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**Master Thesis**

**The Influence of Industry Differences and Restructuring on the Disclosed IT Control Weaknesses under SOX Section 404 in US based companies**

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**Abstract**

This research study investigates the impact of industry differences and restructuring on the IT control quality, as measured by the existence of material IT control weaknesses. The growing importance of IT controls is highlighted by the Sarbanes Oxley Act (2002), which requires management and auditors to report on the effectiveness of internal controls, including IT controls.   
The investigation of IT control quality in this study is relevant, because it may help auditors to determine which industries/ circumstances need extra attention to identify IT control weaknesses. Investors and management may also use these research results to assess whether a company is more likely to have IT control weaknesses.   
  
The results reveal that industry differences are significantly and positively associated with firms disclosing material IT control weaknesses under SOX section 404 in the years 2004-2011. Industry differences are partly based on the complexity of financial reporting. The research study results support the hypothesis that technology, health care and financial services industries (having more fraud opportunities) are more likely to have material IT control weaknesses. Other industry differences, based on the competitiveness level, are also significant and support the hypothesis that non-competitive industries have more material IT control weaknesses.   
  
This study also highlights the effect of restructuring on material IT control weaknesses. Three measures are used to analyze this and the results indicate that only the existence of a restructuring in the sample period is significant and supports the hypothesis. The existence of a restructuring and the amount of the restructuring costs in the same year as the IT material weakness are highly inter-related, causing a possible bias in the analysis. The correlations of these variables also have a negative sign for the coefficient and therefore do not support the hypothesis.   
  
An additional analysis of the trend of the material IT control weaknesses shows a downward trend from the year 2007. A surprising finding is that the year 2007 shows relatively more material IT control weaknesses than other years, while the total number of material weaknesses remained the same.   
  
Finally in the discussion the limitations of this study and recommendations for further research are considered.

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# Chapter 1 Introduction

## Relevance and motivation

Since the 1990’s Information Technology (IT) has become an increasingly important part of the operations within companies. An example is the increasing usage of Enterprise Resource Planning (ERP) systems that integrate multiple business functions into one information system. The development in the usage of IT in organizations has increased the dependence on the functioning of the systems. Therefore it is important that companies implement control systems to guarantee the safety and integrity of their IT systems. The importance is underlined by the introduction of the Sarbanes Oxley Act (SOX) in the U.S.A. This law was introduced in 2002 after multiple accounting scandals. Since the implementation of SOX most of the listed companies in the U.S.A. have to report their material internal control weaknesses. A material internal control weakness occurs when certain critical controls protecting the financial reporting are omitted or not working effectively. This can be established by using control frameworks like the Committee of Sponsoring Organizations of the Treadway Commission (COSO) framework. There are different categories of material weaknesses in the internal controls of a company; some examples are: insufficient accounting documentation, compliance issues due to personnel problems, inadequate disclosure controls and auditor adjustments in the financial statements and Information Technology (Grant et al., 2008). The IT controls on financial reporting are an important part of the internal controls, because all companies that have to report under SOX use IT systems to produce financial statements.

The relation between IT control weaknesses and financial reporting has been investigated in several earlier studies and is an interesting subject for the following reasons:   
1) IT control weaknesses can be an indicator for problems in financial reporting, because financial reporting is dependent on reliable information technology (Grant et al., 2008),2) Information technology plays an increasingly important part in the internal control system, for example by using automated controls in financial reporting processes (Hall, 2011),   
3) The increasing usage of ERP systems can have negative side effects , which could result in more IT control weaknesses, when the implementation fails (Davenport, 2000; Doyle et al.,2007).   
These reasons indicate that the quality of information technology and financial reporting are related and a better understanding on the explanatory variables could improve risk assessments of auditors and management to ultimately provide reliable financial statements.

The literature in the area of IT control weaknesses is mostly focused on U.S. based firms. This is because SOX requires that listed companies disclose reports on the quality of the internal control system on financial reporting. This requirement makes it possible to do empirical database research to look for factors that influence the internal controls and IT controls. Doyle et al., 2007 is an often cited study that investigates the variables that influence the internal control quality. One of the significant explanatory variables is restructuring of the organization. There are also studies that specifically focus on IT control weaknesses. These studies look at the relation between IT controls and accounting errors (Grant et al., 2008), elements of external and internal governance that explain IT control weaknesses (Li et al., 2007), the relation between IT control quality and management forecasts (Li et al., 2012) or study the influence of IT control weaknesses on the firm’s performance (Stoel & Muhanna, 2011). The relevant literature on theories and results of empirical studies in the field of internal control and IT control weaknesses is further discussed in chapter 3.

This research study wants to contribute to the already available literature by investigating two possible explanatory variables that could explain the disclosure of material IT control weaknesses. The first explanatory variable is industry differences and the second variable is restructuring of the organization. In the descriptive statistics this study will also provide an investigation of the trend in IT control weaknesses.

The investigation on possible explanatory factors of IT control weaknesses is an extension on the research of Li et al. (2007), Li et al. (2012) and Doyle et al. (2007). In these studies it is indicated that industry factors and restructuring costs could have an effect on internal control and more specifically on IT control weaknesses.   
Industry differences are investigated as explanatory variable in various earlier studies and these studies revealed a significant influence of the type of industry on the effectiveness of internal controls (Bryan & Lilien, 2005; Elbannan, 2008; Goh & Li, 2011; Li et al., 2012). Li et al. (2012) already provided a division of IT control weaknesses across industries, but did not provide further analysis or conclusions on this variable. This research study investigates the industry differences much further and provides a statement on which industries are more sensitive to IT control weaknesses. The theory behind the existence of industry differences is based on empirical studies that indicated that certain industry characteristics explain differences in reporting and governance (Bell and Carcello, 2000; Beasley et al., 2000; Giroud & Mueller, 2007). They found that industries with complex financial processes are more likely to have a deficiency in reporting and governance than other industries. Beasley et al. (2000) found that financial reporting fraud occurs more often in technology, finance and healthcare organizations, because these industries are more prone to fraud opportunities and therefore more difficult to control. Giroud and Mueller (2007) have another theory; they argue and find that non-competitive industries (like energy companies) have more governance problems than competitive industries, because non-competitive industries do not feel the pressure of the market to solve agency problems. Based on the theories of Beasley et al. (2000) and Giroud & Mueller (2007) it may be expected that industries with complex financial reporting, more fraud opportunity or operating in a non-competitive environment have more IT control weaknesses than other industries. By analyzing industry differences this research study can help indicate which types of industry have relatively more IT control weaknesses. The empirical research is done by making groups based on the SIC industry code and the categorization is based on prior literature, like the categorization used by Li et al (2012). This makes it possible to compare the results.

Another possible explanatory variable is the influence of a restructuring of the firm in the year of the IT control weakness. The reasoning behind this is that when a company is restructuring its organization/ IT organization, this could have an influence on the quality of internal control. Important to note is that there are two possible effects that the restructuring could have. The first possibility is that a company is implementing a new IT system or an organizational structure, resulting in extra costs and reducing the effectiveness of the operations (Bingi et al., 1999). This concerns only a short period after the implementation. In the long run the restructuring should make the organization more efficient. Also Doyle et al., (2007) has already provided evidence that restructuring of firms has an influence on internal control weaknesses. This study wants to extent on Doyle’s study by looking at the influence of restructuring on IT controls.   
The proxy for identifying restructuring costs is the announcement of companies that they intend to restructure the organization. Hayes et al. (2001) investigated the influence of an ERP implementation on the stock market. To collect the necessary information the authors investigated disclosed announcements and looked for specific ERP implementation announcements. Bens (2001) used another method that first identifies companies with a negative special item account and then looked into the earnings announcement to see if a restructuring took place. For this research study the same method is used to analyze the influence of new IT systems/ structures on IT control weaknesses.

The second contribution of this study is an investigation of the development of IT control weaknesses over the years. The empirical analysis focuses on the absolute change in the number of disclosed IT control weaknesses under SOX. It is interesting to investigate this, because there are multiple explanations for possible changes over the years. The first possible explanation is that the number increases because the implementation of IT systems has increased and so did the IT control weaknesses. The second possibility is that the number of weaknesses decreases, because the internal control systems have improved due to the SOX regulation.

In addition to the analysis of the absolute change in disclosed control weaknesses, this research also investigates the importance of IT controls within the internal control systems. This is possible by using a relative measure that looks at the ratio of IT control weaknesses on the total number of control weaknesses. This measure can indicate how much the internal control relies on IT (controls) and can also measure the importance of IT controls over the years.

