Study	Technological dimension	Human dimension	Organizational dimension
Ross et al. (1996)	- Technology base	- Competent IT human resources	- IT & business management partnering relationship
Bharadwaj et al. (1999a)	- IT infrastructure - External IT linkages	- Business IT strategic thinking - IT management	- IT business partnerships - IT business process integration
Bharadwaj (2000)	- IT infrastructure	- Human IT resources	- IT-enabled resources
Melville et al. (2004)	- Technological IT resource (infrastructure and applications)	- Human IT resources	- Complementary organizational resources

Table 1. IT Capability dimensions and underlying resources

2.2 Institutional Investors

Until the end of the 19th century, the American industry mainly consisted of companies operated by owner-managers. Increasing capital needs for business activities like railroad construction and mining, however, required outside financing and the consolidation of individuals' capital in a corporate form (King 2006). The first companies that issued stocks and bonds to external, individual investors were railroad companies in the middle of the 19th century. With the issue of shares to outside equity investors and their tradability, the number of shareholders rapidly increased. These new minority stockholders were no longer engaged in the management of companies and had little to no control over business operations. The majority of shares required to control a company was no longer held by a few owners but widely dispersed among an increasing number of investors (for example from 6.49 million individual shareholders in 1952 to 51.44 million in 1990)[4]. The managers in turn only held a small fraction of the outstanding shares, if any, and became employees rather than owners. Since the beginning of the 20th century industry by industry became dominated by public corporations (see Figure 2). The transition from private to public companies depended mainly on the type of activity and capital requirements. This phenomenon is better known in the literature as the separation of ownership and control (Berle and Means 1932).

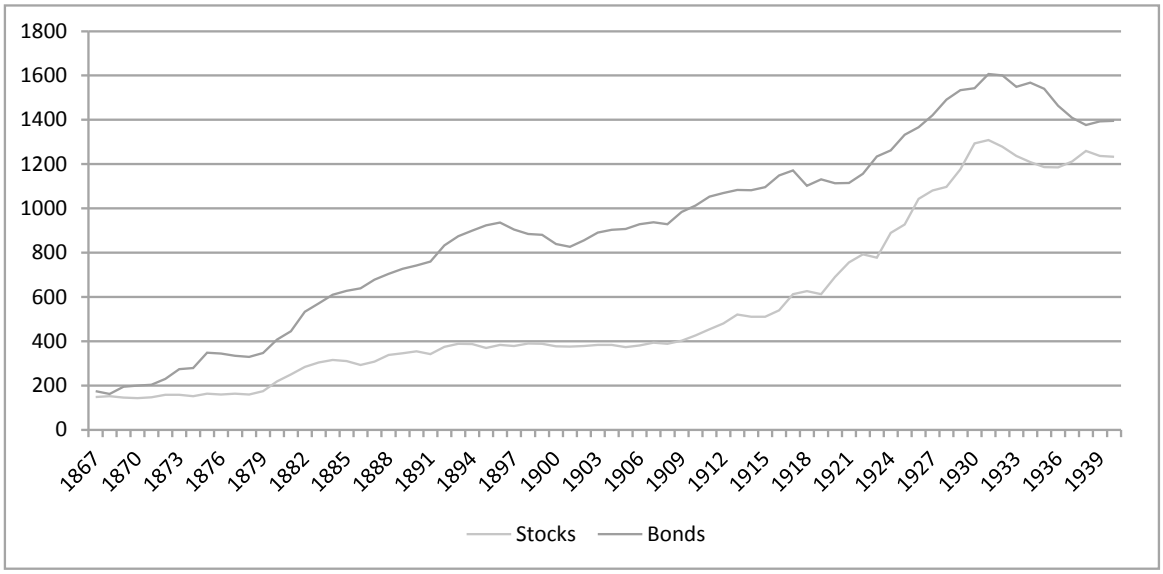


Figure 2. Number of issues listed on the NYSE from 1867-1940[5]

Until the second half of the 20th century, shareholders typically corresponded to private and individual owners. In subsequent decades the amount of shares held by institutional investors increased continuously from 6.1 percent in 1950 to over 70 percent in recent years (Gillan and Starks 2003; Gillan and Starks 2007). Figure 3 displays the development of institutional investors since 1997. Pension funds were among the first established institutional investors. Over time, other types such as mutual funds and later on hedge funds became further dominant players in

[4] Data was retrieved from the NYSE, http://www.nyxdata.com/nysedata/asp/factbook/viewer_edition.asp?mode=table&key=2312&category=11 (last accessed on 17/04/2014)

[5] Data was retrieved from the NYSE, http://www.nyxdata.com/nysedata/asp/factbook/viewer_edition.asp?mode=table&key=1862&category=4 (last accessed on 17/04/2014)

the market. In the present, institutional investors play a predominant role in the financial market, "particularly in their capacity as monitors of corporate performance and agents of change" (Gillan and Starks 2007, p. 55).

Institutional investors are regulated by the Securities Exchange Act of 1934[6] and subject to the U.S. Security and Exchange Commission (SEC). According to Section 13(f) of the Exchange Act, an institutional investor is defined as any natural person or entity that exercises investment discretion over more than $100 million in exchange-listed equity securities for its own account or with respect to the account of any other natural person or entity. Those institutions encompass banks, insurance companies, pension funds, and other investment companies such as mutual funds and hedge funds that invest in or buy and sell securities.

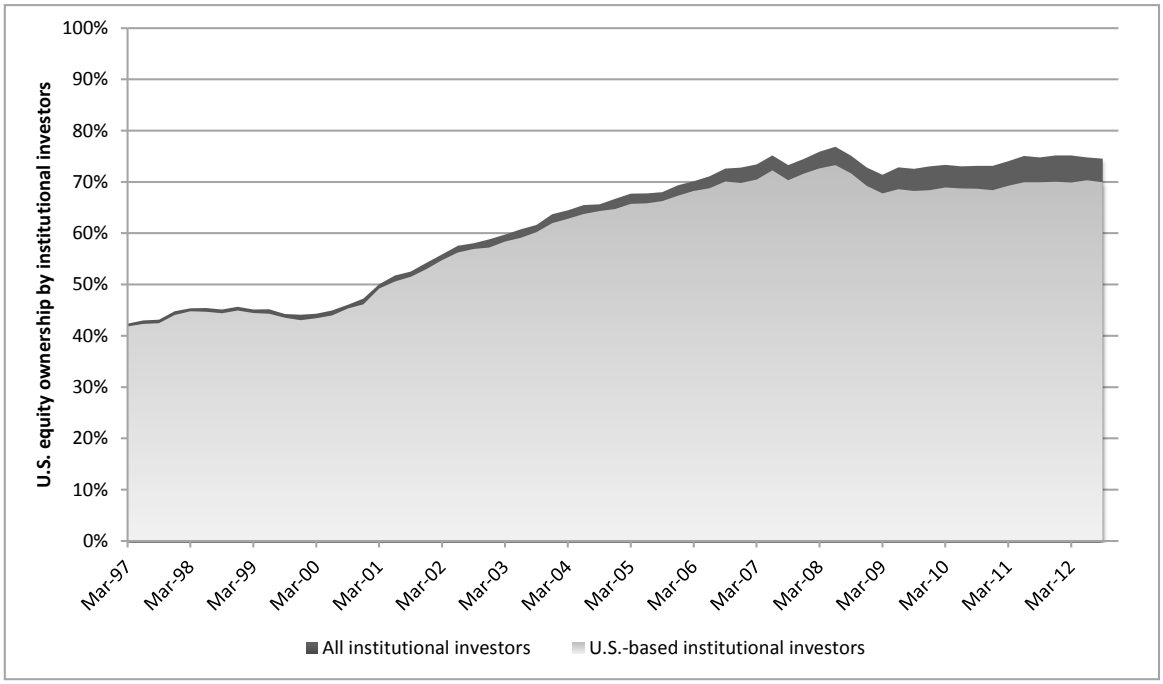


Figure 3. Increase of institutional ownership in NYSE listed companies (based on 13F filings, see 3.1.2)

Institutional investors have always been considered to be a heterogeneous group of market participants (Bennett et al. 2003; Yan and Zhang 2009). Besides as different owner types, institutional investors have been classified according to different characteristics such as existing business relationships, trading behavior, and investment horizon. Some common classifications in the literature that have been widely used in accounting and finance research are as follows:

- Brickley et al. (1988, p. 277) place institutional investors in "three mutually exclusive categories based upon their susceptibility to management influence": pressure-resistant, pressure-indeterminate, and pressure-sensitive. The classification is based on the existence and degree to which institutional investors have business relationships with

[6] While the Securities Act of 1933 regulates the primary market, i.e. the issuance of securities like stocks and bonds, the Securities Exchange Act of 1934 regulates the secondary trading of securities in the United States of America. The Exchange Act contains the underlying rules for financial markets and market participants. The Security and Exchange Commission (SEC) – established as a supervisory authority by Section 4 of the 1934 Act – enforces both Acts and subsequent statutes and amendments.

companies they hold. Adoptions of this classification can be found in Dalton et al. (2003) and David et al. (1998).

- Bushee (1998) developed and later refined (Bushee 2001; Bushee and Noe 2000) a classification of institutional investors' behavior. Using different variables related to portfolio diversification, portfolio turnover, and trading sensitivity to current earnings he identified three main forms of institutional investor behavior. Transient institutional investors "hold small stakes in numerous firms and trade frequently in and out of stocks", dedicated institutional investors have "large, long-term holdings, which are concentrated in only a few firms", and finally quasi-indexer "use indexing or buy-and-hold strategies that are characterized by high diversification and low portfolio turnover" (Bushee 1998, pp. 310-311).
- Several measurement approaches determine the investment horizon of institutional shareholders in a particular firm, respectively the short- or long-term orientation of institutional investors. In this context, a high stock turnover of an investor indicates his short-term orientation. Differences in investor orientation result from "investment objectives and styles, legal restrictions, and competitive pressures" (Yan and Zhang 2009, p. 894). Based on prior work by Carhart (1997), Wermers (2000) and others, Gaspar et al. (2005) and Yan and Zhang (2009) use two similar approaches to measure investors' portfolio turnover. Whereas the latter only consider actual trading activities of institutional investors, the former also incorporate investor cash flows. Both approaches have been widely adopted in the finance and accounting literature (e.g. Attig et al. 2013; Cella et al. 2013).

2.3 Shareholder Influences

Institutional investors face the choice either to trade securities for private gain based on gathered information or to bear the costs of monitoring and influencing management and in return awaiting higher returns in the future. Chen et al. (2007, p. 280) find that the "benefits of monitoring increase with the size of the stake, the length of time invested, and the independence of the institution". Thus, the investment horizon of an investor plays a critical role, with long-term oriented investors being more likely to monitor their portfolio companies. Dharwadkar et al. (2008) find further support for this relationship in the context of executive compensation. Among other factors, higher portfolio turnover, which indicates an increasingly short-term orientation, reduces the monitoring effectiveness of institutional investors. Conversely, long-term orientation and holding large blocks of shares incentivizes institutional investors to exercise voice and to "police the efficiency of poorly performing investments by pressuring those who manage the investments to do better" (Hoskisson et al. 2002, p. 698). Moreover, compared to individual investors, institutional shareholders have greater expertise and easier access to managers, directors, and other large shareholders (Dalton et al. 2007).

Weak shareholder monitoring and pressure from short-term oriented investors increase the likelihood of myopic management. Myopic behavior refers to active earnings management by cutting costs or avoiding investments for long-term projects (Bushee 1998). In order to meet short-term earnings targets, executives sacrifice long-term investments in tangible and complementary intangible assets such as R&D, advertising, information systems, and employee training (Porter 1992). In the case of R&D, insights from a study by Bushee (1998) show that

transient investors drive myopic behavior and create incentives for corporate managers to cut R&D expenditures in order to meet short-term earnings goals. In contrast, long-term oriented investors "remove incentives for myopic investment behavior by providing a higher degree of monitoring of managerial behavior" (Bushee 1998, p. 309). Further, Gaspar et al. (2005) find that these investors have "a higher ability to hold out" in difficult situations such as merger negotiations. Connelly et al. (2010) find that dedicated investors support strategic competitive actions whereas transient investors have a negative influence. Consistent with their focus on current earnings, short-term oriented investors are positively associated with tactical competitive actions that "create value in the short term via direct influence on current earnings and market share" (Connelly et al. 2010, p. 724). Overall, insights from research suggest that only long-term oriented investors demand and support investments in intangible and strategic assets like IT capability.

Among long-term oriented investors, blockholders whose holdings exceed five percent of outstanding shares play a special role. Contrary to common belief, Holderness (2009) provides evidence that blockholders are much more present in the U.S. than generally assumed. Monitoring by large investors has turned out to be a continuous and more efficient mechanism in the U.S. than the market for corporate control[7] (Demsetz 1986). As Shleifer and Vishny (1986; 1997) point out, large shareholders have the incentive and power to monitor management. These investors either hold enough votes themselves or form alliances with other blockholders to have "enough voting control to put pressure on the management" (Shleifer and Vishny 1997, p. 754). Large shareholders generally take a fiduciary role and have incentives not only to monitor managers but also to exert influence if managers do not engage in long-term value maximization. This includes the development of complementary and intangible assets as discussed above. Recent research shows that higher ownership concentration in terms of large ownership positions by institutional investors increases R&D input (expenditures) and output (e.g. number of granted patents) (Lee 2005; Lee and O'Neill 2003). Further, Edmans (2009) finds that informed blockholder trading causes prices to reflect fundamental value rather than current earnings and thereby increases the pressure on managers to undertake long-term investments. Due to their size and associated power blockholders can easily make their voice heard.

In recent years, institutional investors have increasingly engaged in shareholder activism to influence corporate management. In the 1980s, pension funds started to submit shareholder proposals, engage in proxy voting, and use mass media to target managers and directors directly (Gillan and Starks 2007; Ryan and Schneider 2002; Smith 1996). Institutional investors primarily engage in activism if the board of directors fails to implement adequate corporate governance mechanisms or if companies show poor performance. Research so far has looked at the effectiveness of activists with regard to R&D. David et al. (2001) show a positive influence on both short- and long-term R&D expenditures as well as on R&D outcomes. Other empirical studies have looked into the effect on corporate governance (Gillan and Starks 2000) and executive turnover (Helwege et al. 2012). Besides blockholders, institutional activists represent another major group of investors that closely monitors managerial actions and actively

[7] In the U.S., the market for corporate control is a dominant mechanism for controlling and disciplining managers. Competitors initiate hostile takeovers of poorly performing companies and replace inadequate, entrenched, or shirking managers (Macey 1997; Shleifer and Vishny 1997).

influences companies if management does not act in their interest. Although some activists, for example corporate raiders, focus on short-term gains, others such as pension funds and large investment companies are successful in demanding long-term growth strategies (for an example of the Hermes Fund see Becht et al. 2009).

Overall, theories on institutional investors suggest that they exert influence on corporate management to achieve their long-term objective of shareholder value maximization. This includes corporate investments in tangible and intangible assets including IT capability. As Ravichandran et al. (2009b, p. 681) point out, "firms that do not demonstrate their commitment to IT through appropriate investments could be questioned or penalized by their institutional shareholders". Shareholders have various mechanisms at hand and use them to make their voices heard. However, short-term oriented investors represent a central counterparty with conflicting interests.

2.4 Market Implications of IT Capability and IT Capability Reputation

Research on the business value of IT and on IT capability in particular offers broad evidence of firm-level benefits that result from successful IT deployment. These benefits include above average financial performance (Bharadwaj 2000; Masli et al. 2011b; Santhanam and Hartono 2003) and competitive advantages over competitors (Dehning and Stratopoulos 2003). In addition to benefitting financially, these companies are able to react and respond more quickly to competitive pressures and market opportunities (Pavlou and El Sawy 2010; Sambamurthy et al. 2003) and gain flexibility through improved processes (Mithas et al. 2011). New market opportunities can be exploited through lower coordination costs (Ray et al. 2009) and complementary IT-enabled capabilities (Chi et al. 2010). These strategic benefits are available to those companies that "can exploit IT functionality on a continuous basis" (Bharadwaj et al. 1999b, p. 383). IT expenditures to develop IT infrastructure, information systems, and human skills have been increasing over time and now generally exceed investments in R&D and advertising (Henderson et al. 2010). Today, they represent a substantial part of annual corporate budgets. In summary, annual costs and resulting benefits are apparent and can hardly be overlooked by investors that analyze companies. Even if short-term oriented investors only focus on earnings related figures (Ke and Petroni 2004; Yan and Zhang 2009), at least long-term oriented investors have to bear IT-related activities in mind when they pursue a thorough company analysis.

The development of a firm's IT capability is a continuous process. Research shows that only those companies that are able to maintain and constantly renew their IT capability over several periods can reap the benefits (Bharadwaj 2000; Masli et al. 2011b). This development, however, takes time (Ravichandran and Lertwongsatien 2002; Tanriverdi et al. 2010) and is path-dependent (Lim et al. 2012a). Some studies highlight the risks associated with IT activities as well (Dewan and Ren 2011; Dewan et al. 2007; Otim et al. 2012). IT investments need to be transferred into resources and capabilities that improve business operations (Bharadwaj 2000; Santhanam and Hartono 2003) and core competencies (Ravichandran and Lertwongsatien 2005). To achieve such improvements, the global IT strategy should be long-term oriented and handled by top management (Ravichandran et al. 2009a). Dedicated investors are in direct contact with executives to gather information (Bushee 1998) and if necessary have the ability to enforce their interests (Hartzell and Starks 2003; Helwege et al. 2012). Research shows that IT executives play

a crucial role in developing and constantly renewing a firm's IT capability (Lim et al. 2012b). Moreover, they "project an image of superior IT capability to external stakeholders" and sustain the firm's public recognition or reputation for such a capability (Lim et al. 2013, p. 57). IT-related activities and their benefits in the long-run are therefore likely to attract like-minded investors who are willing to take entrepreneurial risks but in return receive higher profits and future growth. Considering the current costs and risks entailed in developing and renewing an IT capability as well as the lagged effects of IT capability, it can be expected that only long-term oriented investors are attracted by IT-related activities and value these efforts.

The investment behavior of institutional investors has many facets. Especially differences between short- and long-term oriented investors are notable. Ke and Petroni (2004) for example show that institutional investors that pursue an active trading strategy have developed skills to predict changes in quarterly earnings. These investors exploit their informational advantage to realize and maximize short-term profits (Yan and Zhang 2009). In contrast, predicting the value of strategic and complex assets such as a firm's IT capability including the related management skills and human capital is more complicated and requires different abilities. A firm's IT capability rates among those assets that are hardly measureable and considered intangible assets (Lev 2001). IT-related information is neither available in financial statements nor disclosed otherwise. As these assets do not provide short-term profits but rather benefits in the long-run, it can be argued that they are only of interest to long-term investors. Research indicates that dedicated investors have both the incentive and ability to constantly gather profound information about companies they hold (Bushee 1998; Porter 1992). The ability to recognize and evaluate a firm's IT capability provides insights into a valuable and strategic asset that enables sustainable profits and growth in the future.

In summary, comparable to a firm's R&D activities, the benefits that can be achieved from maintaining a superior IT capability usually pay off in subsequent periods and affect future earnings. As argued above, it can first be expected that certain institutional investors, especially long-term oriented investors, incorporate information on a firm's IT capability into their investment decisions. Second, based on the previous literature, it can further be expected that long-term oriented investors have developed capabilities to recognize and value a firm's IT activities. The heterogeneity among investors and firms' IT capability should thus be reflected in firms' ownership structure and observable across firms and time.