An investigation of the development of IT control weaknesses is relevant for the following groups: 1) auditors, 2) regulators like the Security Exchange Committee (SEC) and Public Company Accounting Oversight Board (PCAOB), 3) investors, and 4) companies (management and the IT organizations involved in financial reporting). First of all this research is relevant for auditors/ IT auditors because the results may indicate how important IT controls are in the internal control system of a company and show if there is a trend of a growing importance of IT controls in comparison with other internal controls. Also the investigation of the influence of industry factors or restructuring cost on IT control weaknesses can help auditors to determine which industries/ circumstances need extra attention to identify IT control weaknesses. Second, the results of this research can also be relevant to regulators, because it gives an analysis of the disclosed IT control weaknesses under SOX. This analysis can indicate that the regulator needs to adjust the current regulation because of the growing importance of IT controls within the internal control disclosures. Investors are the third group for which this research could be relevant. Investors demand that the management of companies is in control and that the financial reporting is reliable. The development of IT controls within the internal control system can be an indication to the investors to also look at the disclosed IT control weaknesses to determine if the company is in control. Finally, the results of this research may also be relevant for the company itself and more specifically the management and the internal IT organization involved in financial reporting. This is because the results from the analysis may identify certain industries or trends that are helpful in making business decisions on the organization of IT controls.

## Research questions

First the descriptive statistics analysis on the IT control weaknesses will focus on the development and the importance of IT control weaknesses within internal control systems. The first analysis will focus on what the development of the reported IT control weaknesses under SOX from 2004-2011 is; so it investigates the trend of the reported IT control weaknesses over the years. The sample period 2004-2011 is chosen, because 2004 is the first year that the database Audit Analytics included SOX section 404 reports about the internal control quality and 2011 is the last year for which all necessary data is available. The second part of the analysis looks whether the importance of IT control weaknesses has increased in comparison with other internal control weaknesses in the period 2004-2011. The importance of IT control weaknesses is measured by a relative measure that compares the number of IT specific material weaknesses with the total number of internal control material weaknesses.

The main research is about the effect of the explanatory variables industry differences and restructurings on IT control weaknesses. The following research questions are based on studies indicating that industry differences and restructuring are associated to the disclosure of internal control weaknesses (Bryan & Lilien, 2005; Elbannan, 2008; Goh & Li, 2011; Li et al., 2012). Industry factors and restructuring could have a significant influence on the number of disclosed IT control weaknesses and therefore the first and second questions are:

1. *What is the impact of industry differences (like complex financial reporting and competiveness level) on the disclosed IT control weaknesses under SOX section 404 in the reporting years 2004-2011?*
2. *What is the influence of the restructuring on the disclosed IT controls under SOX section 404 in the years 2004-2011?*

## The empirical results

A trend analysis regarding the descriptive statistics of the material IT control weaknesses shows a downward trend from the year 2007. A surprising finding is that the year 2007 shows relatively more material IT control weaknesses than other years, while the total number of material weaknesses remained the same. The empirical results reveal that industry differences are significantly and positively associated with firms disclosing material IT control weaknesses under SOX section 404 in the years 2004-2011. Industry differences are partly based on the complexity of financial reporting. The research study results support the hypothesis that technology, health care and financial services industries (having more fraud opportunities) are more likely to have material IT control weaknesses. Other industry differences, based on the competitiveness level, are also significant and support the hypothesis that non-competitive industries have more material IT control weaknesses.   
This study also highlights the effect of restructuring on material IT control weaknesses. Three measures are used to analyze this and the results indicate that only the existence of a restructuring in the sample period is significant and supports the hypothesis. The existence of a restructuring and the amount of the restructuring costs in the same year as the IT material weakness are highly inter-related, causing a possible bias in the analysis. The correlations of these variables also have a negative sign for the coefficient and therefore do not support the hypothesis.

## Structure of the paper

The next chapter provides background information about the disclosure of IT controls under SOX and about the criteria being used to do an IT audit. In chapter 3 a literature review is presented, summarizing the empirical results published in the relevant papers about IT controls and possible explanatory variables. In chapter 4 the hypotheses and the theoretical support for these hypotheses are explained. Chapter 5 presents the research design, which includes information about the measures used and about the sample used to test the hypotheses. Chapter 6 shows the empirical results and finally in chapter 7 the discussion and conclusion are presented.

# Chapter 2 Background information

This chapter introduces the main regulations and frameworks related to IT controls in financial reporting. It starts with an introduction of the internal control related regulations for U.S. based firms: the Sarbanes Oxley Act (SOX; Section 404) and the Statements on Auditing Standards. Providing background information on the internal control regulations is important, because the IT controls form just a part of the total internal control system for financial reporting. Next the relevant internal control and IT control frameworks are introduced and explained. Finally, this chapter provides the theoretical background on the explanatory variables industry differences and restructuring costs.



## SOX Section 404

After several major accounting scandals in the U.S.A. the U.S. government decided to implement additional regulations for public companies and auditors. This resulted in SOX, entering into force as of 2002 (Public Law 107–204/SOX section 1, 2002). One of the more important sections of SOX is Section 404 (Public Law 107–204/SOX section 404, 2002), which requires companies to disclose the effectiveness of their internal controls for financial reporting. Section 404 is related to Section 302 (Public Law 107–204/SOX section 302, 2002) which requires management to disclose reports about the internal controls and to certify these reports. The difference is that Section 404 is for ‘accelerated filers’ (the larger companies), has more requirements and is effective as of 2004, while Section 302 entered into force in 2002 and concerns all filers at the Securities Exchange Committee (SEC) (SEC, 2003). In accordance with Section 404 management has the responsibility to provide a report that contains: 1) A responsibility statement of management which says that management must implement and maintain internal controls for financial reporting (design), and 2) An assessment of the internal control effectiveness regarding the structure and procedures (effectiveness) (SEC, 2003).

Not only management has a responsibility, but also the auditor should review the internal control system of the company as stated in SOX section 103 (Public Law 107–204/SOX section 103 a.2.iii, 2002). This SOX section 103 is important to make sure the audit quality is sufficient and stimulates the auditors to look more closely to the effectiveness of internal controls. To further improve the audit quality and independence the SOX act also introduced the Public Company Accounting Oversight Board (PCAOB) (Public Law 107–204/SOX section 101, 2002). The PCAOB has the task to oversee the public auditors to see if the auditor’s reports are independent and are of sufficient quality. PCAOB also has the task to make rules and regulations to ensure the audit quality is up to standard and in accordance with SOX section 103. This mandatory task of the auditor is further regulated and standardized by the Auditing Standards Board (ASB) which is a part of the American Institute of Certified Public Accountants (AICPA).[[1]](#footnote-1) Long before the implementation of SOX section 404 the ASB had already issued several ‘Statements on Auditing Standards’ (SAS) related to the review of internal controls, namely SAS No.1, which requires the auditor to evaluate the internal controls and was implemented by AICPA in 1973 (Arens et al., 2012). Since SAS No. 1 several new standards have been introduced concerning internal controls quality and also more specific standards on the effect of IT on internal controls (SAS No. 94) (Yang and Guan, 2004). The regulations related to IT controls are discussed in paragraph 2.3 concerning the IT control framework. Although the requirement for the auditor to review the internal controls is older than the SOX regulation for management, Section 404 of SOX did change the responsibility of the auditor. Section 404 requires the auditor to issue an opinion about the effectiveness of the internal controls on financial reporting, which is called an in-control statement. This opinion is published in an audit report and is mandatory for the larger companies.

## Framework to determine the quality of internal controls (COSO)

In order to assess the quality of internal controls, most companies use frameworks to look at the design and the effectiveness of the internal controls. The most frequently used framework to determine the quality of internal controls in the United States is the COSO framework. COSO defines internal controls as processes with the purpose to give reasonable assurance for the following objectives: 1) Effectiveness/efficiency of the operations, 2) Reliable financial reports and 3) Compliance with regulations and laws (COSO, Executive Summary, 2th paragraph, 1992). To achieve these objectives the framework consists of five components which cover different areas where controls need to be in place. These components are: 1) Control Environment, 2) Risk Assessment, 3) Control Activities, 4) Information and Communication, and 5) Monitoring (COSO, 1992 (3-7th paragraph)).

For each of these components there are several controls to guarantee the proper operation of the internal control system. Regulations like SOX (Section 404) and SAS No. 1 only require that financial reporting internal controls are working properly, causing auditors to focus mainly on internal controls that prevent material misstatements in the financial reports (Yang and Guan, 2004).   
The first component of COSO is the control environment; this component focuses on the structure and policies of management to implement, maintain and communicate the internal controls to the employees. The second component is a risk assessment, considering threats to the financial reporting operations. Control activities are also a component of the framework, reviewing procedures intended to make sure that objectives are met (for example separation of duties and authorizations). The fourth component is information and communication, looking at the methods used to process and record transactions. The last component is monitoring to see whether the controls stay effective at a certain level. When controls appear to fail, there should be a proper response (COSO, 1992 (3-7th paragraph)).

Since the original internal control framework was introduced in 1992 the COSO Commission decided to develop an updated internal control framework which is released in May 2013 (COSO, 2013). Although this improved framework is not used by the firms in the sample of this study, it is still important to see in which areas the COSO framework is adjusted to see the possible weaknesses in the original framework. The reasons for the update is that the business environment has changed dramatically, because of globalisation, more shared services, changed standards, more information technology in operations and higher standards on governance quality (COSO executive summary, 2013). The new framework still has the same five components of internal controls as mentioned above, but these components in the new framework are further specified with additional principles. These additional principles make sure that the organization not only focuses on the external financial reporting internal controls, but also on the overall reporting operations within the firm. Within the principles the new framework also adds points of focus that can help management properly implement the controls (COSO, 2013).

When the auditor has assessed and tested the quality of the internal controls, SOX Section 404 requires that all material weaknesses in the internal control affecting the financial reporting should be published in the auditor’s report. Following the definition of the COSO framework, a material weakness in internal control exists when the weakness ’severely reduces the likelihood’ of the firm achieving their objectives (COSO, 2013). This means that weaknesses in the internal controls that do not affect the financial reporting and objectives are (usually) not communicated (Doyle et al., 2007). When no material weaknesses are identified, the auditor issues an unqualified opinion. An adverse opinion is issued when the auditor finds one or multiple material weaknesses in the controls. A qualified/ disclaimer opinion is possible when the auditor has not been able to test the controls (properly). This may occur when the auditor is unable to assess the materiality of a weakness or when the company does not provide sufficient information (Arens et al., 2012).

## Framework to determine the quality of IT controls (COBIT)

The COSO framework provides a broad standard to determine the quality of internal controls, but when it comes to determining the quality of IT-related internal controls companies need to rely on more specific frameworks. Because this research study focuses on the material IT control weaknesses it is also important to know which framework is used to determine what a material weakness is in an IT environment. Since 2003 the audit standard SAS no. 1 paragraph 2.3 from AICPA demand that general IT controls need to be reviewed when the internal controls are being audited. The audit standards do not make explicit which controls need to be in place, so companies need to make an assessment to which extent information technology is important to their internal control systems. The assessment needs to contain information on how the IT controls are integrated in the COSO framework and information whether the IT controls are functioning correctly (Demianides, 2004). The dominant IT governance framework used to assess IT controls in the U.S.A. is COBIT (Control Objectives for Information and Related Technology). This framework contains IT control objectives related to financial reporting, compliance and operational areas and is developed by the Information System Audit and Control Association (ISACA). COBIT is partly based on COSO, but has only four main domains, which are: 1) Planning and organization, 2) Acquisitions and implementations, 3) Delivery and support of IT services and 4) Monitoring and evaluation (ISACA, 2007). The control objectives formulated by COBIT have been adjusted and expanded over time and continue to be changed due to new developments and insights. In this chapter the two latest versions of the framework will be discussed, namely COBIT 4.1 and COBIT 5.0 (2012).

COBIT 4.1 was introduced in 2007 and is currently used in many organizations (Oliver and Lainhart, 2012). This framework contains four domains (as mentioned above) which consist of 34 high-level processes where IT controls need to be applied. The method is process oriented to make sure that all critical processes are managed by IT controls. The target users for this framework are not only auditors, but also managers involved in managing IT resources. Therefore COBIT also focuses on linking the business requirements to the IT resources. So the main principle is that IT resources are controlled by IT processes so that the IT objectives are achieved to respond to the business requirements. These business requirements include 7 requirements for the IT function: effectiveness, efficiency, confidentiality, integrity, availability, compliance and reliability. The IT resources are the applications, information, infrastructure and the people interacting with IT (ISACA, 2007).

When an organization uses the COBIT 4.1 framework to assess the quality of IT controls, it follows the four main domains of COBIT. For each domain COBIT specifies what control objectives need to be achieved. The high level IT control objectives are shown in table 1 from Mead et al. (2007).

The first domain in the table is the Planning and Organization, some examples of the IT controls related to planning and organization are: defining an IT plan, define the information architecture and also defining and managing the different IT functions. For the second COBIT domain Delivery and Support it is important that the organization manages the service desk, problems, data, operations and performance of the IT service organization, but also the education of users need to be in place. The third domain focuses on a proper Acquisition and Implementation of new IT systems in the organization, by implementing controls like change management, identification of new solutions and acquiring and maintaining new software and IT infrastructure. The last and fourth domain is Monitoring. For this objective the firms must monitor and evaluate IT processes and internal controls and make sure they comply with regulations. (Mead et al., 2007).

|  |
| --- |
| ***Table 1: The main high level control objectives of COBIT 4.1 (Mead et al.,2007, p.33)*** |
|  |

Since the introduction of COBIT 4.1 there have been many developments in the area of IT governance and the framework does not provide guidance for these new areas. New developments include the widespread use of enterprise information systems and increased sourcing of IT functions. Also COBIT 4.1 does not provide adequate objectives for innovations and new technology processes within a company, where different business objectives are important, like attracting new customers and development of new products. Other developments are that businesses want more structures and policies to get better IT governance. Management also needs a framework on how to cope with user initiated and managed IT systems (Oliver and Lainhart, 2012). COBIT 5.0 wants to improve on these areas and includes more processes and IT controls to be more comprehensive. The new framework was introduced in 2012 and currently not many organizations have implemented it. However, it is still important to consider COBIT 5.0, because the new framework has some significant adjustments.

One of the major differences between 4.1 and 5.0 is that the new framework focuses on five principles. These principles are: 1) Meeting stakeholder demands, 2) To cover end to end business, 3) Having one single integrated framework, 4) A Holistic approach and 5) Separating governance from management (ISACA, 2012).

There are also new processes included that integrate the IT value delivery (Val IT) and IT risk (Risk IT); frameworks that cover area’s like: security, innovation, relationship and organizational changes. These additions to the processes are introduced to align COBIT with the ISO 38500 governance standard (Taylor and Francis, 2012). Besides the changes in the processes, also the objectives and the measurements have changed. In COBIT 5.0 there is still a focus on the link between business objectives and IT resources. However, it provides guidelines at enterprise and management levels and not on a lower process level like COBIT 4.1 (ISACA, 2012).

Since the introduction of the new COBIT framework in 2012, not much information has become available about the ‘real world improvements’ of COBIT 5.0 over COBIT 4.1. Anyway the adjustments in the framework make it clear that the developments in IT continue and that guidelines become more extensive over time. This has also an effect on the disclosure of IT control weaknesses, because the implementation of a new framework by management or auditors may result in more disclosed weaknesses than before. Therefore in this research study the empirical results are controlled for the introduction of the new frameworks and standards related to IT controls.

## Background on the **explanatory variables industry differences**

Besides providing a background on the regulations and frameworks of internal controls and IT controls, it is also important to introduce the theories behind the explanatory variables industry differences and restructuring. The variable industry differences is discussed in this section (2.4) and the variable restructuring is discussed in the next section (2.5).

The theory behind the association between the type of industry and material internal control weaknesses is based on empirical studies (Bell and Carcello, 2000; Beasley et al., 2000; Giroud and Mueller, 2007) that show (the impact of) differences between industries. The rationale behind this finding is that industries with complex financial processes have a higher chance of a deficiency than for example a straight forward manufacturing company.

Beasley et al. (2000) give some more background on the industry differences, but then applied to the occurrence of financial reporting fraud. Beasley et al. (2000) give three indicators to prove that there are industry differences:   
1) The number of fraud cases related to the financial statements differ across the industries. Some industries, like technology, financial institutions and healthcare, account for 40 percent of all fraud reports (Carcello and Hermanson, 1999). So these industries seem to have a higher concentration of fraud cases.   
2) Also other empirical studies (Bell and Carcello, 2000; Beasley et al., 2000) indicate relatively more reporting fraud in technology, health care and financial services industries.  
3) There is also a trend that audit firms structure is focused on the type of industry indicating there are differences in industry specific (fraud) risks.

The theory behind industry differences has to do with specific fraud opportunities in certain individual industries. In technology, health care and financial services industries there are relatively more opportunities to commit fraud and therefore these companies are more difficult to control. These fraud opportunities arise because in these industries there is often a more complex organizational structure and complex financial reporting. Based on the study of Beasley et al. (2000) it can be expected that in certain industries there will be a higher concentration of IT control weaknesses. This expectation is based on: 1) Some industries (technology, health care and financial services industries) have specific possibilities for weaknesses in financial reporting and 2) There are differences between industries concerning complexity of financial reporting and governance. The empirical results of Beasley et al. (2000) and the method used to measure the industry differences is discussed in chapter 5.

Giroud and Mueller (2007) indicate that differences in governance exist between competitive and non-competitive industries. The reason to expect such differences is based on the opinion of economists like Friedman (1953) and Leibenstein (1966), that a firm in a competitive industry has less management/budgetary slack than firms in non-competitive markets. The consideration is that the pressure of competitive markets makes sure that agency problems disappear, because the individual objectives of management (maximize income) and the shareholder (maximize dividend) are aligned in a competitive environment. The implication of this theory is that a difference between industries may exist in the occurrence of agency problems and managerial slack. These governance problems can also results in internal control weaknesses or more specific IT control weaknesses. The theory behind this is based on the Alchian-Friedman-Stigler Hypothesis (Stigler, 1958), which states that in a competitive industry there is no opportunity for managerial slack. In other words the operating performance is more efficient than for non-competitive industry companies. The empirical study of Giroud and Mueller (2007) indicates support for the Alchian-Friedman-Stigler Hypothesis, by establishing the absence of managerial slack and a constant operating performance in competitive industry firms. Companies in a non-competitive industry have more managerial slack opportunities and have weaker corporate governance. These results indicate that there is a difference between industries in the occurrence of weak corporate governance and management slack. Therefore it may be expected that in non-competitive industries IT control weaknesses will occur more often than in competitive industries, because in competitive industries there is no opportunity for a (persistent) corporate governance weaknesses. The method and the results of the empirical study of Giroud and Mueller (2007) are discussed in chapter 5 where the proxies for industries differences are formulated.