3 Research Methodology

This section consists of two sub-sections that introduce the data (3.1) and methods (3.2) used in this thesis. Three different sources of archival data – the InformationWeek 500 ranking, the Thomson Reuters Ownership and Profiles data feed, and the Worldscope database – have been combined for the empirical analysis of the relationship between IT capability and firm ownership. The analytical framework discussed in Sub-section 3.2 includes a preparatory literature review and different quantitative methods to analyze the cross-sectional and panel data obtained from the three sources.

3.1 Data

3.1.1 InformationWeek 500

Each year, InformationWeek (IW) publishes a ranking of 500 leading users of information technology – the IW 500 ranking. For companies to be on the list, CIOs and senior IT managers of U.S.-based firms have to complete a survey that covers various IT-related topics from technical infrastructure and IT usage through to questions regarding the adoption of the latest technological innovations. Overall, the ranking represents a current image of companies' IT landscape including the IT workforce, process-level data, and recent initiatives. Although the survey design is occasionally adjusted to recent technological developments, the signal effect and accompanying honor for award winners remains the same. First published in 1989, the IW 500 ranking identifies different constituents each year, but most companies are listed repeatedly. Pooling the annual rankings provides a valuable – although unbalanced – panel data set for longitudinal studies. Due to its high correlation with comparable IT-related company data (Rai et al. 1997), the IW 500 ranking is a valid and widely used data set in academic research (e.g. Muhanna and Stoel 2010; Wang and Alam 2007). While early research used the data as a firm-level indicator for IT resource deployment respectively IT capability (Bharadwaj 2000; Santhanam and Hartono 2003), most recent studies associate a repeated ranking with reputation gains (Lim et al. 2013). Following prior research, this thesis uses the IW 500 data as a proxy for firms' IT capability and respective reputation.

3.1.2 Institutional Equity Ownership

A 1978 amendment to the U.S. Securities and Exchange Act of 1934 requires institutional investors to report their holdings of U.S. equity securities that exceed 10,000 shares or $200,000 in market value to the U.S. Security and Exchange Commission (SEC) within 45 days after the last day of each quarter by using Form 13F (see Wines (1990) and Giachetti (2013) for additional details on 13F filings). Institutional investors are classified as investors who maintain discretionary authority over at least $100 million in exchange-listed equity securities for their own accounts or with respect to accounts of third parties (see 2.2 for further details). Disclosure of short positions, derivatives on equity securities, and holdings of private securities is not required.

Data on institutional stock holdings is provided by Thomson Reuters through the Ownership and Profiles (OP) data feed. The OP database contains historic equity holdings of institutional investors on a quarterly basis since 1997. By the end of the 4th quarter of 1997, the database contained 2,098 (1,492 US-based) institutional investors and 30,865 (13,809 US-based) equity securities connected via 700,244 holding positions. By the end of the 4th quarter of 2013, the database contained 5,534 (3,486 US-based) institutional investors and 43,041 (12,155 US-based) equity securities connected via 1,722,176 holding positions. This data set serves as the basis for calculating aggregated stockholdings, portfolios, and characteristics of institutional investors and corporations that are used in this thesis.

3.1.3 Financial Data (Worldscope)

Additional fundamental data on public and private companies is retrieved from the Worldscope database which is operated by Thomson Reuters as well. The database contains high quality historic annual data collected since the early 1980s and standardized to enable comparability

and consistency between companies and throughout time and geographic regions. Worldscope includes accounting data from financial statements, such as Form 10Q and 10K in the U.S., and capital market data for exchange listed companies. The data set has mainly been used in this dissertation for control variables in empirical models, including firm size, return on assets (ROA), and Tobin's q.

3.2 Methods

3.2.1 Literature Review

The purpose of a literature review can be summarized as organizing prior research and identifying areas for further research. This task is increasingly relevant in academic research as the number, length, and complexity of publications constantly grows (Fettke 2006). The primary objective of Paper I is to summarize the antecedents and outcomes of IT capability in the academic literature and to identify gaps where further research is needed. To accomplish this task, the literature review presented in Paper I was conducted in accordance with the guidelines suggested by Webster and Watson (2002). In order to write a systematic literature review, Webster and Watson (2002) suggest a two-step procedure to identify the relevant literature. First, the researcher is advised to screen relevant journals by automated key word search in online catalogues and to scan journals' table of contents manually. A subsequent backward and forward search based on references yields additional articles relevant to the topic. For the core analysis of the identified articles, Webster and Watson (2002) advise authors to develop a concept matrix while reading through the articles and to classify the articles carefully by topics (concept-centric) instead of solely listing articles by authors independent of their content (author-centric). The outline procedure has been widely adopted and is recommended to systematically identify knowledge gaps and motivate further research.

3.2.2 Latent Semantic Analysis

Latent Semantic Analysis (LSA) is a technique used in natural language processing and information retrieval that was first mentioned by Deerwester et al. (1990)[8]. The central idea of this technique is to identify underlying or latent concepts from unstructured text by reducing dimensionality through the application of a technique from linear algebra called singular value decomposition (SVD). The advantage of this process is that "documents which share frequently co-occurring terms will have a similar representation […], even if they have no terms in common" (Hofmann 1999, p. 50). Paper II applies this technique to detect passages in financial analyst reports that refer to organizational capabilities, especially IT and innovation capability.

The first step is the creation of a term-document matrix from a collection of unstructured documents. Some corrections like stemming, stopping, and weighting can be applied in this process to improve the quality of the resulting matrix (Evangelopoulos et al. 2012). In the next step SVD is applied to the high-dimensional term-document matrix. The result is a much smaller, latent semantic or concept space "wherein terms and documents that are closely associated are placed near one another" (Deerwester et al. 1990, p. 391). A dimensionality parameter k is chosen to select a limited number of final concepts. The determination of k needs to be done carefully because all relevant concepts should be captured while modeling noise or irrelevant

[8] The methodology had already been patented by Deerwester and colleagues in 1989 (US Patent 4,839,853) http://patft.uspto.gov/netacgi/nph-Parser?patentnumber=4839853

details should be avoided (Bradford 2008; Deerwester et al. 1990). After constructing the semantic space, an information retrieval query can be used to identify and retrieve documents that have a similar representation. The degree of similarity can be used as a measure to rank the documents in accordance with the content of the query (Deerwester et al. 1990).

LSA was designed to handle synonymy, but is not able to deal with polysemy and homonymy (Deerwester et al. 1990). Further, LSA makes no use of "syntactic relations or logic, or of morphology" (Landauer et al. 1998, p. 263). The method is computationally costly (Karlgren and Sahlgren 2001) and therefore inadequate for dynamic collections that require frequent recomputations. Overall, LSA offers an automated process to extract latent concepts and similarities from unstructured documents.

3.2.3 Group Comparisons

Statistical methods for group comparisons are designed to test whether two or more groups, here groups of firms, differ from each other regarding a certain variable of interest. Comparing groups is an alternative analytical approach to techniques like correlation and regression analysis that are looking for relationships between variables of groups. Methods for group comparison can be classified by three main criteria described in the following. Figure 4 visualizes and classifies corresponding tests.

- **Number of groups**. Basic methods such as the t-test are designed to compare two groups $(k = 2)$. Other methods, such as the Analysis of Variance (ANOVA) have been developed to compare three or more groups $(k \geq 3)$.
- **Independent** versus **dependent** sample. An independent sample relates to observations of two or more different groups whereas a dependent sample contains two or more (repeated) observations of the same group.
- **Parametric** versus **non-parametric tests**. Some tests like the t-test rely on parametric assumptions, especially the assumption of normally distributed data. Most tests have non-parametric counterparts that are "sometimes known as assumption free tests because they make fewer assumptions about the type of data on which they can be used" (Field 2009, p. 540).

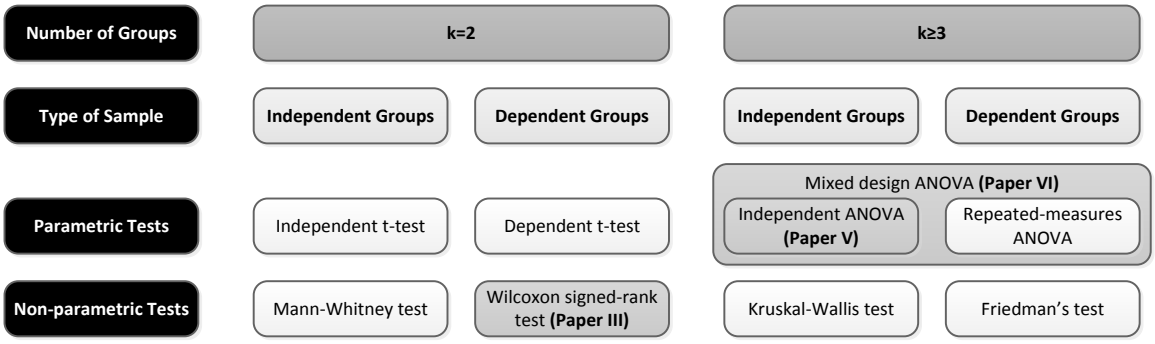


Figure 4. Methods for group comparison

The following briefly discusses the three methods used in Papers III, V, and VI of this cumulative dissertation. For further details and descriptions of the other tests see Field (2009, Chapter 9 to 15).

- **Wilcoxon signed-rank test**. This test was designed to compare two variables of a single group or sample when the variables are not normally distributed. In the context of this dissertation, the first variable contains firm-specific values and the second variable can either contain repeated measures for the same firm or reference values of a related variable such as an industry benchmark. The difference between the two variables is then calculated for each company and ranked in ascending order. Next, the ranks are aggregated separately for positive and negative differences. Finally, the test statistic, standard error, z-scores, and significance value can be determined. The null hypothesis of no difference between the two variables, i.e. that the values are similar, can be rejected if the significance value is below the 0.05 threshold.
- **Independent ANOVA**. This test is used for comparing the means of three or more different groups, i.e. groups of firms. The null hypothesis is that all group means are equal, respectively the alternative hypothesis states that at least one group mean is different. Consequently, an ANOVA does not indicate which and how many groups are different, just that there is some difference. A subsequent post hoc analysis is used to identify pairs of groups that deviate significantly. In general, the ANOVA assumes normally distributed variables and homogenous variances, i.e. that heteroscedasticity is not present. Several adjustments and robust alternatives like Welch's F and the Brown-Forsynth F-test are discussed in the literature in the case of violated assumptions (see Field 2009 for further details). The basic ANOVA design compares different groups defined by a single independent variable. This design can be extended to an arbitrary amount of independent variables, such as a two-way independent ANOVA in the case of two independent variables and so forth.
- **Mixed design ANOVA**. The mixed design combines between-group variables from the independent ANOVA and within-group variables from the repeated-measures ANOVA. A repeated-measures design is applied if the same firms are observed several times. Especially in the context of archival data, repeated observations are available for a large number of companies. Contrary to the independent design that examines differences between firms, the repeated-measures design examines differences over time for firms that experience certain changes, like a change in IT capability. The mixed design therefore requires at least two independent variables, one or more between-group variables, and one or more repeated-measures variables. Because of the repeated measures, the assumption of independence among observations is no longer valid in the repeated-measures design and an additional assumption of sphericity is required. This assumption requires that both variance between and covariance within groups are equal. The Greenhouse-Geisser correction can be applied if this assumption is violated (Field 2009). The assumption regarding normality from the single designs remains valid and corresponding corrections are equally applicable.

3.2.4 Panel Data Analysis

Panel or longitudinal data combines cross-sectional and time-series data and contains repeated observations of a constant group of entities (N), such as a set of firms, over several periods of time (T). The time dimension is usually equidistant, for example quarters or years, but does not have to be equidistant. The availability of repeated observations of the same companies allows analyzing changes over time. Observations for each entity are generally retrieved from repeated surveys or archival databases such as financial databases like Worldscope. Both Paper IV and Paper VII make use of panel data in the empirical analysis.

Panel data can take different forms depending on the availability of observations of each entity over time. If a data set contains one observation for each entity (n) in each considered time period (t), it is referred to as balanced panel data and encompasses a total of $N * T$ observations. In practice, balanced panel data represents an ideal data set but is generally difficult to obtain. By contrast, an unbalanced panel that has missing values, i.e. missing observations, is typical. For example, of all constituents of a stock exchange index, at certain dates some corporations drop out and new ones are included because of changes in market capitalization or other factors. Modern econometric methods presented in the following have been adjusted to support both balanced and unbalanced panel data (Baltagi 2008; Wooldridge 2010).

In general, panel data takes one of two characteristic shapes. In short panels the number of observed entities far exceeds the number of time periods $(N \gg T)$. Typical areas of application for short panels exist in sociology and economics where large groups of individuals or companies are studied in subsequent years. Long panels cover the opposite case, where few entities are observed over long periods of time $(T \gg N)$. Long panels occur in political science and macroeconomic research where a small number of countries is compared over long time periods, such as inflation rates in Europe since World War II. According to the different shape of the data, different methods for analysis have been developed for these two types of panel data. The methods used in Paper IV and Paper VII correspond to those used for short panels, as many firms are observed for approximately ten to fifteen years.

Panel data can contain heterogeneity across entities (similar to cross-sectional models) and within entities respectively over time. In practice, the difficulty resides in modelling this heterogeneity entirely through observable variables (omitted variables problem). Two essential approaches have been developed in econometrics to consider unobserved heterogeneity in panel data: the fixed-effects (FE) model and the random-effects (RE) model. The two models can be seen as extensions of the classic linear regression model and make additional but different assumptions regarding unobserved heterogeneity.

The fixed effects model allows unobserved variables to be correlated with the independent variables (x_{it}) and models them as individual or firm fixed effect (μ_i). This individual effect is different (heterogeneous) among firms but constant for each firm as it covers certain characteristics unique to the firm. In estimation procedures, the individual effect including any unobserved heterogeneity it represents is eliminated by mathematical transformation, i.e. the within transformation (Wooldridge 2010). A possibly existing correlation is therefore harmless and coefficients of the independent variables can be estimated consistently. By eliminating the

individual effects, they cannot be estimated which is acceptable because the coefficients of the independent variables contain the relevant information.

The random effects model imposes the stronger assumption that the individual effect (μ_i) may not be correlated with the independent variables (x_{it}). This implies that all relevant, i.e. potentially correlated variables (x_{it}), have to be modeled. Otherwise, remaining heterogeneity and correlation would be contained in the residual error term (ε_{it}), which leads to biased and inconsistent estimates. However, if the stronger assumption is satisfied, the RE estimator will result in more efficient estimates because it makes use of more variation and is superior to the FE estimator (Wooldridge 2010). Thus, in the case of no correlation among the individual terms and the independent variables, both models are consistent, but the RE model is more efficient. Hausman (1978) developed a specification test to examine the consistency of the estimators.

In the case of no individual effects ($\mu_i = \alpha$) or if all individual differences are perfectly explained by the model, the RE estimator and the classic linear regression of a pooled model will be equivalent[9]. The differences and applicability of the three estimators are visualized in Figure 5.

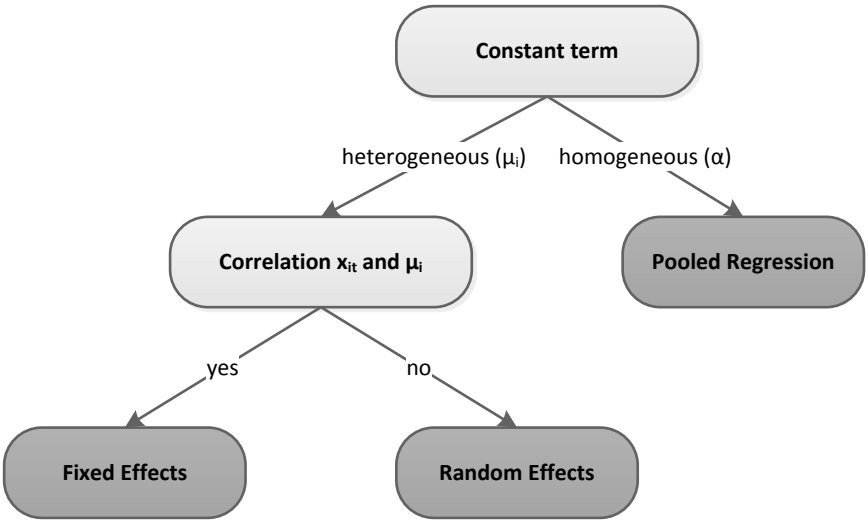


Figure 5. Unobserved heterogeneity and appropriate estimators (adapted from Schröder 2006)

Another source of inconsistency in the estimators originates from a correlation between the independent variables (x_{it}) and the error term (ε_{it}). This correlation is commonly referred to as endogeneity bias (Wooldridge 2013). Potential causes for such a correlation are omitted variables, simultaneity, model misspecifications, and measurement errors (Chenhall and Moers 2007). The endogeneity bias can lead to biased coefficient estimates and thus faulty conclusions. Instrument variables represent a classic textbook solution but are controversial in practice (Chenhall and Moers 2007; Hamilton and Nickerson 2003). Less critical concerns in panel analysis are unequal variances of the residuals (heteroscedasticity) and serial correlation. Heteroscedasticity- and autocorrelation consistent (HAC) covariance matrix estimators, in short robust versions of the above mentioned estimators, are widely available in econometric packages and standard in statistical analysis (Petersen 2009; Rogers 1993; White 1980; Wooldridge 2010).

[9] The Breusch-Pagan (1980) Lagrange multiplier test can be used to test for the existence of random effects.

Overall, the analysis of panel data offers several advantages besides controlling for individual heterogeneity (Baltagi 2008). It permits the analysis of lags including the consequences of decision making. This analysis is especially important because many decisions have implications at a subsequent date. Additionally, panel data contains more variation, less collinearity among variables, and more degrees of freedom, all of which increase the efficiency of panel data estimators.

4 Main Results

This section briefly describes each paper included in this cumulative dissertation and highlights the main results. The order of the papers follows the logic presented in the introduction (see 1.2) beginning with the IT capability concept (**Paper I** and **Paper II**), then looking at shareholder influences (**Paper III** and **Paper IV**), and concluding with market implications (**Papers V to VII**).

4.1 Paper I

Paper I of this dissertation represents a literature review of published IT capability research following the guidelines suggested by Webster and Watson (2002) and described in the methods section (see 3.2.1). The main purpose is to provide an overview of the determinants and outcomes of IT capability covered in the existing literature and to identify research gaps worth exploring. The literature review includes studies using primary and secondary data sources, but excludes related fields such as the IT spending literature which has been covered previously (see Lim et al. 2011; Masli et al. 2011a). For this synthesis, a collection of 30 relevant research articles out of 137 initially identified articles, published between 1996 and 2012, is analyzed. The peer-reviewed journal Management Information Systems Quarterly (MISQ) is most prominent with eight relevant publications.

Overall, the literature review shows that research on antecedents of IT capability is rather sparse. The factors currently covered include organizational learning (Bhatt and Grover 2005) and IT executives (Lim et al. 2012b). In contrast, the review shows a clear research preference for the benefits and outcomes of IT capability, which are considered in most of the articles. The studies on outcomes of IT capability can be clustered into three main categories: performance, competitive advantage, and innovation success.