## Background on Restructuring

Not only the association between the type of industry and IT control weaknesses is investigated in this study, but also another possible explanatory variable is taken into account, namely the restructuring of a company. There are several reasons why this relation between restructuring and control weaknesses may be found. Doyle et al. (2007) name the following reasons why firms that undergo restructuring have relatively more internal control weaknesses. The first reason is that restructuring often results in downsized business units, the experience of fired workers is lost in a situation of adjustment to a new structure. Also the internal control system must be restructured to complement the new structure. The second reason for more material control weaknesses is that restructuring involves difficult accrual estimations and adjustments, because there is less staff and more estimations may eventually lead to more internal control problems. So Doyle et al. (2007) has the theory that larger restructurings in time or costs are likely to cause proportionally larger challenges for internal control systems.

Another study that more specifically investigated the effects of restructuring is the research of Chaney et al. (1999). This study is based on the theory that restructuring charges are an indication for analysts that the performance of the firm declines in the short run due to the restructuring. The decrease in performance is caused by an increase in expenses for the current period, which endures in future periods. The empirical results of Chaney et al. (1999) show that the performance after reporting the restructuring charges has decreased and no increase in profitability is observed within 3 to 5 years after the restructuring. This last result is surprising because the main goal of restructuring is usually an improvement in performance.

Both Doyle et al. (2007) and Chaney et al. (1999) indicate that restructuring can have an effect on the performance and the internal control weaknesses. Therefore it is interesting to see if there is empirical evidence for a relation between IT control weaknesses and the restructuring of a firm. Another reason to study this relation is that restructuring often results in a change in the IT structure. This change can also result in adjustment problems which in turn lead to IT control weaknesses.

## Summary chapter 2

This chapter has introduced the institutional background and theories on which this research is based. First the Sarbanes Oxley act section 404 which is the main regulation in the U.S.A. in the field of internal control quality. It forms the basis for other frameworks that help companies to comply with the mandatory regulations of SOX. One of the main frameworks for determining internal control quality is the COSO framework introduced in 1992. With its five main components it provides standards that can be customised for each company. This flexibility is even more improved by the new 2013 COSO framework which is adjusted to the new business environment. Because this research study is about IT control quality, it is also important to know which specific framework is used to determine the IT quality. In the U.S.A. the main framework for IT controls is COBIT which is partly based on COSO, but has different domains. These domains and standards form a benchmark on which auditors can make a judgement whether functions and controls are present or not. Also COBIT has had a recent update with COBIT 5.0 (2012). This new framework integrates more areas, like IT value delivery and IT risk management, and has more focus on management level rather than operational levels.

In the last section of this chapter the theoretical backgrounds of the explanatory variables industry differences and restructuring are presented. The theories behind industry differences in financial reporting fraud are based on the differences in complexity in the organization and financial reporting. Beasley et al. (2000) supported this theory by showing that industries with more fraud opportunities, like technology, health care and financial services industries have more fraud cases than other industries. A different theory on industry differences is provided by Giroud and Mueller (2007). They argue that the level of competitiveness has an effect on the quality of governance. The theory is that non-competitive industries have less pressure to have good governance than high competitive industries. Combining the two theories of Beasley et al. (2000) and Giroud and Mueller (2007) results in the conclusion that more complex and non-competitive industries are likely to suffer more from fraud and have more difficulty with good governance. They are therefore more likely to report internal control weaknesses. Finally the theories of Doyle et al. (2007) and Chaney et al. (1999) show that restructuring could have a short term negative effect on the operations of a company. The reasoning is that restructuring may cause a loss of experienced workers and generate adjustment problems and therefore results in a higher chance of material weaknesses. In the next chapters the empirical results and methods in the field of (IT) control weaknesses are discussed to see whether the theories can be tested and generate significant results.

# Chapter 3 Literature review

The literature review in this chapter provides an overview of the relevant empirical research done in the field of internal controls and IT controls in relation to financial reporting. The first part of this chapter shows the empirical research done in the field of internal control weaknesses. These studies look at the possible explanatory variables that explain the occurrence of control weaknesses. The second part looks more specifically at empirical results in the field of IT control weaknesses in the context of financial reporting.



## **Internal control weaknesses determinants**

In this section two studies (Doyle et al., 2007; Morris, 2011) are discussed. These studies provide empirical research about the effect of firm-specific characteristics on internal control weaknesses. Research to the effect of internal control weaknesses is related to material IT control weaknesses, because IT weaknesses form a specific part of the total internal control system.

Doyle et al. (2007) examine the firm characteristics in relation to internal control weaknesses as a whole. In this research the material internal control weaknesses are defined as significant flaws that may result in material misstatements that are not detected (PCAOB, 2004). The associated investigated variables (mainly related to the firm characteristics) are: 1) firm size, 2) firm age, 3) the financial health of a company (measured by leverage ratio), 4) complexity of financial reporting, 5) fast growth, 6) restructuring charges and 7) corporate governance. Especially the variable of restructuring charges appears to be relevant, because this may prove a possible empirical relation between internal control weaknesses and restructuring costs. The restructuring charge is measured by a continuous variable that aggregates multiple restructuring costs for multiple years. The hypothesis is that the longer the restructuring takes, the more control weaknesses are noted. To do the empirical research Doyle et al. use an archival research with a sample of about 970 firms (from 2002 to 2005). The observed internal control weaknesses are disclosed mandatory under the SOX 302 and 404 rules. The results show that the firm size and age are significantly related to the number of material weaknesses, so younger and smaller companies tend to have relatively more weaknesses than larger and older firms. The multivariate analysis also shows that firms undergoing restructuring are more likely to have more material weaknesses in internal controls. This study also differentiates the type of weaknesses into two groups: Account-specific weaknesses and Company level weaknesses. Account-specific weaknesses are weaknesses that are related to a specific account balance/transaction level process. The company-level weaknesses are about controls for the overall financial reporting operations and governance of the controls; in other words when a company-level weakness occurs, management is unable to properly control the firm. The results of this differentiation in type of weakness show that account-specific material weaknesses are more common for larger, older and financially stronger firms in comparison with company level weaknesses. An important thing to consider is that the sample dates from 2002 to 2005, the first years after the SOX implementation. It is possible that future periods show fewer weaknesses due to more experience with SOX regulations.

Morris (2011) is another study investigating possible explanatory variables influencing the effectiveness of internal control systems. In comparison with Doyle et al. (2007) Morris focuses more on one specific variable, namely the influence of Enterprise Resource Planning (ERP) systems. ERP systems should bring all kinds of improvements in the organization like better and faster communications between management and the operational units and an improved internal control system. The theory behind this relation is based on the consideration that ERP systems have a lot of build-in controls that could make the internal control over financial reporting easier to establish. The software controls embedded in ERP systems are designed to reduce the impact of possible agency problems and therefore lower the risk of a material internal control weakness. The empirical results are derived from a database research on data from Audit Analytics. The sample is separated into a group of ERP firm (108) and a group of non-ERP firms (377), collected between 1997 and 2008. The included control variables are restructuring costs, earnings, big 4 audits, foreign transactions, acquisitions, number of segments and firm age.   
The regressions show that ERP firms have significantly less internal control weaknesses than non-ERP companies. When looking at the control variables, the analysis shows that acquisitions, sales growth and market value have significant effects on the existence of internal control weaknesses. Restructuring cost, foreign transactions, segments and firm age do not have significant values, while study results of Doyle et al. (2007) do show very significant effects for all these control variables. It is possible that the inclusion of other explanatory variables and a different data sample explain these differences between Doyle et al. (2007) and Morris (2011), but from these results there is not a clear indication which variables are consistently important for internal control weaknesses. Like Doyle et al. (2007) Morris (2011) differentiates between the two types of internal control weaknesses: general or entity-level weaknesses (company-level) and individual or account-level weaknesses (account-specific). The additional analysis shows that there is no difference between specific and general control weaknesses for ERP firms, only the non-ERP group shows more general control weaknesses than specific weaknesses. This result is difficult to compare with Doyle et al. (2007), but may indicate that smaller and weaker firms are in the non-ERP group, because this group has more general control weaknesses than specific weaknesses.

## Relation IT controls and financial reporting

Concerning the disclosure of IT control weaknesses there are a couple of studies specifically looking at possible explanatory variables having an impact on IT-related material control weaknesses. In this section the studies of Li et al. (2012), Stoel and Muhanna (2011), Klamm et al. (2012), Grant et al. (2008) and Li et al. (2007) are reviewed to see what relations have been investigated. Most of these studies are from the period 2007-2012, because SOX 404 has been introduced in 2002, which made it possible to conduct empirical research on the relations with IT control weaknesses.

Li et al. (2012) look at the relation between IT control weaknesses and the management information system. The internal controls in management information systems are important for producing reliable management forecasts. The theory is that IT control weaknesses may reduce the reliability of financial reporting, thereby making the data on which management has to base its forecasts less accurate. To conduct the empirical research Li et al. (2012) use information from internal control reports (also SOX 404 reports) that are collected from Audit Analytics. The sample of 14091 firms (from 2004 to 2008) covers 250 IT control weaknesses and 934 non-IT weaknesses.   
The main variables are the analyst’s forecasts, forecast horizons and forecast revisions. The included control variables are: firm size, firm age, cash flows, earnings, segments and foreign transactions.   
The descriptive statistics include a distribution of the weaknesses between different industries, but this is not further analyzed or used in the regression analysis. However, it shows that certain industries have far more material IT control weaknesses. These industries are Measuring, analyzing, and controlling instruments (SIC 38), Chemical industries (SIC 28), Electric industries (SIC 49) and Business services (SIC 73). The multivariate regressions and results show that there is significant support for the relation between IT control weaknesses and a lower reliability of management forecasts. So a firm with an IT control weakness is less likely to produce accurate forecasts, than a firm with non-IT control weaknesses or no weakness at all. The significant control variables were earnings, firm size and sales growth, but the study results only indicate the effect of those variables on forecast errors and not on material IT control weaknesses. The additional analysis of a change in IT control quality shows that firms with an improvement (deterioration) in quality have less (more) forecast errors. This study shows empirical evidence that IT controls have an influence on the operations of the company.

Stoel and Muhanna (2011) also focus on the IT internal control weaknesses and investigate the relation between IT control weaknesses and the company’s performance. The study consists of two analyses; the first analysis is the relation between IT control quality and the current firm performance measured by the return on assets. The second analysis is the relation between the IT control weaknesses and the stock market valuation of the company.   
The theory which should explain the relation between IT controls and firm performance is based on strategy theories. Stoel and Muhanna (2011) argue that the competitive advantage strategy theory proves the relation between IT control quality and performance, because IT can be a source of competitive advantage. If a company does not invest enough in IT, this is a competitive disadvantage and therefore negatively impacts the performance. The second theory of Stoel and Muhanna argues that a material IT control weakness in financial reporting has a greater impact on the quality of operations than non-IT weaknesses in financial reporting. This is because most IT systems are used for financial reporting, but also in production processes. Therefore IT control weaknesses may have an effect on performance.   
The data used for the empirical database research is derived from Audit Analytics and Compustat. The sample consists of 16415 observations and includes a group of firms with IT control weaknesses and a group with no IT control weaknesses (from 2004 to 2008).  
The results show that firms with material IT control weaknesses have a lower return on assets and have lower overall earnings than other companies. The results also show that control variables like firm age, foreign transactions, restructuring and total assets, all have a significant effect on the existence of IT control weaknesses, while other control variables like big 4 audits, number of segments and sales growth, are not significant.[[2]](#footnote-2) The inclusion of control variables and the variable of the existence of non-IT weaknesses besides material IT control weaknesses did show that the main relation between material IT control weaknesses and firm performance remained significant.

Klamm et al. (2012) try to determine what makes a company disclose internal control weaknesses for a longer time. The relevance of this study is that current material weaknesses in controls may be an indication for the future quality of the internal control system. The material internal control weaknesses are separated into IT and non-IT control weaknesses and the other distinction is between entity level and account level weaknesses, just like Doyle et al. (2007). The hypothesis for the distinction between IT and non-IT weaknesses is based on the theory that firms with material IT control weaknesses have more other material weaknesses, lower quality of financial statements and management troubles. Therefore Klamm et al. (2012) expect that IT control weaknesses are an indication for future material weaknesses in internal controls. The research is conducted by doing an archival research using the Audit Analytics database for the period of 2004 to 2009. Of the 20318 observations there are 397 SOX 404 reports that have at least one IT material weakness and there are 1386 non-IT SOX 404 reports.

The multiple empirical analyses shows that firms with material IT control weaknesses have more non-IT deficiencies, entity-level /company-level and account-level weaknesses in the same year. Also the number of future material weaknesses is higher and these weaknesses persist longer for the IT material weakness firms, than for the non-IT weaknesses firms. The multivariate analysis also shows that firms with non-IT entity-level/company-level weaknesses have an even higher number of future material weaknesses than other kinds of weaknesses. The analysis of the persistence of the different types of material weaknesses in internal controls shows that for the non-IT material weaknesses, the senior management and training weaknesses are associated with more persistence of material weaknesses, while for IT-related material weaknesses the results show only significant persistence in IT control environment weaknesses. So senior management, training or IT control environment weaknesses can be an indication of more future material weaknesses for a longer time. These results hold for both account-level and entity-level/company-level material weaknesses.

Grant et al. (2008) study the effect of IT control weaknesses on financial reporting. IT control weaknesses may indicate that software, hardware, IT organization or access controls to accounting data/ programs are not properly working. That is why this study looks at the relation between IT control weaknesses and accounting errors.  
The IT control weaknesses are measured by looking at the disclosed internal control weaknesses under the SOX 404 rule. For accounting errors the authors look at the most common financial reporting errors reported under SOX and coded by Audit Analytics and see if there is a significant relation with IT control weaknesses.  
The sample consists of 278 U.S. based firms reporting under SOX 404. The review period is 2004 to 2006 and the data are collected from Audit Analytics. The accounting errors used by Grant et al. (2008) are coming from audit reports disclosed under SOX and categorized by Audit Analytics.  
In the results of the statistical analysis the authors find that four accounting errors are significantly correlated to IT control weaknesses. These accounting errors are: revenue recognition problems, receivables/investments/cash issues, vendor/cost of sales problems and disclosure issues (footnotes, US GAAP, segments etc.). The limitation of this observational study is that the results only count for companies that report under SOX. This means that for smaller firms, not having to file IT control weaknesses, the results can be different.

Li et al. (2007) investigate the relation between internal and external governance on IT control weaknesses. The governance is defined by the quality of senior management, board of directors and audit committee on IT controls. The implementation of SOX is supposed to have improved the effectiveness of internal controls and also IT controls. Therefore the authors want to examine the relation between the quality of senior management, directors and audit committee on IT control effectiveness. The quality of the governance is measured by looking at different proxies that look at experience in IT or independent directors and the existence of a Chief Information Officer (CIO) position.  
The IT control weaknesses are derived from the disclosure of SOX 404 reports on material weaknesses. The authors categorize all disclosed material weaknesses to IT related or not-IT related. The internal and external governance variables are: 1) IT experience CEO/CFO, 2) existence of CIO position, 3) IT experience senior management and 4) number of independent directors. The sample is taken from Audit Analytics for the SOX 404 disclosure of material weaknesses. The data on financial control variables is taken from Compustat. The sample consists of 626 companies, of which 110 had IT control weaknesses. The sample period is the year 2005.  
On the basis of multivariate regression the authors conclude that companies having managers with IT experience are significantly less likely to have IT control weaknesses than companies having managers without IT experience. Also relatively more independent directors mean significantly less IT control weaknesses. The main conclusion is that internal and external governance have an influence on IT control quality. Like Li et al. (2012) Li et al. (2007) have similar results for the control variables; restructuring does not have a significant effect, while sales growth, leverage and earnings are significant. The important limitation of this research is the sample size and the length of the sample period, there are only 626 firms investigated for only one year. This could be expanded to increase the robustness.

Table 2 summarizes all literature discussed and provides information about the authors, object of study, the sample selection, the research method and the outcome of the empirical regressions.