- **Performance**. The majority of studies on IT capability investigate performance implications (22 articles). While longitudinal studies (11 articles) mainly use archival and secondary data sources, cross-sectional designs (9 articles) are generally based on survey data. Performance measures from secondary data sources are further separated into accounting-based (e.g. ROA) and market-based measures (e.g. market valuation, Tobin's q). Overall, archival data sets offer possibilities to study changes over time using aggregated data, whereas survey data allows detailed measurement at the process and firm-level.
- **Competitive Advantage**. Four articles predominantly investigate the contribution of different dimensions of IT capability on competitive advantage. The resource based view (e.g. Barney 1991) serves as the theoretical foundation of these studies. While most of the research is based at the firm-level, Rai and Tang (2010) additionally examine the implications at the process-level.

- **Innovation Success**. The three articles covering innovation-related outcomes represent the smallest group. Two of these papers represent case studies that are context-specific and provide limited possibilities for generalization. Only the study by Aral and Weill (2007) uses quantitative methods that allow drawing conclusions about a general positive relationship.

Besides the work by Rai et al. (2012), who study the network of a logistics supplier, there is no research article covering outcomes of IT capability beyond the firm-level. These outcomes would include research on external stakeholders such as suppliers, customers, and shareholders. At the firm-level, existing studies in the three presented categories provide varying depth of empirical evidence. Besides research on performance outcomes, the other fields are still emerging and certain questions remain uncovered. Further, additional research at the process-level would provide a better understanding of underlying mechanisms and differences within organizations. Regarding the antecedents of IT capability, theoretical and empirical work remains sparse and only a few researchers have contributed insights up to now.

Another drawback relates to the availability of data sources. The InformationWeek ranking is widely used and has been found to be reliable and comparable to other data sets (Rai et al. 1997). However, alternative, especially detailed, and longitudinal data sets are not available (see as well Kohli and Grover 2008). Data from additional sources and databases that would be required for statistical analyses is mostly unavailable for non-public companies.

4.2 Paper II

Available data sets on IT and especially IT capability are limited (Kohli and Grover 2008). The widely used InformationWeek ranking only provides aggregated ranks that do not allow a detailed evaluation. On the contrary, manual coding of articles from news magazines is time consuming, subjective, and only feasible for a small number of companies and years (e.g. Chi et al. 2010). Research on IT capability (e.g. Wang and Alam 2007) as well as the innovation literature (e.g. Kimbrough 2007) both indicate that these topics are covered in financial analyst reports. Paper II addresses current calls for research (Kohli and Grover 2008; Masli et al. 2011a) and develops an automated text-analysis approach based on latent semantic analysis (LSA) (see 3.2.2) to measure IT capability and innovation capability from these reports.

Paper II evaluates a collection of 153 financial analyst reports on 140 publicly listed companies from various industries. Analyst reports are mostly written by financial analysts that work for investment banks and brokers. They contain information on companies and their activities and are intended to facilitate investment decisions or to provide background information for large investors.

Overall, the automated content analysis shows that analyst reports are more appropriate for evaluating innovation capability than IT capability. Innovation related activities, including new products and services, are generally communicated by companies, whereas IT-related internal processes are hardly disclosed and remain obscure. For both capabilities, all companies are ranked according to their contextual fit to the construct. For IT capability, companies that are active in the IT industry tend to have the highest fit. Regarding innovation capability, the ranking

is dominated by pharmaceutical and healthcare companies. Interestingly, there is no overlap between the two rankings.

In summary, the content analysis approach seems to be more suitable for evaluating market-based capabilities like innovation. The identification of internal capabilities such as IT capability is limited and requires appropriate coverage in the documents used for the automated analysis. Generalizations from this rather small and experimental data set are therefore difficult. Further, it should be noted that the content of financial analyst reports may be influenced by institutional investors (Gu et al. 2013).

4.3 Paper III

This paper is the first of two empirical studies that investigate the influence of institutional investors on a firm's IT capability. As outlined above (see 2.3), dedicated investors have an interest in future development and long-run growth of their portfolio companies. Firms with a continuous IT capability are expected to have a more long-term oriented ownership structure that supports the development and continuous renewal of organizational capabilities and reduces myopic management. Prior research shows that institutional shareholders value the long-run benefits that are associated with intangible assets (Chen et al. 2007). This includes the development of information systems, their integration into daily operations and processes, as well as the appropriate training of employees (Porter 1992). Therefore this paper addresses the following research question:

RQ: How is a firm's ownership structure related to its IT capability?

Following prior research (Bharadwaj 2000; Santhanam and Hartono 2003), Paper III applies the Wilcoxon signed-rank test (described in 3.2.3). For each firm that is characterized with a superior IT capability, the test compares the investment horizon of its institutional shareholders with the average industry value at the two-digit and four-digit SIC code level. In particular, for each year between 2000 and 2009, the investment horizon of the previous three years is compared for those firms that are found to possess a superior IT capability in the subsequent year (approximately 220 firms per year). The investment horizon is calculated based on the approach by Gaspar et al. (2005).

The empirical results support the expected relationship between institutional investors' orientation and firms' IT capability. Firms in the sample that have a superior IT capability are consistently held by more long-term oriented institutional shareholders than their industry peers. These findings are robust to several variations, such as additional lags and the exclusion of potential outliers in the peer groups. Differences are generally greater when compared at the two-digit SIC code level. Overall, firms that develop or maintain a superior IT capability are held in preceding years by institutional investors that have approximately five to ten percent less stock turnover than the shareholders of industry peers. These findings indicate that long-term oriented investors are related to capability development through providing stability and adequate governance.

Comparing the R&D intensity of the sample firms yields unexpected results. Surprisingly, firms with superior IT capability in the sample have lower R&D expenditures than the industry average. This contradicts the insights from Bushee (1998) on firm ownership and R&D

expenditures, that show that firms held mainly by short-term oriented investors are likely to cut budgets. A possible explanation for this finding could be the input oriented R&D measure. As with IT, successful innovations result from a superior innovation capability and not from a high level of expenditures (Hult et al. 2004; Zaheer and Bell 2005). IT capability is further associated with higher innovation outcomes such that less expenditure is required to achieve innovation success above the industry average (Gordon and Tarafdar 2007; Tarafdar and Gordon 2007). Some caution is required when interpreting these results. The number of analyzed firms drops to around 100 per year and constrains generalizability. Further, many industries do not engage in R&D activities or at least do not disclose corresponding expenditures.

4.4 Paper IV

The second paper on shareholder influences examines how prior changes in the ownership structure affect the probability that firms will develop a superior IT capability. In particular this paper studies the potential influence exerted by stable, long-term oriented investors in parallel with institutional blockholdings. Building on the differences in investment horizon of a firm's shareholders as considered in Paper III, this paper investigates changes in shareholders' orientation and how they affect a firm's future IT activities. Further, as Holderness (2003) points out, "the relationship between ownership concentration and many major corporate decisions has not yet been addressed". This paper is a first step in studying the impact of institutional blockholders on a firm's IT capability. Paper IV is therefore guided by the following research question:

RQ: To what extent is a firm's superior IT capability influenced by its ownership structure?

Compared to Paper III, this study follows a longitudinal approach to examine changes over time. The panel data set contains 899 publicly listed companies from the IW ranking and covers the years from 1998 to 2008. Two measures of ownership characteristics discussed in 2.3 are analyzed: the long-term orientation of institutional investors is measured by the stability of their holdings, and their blockholdings are measured by determining the percentage of portfolio positions that exceed a five percent threshold of total shares outstanding (cf. Bushee 1998).

The research model provides evidence that stable, long-term oriented investors have a positive and significant effect on the development of IT capability in subsequent periods. These findings are in line with prior research and offer further support for the role of institutional investors and their engagement in sustainable growth (Hoskisson et al. 2002). In comparison, the expected influence of investors with large blocks of shares shows no significant effect. A potential explanation warranting further investigation might be that although investors hold concentrated portfolios, their corresponding share of a company might still be comparatively small such that these investors fall below a critical size to exert influence. Similarly, prior research does not find a significant relationship between institutional blockholdings and firm performance either (Mehran 1995).

Comparable to recent findings by Lim et al. (2012b), this paper finds that firm size is positively related to the likelihood of developing superior IT capability whereas past performance in terms of ROA has no influence. Larger firms have a higher probability to develop intangible assets,

which might be due to a higher availability of diverse resources, organizational slack, and past experience. All results are robust to variations of the dependent and independent variables.

While Paper III shows that there are certain differences in the ownership structure between firms that possess a superior capability and those that do not, Paper IV extends these insights and provides further evidence that changes in the ownership structure towards long-term orientation are related to a higher probability of firms developing a superior IT capability.

4.5 Paper V

IT capability is considered a strategic asset (Ross et al. 1996) that has long lead times and requires continuous investments to take full effect (Tanriverdi et al. 2010). Besides dedicated management through IT executives (Lim et al. 2012b), the development of IT capability can most likely be achieved with a long-term corporate strategy. In return, above average financial performance (Santhanam and Hartono 2003), competitive advantages (Dehning and Stratopoulos 2003), and other benefits are expectable. Consequently, should institutional investors not be interested in IT capability? Accounting and finance research has investigated many factors but so far neglected IT capability. Paper V attempts to fill this gap by arguing based on insights from prior research (e.g. Yan and Zhang 2009) that short- and long-term investors have deviating interests in strategic assets like IT capability. Thus, it can be expected that there are differences in the ownership structure between companies that possess IT capability in contrast to those that do not – or at least to those that do not disclose related information. This discussion about ownership structure leads to the following research question:

RQ: Do firms with superior IT capability attract certain types of investors?

For the empirical analysis, data on publicly listed U.S. companies that have been indexed by the Wilshire 5000 or Russell 3000 stock index is selected for the period 2000 to 2009. The sample of indexed firms is then split into two groups. The first one contains those companies that have been ranked repeatedly by InformationWeek, and can be classified as having a superior IT capability (Bharadwaj 2000). The second group (control group) contains the remaining indexed firms that never appeared in the IW 500 ranking. A third group of companies that are listed in the IW 500 ranking but not indexed is excluded because of missing capital market data. Different independent ANOVA designs and additional robustness tests (see 3.2.3) are used to compare the ownership structure of the two groups in each of the ten years. The ownership structure is measured by the investment horizon of a firm's institutional investors according to Gaspar et al. (2005). They first calculate each investor's orientation based on quarterly portfolio turnover. In a second step they determine for each company the average investment horizon of all institutional investors currently holding the outstanding shares. Low values indicate ownership by rather long-term oriented investors and higher values the opposite.

The statistical analysis provides the following central insights regarding hypothesized differences in ownership structure among the two groups of firms.

- In all years of analysis, companies that possess a superior IT capability are held by more long-term oriented institutional investors than other publicly listed companies.
- Additional consideration of industry types: Within the three considered industry classifications (automate, informate, and transformate; see Chatterjee et al. (2001) for

more details), the previously described difference between the two groups is still prevalent (see Figure 6). If differences according to industry types are considered within each of the two groups, only differences in the control group are observable. Industries that use IT for automation purposes show different ownership profiles than industries that run through transformation processes or have high information intensity.

- The inclusion of an indicator for financial performance above or below the industry average yields a similar result: Within either performance group there are significant differences in institutional investors' orientation between firms in the IT capability and the control group. Comparing differently performing companies within each of the two main groups, reveals only differences between high and low performing companies in the control group. Firms that possess a superior IT capability are held by investors with a similar investment horizon regardless of their relative performance.

In summary, firms with superior IT capability are characterized by more long-term oriented institutional investors than non-ranked companies. Within the group of superior IT capability firms no statistically significant differences could be identified, although small differences exist and can be visualized. Within the control group, performance differences and industry types both affect the investment horizon of a firm's institutional shareholders. Poor-performing companies and those that are engaged in industries characterized by transformation and high information intensity have the smallest share of long-term oriented investors.

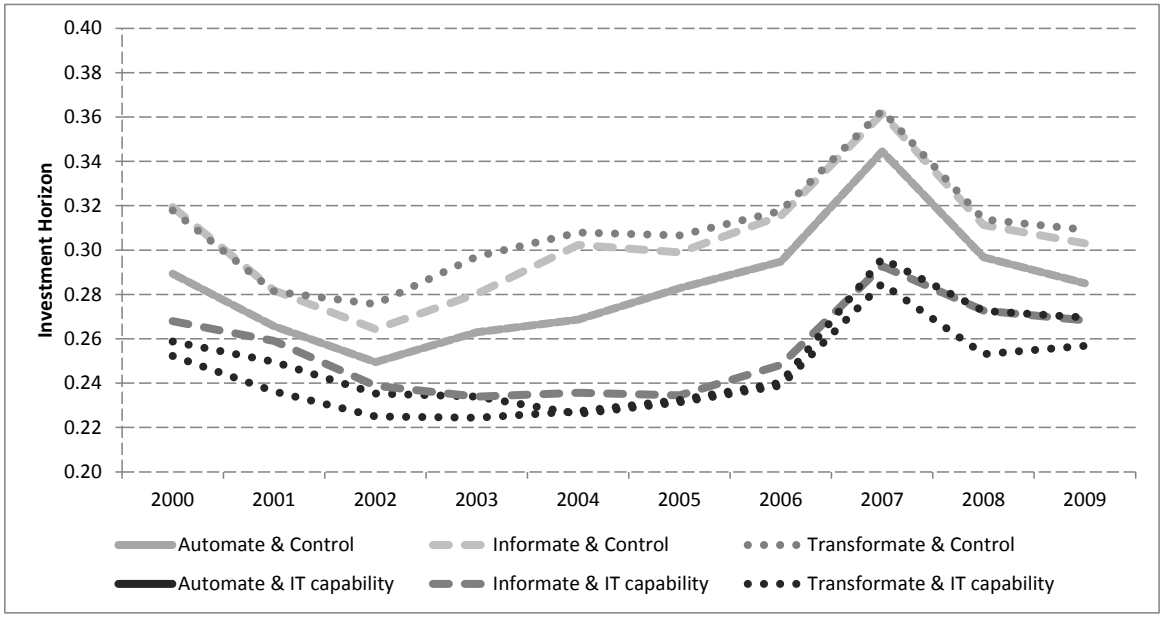


Figure 6. Mean values of investment horizon by industry types (low values of investment horizon correspond to long-term oriented institutional investors)

4.6 Paper VI

This paper is motivated by crucial differences in the frequency and longevity with which firms appear in the IW ranking. While some companies are ranked almost every year, others only appear temporarily and some companies even reappear occasionally. Possessing a superior IT capability has been associated with various benefits in the IT business value literature (see Paper I for a summary). The potential value associated with superior IT capability can hardly remain unrecognized by certain types of institutional investors especially as IT investments are

constantly increasing each year and amount to a large fraction of corporate expenditures (Ray et al. 2009). Therefore, the research question of Paper VI reads as follows:

RQ: What is the relationship between the development of IT capability and firm ownership over time?

Based on previous IT capability research, this paper compares different patterns of companies that participate in the IW 500 ranking during two 5-year timeframes, i.e. from 2000 to 2004 and from 2005 to 2009. In particular, four states are defined: being constantly in or out of the ranking in both periods and entering or leaving the ranking between the first and the second period. This setting combines differences among companies (the four states) with two repeated observations (period one and two). The dependent variable measures the long- or short-term orientation of institutional investors holding the stocks, following the approach by Gaspar et al. (2005). A mixed design ANOVA (see 3.2.3) is applied to analyze the combination of between-subjects effects (the four states) and within-subjects effects (repeated measures). The final sample consists of 1,046 publicly listed companies selected from the Russell 3000 and Wilshire 5000 stock indices.

The paper reports several findings. First of all, a comparison of firms that have been ranked constantly throughout both periods with companies that have never been ranked (or not more than a negligible number of times) shows significant differences among the two groups. Ranked firms, i.e. firms that are ascribed a superior IT capability, are held by more long-term oriented institutional investors that stand for stability and continuity. Second, an additional consideration of industry types according to Chatterjee et al. (2001) indicates that IT capability is considered more important by long-term oriented investors in industries where IT is used for informational purposes or where it acts as a driver of transformation. In industries where IT is mainly used for automation purposes no significant differences in the ownership structure are observable. Third, comparing changes over time shows significant differences among the groups. If the groups are split up further into industry groups, these differences become non-significant. A possible explanation therefore could be the small sample sizes of the resulting groups or the necessity for statistical correction due to violated assumptions. The latter requires a more conservative test that could underestimate the effect. Overall, the results provide compelling evidence of differences in the ownership structure between firms that possess a superior IT capability and those which do not.

4.7 Paper VII

Prior research provides ample evidence on the financial and strategic benefits of firms possessing a superior IT capability. The firm's external image of a superior IT capability, also referred to as a reputation for IT capability (Lim et al. 2013), reflects past activities and future prospects to external stakeholders, especially financial market participants. While short-term oriented investors neglect these types of strategic signals and search for more obvious predictors of short-term gains (Ke and Petroni 2004; Yan and Zhang 2009), long-term oriented investors have different interests and ways to incorporate such information (Chen et al. 2007). For companies it is not only important to integrate IT-based resources into processes and operations but also to signal such activities to external stakeholders. Building a reputation for being successful in exploiting new technologies is an important step in attracting the right

investors (Useem 1996). Following this expected difference among institutional investors this paper is guided by the following research question:

RQ: To what extent does a firm's IT capability reputation affect its ownership structure?

This study examines the reputation for IT capability of S&P 500 companies and their ownership structure from 1997 to 2012. Using a longitudinal approach, this paper integrates 16 years of archival data into a comprehensive panel data set. This data enables the econometric analysis of changes in both IT capability reputation and institutional ownership over time. Several approaches including fixed- and random-effects models and alternative model specifications guarantee the robustness of the results. Contrary to the previous papers, this study follows the calculation of the investment horizon of a firm's institutional investors, i.e. the shareholders' orientation as suggested by Yan and Zhang (2009). This measure is robust to investors' capital flows and only considers actual trading activity. The statistical analysis includes 4,263 observations from 353 distinct companies of the S&P 500 universe.

The Hausman test (Hausman 1978; Wooldridge 2010) suggests that the RE model is inconsistent due to a correlation between the individual effect and the independent variables and that the FE model should be preferred. The results of the FE model prove to be robust to further variations and can be summarized as follows:

- As expected, the empirical findings support the claim that long-term oriented investors are attracted by IT capability reputation. All tests indicate a clear association between IT capability reputation and the investment horizon of a firm's institutional shareholders.
- Financial performance in terms of ROA is associated with more transient investors. This finding is in line with research on short-term oriented investors and their preference for earnings related information (Yan and Zhang 2009).
- Firm size, dividend yield, and capital expenditures are all preferred by long-term oriented investors. Larger size and dividend payments mainly correspond to mature companies that attract dedicated investors. Increasing capital expenditures are an indicator of future investments in tangible and intangible assets.
- Both advertising and R&D expenditures are not significant, which could be due to missing values. As previously mentioned, the number of companies that report these figures is quite low.

Overall, the results support the expected impact of IT capability reputation on firms' ownership structure. Maintaining a positive reputation attracts long-term oriented investors and reduces the earnings pressures of transient shareholders.

5 Contributions

The theoretical and empirical analysis of the relationship between IT capability and firm ownership has several implications. The following two sub-sections summarize and briefly discuss the contributions to research (5.1) and practice (5.2).

5.1 Contributions to Research

This cumulative dissertation contributes to three main areas at the interface of IS and accounting research. First, it contributes to the body of knowledge on the IT capability concept. Second, theoretical reasoning and empirical evidence indicate that institutional investors influence the development of IT capability. Third, by extending prior IT impact research, this thesis presents new insights into capital market effects of IT capability.

5.1.1 IT Capability Concept

The literature review conducted in Paper I synthesizes past research on IT capability, its antecedents and outcomes. There are two main points that stand out. First, although two decades have passed since the first articles were published in this area (Ross et al. 1996; Sabherwal and Kirs 1994), the body of knowledge concerning the antecedents of IT capability is surprisingly limited. Few researchers so far have studied its determinants. Second, research on outcomes is mainly clustered in three areas (i.e. performance, competitive advantage, and innovation). Other implications, especially outside the firm's focus, are hardly covered and remain neglected.

Paper II contributes to the development of new measures for IT capability. Existing measures such as rankings from news media – e.g. InformationWeek and ComputerWorld – are highly aggregated and only provide limited information. Alternative and more detailed measures are required (cf. Kohli and Grover 2008; Masli et al. 2011a) that provide information on single dimensions of IT capability including technological, organizational, and human IT resources. Paper II implements an automated content analysis approach to infer single IT capability dimensions from unstructured documents, in particular financial analyst reports that provide detailed company coverage for large investors. The results provide evidence of the applicability of the content analysis approach, although analyst reports seem to be more appropriate for uncovering market based capabilities (e.g. innovation capability) than resource based capabilities (e.g. IT capability). However, Paper II is a first step in the direction of using automated text analysis techniques for measuring IT capability.

5.1.2 Institutional Investor Influence as Antecedent of IT Capability

Relatively little is known about the determinants of IT capability. According to a recent study by Lim et al. (2012b), IT executives and their structural power play a crucial role in leveraging IT resources to achieve superior outcomes. Executives, however, are closely monitored by corporate shareholders, in particular by institutional investors (Almazan et al. 2005; Del Guercio et al. 2008; Helwege et al. 2012). Paper III and IV of this cumulative dissertation provide evidence that long-term oriented institutional investors are linked to the development of a firm's IT capability in subsequent periods. In particular, Paper III shows that the existence of a continuous IT capability is related to higher levels of institutional shareholders in previous periods. Building on these results, Paper IV finds that changes in the ownership structure towards higher shares of long-term oriented investors increases firms' likelihood of developing and sustaining IT capability.

In contrast to the sparse research on determinants of IT capability, researchers have investigated institutional investors and their influence on public companies from various angles. Although influence on R&D has been studied extensively (e.g. Bushee 1998; Hoskisson et al. 2002; Lee and

O'Neill 2003), research on IT capability is lacking. This thesis complements recent evidence by Ravichandran et al. (2009b), who show that institutional investors are positively related to IT investment intensity. The authors, however, do not examine whether differences in the investment intensity depend upon certain types of institutions. Paper III and IV both add to the debate on the benefits of long-term oriented investors and prevention of management myopia. In line with prior research, the findings suggest that long-term oriented shareholders provide a healthy environment for firms to develop sustainable strategies and corporate capabilities to effectively support them.

5.1.3 Implications of IT Capability and IT Capability Reputation on Capital Markets

Insights from this thesis complement prior IT impact research on the positive association between IT capability and firms' market value. Previous research related to capital market implications of IT capability basically investigates changes in market value and abnormal returns (e.g. Muhanna and Stoel 2010). The Papers V to VII provide robust findings that IT capability and IT capability reputation affect not only the market valuation of a company but also the ownership structure. Paper V and VII both find that firms characterized by a superior IT capability exhibit a more long-term oriented ownership structure than other companies. Paper VII shows that changes in the external recognition and consequently in the reputation of a firm's IT capability lead to changes in the ownership structure. Firms that create (lose) a corresponding reputation are held by more (less) long-term oriented investors.

From an IS perspective, these findings add a previously neglected but strategically important factor to the research agenda and are a first step in this new research direction. The impact on financial markets and external stakeholders, in particular institutional investors, is still an emerging field in IT impact research. Exceptions, for example, are Rai et al. (2012), who study supplier networks and Kim and Mithas (2011) who provide first insights on how IT intensity is related to the bond market. This thesis contributes to the discussion of IT capability by considering it in terms of an intangible and strategic asset. Further, the results presented in Paper V show differences in IT capability across industry types (Chatterjee et al. 2001; Dehning et al. 2005; Otim et al. 2012; Schein 1992).

The information environment of institutional investors has received considerable study from a finance and accounting perspective (e.g. Ke and Petroni 2004; Yan and Zhang 2009). In this context, intangible assets have always been of interest (Lev 2001). This thesis contributes to the understanding of differences among institutional investors and their preferences for certain firm characteristics. In particular, Papers V to VII extend the literature on investor preferences of short- and long-term oriented investors.

5.2 Contributions to Practice

The findings from studying the relationship between a firm's IT capability and its ownership structure offer valuable insights for various groups of actors.

Executives should bear in mind that the presence of long-term oriented investors is associated with several benefits. These include lower costs of capital (Attig et al. 2013; Elyasiani et al. 2010), price stability (Cella et al. 2013), and better positions in takeover battles (Chen et al. 2007; Gaspar et al. 2005). By contrast, short-term oriented investors transfer their focus onto

corporate management. Increasing pressure to reach quarterly earnings targets fosters myopic management and destroys long-term company value. This thesis shows that a firm's IT capability is associated with long-term ownership by institutional investors in different ways. Thus, executives should communicate IT-related activities that indicate a superior IT capability to external stakeholders and financial markets. Dialogue with investors has proven to be a powerful instrument to attract the 'right' investors (Bushee 2004; Useem 1996). In cooperation with the investor relations department, executives should pursue participation in beneficial rankings, like the IW 500 ranking, and engage in relationship investing by disseminating IT-related information to institutional investors (Bushee and Miller 2012). For executives, "it does make a difference who the shareholders are" (Gaspar et al. 2005, p. 138). Short-term investors are not as committed to the company as long-term investors who provide guidance in good as well as in bad times.

Data shows that the volume of assets under management of **institutional investors** continues to increase. Equity investors need to decide in which companies they should invest their money to achieve long-run value for their clients. This thesis shows that considering intangible assets like IT capability is a relevant decision criterion for long-term oriented investors. Academic research provides broad evidence of the positive benefits associated with IT (e.g. Kohli and Grover 2008; Masli et al. 2011a). Investors wanting to participate in profits and value increases should develop skills to identify these intangible assets. The same holds true for **financial analysts** who serve as a major information source for investors. While prior research suggests that analysts have developed certain skills to estimate the potential of R&D activities (Kimbrough 2007), a backlog exists for IT related topics. Looking ahead, institutional investors have the size and power to exert influence on executives to invest in intangible assets like R&D, information systems, and employee training that create sustainable growth in the long-run (Porter 1992). Investors should fulfill their fiduciary duty and engage in adequate company development by exploiting the full spectrum of given options.

Insights from this study are of interest to **policy makers** as well. Despite its implications and value, IT related information is not disclosed in financial statements. Intangible assets only have to be balanced after a takeover transaction if certain rules apply. Otherwise they remain hidden as goodwill. In the digital age where IT expenditures account for a large part of corporate budgets, the disclosure of these expenditures would be a first step toward evaluating companies' IT activities and their implications for market value.

6 Limitations

Some limitations that might occur due to the selected research design of the single papers must be noted. These limitations should be considered when interpreting the results of this dissertation.

Considering the literature review conducted in Paper I, some IT capability related articles might have been overlooked. The use of key words to identify relevant articles and the search in electronic databases are a potential source of error. Techniques such as a forward and backward search of citations mitigate the risk of missing any relevant paper. However, with regard to the

basket journals, all relevant articles published prior to 2012 should have been identified and included.

The results of the content-based analysis applied in Paper II are especially limited by the small size of available research reports. These documents are of high quality and widely used in the financial industry but too expensive for large-scale academic projects. As only very few reports were available for each firm, the implemented LSA-based approach is limited as well.

Empirical studies are generally susceptible to limitations regarding the selected data and applied research methods. The following points mainly concern Papers III to VII. Although the data sources used in this dissertation are widely used in finance and accounting research, there might be some quality issues. The IW 500 ranking only represents a highly aggregated proxy for IT capability. IW collects detailed data including process-level activities, but only publishes final ranks. It is therefore impossible to reconstruct the dimensionality of the IT capability concept. As reported by Wines (1990) some quality concerns arise with regard to 13F filings of institutional equity holdings. These reports are not top priority and sometimes inaccurate and inconsistent. Thomson Reuters has implemented corresponding checks to avoid incorrect data. Finance and accounting data is also prone to quality issues. The reliability of available data can be limited due to changes in regulations and reporting standards over time, managers' discretion in financial reporting, and the standardization of key figures through data providers. With regard to statistical methods, issues like endogeneity can limit the validity of the results (see 3.2.4). Potential sources such as unobserved heterogeneity (i.e. omitted variables bias) have been addressed by considering relevant control variables and appropriate statistical models. However, remaining effects of feedback loops and reverse causality could not be ruled out completely.

The samples in Papers III to VII all focus on publicly listed U.S. companies and institutional holdings thereof. Other types of shareholders such as households and governments are thereby excluded. However, as institutional investors nowadays hold over 70 percent of U.S. equity, the focus is acceptable and common in the literature (e.g. Attig et al. 2013). Similarly, this thesis does not support any conclusions about non-public companies, such as private companies and other organizations. Moreover, the samples are limited to U.S.-based companies. Other countries have different market systems or are less dominated by institutional investors. Considering Europe, there is a growing importance of institutional investors in different countries. With respect to Germany, BlackRock, for example, holds on average more than five percent of each DAX30 company and thereby considerable power and influence.

7 Future Research

This section highlights several suggestions for further research. These include advances in data sources and further theoretical and empirical extensions to related areas.

The availability of adequate data sources on IT-related corporate resources and activities is still a major shortcoming in empirical IT business value research (see Kohli and Grover 2008). Longitudinal data sets spanning several years and many companies are especially required. IT capability is a multidimensional concept and should ideally be studied as such. Paper II uses techniques from content-based analysis to develop a new approach for measuring the different facets of IT capability. Future studies could extend this approach in two ways. First, alternative

data sources such as articles from newspapers, company representatives, IT experts, or blogs could be used. These texts are more easily available and are rich in context if selected thoroughly. Second, a comparison of different methods and their outcomes would help to assess the reliability and robustness of this approach.

Additional research on the antecedents of IT capability could consider the joint effects of institutional shareholders and top management characteristics. As Lim et al. (2012b) and Lim et al. (2013) show, IT executives play a critical role in leveraging IT capability and creating a corresponding reputation in the market. Institutional investors in turn are closely connected to executives (Almazan et al. 2005; Del Guercio et al. 2008; Helwege et al. 2012). Considering joint effects and mutual dependencies will clearly contribute to prior findings that considered both factors separately.

The papers of this cumulative dissertation are focused on the IT capability concept. As Ravichandran et al. (2009b) show, the proportion of institutional ownership is related to the level of corporate IT expenditures. Further research could look into the relationship between IT expenditures and the development of IT capability when considering the ownership structure. Prior studies on IT impact that consider both IT spending and IT capability jointly conclude that only IT capability is a relevant factor (Aral and Weill 2007; Muhanna and Stoel 2010). It would be interesting to examine how this relationship turns out in the context of investors and capital markets. For investors it is easier to collect information regarding overall IT expenditure than detailed IT initiatives. Compared to IT expenditures, activities to constantly renew a firm's IT capability are more complex and more difficult to monitor.

Institutional investors are a heterogeneous group of actors with varying interests, strategies, and behavior. Initial research mainly considered the aggregated percentage of a company's shares held by institutional investors (e.g. Gompers and Metrick 2001). Over time, more differentiated measures have been developed to capture certain behavior (Bushee 1998; Gaspar et al. 2005). This thesis predominantly focuses on the investment horizon of a firm's institutional shareholders. Further research could extend the findings presented by using a combination of ownership measures, such as investment horizon and investor type, to identify more detailed ownership effects. Another option would be alternative measures that are more firm than investor centric (Dharwadkar et al. 2008; Elyasiani and Jia 2010).

Finally, this dissertation is limited to the study of U.S.-based public companies. Further research should consider small and medium sized and private companies as well. Studying these companies might provide a better understanding at least about the direction of the influence of owner-managers on IT capability development. Moreover, the scope should be extended to other countries, especially in Europe and Asia. Deviating market and ownership structures in these countries might offer additional insights into the relationship between investors and IT capability. In April 2014, Laurence D. Fink, the head of BlackRock, sent the same letter mentioned in the introduction to chairmen and CEOs in European countries. He encouraged managers to reinvest profits and to focus on long-term sustainable growth instead of paying large dividends in the present. Although this thesis focuses on the U.S. equity market, this letter suggests that the same relationship can be found in other countries.

8 Conclusion

This thesis investigates the relationship between corporate IT capability and institutional investors from two different perspectives. From the first perspective, institutional investors influence companies in their strategies and objectives. From the second, IT capability has considerable firm-internal implications that increase future prospects and firm value, which in turn attracts certain investors. The empirical results illustrate significant differences in ownership structure for firms characterized by superior IT capability. Looking deeper into this phenomenon indicates that the development of a firm's IT capability is related to subsequent changes in the ownership structure towards more long-term oriented institutional shareholders and vice versa. This thesis advances our understanding of the firm-external influences of institutional investors as well as the capital market implications of firms' IT capability. However, the limitations and outlined areas for further research indicate that this thesis is only a first step toward insights into IT capability and market interactions. This perspective on IT capability is still an emerging field that requires further theoretical and empirical investigation. Market changes and the growing dominance of institutional investors result in new and relevant research questions worth exploring.

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Paper I

Determinants and Consequences of IT Capability: Review and Synthesis of the Literature

André Schäfferling
German Graduate School of Management and Law

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Paper II

A Latent Semantic Analysis Approach to Measure Organizational Capabilities

André Schäfferling
German Graduate School of Management and Law

Felix Middendorf
University of Bamberg

Abstract

Organizational capabilities provide crucial benefits to companies and constitute a source of above average financial performance and competitive advantage. However, from a firm-external perspective these capabilities are hard to assess for researchers and practitioners like investors and analysts. Our study builds upon latent semantic analysis (LSA) – a modern technique for automated text-analysis – to evaluate organizational capabilities from unstructured documents. The purpose of our work is to develop, implement, and evaluate a universally applicable method using the example of IT and innovation capability. Analyzing a collection of financial analyst reports, we find that these documents are adequate for evaluating market-based capabilities such as innovation and limited in the case of internal capabilities like IT capability. In general, the results support the applicability of our automated text analysis approach for the measurement of organizational capabilities and related problem sets.

1 Introduction

In today's age of "Big Data", vast amounts of valuable information on organizations are available to Information Systems (IS) researchers and practitioners. Organizations themselves publish both short press releases as well as quarterly and annual reports spanning hundreds of pages. Financial analysts and investment banker offer independent reports that integrate and condense available information. In a similar way, news agencies include business news in their coverage and supply reports to news organizations. Magazines, newspapers, and blogs finally distribute news and background information to the broad public and discuss companies and their actions.

In all these examples, information is processed, stored, and published as unstructured text, "the primary transmitter and repository of human knowledge" (Karlgren and Sahlgren 2001, p. 295). A widespread factoid states that 80 percent or more of all enterprise information is stored in unstructured forms, mostly text (Kuechler 2007, p. 86). The unstructured nature of the medium text hinders information access and usage by researchers and practitioners. Until recently, there has not been an alternative to manual coding in content analysis, a tedious, time-consuming, and error-prone process that does not scale well.

The emergence of text mining has paved the way for automated, computational approaches that are affordable, scalable, repeatable, and consistent (Indulska et al. 2012, p. 50). Text mining and analysis techniques have been applied to problems and phenomena in various disciplines, e.g., marketing, linguistics, psychology, and biomedicine. However, they have not yet found their way into mainstream IS research where they still remain an "underexplored" (Indulska et al. 2012, p. 50) area. The few existing exceptions in IS journals are altogether relatively straightforward and do not go beyond an identification and analysis of core topics that occur in the abstracts of scientific articles.

The purpose of this work is to explore the application of content analysis techniques to unstructured documents for the evaluation of organizational capabilities. It aims to develop, implement, and evaluate a universally applicable method using the example of an intra-organizational comparison of both IT and innovation capability, based on a collection of analyst reports.

Organizational capabilities are considered as “complex bundles of skills and collective learning, exercised through organizational processes” (Day 1994, p. 38). They are rooted in the Resource-based View (RBV) and are a special type of resource that has the purpose of improving the productivity of other resources controlled by the organization by deploying them advantageously, usually in combination (Amit and Schoemaker 1993; Makadok 2001; Melville et al. 2004). Therefore, capabilities are considered as a source of sustained competitive advantage.

Prior research provides evidence that IT capability is positively related with higher accounting performance (Bharadwaj 2000), above average market valuation (Muhanna and Stoel 2010), and sustained competitive advantage (Dehning and Stratopoulos 2003). On the other hand, innovativeness in general and IT innovations in particular (Stratopoulos and Lim 2010) are key nonfinancial goals of companies (Moos et al. 2010). Both, IT and innovation capability have therefore received considerable attention in IS research during the last years.

However, capability-related data is hardly available and difficult to retrieve (Kohli and Grover 2008). So far, the analysis of secondary data for capability research has relied heavily on manual coding (e.g. Chi et al. 2010), which is time consuming and has its limitations. Other studies use publicly available but highly aggregated IT rankings as proxies for IT capability, such as the InformationWeek 500 ranking (e.g. Bharadwaj 2000; Muhanna and Stoel 2010) or the Computerworld ranking (e.g. Dehning and Stratopoulos 2003). Other drawbacks are the limited number of companies covered and the periodically changing sample. The application of content analysis techniques is expected to enable the usage of more information from secondary data, a pivotal notion for our work.

This paper addresses current calls for research (Kohli and Grover 2008; Masli et al. 2011), by suggesting an automated content analysis approach to evaluate organizational capabilities from unstructured documents.

The remainder of this paper is organized as follows. First, the background section introduces the considered capabilities and the content analysis technique latent-semantic analysis (LSA). Second, the measurement approach is present. The paper concluded by presenting and discussing the results.

2 Theoretical Background

2.1 IT Capability

The concept of IT capability has received a lot of attention in academia and practice during the last two decades. IT capability has been defined as an organization’s “ability to control IT-related costs, deliver systems when needed, and effect business objectives through IT implementations” (Ross et al. 1996, p. 31). In accordance with the resource based view and the definition of capabilities in general (Makadok 2001), IT capability is understood as an organization’s “ability to mobilize and deploy IT-based resources in combination or copresent with other resources and capabilities” (Bharadwaj 2000, p. 171). The concept of IT capability is very important to IS research, because it helps to explain how IT creates business value. While early studies considered IT capability either from a managerial (Sambamurthy and Zmud 1997) or technical perspective (Sabherwal and Kirs 1994), current research follows a multidimensional perspective

covering technological, human, and organizational aspects (e.g. Bharadwaj et al. 1999; Bharadwaj 2000; Melville et al. 2004). Empirical research in this area has generated several insights. For example, at the process-level it has been found that IT capability provides operational benefits (Kim et al. 2011) and facilitates integration processes (Rai et al. 2006). At the firm-level superior IT capability is associated with higher accounting-based performance (Bharadwaj 2000; Santhanam and Hartono 2003), sustainable competitive advantage (Dehning and Stratopoulos 2003), and higher market valuation (Wang and Alam 2007).