***Table 2: Summary of relevant empirical research in (IT -) material control weaknesses***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Authors** | **Object of study** | **Sample** | **Research methodology** | **Outcome** |
| Doyle et al. (2007) | Examining the firm characteristics (Firm size, firm age, financial distress etc.) in relation to internal control weaknesses. | Sample consists of 970 firms from 2002 to 2005 and is separated in a company level weakness group and an account specific weakness group. | Archival/ database research from Audit Analytics and Compustat. | The firm size and age are significantly related to the number of material weaknesses. Restructuring organizations are also more likely to have more weaknesses. |
| Morris (2011) | Studies the influence of an Enterprise Resource Planning (ERP) system on the internal control system. | The sample includes a group of ERP firms (108) and a group of non-ERP firms (377) and was collected between 1997 and 2008. | Archival/ database research from Audit Analytics. | ERP firms have significantly less internal control weaknesses than non-ERP companies. The additional analysis shows that there is no difference between specific and general control weaknesses for the ERP firms. |
| Li et al. (2012) | Relation between the IT control weaknesses and the management information system. | The sample encompasses 14091 firms (from 2004 to 2008). 250 IT control weaknesses were observed and 934 non-IT weaknesses. | Archival/ database research from Audit Analytics and Compustat. | Support for the relation between IT control weaknesses and the number of forecast errors. In case of an improvement in IT control quality, also a decrease in forecast errors was noted. |
| Stoel and Muhanna (2011) | Investigate the relation between IT control weaknesses and the company’s performance (ROA and stock market valuation). | The sample consists of 16415 observations (from 2004 to 2008), separated in an IT weaknesses group and a non-IT weaknesses group. | Archival/ database research from Audit Analytics and Compustat. | Firms with material IT control weaknesses have a lower return on assets and have lower overall earnings than other companies. Also restructuring has a significant effect on the occurrence of IT control weaknesses. |
| Klamm et al. (2012) | Determination of the persistence of Internal control weaknesses and more specifically IT control weaknesses. | The sample has 20318 observations of which 397 IT control weaknesses and 1386 non-IT weaknesses. Sample period is 2004 to 2009. | Archival/ database research from Audit Analytics. | Firms with material IT control weaknesses have more non-IT deficiencies, entity-level and account-level weaknesses in the same year. The future material weaknesses occur more often and persist longer for the IT deficiency firms, than for the non-IT weaknesses firms. |
| Grant et al. (2008) | Study the effect of IT control weaknesses on financial reporting, more specifically the relation between IT control weaknesses and accounting errors. | The sample consists of 278 U.S. based firms that report under SOX 404. The studied period is 2004 to 2006. | Archival/ database research from Audit Analytics. | The four errors related to IT control weaknesses are: revenue recognition problems, receivables/investments/cash issues, vendor/cost of sales problems and disclosure issues. |
| Li et al. (2007) | Investigates the relation between internal and external governance on IT control weaknesses. | The sample period is the year 2005. The sample consists of 626 companies, of which 110 have IT control weaknesses. | Archival/ database research from Audit Analytics and Compustat. | Firms having managers with IT experience have less IT control weaknesses, than firms having managers without IT experience . Also independent directors decrease the likelihood of IT control weaknesses. |

## Summary chapter 3

In this chapter the different empirical research studies in the field of internal control and IT control weaknesses have been discussed. First Doyle et al. (2007) and Morris (2011) showed that some firm-specific characteristics have a significant effect on the existence of internal control weaknesses. The main result of Doyle et al. (2007) is that smaller, younger firms or firms that restructure are more likely to disclose internal control weaknesses than others. Morris (2011) focuses on the effect of ERP systems on internal controls and the results show that the implementation of ERP systems seems to reduce the number of internal control weaknesses. However the results of the control variables are not consistent for these studies. Doyle et al. (2007) find significant associations with firm age, firm size and restructuring costs. Morris (2011) however, does not find any significant results for firm age, size and restructuring effects, while including the same controls in his study. A possible explanation for this difference is the usage of other regressions and different data samples.

The second section of this chapter has discussed the research specifically focusing on the disclosure of material IT control weaknesses. Li et al. (2012) has analysed whether the management information system is affected by material IT control weaknesses and the results indicate that the reliability of management forecasts is significantly reduced in case of material IT control weaknesses. Li et al. (2012) also included an industry distribution of material IT control weaknesses showing that measuring/analysing instruments, chemical, electrical and business services industries have more material IT control weaknesses than other industries. The significant control variables are earnings, firm size and sales growth, which is consistent with results from Doyle et al. (2007).   
Stoel and Muhanna (2011) focus not only on disclosed firm information, but also on the market valuation of IT material weakness firms. The results also show significant associations for the main variables return on assets and market valuation. Important to note is that the control variable restructuring is found to have a significant association, just like Doyle et al. (2007), while Li et al. (2012) and Morris (2011) did not find a significant relation. Also the controls firm age, total assets and foreign transactions are significant.   
Klamm et al. (2012) look at the persistence of material IT control weaknesses and compare the results with non-IT material weakness firms and the results show significant differences between these groups. The specific area’s that may indicate persistence in weaknesses are: senior management, training or IT-control environment weaknesses. In addition to Doyle et al. (2007), Klamm et al. (2012) find that company-level IT material weakness firms are more likely to disclose weaknesses in the future, concluding that company-level weaknesses are more severe.

Grant et al. (2008) show that material IT control weaknesses also have a significant effect on financial reporting errors, but the empirical analysis does not include a multivariate analysis; so there are no control variables that could be relevant.   
Finally the study of Li et al. (2007) shows that the governance of a company has a significant effect on material IT control weaknesses. The found associations of the control variables are very similar to Li et al. (2012), so restructuring is not significant, while sales growth, leverage and earnings have significant associations.

The results of the empirical research studies are not very consistent and therefore it is hard to identify good proxies that have consistent significant empirical results. First industry differences are only studied by presenting an industry distribution, but are not tested as a possible explanatory variable. Secondly the variable restructuring is multiple times included in the analysis as control variable. The results of Doyle et al. (2007) and Stoel and Muhanna (2011) show significant effects of restructuring, while Li et al. (2007 and 2012) and Morris (2011) do not have significant associations with restructuring. The following chapters 4 and 5 explain how this research study wants to examine the industry differences and restructuring and which controls are being included.

# Chapter 4 Hypotheses



## **Industry differences**

Industries differ in multiple ways for example in profitability, competitiveness and type of business. The analysis of the existing literature shows that industry differences have an impact on financial reporting. Beasley et al. (2000) show that some industries like technology, financial and health care sectors have significantly more financial reporting fraud cases than other industries. These industries have more fraud opportunities and are therefore harder to control. Giroud and Mueller (2007) indicate that industry differences in competitiveness significantly influence governance and control of an organisation. A competitive industry firm has less management slack and corporate governance problems than non-competitive industry firms. In the field of IT control quality there are very few studies that include industry differences as variable. Li et al. (2012) are an exception since they provide an industry distribution of IT control weaknesses; however, no further analysis.

This research study investigates whether industry differences based on fraud opportunities (Technology, Health Care and Financial Service Industries) and the competitiveness level have an influence on the disclosed IT control weaknesses. A first hypothesis about the industries differences may be based on the results of Beasley et al. (2000). As discussed in chapter 2.4 three particular industries (Technology, Health Care and Financial Service Industries) are more likely to report fraud cases. It may be expected that this also translates in more disclosed IT control weaknesses, because the internal control quality in these industries is more difficult to guarantee due to more fraud opportunities and more complexity. Based on these assumptions and theory hypothesis 1a of this study is:

*Hypothesis 1a)  
Companies in industries with complex financial reporting and control issues (technology, financial and health care institutions) are more likely to have IT control weaknesses, than other industries.*

In the analysis the technology, health care and financial services industries are separated using the 2-digit Standard Industries Codes (SIC). In chapter 5 the method is explained further.

The results of Giroud and Mueller (2007) indicate that the competitiveness level of the industry influences the quality of governance. The study of Li et al. (2007), as discussed in chapter 3, shows that the disclosure of material IT control weaknesses and the quality of governance is significantly associated. Combining the theory of Giroud and Mueller and empirical results of Li et al. (2007) result in the assumption that non-competitive industries have weaker corporate governance and more management slack than competitive industries and that the weaker governance of non-competitive firms will result in more IT control weaknesses than competitive companies have. These theories, empirical results and measurements lead to hypothesis 1b:

*Hypothesis 1b)  
Companies in non-competitive industries (Herfindahl >33%) are more likely to have IT control weaknesses, than competitive industries.*

The competitiveness level is determined based on the Herfindahl index used by Giroud and Mueller (2007) and when the index is above 33%, it is assumed that the industry is non-competitive. This measurement is explained further in chapter 5*.*Both hypotheses 1a and 1b are presented in the Libby box below. The two upper boxes represent the conceptual dependent and independent variable and the boxes below show the operational variables. The box on the right present the control variables used in the multivariate analysis.

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| **Libby box hypothesis 1:** |
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## Restructuring

The second explanatory variable analyzed in this research study is the restructuring of the organization. The effect of restructuring on a firm’s performance and governance is an interesting variable, because in the first years after restructuring most firms report a decrease in profitability instead of an increase (Chaney et al., 1999). Doyle et al. (2007) argue that the decrease in performance is explained by the negative effects of downsizing of the organization; this result in loss of knowledge and a compromised ability to produce reliable forecasts. Unlike the variable industry differences, there are many empirical results for restructuring effects on internal control quality. As discussed in chapter 3 the empirical results of Doyle et al. (2007) and Stoel and Muhanna (2011) indicate significant associations with the existence of (IT-) material weaknesses, but the results of Li et al. (2007 and 2012) and Morris (2011) did not find significant results. Because of these inconsistent results, it is interesting to investigate the effect of restructuring further and with more measures. This study still assumes that restructuring an organization will have a negative impact on the IT control quality and therefore result in more disclosed IT control weaknesses. The first part of hypothesis 2 is devoted to testing the impact of restructuring on the occurrence of material IT control weaknesses in the same year, because in the same year the negative effects are expected to be the strongest. This assumption is formulated in hypothesis 2a):

*Hypothesis 2a)  
Firms restructuring their organization are more likely to disclose IT control weaknesses under SOX section 404 in the same year.*

The second part of hypothesis 2 is based on the measure used by Doyle et al. (2007). This measure not only indicates the existence of a restructuring, but also the size of the restructuring. The theory is that a larger scale restructuring will results in more (IT) material weaknesses, because more knowledge is lost. The measure is based on the scaled restructuring costs of the firm. This results in hypothesis 2b:

*Hypothesis 2b)  
Firms with larger scale restructuring (costs) are more likely to disclose IT control weaknesses under SOX section 404.*

As indicated by Chaney et al. (1999), the negative effect of restructurings may exist multiple years. Most problems related to restructuring, like the loss of knowledge and adjustments need a longer period to be resolved. This is also reflected in the measure of Stoel and Muhanna (2011) where the existence of a restructuring in the sample period is chosen as measure instead of the existence of a restructuring in the same year of IT material weakness. Based on the results of Chaney et al. (1999) and the measure of Stoel and Muhanna (2011) the third part of hypothesis 2 is:

*Hypothesis 2c)  
Firms with a restructuring in the period (2004-2011) are more likely to disclose IT control weaknesses under SOX section 404.*

The three hypotheses 2a, 2b and 2c are integrated in a Libby box. The difference between the hypotheses is clearly presented in the operational independent variable box, where three different methods to measure restructuring are shown.