2.2 Innovation Capability

A firm's innovation capability or innovativeness not only has "emerged as a firm's key non-financial goal" (Moos et al. 2010, p. 1), it is considered a competitive imperative: organizations are required "to innovate, not just occasionally but often, quickly and with a solid success rate" to create value for the organization and its stakeholders (Lawson and Samson 2001, pp. 380, 384). Thus, innovation capability can be defined as a "firm's tendency to lead the industry in creating and introducing new products or services and adopting new technology to enable new products or services" (Zaheer and Bell 2005, p. 810). This definition encompasses two commonly differentiated types of innovation: product or service innovation, which results in new product or service offerings by the organization, and process innovation, which improves the organization's internal processes and systems. The innovation literature provides broad empirical evidence of the positive effects of innovation, for example on firm performance (Bell 2005; Deshpandé and Farley 2004), and market share (Zaheer and Bell 2005).

2.3 Latent Semantic Analysis (LSA)

Latent Semantic Analysis (LSA) aims to uncover the higher-order structures, i.e. concepts, that it assumes to implicitly exist in the association of terms and documents (Deerwester et al. 1990). Although it cannot be considered a mainstream method in IS research, LSA is comparatively well-known due to being discussed and applied in recent articles in the IS field (Evangelopoulos et al. 2012; Indulska et al. 2012; Kuechler 2007; Sidorova et al. 2008).

LSA extracts the meaning of words exclusively from the analysis of texts, i.e. it does not tap external sources such as dictionaries or thesauri. Essentially, a feature extraction is conducted: The high-dimensional term-based feature space is projected into a much smaller, latent semantic space "wherein terms and documents that are closely associated are placed near one another" (Deerwester et al. 1990, p. 391), i.e. "documents which share frequently co-occurring terms will have a similar representation […], even if they have no terms in common" (Hofmann 1999, p. 50).

The dimensionality is reduced by Singular Value Decomposition (SVD), a technique from linear algebra that is closely related to the eigendecomposition of a matrix. SVD factorizes the original term-document matrix X into three matrices: $X = T_0 S_0 D'_0$. The matrices of left and right singular values for terms (T_0) and documents (D_0) have orthonormal columns. S_0 is the diagonal matrix of singular values, whose diagonal elements are "by convention […] constructed to be all positive and in decreasing magnitude" (Deerwester et al. 1990, p. 397).

S_0 is truncated by keeping only the k-largest singular values and setting the remaining ones to zero. The deletion of all zero rows and columns of the truncated matrix S_0 yields a new diagonal

matrix S. The corresponding columns of T_0 and D_0 are also deleted; this produces the matrices T and D, respectively. By multiplication of these three matrices, the matrix $\hat{X} = TSD'$ is constructed. This new matrix is the matrix of rank k, which is the closest approximation to X in the least squares sense, i.e. $\hat{X} \approx X$. It is presumed that $\hat{X}$ represents the important and reliable patterns underlying the data in X.

Obviously, the choice of dimensionality is of great importance. The dimensionality parameter k needs to be large enough to capture the real latent structure, but also small enough to avoid modeling noise or irrelevant detail (Deerwester et al. 1990, pp. 398, 402). Finding a good value remains a challenging problem. Deerwester et al. (1990, p. 402), propose an empirical solution. An empirical study by Bradford (2008), which identified an "island of stability" in the k ∈ [300, 500] range for large-scale applications, supports this claim.

3 Research Approach

This work aims to develop a method for the automated evaluation of organizational capabilities based on a collection of unstructured documents using the latent semantic analysis approach.

The method has two inputs. First, a collection of documents to be analyzed in which each document is associated with an organization. Second, a definition of the organizational capability to be evaluated, i.e. a specification of a capability's positive manifestation in text, e.g., in the form of a list of important and related keywords.

The method's objective is to analyze all documents associated with an organization, evaluate them with regard to the definition and determine a score, preferably in the interval [0, 1]. The content-based evaluation scheme chosen for this work can be explained easily: the more similar the document's content is to the definition of the capability, the higher is the score. In essence, the similarity between the capability definition and the contents of the documents that describe an organization is interpreted as a proxy for the actual presence of the capability in the organization.

While the method is in principle universally applicable for all kinds of different organizational capabilities and collections, its development is guided by a concrete example: the analysis of a collection of analyst reports for an intra-organizational comparison of both IT and innovation capability.

3.1 Data collection

The collection D to be analyzed contains N = |D| = 153 documents on 140 publicly listed organizations from various industries. All documents were published in the first half of 2011. Each document is associated with exactly one organization and is assigned a unique identifier. Two classes of documents can be differentiated: analyst reports, which make up the two-thirds majority of the collection, and conference call transcripts. An analyst report is a comprehensive report on an organization similar to an annual report. Both analyst and annual reports give potential and actual investors as well as other interested people insight into an organization's financial performance and activities.

Unlike an annual report that is published by an organization itself, an analyst report is authored by professional analysts on behalf of an independent third party, e.g. an investment bank, a fund, a securities firm, or a business information service company. Therefore, this work assumes each analyst report to be unbiased and objective with regard to the discussed organization.

The transcripts are textual records of conference calls and meetings between independent financial analysts and representatives of the organization, usually C-level executives. Similar to an interview in a magazine, they contain the answers of the representatives to questions posed by analysts. The topics covered are congruent to those in the analyst reports, however the level of detail tends to be higher.

In addition to textual data, the documents also contain a lot of tables, graphs and images. This work ignores non-textual contents and focuses solely on the textual data.

3.2 Measurement of capabilities

Capabilities can be seen as "complex bundles of skills and collective learning, exercised through organizational processes" (Day 1994, p. 38). Their complexity makes measuring them as a whole difficult. However, if the bundle's composition is understood, it can be broken down into its constituting factors. The relationship between factors and capability is one of indication: the factors are indicators for the capability. These reflect the level of discussion in the documents much better and may be used for evaluation purposes by measuring them individually and aggregating them subsequently.

The organization-wide IT capability is composed of a multitude of facets that can be organized into six categories: IT business partnerships, external IT linkages, business IT strategic thinking, IT business process integration, IT management and IT infrastructure. Table 1 summarizes the categorization by Bharadwaj et al. (1999, p. 380).

This work employs the construct by Bharadwaj et al. (1999) as the basis for an evaluation of IT capability. Each of the categories is interpreted as a factor and shall be measured individually. All factors are considered to be of equal importance.

IT capability dimension	*Description*
IT business partnerships	Multi-disciplinary teams, relationships, encouragement and sponsorship of IT initiatives, IT experimentation friendly climate
External IT linkages	Technology-based links with customers and suppliers, IT-based entrepreneurial collaborations with external partners
Business IT strategic thinking	Clarity of vision how IT contributes to business value, integration of business and IT planning, management understanding of value of IT investments
IT business process integration	Consistency of application portfolios with business processes, restructuring of IT and business processes to leverage opportunities
IT management	Effectiveness of IT planning, IT project management practices, security, compliance and continuation planning, system development practices, consistency of IT policies, IT evaluation and controlling, adequacy of the skill base
IT infrastructure	Appropriateness of data and network architectures, architectural flexibility, efficiency and reliability, processing capacities

Table 1. IT capability dimensions

A myriad of approaches to measuring an organization's innovativeness can be found in literature from fields such as marketing, management and IS. A review of measurement models by Moos et al. (2010) proposes to differentiate between input and output oriented measurement. Input-oriented measurement considers the various resources (R&D staff, budget etc.) as well as the organizational structure (leadership, climate etc.) that affect innovativeness. Output-oriented measurement focuses on the results of innovativeness, i.e. the amount and frequency of innovations. The simultaneous use of both within the same model is strongly discouraged (Moos et al. 2010, p. 3).

Judging from the contents of the documents, an output-oriented approach to measuring innovativeness is more promising and therefore pursued. An output-oriented measurement model such as proposed by Moos et al. (2010) (cf. Table 2), emphasizes "first movership", the percentage of the overall profits contributed by recent product and service innovations, the amount of product and service innovations, and the volume of patents registered by an organization (Ahuja and Katila 2004; Bell 2005; Liao et al. 2007; Rothaermel and Hess 2007; Srinivasan et al. 2002; Zaheer and Bell 2005).

No	*Measure*
1	compared to others in the industry, the organization tends to be (Srinivasan et al. 2002): • first to market with innovative new products or services • first to develop a new process technology • first to recognize or develop new markets • at the leading edge of technological innovation
2	great majority of profits generated by new products and services (Liao et al. 2007)
3	launch of more new products and services than others in the industry (Zaheer and Bell 2005)
4	number of successful patent applications or granted patents (Ahuja and Katila 2004; Rothaermel and Hess 2007)

Table 2. Output-oriented measurement of innovativeness

It should be noted that this measurement model largely measures an organization's innovativeness relatively to others in the same industry. In particular, this becomes evident in factors 1 and 3. As with IT capability, all factors are given equal importance in this work.

3.3 Analysis

Before any further analysis can begin, a vector space representation of the collection based on the bag of words model needs to be constructed.

The first decision to be made is the granularity at which documents are modeled. All documents in the collection to be analyzed deal with various different topics, e.g., products and services offered in one section, leadership changes in another. Therefore, each document should be divided into passages with coherent meanings. A review of the collection suggests looking at individual paragraphs. Each document is split into a sequence of paragraphs; each paragraph is associated with exactly one document.

Since the collection to be analyzed is rather small, tokenization is pursued aggressively in order to increase exact term matches and in consequence term co-occurrences. However, the peculiarities of the technical vocabulary used in the collection need to be taken into account as

well. While it is deemed acceptable to tokenize “revenue/year” into two words, breaking up common abbreviations, e.g., “M&A” or “R&D”, would result in a severe loss of information.

Function words (e.g. “the”, “of”, “a”, “to”, etc.) are stopped for the usual reasons: they are a source of noise and do not contribute much to the meaning of a passage. Words should be stopped in a case-sensitive manner in order to avoid false positives, e.g. mistaking the acronym “IT” for the pronoun “it”. For the same reason, the stop-list should be carefully composed to address the language of the collection and be kept rather short. Nonetheless, it seems practical to categorically stop all one-letter words.

With regard to the small collection size, stemming is another essential task: It reduces the number of unique terms and can be argued to already capture some of the semantic structure without requiring co-occurrence data (Deerwester et al. 1990, p. 404).

An initial term-passage matrix is constructed using the tf-weight, the frequency with which each term occurs in a document. The initial, tf-weighted term-passage matrix is transformed into a tf.idf-weighted matrix to adjust for different text length and frequency of occurrences.

To transform the term-passage matrix into a semantic vector space the LSA is conducted. All documents that need to be represented in concept space are cleaned and available in the form of a tf.idf-weighted term-passage matrix.

LSA is designed to deal with synonymy, but not with polysemy or homonymy. However, when dealing with analyst reports the latter are assumed to be not as important as they are in typical collections written in common English. The specificity of the technical vocabulary used in the reports leads to few terms with ambiguous meanings.

The transformation of the tf.idf-weighted term-passage matrix into a concept-passage matrix using LSA is straightforward: it is carried out as described above. Aside from the collection, LSA requires a parameter to be set a priori: the number of concepts k that is assumed to be in the collection.

The capabilities to be analyzed are broken into factors, which are then measured individually. Each factor is operationalized using a natural language query. Although keyword-based queries are assumed in the following, the form of the queries is not restricted in any way. Thus, a query-by-example mechanism, where the factor is operationalized with the help of an exemplary text, can also be pursued in theory.

The queries are written in natural language; the passages are represented as vectors in k-dimensional semantic space. In order to compute a query’s similarity to each passage in the collection, both need to be represented in the same format, i.e. in semantic vectors.

Therefore, the queries are also tokenized, stopped, stemmed and represented as a term-based vector in the same manner as the passages have been before. Subsequently, the term-based query vectors are projected into the semantic space by a process called “folding-in”: each query is placed at the centroid of its constituent terms (Deerwester et al. 1990, pp. 396, 399).

Now that both passages and queries are represented by k-dimensional semantic vectors, in which each component carries a weight for a concept, their similarity can be computed. Cosine similarity is chosen from the various existing similarity measures. It is defined as the cosine of the angle between a passage p and a query q:

$$similarity(p,q) = \cos\theta = (\hat{p} * \hat{q}) = \frac{p * q}{|p| * |q|}$$

The cosine of the angle between any two vectors is a value in the interval [−1, +1] and can be easily interpreted: the greater the cosine, the more similar are the texts represented by the vectors, i.e. query and passage. The maximum similarity of 1 is reached when both vectors are co-directional, i.e. they point in the same direction which implies that the angle between them is 0. For every other angle, the value will be < 1. Each query's similarity to each passage in the collection is computed using the cosine. Afterwards, the passages are sorted by similarity in descending order, which results in a ranking per query. Table 3 shows an example of such a ranking for a single query. Due to the fact that the collection is analyzed on a passage-level, documents may occur several times.

#	*Passage*	*Similarity*
1	doc1-pass2	0.9324
2	doc2-pass3	0.8165
3	doc1-pass9	0.8012
4	doc3-pass4	0.7698
5	doc5-pass1	0.6208
6	doc2-pass12	0.5908
7	doc3-pass5	0.5863
	…	…

Table 3. Passages ranked by cosine similarity

Often, similarity rankings are clipped either by introduction of a similarity threshold or by retaining only the top n ranking matches. Determining a good similarity threshold is inherently problematic as there is no value that will suit all purposes (Evangelopoulos et al. 2012, p. 78); keeping only the n best matches is arbitrary in itself. Therefore, this method avoids both and keeps the whole ranking as-is.

So far, there are as many passage rankings as there are queries or factors, respectively. In order to obtain a single capability score for each organization, the various passage-level similarity scores need to be aggregated. There is a multitude of aggregation techniques ranging from simply taking the average of all results to complex voting systems. This method proposes a rather simple two-step process:

1. A document's overall score with regard to a query is the maximum similarity between each of its passages and the query. The arithmetic mean of the scores for all queries is a document's score for the capability to be evaluated.
2. The arithmetic mean of the document-level capability scores produces a single capability score for each organization.

Due to the fact that each document deals with a number of different topics and the passage similarity ranking was left as-is, there will be many passages that are not relevant for the query at all. This is natural and should not have a negative effect on the documents ranking. Therefore,

this method opts for selecting the maximum similarity: Only the part of the document that matches best, i.e. has the highest relevance, is of interest. Each document's score is the maximum similarity that has been computed between its passages and the query.

This yields a document-level score for every query. The interpretation of these scores is straightforward. For example, a document has a very high score for query A and a low score for query B. Each query measures a factor of a capability. If query A represented IT infrastructure and query B IT business process integration, this would imply that the organization described by the document has a strong IT infrastructure while its IT business process integration is considered weak.

Each document describes exactly one organization, but one organization can be described by several documents. If this is the case, the document-level capability scores need to be aggregated into a single score for the organization. This is achieved in the second step of our aggregation process by taking the mean of all available documents for that organization. Thus, more documents per organization lead to a higher precision of the predicted capability value. Each of the document-level capability scores can be interpreted as an opinion on the capability of the described organization. All documents on an organization are considered to be of equal authority and importance and should be included in the final score. The arithmetic mean is appropriate for this scenario, because it produces the "average opinion". Therefore it is chosen for this final aggregation, which yields a single capability score for every organization.

An interpretation of the results needs to carefully consider the fact that minor differences between scores are not very meaningful due to the high amount of aggregation that is involved in scoring.

4 Results

The collection to be analyzed consists of N = 153 documents on 140 stock-quoted organizations. Each of the documents is assigned to exactly one organization; some organizations are described by more than one document and therefore yield more accurate estimates. All documents are from early 2011 and contain a substantial amount of unstructured text. The documents originate from different sources, i.e. different financial analysts from various financial institutions.

The organizations belong to several different industries, i.e. energy, telecommunication, healthcare, life science, restaurants, retail, and raw materials. However, a categorization of the organizations into industries in the form of associated metadata is not available but might be of interest for other especially larger collections.

Neither alternative collections, nor additional documents are available for use in this work. Hence, in light of the already small amount of data available, a sample selection in the strict sense of the word is not performed: only documents failing to meet the criterion of containing a substantial amount of text were removed beforehand. Thus, the composition of the collection can be described as random.

The descriptive statistics shown in Table 4 provide more insight into the structure of the collection to be analyzed. After tokenization, stopping and stemming, the dictionary contains

24,842 unique terms. Thus, the matrix has 480,394,596 cells, of which 988,146 (ca. 0.2057%) contain non-zero values.

	min	*max*	*mode*	*median*	*mean*
documents/organization	1	3	1 (129)	1.0	1.093
pages/document	12	127	22 (7)	48.0	50.490
pages/organization	12	226	53 (7)	49.5	55.179

Table 4. Statistics of the collection

A representation of the collection in semantic space is constructed for eight different parameterizations of LSA: for every $k \in \{10, 25, 50, 75, 100, 150, 200, 300\}$. The values on the lower and upper end of the spectrum are expected to capture too much or too little of the latent semantic structure, respectively. Nonetheless, they are included to illustrate the impact of k on the results.

Table 5 shows the top 20 of the resulting rankings for both capabilities and k = 100. The last entry has been added in order to show the spread in the results. Without an already validated ranking of the same organizations that this ranking can be compared to, generalizations are limited. However, although there is no industry categorization for the collection, three things stand out. First, many organizations that have a high IT capability ranking belong to the IT industry. Second, large parts of the top spots in the ranking for innovation capability are taken by organizations from the pharmaceutical and healthcare industry. Third, there is no overlap. For values of $k \in \{75, 150\}$, the results are very similar.

#	*ITC-Ranking*		*Innovation-Ranking*	
1	Hewlett-Packard	0.53	Document Capture Tech.	0.79
2	Juniper Network	0.50	Amyris	0.79
3	Dell	0.50	Hospira	0.76
4	Verizon Communications	0.49	Polymedix	0.75
5	Document Capture Tech.	0.47	Myriad Genetics	0.74
6	Lexmark	0.47	Medicis Pharmaceuticals	0.72
7	Solarwinds	0.47	Acacia Research	0.71
8	Cisco Systems	0.46	Illumina	0.69
9	IBM	0.46	Allergan	0.69
10	Booz Allen Hamilton	0.46	Peregrine Pharmaceuticals	0.67
11	Health Net	0.45	Cephalon	0.66
12	Aetna	0.45	Neostem	0.66
13	Netscout Systems	0.45	Abott Laboratories	0.64
14	Liveperson	0.45	Green Mountain Coffee	0.64
15	Target	0.44	WebMD	0.64
16	Ebay	0.44	Monsanto	0.59
17	amazon.com	0.44	Qualcomm	0.59
18	Salesforce	0.44	CR Bard	0.57
19	United Technologies	0.44	Regeneron Pharmaceuticals	0.56
20	CSX	0.43	St. Jude Medical	0.55
	…		…	
140	QR Energy	0.17	Emdeon	0.17

Table 5. Capability rankings for k = 100

5 Conclusion

This work proposes a LSA-based method that automates the analysis of unstructured documents for the evaluation of organizational capabilities. Although its development was guided by a concrete example, the method is theoretically universally applicable.

The evaluation scheme employed by the method is content-based. Given a collection of documents, which describe organizations, and a capability, which is operationalized with the help of keyword-based natural language queries, the cosine similarity of documents and queries in semantic space is computed. The similarity between a document and a query is interpreted as a proxy for the actual presence of the capability, which is operationalized by the query, in the organization, which is described by the document. The similarity scores for the various queries are aggregated to a single capability score per organization.