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| --- |
| **Libby box hypothesis 2:** |
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# Chapter 5 Research design



## **Research measurements**

**Measurement of IT control quality**

In order to have a replicable and comparable empirical research study, it is important to look at the proxies used by prior studies. So first the measurement of the IT control quality is analyzed. In order to measure the IT control quality most research studies look at the internal control reports filed under SOX section 404. In this section the material weaknesses of the internal control on financial reporting are disclosed, thereby giving an indication of the quality of the controls. As part of the internal controls the material IT control weaknesses are also disclosed and allow studies to identify material IT control weaknesses firms. In the following sections the different methods of measurement and collection of prior research studies are discussed.

Li et al. (2012) use a binary variable to measure the effect of material IT control weaknesses, the variable has the value 1 when a company has an IT material weakness and 0 for otherwise. To determine the specific IT related weaknesses the disclosed material weaknesses in the audit analysis database are divided into two groups: the IT related material weaknesses and the non-IT related material weaknesses. In order to measure the correlation between IT related material weaknesses and non-IT related material weaknesses the variable other material weaknesses is included in the multivariate analysis. Important to note is that the IT material weakness variable is an explanatory variable and not a dependent variable, so the found associations of the control variables are not related to the existence of material IT control weaknesses.

Li et al. (2007) also use a binary variable with the value 1 for IT related material weaknesses and value 0 otherwise. The coding of audit analytics is used to determine if the weakness is IT related. In the empirical tests the IT material weakness variable is the dependent variable; in other words it is analyzed whether the other explanatory variables have an effect on the occurrence of IT related material weaknesses. As suggested in chapter 4, this study also uses the IT related material weakness variable as the dependent variable.

Grant et al. (2008) use another method in examining the effect of material IT control weaknesses on the financial reporting quality. The sample was simply divided in two groups of firms; 1) IT material weakness firms, 2) other firms with non-IT material control weaknesses. In order to segregate the group the authors also use the categorization of Audit Analytics. The research models of Grant et al. 2008 are not specified, because the only analysis conducted in this research study is to look what accounting errors occur more often in IT related material weakness firms in comparison to other firms.

Boritz et al. (2010) investigate the disclosure of material IT control weaknesses in auditor reports of SOX section 404. Instead of relying on the coding of Audit Analytics, the authors use their own text analysis on the auditor’s reports to identify material IT control weaknesses. The automated text analysis differs in multiple areas from the Audit Analytics method. First Boritz et al. (2010) only look at the auditor’s report of SOX 404, while Audit Analytics also looks at the management reports. In addition the analysis uses different keywords to find material IT weaknesses. A comparison of the different methods reveals that the automated method of Boritz et al. (2010) is not more accurate than the Audit Analytics coding, because the automated search has wrongly identified three firms as having material IT weaknesses and has only found one company having an IT material weakness that was not identified by Audit Analytics.

In this research study the material IT control weaknesses are measured as a binary variable with the value 1 when there is at least one IT related material weakness and the value 0 otherwise. This proxy is comparable to the methods used in prior research studies and improves the comparability. The method to identify the material IT control weaknesses will be based on the coding of Audit Analytics. As the study of Boritz et al. (2010) shows, the automated text analysis of the SOX 404 reports may probably identify more IT material weakness firms, but is not more accurate than the Audit Analytics method. By relying on the data and the coding of Audit Analytics, the results of this study can be compared with the other studies in the field of IT material weakness disclosures (Li et al., 2012; Li et al., 2007; Grant et al., 2008).

**Measurement of industry differences**

The explanatory variable Industry Differences is more difficult to measure, because the tested differences have to be based on proven theories. As discussed in chapter 2 and 3, the literature in the field of IT control weaknesses does discus the distribution of material IT control weaknesses across the different industries, but does not test if some industries are more likely to have IT control weaknesses than other industries. To provide the theoretical basis for the industry differences the studies of Beasley et al. (2000) and Giroud and Mueller (2007) are used to see if those theories also hold for IT material weakness firms.

*Industry differences caused by the difference in fraud opportunities*  
Beasley et al. (2000) have developed and analyzed the relation between the occurrence of fraud and the type of industry and found that some industries are more likely to have fraud than others. The industry differences are measured by first dividing the sample across the different industries using the Standard Industry Codes (SIC). Then the different industries are tested in a test of differences based on a t-test. The empirical results of Beasley et al. (2000) show that three key industries are more likely to report fraud than others industries. These industries are: 1) Technology, 2) Health Care and 3) Financial Service. In the sample of total 200 firms that report fraud there are 25 (12.5%) technology firms, 19 (9.5%) health care related companies and 22 (11%) financial services companies. These industries account for 33% of all fraud cases.

In order to see whether these industries are also more likely to have material IT control weaknesses, the three key industries are included in one dummy variable to segregate them from the total population of firms. This dummy variable INDFRAUD only includes companies in the technology, health care or financial services industries. The variable has the value 1 when the company is working in one of these three industries and has the value 0 when the firm is working in another industry. This explanatory variable investigates if the industries that have more fraud opportunities and more complex financial reporting have significant more material IT control weaknesses than other industries.

*Differences in competitiveness*  
Not only the differences in fraud opportunities can explain industry differences, but also the differences in competitiveness can explain why more material IT control weaknesses occur in certain industries. Giroud and Mueller (2007) found that non-competitiveness industries have significant more agency problems and management slack. The competitiveness level is determined by the Herfindahl index which is the squared sum of the market shares.

In this equation the sijt stands for the market share of a company *I* in the industry *j* in the year *t*. To calculate the market share the sales of the companies are compared with the sales total of the whole industry. In this research study the Herfindahl index is determined per 2-digit SIC code to avoid having too many specific industry groups. This 2 digit SIC code separates the firms based on the type of instruments and type of products and is specific enough to make a distinction between competitive and non-competitive industries. In appendix 3 the Herfindahl index for each 2-digit SIC industry is presented. To measure the effect of competitiveness level a dummy variable is used, this means that the sample is split in two groups. One group has a Herfindahl index > 33%; these firms operate in a more concentrated/non-competitive industry. The other group has an index <= 33%, which means the firms have a more even distributed market share and there is more competition. The value of 33% is chosen because Giroud and Mueller (2007) indicate that a concentration of industries above 33% already leads to a drop in market pressure on the quality of governance. In the multivariate analysis the dummy variable INDCOMP has the value 1 when the firm is active in a non-competitive industry (Herfindahl >33%) and the value 0 for companies in a competitive industry (Herfindahl <=33%). In this study the Herfindahl index and therefore the variable INDCOMP is only determined for the year 2011, because it is not feasible to determine the Herfindahl index for each year. This could be a limitation of this study, since the competitiveness may have changed over time. However, it is reasonable to assume that this dummy variable has not changed a lot during the sample period, since it is not very likely that industries suddenly change from non-competitive to competitive or vice versa.

**Measurement restructuring**

*Restructuring effects in the current year*  
The second hypothesis is about the effect of organizational restructuring on the disclosure of material IT control weaknesses. The effect of restructurings can be measured in multiple ways and for multiple time periods. To get more reliable and robust results, multiple proxies are used in the empirical analysis. The first proxy for restructuring is the variable that looks at the relation between the existence of restructuring costs and the occurrence of a disclosed IT material weakness in the same year. This is a dummy variable RESTRUCTD with a value 1 when the restructuring cost has a non-zero value and the value 0 otherwise. The second proxy is a continuous variable based on the method of Doyle et al. (2007). Doyle et al. (2007) use a continuous variable, because a relative larger restructuring may have a larger effect on the number of material IT control weaknesses. The size of the restructuring is also based on the restructuring cost, but because the absolute restructuring cost can vary the logarithm of the restructuring is determined in order to have a proper scale. The variables RESTRUCTC and RESTRUCTD are collected from Compustat for each firm-year observation based on the restructuring costs before taxes.