We find that the content of analyst reports is more adequate for the evaluation of innovation than that of IT capability. Given their focus on the market-side and lack of coverage of internal processes this is not coincidental. The examination of the extracted concepts via their representative terms reflects the collection's intended target audience: current and potential investors are addressed. It is therefore no surprise that a lot of finance vocabulary can be found in the most important concepts.

There are some limitations that need to be mentioned. First, it can be difficult to formulate queries. Natural language queries might not be the right vehicles for the operationalization of every factor. Second, although analyst reports represent a content-rich and exclusive data set that contains first-hand insights, these documents are costly and mainly limited to a small group of specialists. This constrains the availability to researchers and large-scale academic studies. For practitioners, especially institutional investors, the availability of financial analyst reports should not be any limitation. Further, these documents express analysts' opinions and expectations that might be biased. However, in large samples we expect that these individual assessments represent a valid representation of firms' actual capabilities. Third, there is still a lot of noise that is modeled in the concepts, despite great efforts with regard to automated noise filtering. Fourth, dependent on the size of the collection, the number of documents available per organization, and the expected content of the documents, alternative mechanisms of aggregation should be considered.

Further research should encompass larger collections of data and adopt the approach to alternative domains to further validate it. An alternative source of data could be firm related newspaper articles, reports from rating agencies, or even annual reports. For example the management discussion might contain relevant statements that could be used to automatically infer valuable insights from. Larger samples could allow for comparisons of the resulting capability rankings with those from other sources such as the publicly available IT rankings.

In conclusion, our work represents a small step in the advancement of the application of content-analysis techniques to IS research in general and the analysis and evaluation of organizational capabilities in particular. The results support the applicability of our text analysis approach for the measurement of organizational capabilities and related problem sets. Also, it demonstrates the need for further research in this "underexplored" (Indulska et al. 2012) area

and indicates various promising directions. For practitioners we provide a practical approach to support decision making processes by mining unstructured data. By identifying similarities to pre-specified queries, our approach enables analysts to draw conclusions from large document collections.

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Paper III

Exploring the Relation between Firm Ownership and IT Capability

André Schäfferling
German Graduate School of Management and Law

Heinz-Theo Wagner
German Graduate School of Management and Law

Jochen Becker
German Graduate School of Management and Law

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Paper IV

Institutional Investors and the Development of IT Capability: Evidence from Publicly Listed Companies

André Schäfferling
German Graduate School of Management and Law

Heinz-Theo Wagner
German Graduate School of Management and Law

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Paper V

Exploring the capital market effects of IT capability: The case of ownership structure

André Schäfferling
German Graduate School of Management and Law

Heinz-Theo Wagner
German Graduate School of Management and Law

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Paper VI

Do Investors Recognize Information Technology as a Strategic Asset? A Longitudinal Analysis of Changes in Ownership Structure and IT Capability

André Schäfferling
German Graduate School of Management and Law

Heinz-Theo Wagner
German Graduate School of Management and Law

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Paper VII

Can a firm's IT capability reputation influence its ownership structure? An accounting-based perspective and longitudinal analysis of an unrecognized IT impact

André Schäfferling
German Graduate School of Management and Law

Heinz-Theo Wagner
German Graduate School of Management and Law

Tim Weitzel
University of Bamberg

Abstract

The IT business value literature has established a strong link between IT capability and financial and strategic firm performance. Research has also shown that a firm's image for having superior IT capability, termed IT capability reputation, serves as a signal of past strategy and future prospects to external stakeholders. However, little is known about the relationship between IT capability reputation and capital market participants, especially institutional investors, despite their growing dominance and general importance. In this study, we contribute to the literature by examining the potential benefits of corporate IT capability reputation and the attractiveness of companies with positive IT capability reputations to long-term-oriented institutional investors. Analyzing archival data from various sources from 1997 to 2012 for a panel of S&P 500 companies we find that IT capability reputation is positively associated with higher shares of long-term-oriented institutional investors. This relationship is robust across alternative model specifications and robustness checks. Our study contributes to the information systems and accounting literature by examining the implications of signaling IT capability reputation to financial markets and investors. The results thereby add corporate ownership structure as a new and elemental impact area to the IT value literature.

1 Introduction

One of the most fundamental insights from decades of Information Systems research is that a firm's IT capability is a strategically relevant asset that affects a number of organizational performance measures that go far beyond the IT department. Research involving concepts from reference disciplines, especially finance and accounting, shows that firms with a superior IT capability regularly outperform their peers not only in terms of financial performance but also regarding capital market valuation (Bharadwaj 2000; Masli et al. 2011; Santhanam and Hartono 2003). Similarly, Muhanna and Stoel (2010) show the joint effect of IT capability and IT spending on a firm's market value, and Bharadwaj et al. (1999, p. 1008) demonstrate that IT investments are positively related to Tobin's q which indicates "that IT contributes to a firm's future performance potential" (see also Ravichandran et al. 2009). In addition to these vital impacts, we argue that another far reaching but yet unrecognized impact of a firm's IT capability is on the firm's ownership structure. Ownership structure is strategically relevant for the firm as it influences market valuation, endowment with financial means as well as investment behavior and strategic moves (e.g., Bushee 1998; Connelly et al. 2010; Gillan and Starks 2007; Lev 2001). The reasoning behind assuming an effect of a firm's IT capability on its ownership structure is that a consistently good IT capability is a capital market signal that particularly attracts long-term-oriented investors and thereby shapes the fabric of the firm itself, i.e., its owners or investors who are financially engaged in the firm.

Recent research provides ample evidence that a continuous, superior IT capability (as opposed to occasional strength) is required to achieve and maintain above-average market valuation (Lim et al. 2012b; Masli et al. 2011). Additionally, a recent study shows that the image of a superior IT capability, termed *IT capability reputation*, serves as a signal for past strategy and future prospects and affects market value (Lim et al. 2013). Because of the importance of such IT-related signals, firms signal their IT capabilities to external stakeholders and particularly to

investors[1]. For example, Citigroup, one of the top U.S. financial service providers, announced an agreement with IBM regarding the application of IBM's supercomputer *Watson* (Jinks 2012) and expects billions in new revenue from this investment[2]. By disclosing its IT efforts to the financial market, e.g., in its 2011 Annual Report, Citigroup highlights its "key investments in the long-term health of our businesses" to be "the world's premier digital bank" to launch applications such as "a consumer banking app designed for the iPad® … as well as mobile person-to-person payment capabilities"[3]. Hence, Citigroup signals positive business value expected from its IT efforts which may be interpreted as aiming at establishing a reputation as a firm with a superior IT capability. Accordingly, a firm's reputation for sustaining a great IT capability can be described as "the result of managers' efforts to persuade external stakeholders of their firms' (IT capability) excellence" (Lim et al. 2013, p. 58). It can thus be expected that IT capability reputation not only influences financial and market performance but also a firm's ownership structure, composed of various types of investors such as short- and long-term-oriented institutional investors. More precisely, research has shown that investors vary according to characteristics such as investment horizon and that these characteristics are associated with investors' monitoring of firm behavior, voting in annual shareholder meetings, and influence on top managements' decisions (e.g., Gillan and Starks 2007; Lev 2001). We therefore ask: "*To what extent does a firm's IT capability reputation affect its ownership structure?*"

Considering the strategic importance of a firm's ownership structure on the one hand and the lack of IS studies dealing with firm ownership on the other, we develop and propose a new substantial research direction in IS value research beyond the impact of a firm's IT capability reputation on capital market performance and valuation. Uncovering a systematic impact of IT capability reputation on a firm's ownership structure would open far-reaching IS value research avenues including the reverse – and probably cyclical – impact of long-term investors *enabling* the development of a great IT capability.

To answer the research question, we combine previous insights from accounting research on institutional ownership and IS value research regarding IT capability reputation. We focus on institutional investors that constitute the largest and most important group of investors. Using longitudinal data from the universe of S&P 500 companies over the 1997-2012 period, we show to what extent signaling a superior IT capability shifts a firm's ownership structure towards long-term-oriented investors.

Our study contributes to IS research in two major ways. First, we provide evidence that the corporate ownership structure represents an unrecognized yet strategically important outcome variable to be considered in IT capability and IS value research. Second, we link separate perspectives from the IS and accounting literature to argue that IT capability reputation affects a firm's ownership structure by creating an image of future prospects that attracts specific types of investors but will remain unconsidered by other types of investors who trade based on

[1] By investors we refer to equity investors and exclude other types of investors such as debt holders. The terms (stock) owners and shareholders are used interchangeably along with investors and represent entities that hold or trade equity stakes of corporations.
[2] See as well http://www.citigroup.com/citi/news/2012/120305a.htm (last accessed January 27, 2014)
[3] See http://www.citigroup.com/citi/investor/quarterly/2012/ar11c_en.pdf?ieNocache=915 (last accessed January 27, 2014)

different information. Together, this allows replacing the concept of an anonymous financial market as usually applied in extant research by identifiable types of investors with characteristics that can be influenced differentially through signaling IT capability.

The paper is structured as follows. In the next section, we introduce the theoretical foundation and discuss the concepts of IT capability and IT capability reputation as a basis for developing our research model. In section 4, we first describe the data and our sample and then derive the estimation model. Section 5 presents the results including descriptive statistics, estimation results, and sensitivity analyses. Section 6 concludes the paper by discussing the main findings, limitations of the study, and avenues for future research.

2 Theoretical Foundation

In her seminal paper, Bharadwaj (2000, p. 171) defines IT capability as the "ability to mobilize and deploy IT-based resources in combination or copresent with other resources and capabilities". She shows that firms with a superior IT capability clearly outperform their peers. Santhanam and Hartono (2003) extend this study by comparing the same companies within their industry (instead of a single company) and come up with similar results. Relying on an alternative dataset, a recent study by Masli et al. (2011) further validates those findings. Further studies show that IT enables firms to sense the environment and quickly respond to market opportunities (Sambamurthy et al. 2003). Other authors demonstrate the importance of IT by showing that market opportunities can be exploited by using IT-enabled capabilities (Chi et al. 2010). Joshi et al. (2010) relate IT-enabled knowledge capabilities and innovation outcomes and find that IT usage promotes knowledge capabilities and in turn innovation. Hence, considering prior research and consolidating insights regarding the effect of IT capability on innovation, performance and competitive benefits, IS research typically argues that an IT capability is a strategic asset to be handled by top management (Ravichandran et al. 2009).

In accounting literature, such assets represent so called non-financials, i.e., intangible assets (often referred to simply as intangibles) that are not included in the balance sheets. Intangibles are known to significantly impact a firm's market value. Saunders (2010) determines that IT-related intangibles are correlated with higher market values than their actual costs. He estimates a 30-55 percent premium in market value for firms with a superior IT capability. This finding is in line with another well-known example of value derived through IT capability: Sabre, the reservation and information system of American Airlines. In 1996, AMR Corporation, American Airlines' parent company, sold 18 percent during the IPO of Sabre. In this transaction Sabre was valued a total of $3.3 billion, which accounted for half of the market value of AMR. To put it briefly, Sabre accounted for the equivalent value of all tangible assets possessed by American Airlines, the second largest airline in the world at that time (Lev 2001). Examining the relationship between IT capability, IT spending, and market value, Muhanna and Stoel (2010) show – similar to prior research (e.g. Brynjolfsson and Hitt 1996; Kohli and Grover 2008) – that pure IT spending has no significant effect on a firms' market value. However, a superior IT capability affects the market value significantly and is thus valued by investors. This is connected with findings regarding the performance effects of IT. In that respect, research addresses either accounting-based performance (Anderson et al. 2003; Kobelsky et al. 2008) or market-based performance in terms of market valuation (Anderson et al. 2006; Bharadwaj et al. 1999; Dehning

et al. 2005; Henderson et al. 2010). Therefore, a firm's IT capability, or its expected benefits over time, may influence investment decisions of financial investors who buy, hold, and sell shares which in turn lead to an aggregate market valuation.

Financial investors are a heterogeneous group composed of pension funds, mutual and hedge funds, endowment funds, and others. Nowadays, institutional investors[4] play a predominant role in the financial market and account for over 70% of U.S. equity holdings (Gillan and Starks 2007). Several studies outside the IS domain investigate the relationship between companies' activities and characteristics and investors' behavior. Bushee (1998), for example, studies management's propensity to reduce R&D expenditures in order to meet short-term earnings goals. Results demonstrate differences dependent on institutional investors' orientation and trading strategies. Gaspar et al. (2005) investigate the investment horizon of financial investors and Ryan and Schneider (2002) study the connection between the presence of strategic assets and investor behavior.

However, strategic assets can only influence investors' behavior, including their decision to invest or disinvest, if information about these assets is available to them. Neither IT spending figures nor information regarding the IT capability is reported in balance sheets. They are part of intangible assets that are hardly accessible and measureable from the outside (Lev 2001). Current research shows that investors have mechanisms to become aware of those intangible assets that influence a firm's future prospects. In a study dealing with firms' R&D activities, Kimbrough (2007) finds that financial statements and analyst reports are major mechanisms by which investors estimate the fair value of R&D capital. Information search activities performed by financial analysts offer a useful source of information for investors in determining the market value of intangible and non-financial assets. In addition, Bushee (1998) finds that certain types of investors are sophisticated investors that closely monitor a company's behavior. These monitoring capabilities are typically unique to long-term investors that invest on behalf of their profound analysis. On the other side, short-term investors usually trade based on predicted breaks in a string of consecutive quarterly earnings increases (Ke and Petroni 2004).

3 Research Model

In the following, we hypothesize why certain types of institutional investors are attracted by firms' IT capability reputation. A central finding in the accounting literature is that long-term-oriented investors look for investments that offer sustainable growth and consider enabling and driving capabilities. In contrast, short-term oriented investors expect management to meet quarterly earnings targets and thereby foster myopic management decisions (Bushee 1998). Accordingly, we focus on the investment horizon of institutional investors, i.e., their short- or long-term orientation, which has been shown to be relevant for explaining investment behavior. Finance and accounting studies show that the information collection and processing behavior differs among institutional investors and that different firm characteristics are favored by certain

[4] The SEC rule 13F defines institutional investors as those institutions that administer more than $100 million in equity or whose holdings exceed $200,000 in market value or 10,000 shares. Those institutions encompass insurance companies, banks, mutual funds, and pension funds that manage and invest money on behalf of others (Bushee 1998; Wines 1990)

types of investors (Gompers and Metrick 2001; Yan and Zhang 2009). For example, investments into R&D are considered as strategically important in the long term and are demanded by long-term-oriented institutional investors (David et al. 2001; Hoskisson et al. 2002). IT investments are also typically of a long-term nature because they have to be integrated into daily routines and processes to constantly create new resources that then generate value (Bharadwaj 2000). This process takes time and contributes to developing an IT capability. Continuous IT investments over time are necessary "given the long lead times and costs entailed in the development and deployment of IT capabilities" (Tanriverdi et al. 2010, p. 833). Firms that invest in long-term IT projects and develop a corresponding IT capability usually pursue a long-term strategy. These companies even sacrifice short-term earnings to achieve their prospective long-term goals (Bushee 1998). This fits long-term investors who have "a higher ability to hold out" (Gaspar et al. 2005, p. 162) especially in hard times and economic downturns (Cella et al. 2013).

Finance research shows that long-term-oriented institutional investors have mechanisms to become aware of intangible assets which influence a firm's future (Kimbrough 2007). In this respect, long-term institutional investors closely monitor a company's behavior (Bushee 1998; Chen et al. 2007). Yan and Zhang (2009, p. 894) argue that "short-term institutions are better at collecting and processing short-term information, while long-term institutions are better at collecting and processing long-term information".

Companies such as Citigroup systematically share information on IT-related activities and continuous IT investments that are intended to develop and maintain an IT capability that in turn produces future returns. This strategic signaling refers to "actions taken by individuals or organizations to influence the views – and ultimately the behaviors – of stakeholders, e.g., investors, investment analysts, customers, suppliers, partners, employees, competitors, etc." (Zmud et al. 2010, p. 150). Continuously sending strategic signals about intended actions and expected outcomes regarding the ability of a firm to make use of IT that are supported by acting accordingly and achieving reasonable results in the future may lead to the development of an IT capability reputation. Reputation "consists of two dimensions: (1) stakeholders' perceptions of an organization as able to produce quality goods and (2) organizations' prominence in the minds of stakeholders" (Rindova et al. 2005, p. 1033). A reputation depends on collective awareness and recognition and is, for example, developed through stakeholders' perception of product quality (Rindova et al. 2005). Continuously sending strategic signals may contribute to the former dimension of reputation while fulfilling expectations involved with the signals may contribute to the latter. Continuously sending signals on IT efforts such as presenting information in annual reports or participating in IT rankings creates awareness and recognition which, together with fulfilling expectations in terms of delivering promised results, may build up a reputation (Rindova et al. 2005) for IT capability that in turn affect market value (Lim et al. 2013).

This reputation for developing and maintaining a long-term-oriented IT capability attracts like-minded investors who have the aspiration and capabilities to monitor such firms. Hence, we hypothesize:

Hypothesis: Firms that develop and maintain IT capability reputation will have a higher share of long-term-oriented investors.

4 Research Design and Methodology

4.1 Data Sources

We retrieve the archival data for this study from three different sources.

1. For **investor and ownership** characteristics we use the Ownership and Profiles data feed provided by Thomson Reuters.
2. For **IT capability reputation** we follow prior research and rely on the publicly available InformationWeek (IW) 500 ranking as a proxy.
3. **Financial and accounting data** is collected from the Worldscope database.

Data on investors and ownership were retrieved from the Ownership and Profiles data feed provided by Thomson Reuters. Institutional equity holdings have to be reported each quarter to the U.S. Security and Exchange Commission (SEC) using Form 13F. According to SEC rule 13f, institutional investors who engage in the U.S. stock market and administer more than $100 million in equity securities on own accounts or on behalf of others have to file their stockholdings (see Wines (1990) for a detailed discussion of 13F filings). Such institutions may include insurance companies, banks, investment advisers, pension and hedge funds. Consolidated institutional stock holdings based on 13F filings since 1997 are available through Thomson Reuters Ownership and Profiles data feed. These institutional holdings form the basis of our panel data set.

Proxy data for IT capability reputation was taken from the IW 500 ranking (Bharadwaj 2000; Lim et al. 2013). Each year, InformationWeek publishes a special issue containing the 500 leading users of information technology based on an annual survey of U.S.-based companies assessing various measures, such as technical parameters and questions regarding IT usage. The IW ranking provides a more complete picture of a company's IT landscape than pure investment measures by incorporating intermediate effects such as IT usage at the process level and thereby rules out a common point of criticism of using highly aggregated and abstract measures. Rai et al. (1997, p. 92) find the IW 500 ranking to be "consistent with data from other secondary sources, such as IDG and BEA". The IW 500 ranking has been used widely in past (e.g., see Bharadwaj 2000; Santhanam and Hartono 2003) and more current research (e.g., Banker et al. 2011; Ho-Chang et al. 2014; Lim et al. 2012b). Between 1996 and 2012, IW has ranked a total number of about 2,000 individual firms at least once. Following recent research (Lim et al. 2013), the ranking serves as a signal to a company's stakeholders about a company's IT effort. If this signal is sent repeatedly, the firm may develop an IT capability reputation.

Finally, we also obtained additional annual **financial and accounting data** from the Worldscope database. Wordscope provides extensive worldwide coverage and historic data that encompasses standardized financial and accounting figures on leading public companies back to 1980.

4.2 Sample

Due to the availability of institutional ownership data as well as proxy data from the IW 500 ranking, our sample is restricted to publicly listed U.S.-based companies. We collected data on all past and current S&P 500 firms between January 1997 and December 2012, starting with the

first year of available ownership data in the Ownership and Profiles data feed. Firms for which 13F filing data could not be retrieved were excluded from the sample. In rare but known instances, there may be data inconsistencies or circumstances where institutions file holding positions for which they have voting authority but not investment authority (see Khurana and Moser 2013; Wines 1990; Yan and Zhang 2009). We excluded companies whose aggregated shares held by institutional investors exceeded the number of outstanding shares (i.e., all shares available on the market) at least once over the 16 year period. Our final sample included 353 publicly listed firms from 46 industries (based on two-digit SIC code) and consisted of 4,263 firm-year observations. Our panel data set was unbalanced, ranging from 2 to 16 and averaging 12.1 observations per firm. Such unbalance is common in firm level research because companies enter and leave the S&P 500 index for different reasons.

4.3 Variables and Measurement

4.3.1 Dependent Variable: Institutional Investment Horizon

From a firm level perspective, our dependent variable *institutional investment horizon* (*IIH*) ranging from short- to long-term orientation, reflects the average investment horizon of all institutional investors currently holding the firm's stock (Gaspar et al. 2005).

To evaluate this average investment horizon for a specific firm k, we first determined the trading behavior of each investor, which is also referred to as churn rate or portfolio turnover. We followed the definition by Yan and Zhang (2009) and calculate for each quarter t and investor i the churn rate CR_{it}, taking the minimum value of shares sold and purchased in relation to the investors' overall portfolio value (see Equation 1). By using the minimum, this measure is robust to any trading behavior caused by cash in and out flows (Yan and Zhang 2009) and comparable to the approach originally implemented in the Center for Research on Security Prices (CRSP) database.

$$CR_{i,t} = \frac{min\left(CR_buy_{i,t}, CR_sell_{i,t}\right)}{\sum_k \frac{n_{k,i,t}p_{k,t} + n_{k,i,t-1}p_{k,t-1}}{2}} = \frac{min\left(n_buy_{i,k,t}p_{k,t}, n_sell_{i,k,t}p_{k,t}\right)}{\sum_k \frac{n_{i,k,t}p_{k,t} + n_{i,k,t-1}p_{k,t-1}}{2}} \quad (1)$$

Where n represents the number of shares and p represents the end of quarter share price. An investor's churn rate illustrates how frequently he rotates his portfolio. A value of zero would indicate that the investor did not trade at all and the portfolio remained stable throughout the period in question, i.e., the investor can be classified as long-term-oriented. In turn, a value of one denotes a highly active, short-term oriented investor who changed his entire portfolio during the period in question. Thus, churn rate (CR) values generally range from 0 to 1 with a historic average of 0.1381 for U.S.-based institutional investors. In some instances, a CR value can rise above 1 due to changes in stock prices considered in the denominator.

Table 1 illustrates annualized churn rates and descriptive details of U.S.-based and worldwide (including U.S.) institutional investors. Quarterly average turnover values (not displayed) of U.S.-based institutional investors range from 0.1112 in Q2 1998 to 0.1698 in Q2 2009 (0.1080 in Q3 1998 to 0.1971 in Q2 2009 for all available institutional investors). Although the number of domestic and foreign institutional investors increased significantly over time, there were few foreign investors in the early years. One notable trend in the data is that even as the number of

investors increased, the average number of securities held remained nearly constant. Furthermore, changes in the average value held by institutional investors mirror movements in the global stock markets, e.g., in the S&P 500 index or the MSCI World index. Finally, investor turnover rates declined over the last years of data, reaching nearly 2002 levels.

	U.S.-based institutional investors					Institutional investors worldwide (incl. U.S.)				
Year	No. of investors	Ø No. of securities held	Ø value held (mm)	Ø CR	Ø SD	No. of investors	Ø No. of securities held	Ø value held (mm)	Ø CR	Ø SD
1997	1369	311	3808.00	0.1232	0.1225	1869	304	3251.79	0.1230	0.1206
1998	1527	298	4195.89	0.1220	0.1246	2081	294	3621.49	0.1220	0.1254
1999	1669	288	4574.85	0.1351	0.1357	2344	301	3930.20	0.1340	0.1334
2000	1833	284	4868.16	0.1391	0.1394	2703	299	4080.51	0.1395	0.1358
2001	1959	273	3859.90	0.1342	0.1440	2942	292	3097.63	0.1363	0.1429
2002	2006	269	3350.40	0.1273	0.1416	3139	283	2592.23	0.1311	0.1420
2003	2058	275	3577.80	0.1396	0.1575	3259	279	2714.43	0.1400	0.1544
2004	2201	280	4272.24	0.1413	0.1518	3467	281	3265.50	0.1434	0.1494
2005	2392	272	4410.80	0.1418	0.1470	3856	270	3338.38	0.1495	0.1505
2006	2572	270	4657.91	0.1498	0.1550	4159	271	3595.24	0.1580	0.1597
2007	2789	306	5395.81	0.1520	0.1509	4438	313	4537.07	0.1595	0.1559
2008	2908	288	3941.49	0.1426	0.1440	4528	282	3291.44	0.1457	0.1444
2009	2819	280	3325.73	0.1568	0.1676	4334	268	2826.43	0.1704	0.1722
2010	2828	288	4060.95	0.1452	0.1572	4347	276	3438.59	0.1565	0.1618
2011	3039	284	4159.79	0.1360	0.1483	5000	271	3345.07	0.1435	0.1506
2012	3141	286	4429.75	0.1297	0.1485	5115	277	3561.74	0.1356	0.1507

Notes: The two columns with number of investors contain annual averages. All other columns are average values by year and investor. Data is based on 13F filings by institutional investors provided by Thomson Reuters.

Table 1. Descriptive statistics: Average investor level churn rates

In a second step, we determined the average investment horizon of institutional shareholders for each firm. We only considered institutional stock holdings, excluding shares held by individuals and households. Since institutional investors currently hold more than 70% of the total shares of listed U.S.-based companies, focusing on institutional investors and excluding other groups, such as private investors, who exert much less influence is common (Attig et al. 2013). For each firm, we aggregated the turnover values of all institutional investors holding shares of that company. To consider the differences in the amount of shares held by each investor, we used investors' end-of-quarter shareholdings in relation to all institutional holdings in the particular firm as weighting factor $w_{k,i,t}$ (see Equation 2). In other words, the institutional investment horizon (*IIH*) of firm k in quarter t "is the weighted average of the total portfolio churn rates of its investors" (Gaspar et al. 2005, p. 143).

$$IIH_{k,t} = \sum_i w_{k,i,t} CR_{i,t} \tag{2}$$

The average investment horizon of the institutional investors holding the shares of a company allows us to capture changes in the prevailing investor orientation for each firm and to proxy for short- and long-term orientation of institutional stockholders. As with the churn rates at the investor level, smaller values of institutional investment horizon reflect that long-term-oriented investors are the dominant stockholders and vice versa. Thus, an investment horizon value close to zero indicates that the company's owners hardly trade and can be considered long-term-oriented investors. Values around one reflect a very short-term orientation of the owners, i.e., an ownership structure of institutional investors that frequently rotate their ownership positions

and do not hold stocks for a long time. Thus, managers of firms with a high investment horizon value can expect that their investors will sell their shares sooner rather than later on average.

	NYSE					NASDAQ				
Year	No. of securities	Ø No. of investors	Ø pct. of inst. inv.	Ø inv. horizon	Ø SD	No. of securities	Ø No. of investors	Ø pct. of inst. inv.	Ø inv. horizon	Ø SD
1997	2035	118	0.43	0.1080	0.0372	3108	29	0.24	0.1110	0.0530
1998	1978	131	0.45	0.1065	0.0357	3067	32	0.25	0.1095	0.0495
1999	1883	145	0.44	0.1117	0.0392	2993	39	0.25	0.1220	0.0582
2000	1737	163	0.45	0.1122	0.0426	2981	50	0.26	0.1212	0.0576
2001	1579	193	0.51	0.1020	0.0415	2752	58	0.30	0.1074	0.0546
2002	1504	215	0.57	0.0921	0.0358	2556	63	0.33	0.0997	0.0533
2003	1456	231	0.61	0.0958	0.0368	2416	72	0.36	0.1113	0.0617
2004	1450	246	0.65	0.0992	0.0373	2383	80	0.41	0.1159	0.0590
2005	1447	261	0.67	0.1048	0.0359	2345	85	0.43	0.1188	0.0527
2006	1402	285	0.71	0.1116	0.0384	2305	93	0.47	0.1257	0.0541
2007	1356	306	0.73	0.1198	0.0350	2258	101	0.50	0.1322	0.0535
2008	1297	309	0.74	0.1075	0.0302	2139	102	0.49	0.1183	0.0476
2009	1262	296	0.72	0.1090	0.0315	2060	102	0.47	0.1180	0.0542
2010	1268	303	0.73	0.1009	0.0332	2032	108	0.48	0.1096	0.0499
2011	1281	326	0.74	0.0937	0.0319	2038	117	0.50	0.1003	0.0442
2012	1309	337	0.75	0.0883	0.0296	2078	125	0.51	0.0957	0.0474

Notes: The two columns with number of securities contain annual averages. All other columns are average values by year and security. Data is based on 13F filings by institutional investors provided by Thomson Reuters.

Table 2. Descriptive statistics: Annual institutional investment horizon of U.S.-based companies

The investment horizon for each firm was calculated on a quarterly basis but aggregated at the annual level to match most of the remaining variables available annually. Table 2 outlines the annualized institutional investment horizon for firms listed on NYSE and NASDAQ. Table 2 shows that the number of U.S. securities declined prior to 2000, but the number of investors and the percentage of shares held by institutional investors increased consistently. The average investment horizon is around 0.10 for firms listed on the NYSE and around 0.11 for firms traded on NASDAQ. Our sample represents a subset of these firms with similar properties. The average annual institutional investment horizon of our sample (not tabulated) ranges between 0.0839 (Q1 2013) and 0.1581 (Q2 2009). This indicates that the owners of S&P 500 firms traded 12% of their portfolio value on average each quarter during the time period analyzed.

4.3.2 Independent Variable: IT Capability Reputation

Our measure of IT capability reputation (*ITCR*) follows prior research that adopts the IW 500 ranking as a proxy for reputation (Lim et al. 2013). We created a dummy variable for firms that have been able to signal superior IT capability to the capital market and have developed a positive IT capability reputation. In line with other researchers (Bharadwaj 2000; Muhanna and Stoel 2010) we attribute an IT capability reputation to firms that have been ranked at least twice by IW within the past four years (*ITCR24*). We set the dummy variable to one, meaning an IT capability reputation can be recognized in a given year, if a firm was ranked at least twice in the current and over the past three years. Otherwise, we set the dummy variable to zero for the given firm-year observation. To check for robustness, we also created two more restrictive versions of the IT capability reputation variable. In one case, we decrease the number of years from four to three (*ITCR23*) and in the other case we require three instead of two listings within four years (*ITCR34*).

4.3.3 Control Variables

Consistent with previous research (Lim et al. 2013), we accounted for several firm and industry-related variables that might affect a firm's investment horizon. At the firm level, we controlled for performance, firm size, leverage, dividend yield, growth, and intangibles. Firms with poor Return on Assets (*ROA*) performance are less attractive to investors looking for long-term, stable profits and in turn attract hedge funds and corporate raiders that look for opportunities and quick gains. We controlled for past and present performance to adjust for market attractiveness and potential halo effects as suggested by Santhanam and Hartono (2003). We also controlled for market valuation in terms of Tobin's q (*Q*) following the definition by Chung and Pruitt (1994). High values in Tobin's q reflect and capture investments in intangible assets such as successful IT projects and good management skills (Lim et al. 2013). We measured firm size (*SIZE*) by the natural logarithm of sales. The size of firms plays an important role in capital markets as it is associated with investor attention and preferences (Bennett et al. 2003) or investment decisions (Fama and French 1993). We included leverage (*LVG*) measured as the long-term-debt-to-equity ratio to account for potential risk such as liquidity risks and for potential influence of debt holders as the second type of investors. Debt holders are likely to exert more influence in case of financial distress (Tirole 2006). Dividend yield (*DIV*) reflects the current state of the company from growing, non-dividend paying companies into mature companies that pay out dividends on a regular basis. A change in dividend policy might affect stock turnover as expected payouts change. We included capital expenditure (*CAPEX*) as a proxy for investment activities and potential future growth. Finally, we controlled for advertising (*ADV*) and R&D intensity (*R&D*) measured as the respective expenditures scaled by sales to account for other value-relevant intangible assets not represented in the balance sheet (Muhanna and Stoel 2010).

Variable	Notation	Definition	Expected sign
Institutional investment horizon	IIH	Minimum of the value of shares sold and purchased in relation to the investors overall portfolio value	
IT capability reputation	ITCR24	Repeated appearance in the IW ranking	-
Firm performance	ROA	Return on assets	+
Tobin's q	Q	(Market value plus preferred stock and debt) divided by total assets (Chung and Pruitt 1994)	+
Firm size	SIZE	Natural logarithm of sales	-
Leverage	LVG	Long-term debt to total equity	+
Dividend yield	DIV	Dividend per share divided by the price per share	-
Capital investment	CAPX	Capital investment to total sales	-
Advertising expenditure	ADV	Advertising expenditure to total sales	-
R&D expenditure	R&D	R&D expenditure to total sales	-
Institutional investors	INST	Percentage of shares held by institutional investors	+
Industry dummy	IND	Firms primary industry affiliation based on one-digit and two-digit SIC code	
Year dummy	YEAR	Dummy variable for time fixed effects	

Table 3. Variable definition

Additionally, we considered ownership characteristics. The stock turnover of companies with lower institutional ownership of stock is more susceptible to changes by a single owner. We therefore included the total percentage of all institutional shareholdings (*INST*) to adjust for this influence.

Finally, we included industry and time variables to control for influential factors at the industry and market level. First, we included an indicator variable to account for industry-related factors (*IND1*) at the one-digit SIC code level. In addition, we used dummy variables at the two-digit SIC code level to test for robustness (*IND2*, see section 5.3). These factors might reflect different strategic roles of IT across industry sectors or industry-dependent reactions to economic changes and market volatility and can induce investor reactions. Second, we included year dummies (*YEAR*) to capture time effects that affect the whole economy. A corresponding test for time effects yielded significant results, indicating that they are required and that an omission would lead to inconsistent estimates. Plotting the data reveals cyclic time-dependent movements of high churn rate values especially around the two economic crises where markets in general are more volatile. These time effects in the capital market are captured by using the time dummies.

4.4 Econometric Model

To test the hypothesized effect of changes in IT capability reputation on changes in the institutional investment horizon (*IIH*), we estimated the econometric model formulated in Equation (3). We regressed institutional investment horizon on firms IT capability reputation and a set of additional control variables. Taking advantage of the longitudinal nature of the data allowed us to analyze the effect of changes of variables over time.

$$IIH_{it} = b_0 + b_1 ITCR_{it} + b_2 CTRL_{it} + b_3 FIRM_i + b_4 YEAR_t + b_5 IND_{it} + \varepsilon_{it} \qquad (3)$$

Where *IIH* represents the annualized institutional investment horizon of firm k in year t, *ITCR* indicates if a firm has an IT capability reputation in the given year or not. *CTRL* is a vector of common control variables including performance, firm size and growth, intangible assets, and investor related variables. *FIRM, YEAR,* and *IND* represent a set of dummy variables to model firm and time effects as well as industry affiliation (one-digit SIC code). *FIRM* and *YEAR* capture unit- and time- invariant unobserved heterogeneity. Finally, ε_{it} represents the random error term associated with each observation.

5 Results

5.1 Descriptive Statistics

Table 4 presents a summary and descriptive statistics for our sample. All continuous variables besides the calculated amount of institutional investors (*INST*) have been winsorized to mitigate the effect of extreme outliers. We followed common practice and winsorized variables at the first and last percentiles of their distribution (e.g., Dewan and Ren 2011). Bivariate correlations among the variables are all less than 0.5, which is a first indicator that collinearity is not an issue in our data. The highest correlation among explanatory variables is of 0.47 between the two performance measures ROA and Tobin's q. Additionally, we tested for the potential existence of multicollinearity in our dataset by calculating tolerance values and variance inflation factors (VIF)

for all independent variables. The tolerance values are well above the suggested threshold of 0.10 (our tolerance values are all greater than 0.57) and VIFs are well below the threshold of 10 (our VIFs are all below 1.75 with a mean of 1.22). This indicates that multicollinearity is unlikely to be a problem and estimation results are hardly affected (Hair et al. 2010). Further, condition indices are all below the specified threshold of 30 which would be indicative for serious correlation among regressors (Belsley et al. 1980).

	IIH	ITCR24	INST	ROA	SIZES	DIV	LVG	Q	CAPX	RD	ADV
IIH	1.00										
ITCR24	-0.15	1.00									
INST	0.07	-0.01	1.00								
ROA	-0.15	0.04	0.10	1.00							
SIZES	-0.29	0.18	0.02	0.10	1.00						
DIV	-0.27	0.04	-0.14	-0.03	0.13	1.00					
LVG	-0.01	-0.02	-0.03	-0.03	0.00	0.14	1.00				
Q	-0.04	-0.00	-0.10	0.47	-0.09	-0.28	-0.10	1.00			
CAPX	-0.05	-0.02	-0.16	-0.12	-0.04	0.25	0.09	-0.09	1.00		
RD	0.10	0.02	0.02	-0.03	-0.20	-0.28	-0.09	0.31	-0.06	1.00	
ADV	-0.11	-0.01	-0.01	0.16	0.09	0.00	-0.02	0.24	-0.09	-0.02	1.00
Mean	0.09	0.51	0.67	0.05	8.95	0.02	0.69	1.65	0.07	0.04	0.01
S.D.	0.02	0.50	0.16	0.08	1.14	0.02	1.86	1.18	0.07	0.06	0.03
Min	0.05	0.00	0.00	-0.40	4.74	0.00	-9.19	0.13	0.00	0.00	0.00
Max	0.18	1.00	0.98	0.22	11.69	0.10	15.02	6.48	0.42	0.26	0.13

Table 4. Descriptive statistic and correlations

5.2 Estimation Results

To test the hypothesized relationship between changes in IT capability reputation and changes in investment horizon we estimated and compared different econometric model specifications. In particular we analyzed the results from pooled OLS (POLS), random effects (RE), and two forms of fixed effects (FE) estimation. Regression results are reported in Table 5. The different statistical models are discussed in detail in the following paragraphs.

For all estimation procedures, we used Huber-White adjusted estimators to calculate robust standard errors that account for potential forms of heteroscedasticity (White 1980). A modified Wald test following Greene (2000, p. 598) indicates the presence of groupwise heteroscedasticity in our panel data and the need for robust standard errors. Because we have repeated observations for each firm, we cannot assume that the corresponding error terms are independent. Firms owned by long-term-oriented investors in one year will probably be owned by long-term-oriented investors in the subsequent period. To account for this serial or within firm correlation we clustered the errors for each firm. The cluster approach includes the above mentioned Huber-White correction for heteroscedasticity and estimates standard errors that are additionally robust to serial correlation (Rogers 1993; Wooldridge 2010). Petersen (2009) discusses the presence of dependent errors in finance and accounting data and compares different estimators for correlated error structures. He concludes that “standard errors clustered by firm are unbiased and produce correctly sized confidence intervals” (Petersen 2009, p. 475).

The results from the pooled OLS regression are found in the first column of Table 5. The second and third column tabulates the estimates for random effects (RE) and the fourth column reports the fixed effects (FE) estimation. Due to the panel structure of our data and dependencies in the error terms, OLS estimates might be inefficient or even inconsistent. The existence of time- and firm-specific effects causes pooled OLS estimates to be inconsistent. Additionally, inconsistencies might arise due to unobserved firm-related heterogeneity that persists through time. The fixed effects estimator is used to model firm specific time-invariant unobserved variables and address the problem of omitted variable bias. While the FE model assumes the existence of an individual firm effect, the RE model assumes that differences across firms are random. Comparing the estimation results of the fixed and random effects approach shows a similarity in the estimated coefficients regarding both direction and significance. We run a robust version of the Hausman specification test as suggested by Wooldridge (2010) to compare the FE and RE estimates of our model. We strongly reject the null hypothesis that the individual effects are random, i.e. that there is a no systematic difference between the coefficients of the two models $(p < 0.001)$. The Hausman test (1978) provides support for selecting the FE model and it can be concluded that the stronger assumptions imposed by the RE model are not valid and lead to inconsistent estimates. Nonetheless, the estimates of the FE and RE model are basically equivalent, which is not surprising as the median theta value from the RE model is close to one (0.70). This result also implies that the estimates from the pooled OLS model are inconsistent due to the existence of firm specific effects.

In the following we will discuss the estimates of the FE model tabulated in the fourth column of Table 5. As expected, the estimates provide evidence that IT capability reputation is significantly related to institutional investment horizon. The significant and negative coefficient for IT capability reputation (*ITCR24*) indicates that an existent reputation leads to a significant reduction in the level of institutional investment horizon. This implied that creating and maintaining IT capability reputation is related to an increase in long-term-oriented investors and a decrease in short-term oriented investors. Having a reputation for IT capability strengthens the ownership structure and attracts long-term-oriented institutional investors.

The coefficient of ROA is positive and significant in the fixed-effects models. This is not surprising because short-term oriented institutional investors are looking for well performing companies with further short-term growth potential (Yan and Zhang 2009). On the contrary, long-term-oriented investors prefer large and stable companies that have a high dividend yield and that invest in the future (DIV, SIZES, and CAPX are all negative and significant).

The fact that R&D and advertising are both non-significant is rather unexpected but probably relates to the fact that we replaced missing values by zero. Ravichandran et al. (2009) explicitly refuse to include advertising intensity because values are so often missing. Looking further into this, around 60% of the values for R&D and advertising intensity contain a zero value. There are mainly two reasons for this outcome. First, because we include all types of industries, our sample contains some industries that probably do not engage in R&D. Further, other companies e.g. in the B2B sector like mining do not advertise their products like retailers such as Apple do. Second, expenditures related to R&D and advertising are not always disclosed by companies as such even if they occur. The exclusion of R&D and advertising does not lead to any noteworthy changes in the estimates of the remaining coefficients. However, if we limit the sample to

companies that engage in both R&D and advertising, the sample size drops to 95 companies (883 observations). In this case, IT capability reputation stays negative and significant and R&D shows a negative and significant value, too (-0.029, p<0.05).

	(1) **POLS**	(2) **RE1**	(3) **RE2**	(4) **FE1**	(5) **FE2**
ITCR24	-0.0037***	-0.0020**	-0.0019**	-0.0018*	-0.0018**
	(0.0008)	(0.0007)	(0.0007)	(0.0007)	(0.0006)
INST	0.0035	-0.0036	-0.0028	-0.0034	-0.0034
	(0.0045)	(0.0056)	(0.0056)	(0.0069)	(0.0045)
ROA	-0.0235***	0.0014	0.0017	0.0093*	0.0093*
	(0.0061)	(0.0047)	(0.0048)	(0.0046)	(0.0039)
SIZES	-0.0047***	-0.0067***	-0.0075***	-0.0083***	-0.0083***
	(0.0005)	(0.0007)	(0.0007)	(0.0011)	(0.0005)
DIV	-0.3003***	-0.1880***	-0.1830***	-0.1522***	-0.1522***
	(0.0360)	(0.0321)	(0.0326)	(0.0353)	(0.0257)
LVG	0.0003	0.0001	0.0001	0.0001	0.0001
	(0.0002)	(0.0001)	(0.0001)	(0.0002)	(0.0001)
Q	-0.0018**	0.0005	0.0004	0.0009	0.0009
	(0.0006)	(0.0004)	(0.0004)	(0.0005)	(0.0005)
CAPX	-0.0078	-0.0198**	-0.0216**	-0.0237**	-0.0237***
	(0.0085)	(0.0073)	(0.0074)	(0.0083)	(0.0027)
RD	0.0102	-0.0108	-0.0085	-0.0261	-0.0261
	(0.0099)	(0.0103)	(0.0110)	(0.0192)	(0.0135)
ADV	-0.0185	-0.0334	-0.0177	-0.0026	-0.0026
	(0.0225)	(0.0260)	(0.0284)	(0.0402)	(0.0276)
Year Effects	Included	Included	Included	Included	Included
Industry Effects	SIC1	SIC1	SIC2		
Observations	4263	4263	4263	4263	4263
N	353	353	353	353	353
R^2	0.3965	0.3540	0.4251	0.3926	0.3961

Note: * p < 0.05, ** p < 0,01, *** p < 0,001; Robust standard errors in parentheses; Models include year dummies and industry dummies if applicable. Variables are defined in Table 3.

Table 5. Regression results

The FE estimator assumes the absence of cross-section dependence, i.e. that there is no correlation between firms beyond time effects. This type of correlation could, however, exist due to similarities within industries, dependencies among suppliers, manufacturers, and retailers, as well as effects that only impact certain groups of firms but not all at the same time.

A corresponding test indicates unaccounted cross-section dependence in the residuals.[5] Additionally, the BFN-Durbin-Watson test and the test procedure discussed by Wooldridge (2010) both indicate the presence of auto-correlation in the data. To account for the presence of cross-sectional correlation as well as autocorrelation and heteroscedasticity, we re-estimated our model following the approach by Driscoll and Kraay (1998). In the presence of cross-sectional dependence, the Driscoll-Kraay standard errors are more efficient, i.e. more accurate than the standard errors produced by the general FE model (Driscoll and Kraay 1998; Hoechle 2007). The estimates from the Driscoll-Kraay approach are provided in the fifth column of Table 5. The results from this more robust estimation are in line with the previous findings and provide further support for our hypothesis.

5.3 Robustness Checks

We conducted a series of additional tests to check whether our empirical results are robust. First, although capital markets in general react quickly to new information, some investors might react with some delay. Therefore, we used a one year lagged institutional investment horizon (IIH) as an alternative dependent variable to account for changes in the ownership structure that take place within the following year. This robustness check further alleviates concerns due to reverse causality (Mithas et al. 2012). The estimation results remain qualitatively unchanged although the coefficients are slightly smaller.

Second, we added lagged financial performance (ROA) as additional control variable to account for a potential halo effect of prior financial performance as suggested by previous research (Santhanam and Hartono 2003). Similar to Muhanna and Stoel (2010) we find a significant effect of prior financial performance but estimates for IT capability reputation are only slightly reduced but still consistent with the reported results.

Third, we used alternative operationalizations of our dependent variable. We included the approach by Gaspar et al. (2005), who use the sum of shares sold and purchased instead of the minimum like Yan and Zhang (2009). This introduces more variability because by considering all transactions, this measure does not adjust for capital drain and inflows. Thus, this sum approach is less conservative than the minimum approach in our main analysis. Using this alternative measure, the fixed effects estimates for ITCR are also negative but only significant at the 10% level. For further consideration, we calculate both turnover measures using only end-of-quarter share prices. This mitigates the effect of unnatural price changes and inconsistencies that are observable in the database for certain stocks. Estimates based on the minimum turnover approach (Yan and Zhang 2009) are equivalent whereas changes for the sum approach (Gaspar et al. 2005) are notable. As argued before, the sum approach is much more sensitive and data inconsistencies especially between time-periods have large effects. For this approach, the use of end-of-quarter prices is more reliable. Using the price robust turnover values from the sum approach, all estimation results are significant and fully consistent with the previous findings.

[5] We have to note that due to computational difficulties we could only apply this test for balanced panels. To run this test we had to create balanced subsample from our original data set. We selected balanced subsamples for T=14 and T=15. In both cases the Pesaran test indicates the presence of cross-sectional dependence.

Fourth, we used different specifications to determine a firm's superior IT capability reputation. Besides the common approach of at least two successful rankings within four years (Bharadwaj 2000), we applied two stricter definitions, i.e. two listings within three years (*ITCR23*) and three listings within four years (*ITCR34*). The results for both conservative measures are in line with prior results.

Fifth, in our main analysis, we winsorized continuous independent variables at the one percent level to mitigate the effect of outliers. To assess the robustness of our results, we re-estimated all models using unchanged variables. The presence of outliers slightly influences the estimation coefficients but the overall results remain unchanged.

Further, we included companies described above that had inconsistencies in shares outstanding or where aggregated holding positions exceeded shares outstanding. The inclusion increased the sample size from 353 to 447 companies, but the results stay largely unchanged.

In summary, the evaluations show that our results are quite robust to variations in sample size, changes in measurement approaches, and variable operationalizations. This supports our main finding that IT capability reputation has a significant effect on a firm's ownership structure for the proposed reasons.

6 Discussion

We have argued that a firm's *IT capability reputation* influences the strategically important *ownership structure* and thereby essentially the fabric of the firm itself. The results reveal that IT capability reputation exhibits a significant effect on a firm's ownership structure by shifting the structure towards more long-term-oriented investors. Moreover, the effect of IT capability reputation is stable across different methods applied such as fixed and random effects models and also robust as diverse robustness tests show. Overall, the findings disclose the potential of IT as an intangible asset and reputation signal to the financial market that can even influence a firm's ownership structure which, in turn, influences a firm's market valuation. The implications of this new IT value impact variable are discussed below.

6.1 Contributions to Research

A central contribution of our work is the introduction of a new strategic variable that is influenced by IT but not recognized by extant IS research: ownership structure. We find that firms with better IT capability reputation exhibit a more long-term-oriented ownership structure. This is important for firms for several reasons. Elyasiani and Jia (2008) report that stable (long-term) institutional investors have several effects: a reduction in agency and information asymmetry problems, mitigation of the managerial myopia problem, and better alignment of the interests of managers and shareholders. In contrast to short-term oriented institutional investors (see, e.g., Yan and Zhang 2009), investors with a long-term horizon are active monitors of firm behavior and thereby reduce information asymmetries between shareholders and management (Attig et al. 2012; Chen et al. 2007). Myopic managerial behavior – cutting long-term investments like R&D to satisfy short-term earnings targets – at the expense of future growth and competitiveness is fostered by short-term institutional investors. More investors with a long-term horizon reverse this managerial misbehavior (Bushee 1998). Finally, long-term-oriented institutional investors enhance the alignment with managers, for example

through appropriate compensation packages (Hartzell and Starks 2003) and by reducing managerial opportunism (Khurana and Moser 2013). Hence, the introduction of the variable 'ownership structure' goes beyond market valuation, e.g., measured as Tobin's q, and sheds light on the concept of an anonymous financial market as used by extant research through distinguishing into different types of investors who together make up a major part of this market. These different types of investors are influenced differentially by IT capability reputation, and building up a good IT capability reputation might thereby even be a means to influence the firm's ownership structure over time.

On the one hand, connecting separate perspectives from the IS and finance literature, we show that IT capability reputation affects a firm's ownership structure and introduce a new strategic variable to IS research. On the other hand, we demonstrate that IT capability reputation is an intangible asset. This finding can inform finance research on intangibles that predominantly deals with R&D, advertisement, and brand value. Using an extensive set of longitudinal data allows us to detect relationships between accounting variables, IT capability reputation and various ownership variables and their changes over time.

6.2 Implications for Practice

Our results have important implications for practice. As discussed above, the presence of more long-term-oriented institutional shareholders is associated with several firm level advantages. For example, companies benefit from reduced costs of equity and debt (Attig et al. 2013; Elyasiani et al. 2010), increased corporate firm performance (Bushee 2001; Elyasiani and Jia 2010), and price stability in periods of market turmoil (Cella et al. 2013). Firms and investors both profit from the presence of long-term-oriented institutional investors in mergers and acquisitions deals. They negotiate higher takeover premiums and achieve better post-merger performance by hindering management from making bad acquisitions (Chen et al. 2007; Gaspar et al. 2005).

For investor relations departments, our findings are instructive as they strive to influence a firm's composition of investors and eventually market valuation by revealing or emphasizing information on IT that is not necessarily required by regulation. One method to exert influence on investors might be to develop a reputation of IT capability to signal future prospects and affect the financial market (Lim et al. 2013). Our results should encourage investor relation departments to more specifically pursue activities such as participating in IT rankings. Such activities are effective mechanisms to attract the 'right investors' (Bushee 2004; Useem 1996).

The results also hint at yet another role change for the modern CIO. Given the disclosed fundamental strategic implications of an IT capability beyond internal process and external financial performance, the need for a strategic alignment between CIO and CFO (see Banker et al. 2011) and for further alignment among IT and investor relations managers becomes obvious.

6.3 Limitations

While we used a huge and mostly reliable data set from different sources for our analysis, the availability of data still establishes some inevitable limitations. In particular, the data for IT capability reputation is retrieved from the IW500 ranking. Because of its recognition and consistency with comparable data sources (see Rai et al. 1997), the IW500 ranking is often used

in the capabilities literature (e.g., Aral and Weill 2007; Bharadwaj 2000; Lim et al. 2012a). Also, we are not aware of other more fine-grained measures that are available and could provide more detailed insights or larger coverage of companies. Furthermore, we are limited to the time period after 1997 for which both IW500 ranking data and equity ownership data are available. This in turn creates a limitation to the U.S. market as detailed data for a sufficient period of time is only available for U.S. companies.

The presence of endogeneity can bias estimates and makes exact inferences problematic. Panel data and the use of fixed-effects estimators alleviate potential endogeneity bias because within variation is used instead of between (i.e., cross-sectional) variation. Firm effects are constant in time and therefore canceled out. Remaining unobserved variables that are potentially correlated are assumed to be rather stable for each single firm in time in contrast to large differences across firms that are not taken into account (Chenhall and Moers 2007; Hamilton and Nickerson 2003). By covering a broad range of control variables discussed in the literature (derived from accounting theory and ITBV literature) we expect the remaining endogeneity bias to be rather small. We conduct a series of sensitivity analyses and evaluate different plausible model specifications as suggested by Van Lent (2007). We are confident that the consistency of results provides sufficient evidence in support of our theoretical argument. However, the potential endogeneity bias warrants further research on factors that are likely to influential the underlying relation.

6.4 Further Research

Future IS studies could examine the interplay between IT capability reputation and other ownership characteristics such as short-selling to attain a more specific picture of which characteristics are affected to which degree by IT capability reputation. Future finance studies could also take an investor's perspective and analyze the composition of an investor's company portfolio to find out under which portfolio conditions investors buy, sell, or hold shares of firms with strong IT. In addition, future research can analyze how IT capability reputation shapes the composition of a firm's ownership structure regarding types of dedicated investors such as hedge funds and pension funds apart from differing investment horizon. Further, the extension to markets outside the U.S., especially where investment cultures and legal standards differ, would provide new insights for the generalizability of our results. Lastly, future research could strive for more fine-grained IT measures which could yield new insights in the relationship between IT and strategic value.

6.5 Conclusion

The major finding of this study is that IT capability reputation shapes a firm's ownership structure. This is a fundamental and so far unknown effect of an IT capability that enriches IT impact research and strategic IT management and also has implications for investors, financial analysts, and executives. By actively disclosing and communicating IT related information to capital markets, executives try to attract long-term-oriented investors that serve as an anchor of stability and thereby reduce the risk of extensive pressure by exploitative investors as well as the fear of capital drain. Simultaneously, CIOs' possibilities to influence peers' commitment to convince peers in the Top Management Team to allocate attention and resources (Enns et al. 2003, pp. 155, 158) will be influenced by investors' reactions to the strategic value of IT. From an

investor's perspective, taking a firm's current ownership structure and IT capability reputation into account can reduce risks and prevent misinvestments.

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Appendix

Publications

Scientific Journals (peer-reviewed)

Schäfferling, André; Wagner, Heinz-Theo: (**Paper V**)
Exploring the capital market effects of IT capability: The case of ownership structure
In: Journal of Business Economics (JBE), forthcoming.

Conferences (peer-reviewed)

Schäfferling, André; Wagner, Heinz-Theo: (**Paper IV**)
Institutional Investors and the Development of IT Capability: Evidence from Publicly Listed Companies
In: Proceedings of the 35th International Conference on Information Systems (ICIS), Auckland, New Zealand, 2014.

Schäfferling, André: (**Paper I**)
Determinants and Consequences of IT Capability: Review and Synthesis of the Literature
In: Proceedings of the 19th Americas Conference on Information Systems (AMCIS), Chicago, Illinois, USA, 2013.

Schäfferling, André; Wagner, Heinz-Theo: (**Paper VI**)
Do investors recognize Information Technology as a strategic asset? A longitudinal analysis of changes in ownership structure and IT capability
In: Proceedings of the 21th European Conference on Information Systems (ECIS), Utrecht, Netherlands, 2013.

Schäfferling, André; Wagner, Heinz-Theo:
Exploring the capital market effects of IT capability: The case of ownership structure
75th VHB Annual Congress, German Academic Association for Business Research
75. Wissenschaftliche Jahrestagung des Verbandes der Hochschullehrer für Betriebswirtschaft (VHB), Würzburg, Germany, 2013.

Wagner, Heinz-Theo; Schäfferling, André:
Characteristics of a Firm's Ownership and IT Capability: An elusive Relationship
In: Proceedings of 4th Annual Pre-ICIS Workshop on Accounting Information Systems (SIGASYS), Orlando, Florida, USA, 2012.

Schäfferling, André; Wagner, Heinz-Theo; Becker, Jochen:
IT Capability and Firm Performance: Findings from Periods of Economic Downturn
In: Proceedings of the 18th Americas Conference on Information Systems (AMCIS), Seattle, USA, 2012.

Schäfferling, André; Wagner, Heinz-Theo; Becker, Jochen: (**Paper III**)
Exploring the Relation between Firm Ownership and IT Capability
In: Proceedings of the 20th European Conference on Information Systems (ECIS), Barcelona, Spain, 2012.

Schäfferling, André; Wagner, Heinz-Theo; Schulz, Martin; Dum, Thorsten:
The Effect of Knowledge Management Systems on Absorptive Capacity: Findings from International Law Firms
In: Proceedings of the 15th Pacific Asia Conference on Information Systems (PACIS), Brisbane, Australia, 2011.

Wagner, Heinz-Theo; Dum, Thorsten; Schäfferling, André; Schulz, Martin:
The Effect of Knowledge Management Systems on Absorptive Capacity: The Case of a German Law Firm
In: Proceedings of the 44th Hawaii International Conference on System Sciences (HICSS), Kauai, Hawaii, USA, 2011.

Schäfferling, André; Wagner, Heinz-Theo:
IT capability, innovation capability, and long-term performance: A research approach
In: Proceedings of the 16th Americas Conference on Information Systems (AMCIS), Lima, Peru, 2010.