*Restructuring effects occurrence (period 2004-2011)*   
The first two proxies mainly look at the initial effect of restructuring on the IT control quality, but one can expect that after a couple of years the organization is adjusted and functions better. In order to see whether material IT control weaknesses are temporary in case of a restructuring the third proxy looks at the occurrence of material IT control weaknesses over the total period of the dataset (2004-2011). This variable RESTRUCTP has the value 1 when in one or more of the years between 2004-2011 the firm reported restructuring costs and has the value 0 in all other cases. This dummy variable not only looks if the restructuring is correlated with material IT control weaknesses in the same year, but also investigates the possibility that material IT control weaknesses occur around the time of the restructuring.

**Measurement control variables**

In order to test the explanatory variables ability to explain the occurrence of material IT control weaknesses it is necessary to include control variables. The selection of control variables is based on the variables used by Doyle et al. (2007), Li et al. (2012) and Stoel and Muhanna (2011).

The first control variable is the existence of non-IT related material weaknesses. This variable is included because the empirical results of Li et al. (2012) and Boritz et al. (2010) indicate that the majority of the firms that report material IT control weaknesses are different from NON-ITMW material weaknesses firms. The variable NON-ITMW is a dummy variable that has the value 1 when the firm reported a non-IT related material weakness and has value 0 otherwise. NON-ITMW is included as dependent variable to compare the results of ITMW and NON-ITMW firms.

The second control variable is firm size. The size of a company can be an explanation for the differences across the population. Doyle et al. (2007) argue that larger companies have more resources and personnel to ensure there is proper internal control like segregation of duties and more internal audits. Based on this theory, it is expected that larger firms will have less material IT control weaknesses than smaller firms. The size of the company is determined by looking at the log of total assets at the end of the year. Not the absolute size, but the logarithm of the total assets is included to be consistent with Doyle et al. (2007) and Li et al. (2012). This is done to control for too extreme differences in the population. So the variable SIZE is a continuous variable based on the log of the total assets at the end of the year.

Not only the size of a company could explain the differences in disclosing material IT control weaknesses, but also the firm’s age can have an effect on the disclosures. The theory behind this is that older firms have the experience and the time to resolve issues in their internal control and therefore disclose fewer material IT control weaknesses than newer companies. This variable AGE is measured by taking the log of the firm’s age based on the founding date of the company.

The fourth control variable is the financial health of the firm. If the financial health of a company is good, there are more resources for good internal controls possibly resulting in fewer material IT control weaknesses than for firms with financial problems. The variable LEV is measured by determining the leverage (total liabilities/total assets), also known as the debt-to-equity ratio, where a lower value means that the company has a relative strong financial position. So when LEV has a low value, the better the financial health and the fewer material IT control weaknesses are expected.

Just as the financial health a good profitability could also result in fewer material weaknesses than firms with lower profitability. The measure of profitability in this research study is the return on assets (ROA) which is the net income divided by the total assets. When the return on assets is relatively high this indicates a higher profitability; this implies that the company has enough resources to implement proper IT controls resulting in a lower count of material IT control weaknesses.

The complexity of the corporate structure is also a common control variable in the analysis of material IT control weaknesses (Li et al., 2012; Doyle et al., 2007). The complexity of the structure can make it harder to properly implement an internal control system, for example decentralized business segments can have different procedures and cultures that can compromise the internal controls resulting in more material IT control weaknesses. The complexity of the structure is measured by two control variables, namely the number of business segments (SEGNUM) and the existence of foreign currency transactions (FORTRANS); the latter is a dummy variable with the value 1 when there is a non-zero foreign transaction and 0 otherwise. SEGNUM is the number of segments in the year 2011, because due to matching problems it is not feasible to determine the number of segments for each year. Therefore it is assumed that the number of segments during the sample period remained the same. The variable FORTRANS is collected for each firm-year observation, just like all other control variables.

Another possible control variable is the audit quality, which is also used by Li et al. (2012). The suggestion is that audits done by larger and more experienced audit firms have a higher audit quality, resulting in fewer material weaknesses. The measure (BIG4) used as a proxy for audit quality is if the company is audited by one of the ‘big four’ audit firms (value 1) or not (value 0). The audit quality (BIG 4) is measured for each fiscal year.

**Research Model**

All these variables are included in one regression model that is used in the multivariate analysis. This model is as follows:  
ITMW = α0 + α1 INDFRAUD + α2 INDCOMP + α3 RESTRUCTD + α4 RESTRUCTC + α5 SIZE + α6 AGE + α7 LEV+ α8 ROA + α9 SEGNUM + α10 FORTRANS + α11 BIG4 + ԑ

All these variables are also presented in table 3, that includes the variable definitions with their predicted sign. In appendix 1 you find also the variable definitions with included the precise database measure used in the sample selection.

***Table 3: Variable definitions***

|  |  |  |
| --- | --- | --- |
| **Variable name** | **Predicted sign** | **Definition variable** |
| ITMW | Dependent variable | Dummy variable; value 1 for firms with IT related material weakness, value 0 otherwise |
| NON-ITMW | Dependent variable | Dummy variable; value 1 for firms with non-IT related material weakness, value 0 otherwise |
| INDFRAUD | + | Dummy variable; value 1 for firm in technology, health care or financial services industry , value 0 otherwise |
| INDCOMP | + | Dummy variable; value 1 for firm in industry with a >33% Herfindahl index (non-competitive), value 0 otherwise |
| RESTRUCTD | + | Dummy variable; value 1 for firm with non-zero value for restructuring costs , value 0 otherwise |
| RESTRUCTP | + | Dummy variable; value 1 for firm with non-zero value for restructuring costs in the period 2004-2011, value 0 otherwise |
| RESTRUCTC | + | Ratio variable; the log of the restructuring costs |
| SIZE | - | Continuous variable; the log of the total assets |
| AGE | - | Continuous variable; the log of the firm’s age based on current year- founding year |
| LEV | - | Ratio variable; Leverage (total liabilities/total assets) |
| ROA | - | Ratio variable: Return on Assets (Net income/ total assets) |
| SEGNUM | + | Continuous variable; the number of operational and geographical segments |
| FORTRANS | + | Dummy variable: value 1 for firms with non-zero value foreign currency transaction, value 0 otherwise |
| BIG4 | - | Dummy variable: value 1 for firms audited by BIG 4 audit firms, value 0 otherwise |

## **Sample Selection**

This empirical study is based on an observational / archival research using data from Audit Analytics and Compustat. The investigated period starts in 2004, because since this year most firms had to disclose SOX section 404 reports. Therefore the review period concerns the reporting years 2004-2011 regarding U.S. based firms having the obligation to report under SOX section 404. The collection of all firm year observations in Audit Analytics resulted in 65536 observations. This is the number of all raw observations with duplicates and blank observations, so after removing these useless observations the total number from Audit Analytics is 47000. Of this number there are 944 firm year observations of material IT control weaknesses and 4641 non-IT material weaknesses.   
The Compustat database is used to collect the necessary financial information. The firm year observations are matched with the financial information of Compustat using the Central Index Key (CIK) code, which is unique for each firm in the U.S.A. The observations without matching financial data from Compustat were removed. In total 8769 firm year observations are removed from the total dataset, which resulted in the final sample selection of 38231 firm year observations from Audit Analytics and Compustat for 2004-2011. Of this total dataset 669 observations have an IT material weakness and 2749 have a non-IT material weakness. All the numbers of the sample selections are presented in table 4.

***Table 4: Sample selection***

|  |  |
| --- | --- |
| **Stages in sample selection** | **Number of firm year observations** |
| Firm year observations SOX section 404 reports from Audit Analytics 2004-2011: | 65536 |
| After deleting duplicates and blank observations: | 47000 |
| With Firm year observations with material IT control weaknesses: | 944 |
| And Firm year observation with non-IT material weaknesses: | 4641 |
| *After matching the firm year observations with data from Compustat, 8769 observations were removed, because no financial information was available. This also includes some observations having no values for total assets or liabilities; those observation were also excluded from the dataset which resulted in the following total of observations:* | |
| Final dataset firm year observations Audit Analytics and Compustat for 2004-2011: | 38231 |
| With Firm year observations with material IT control weaknesses: | 669 |
| And Firm year observation with non-IT material weaknesses: | 2749 |

# 

# Chapter 6 Results

Chapter 6 presents the empirical results in multiple sections, not only to provide information about the associations between the variables, but also about the more general characteristics of the dataset. Firstly the descriptive statistics provide an insight in the values of the total sample with the mean, standard deviation and number of observations. Next there is an industry distribution of the material IT control weaknesses in order to compare the results with prior literature. A Pearson correlation matrix is used to analyze the inter-correlations between the variables. The final element of the descriptive statistics is a study of the trend of material IT control weaknesses over the sample period.

The second part of chapter 6 contains the univariate and multinomial logitistic regressions tables, followed by an analysis of the results. Finally to control for multicollinearity some robustness tests are conducted with adjusted regression tables.

## 6.1 Descriptive statistics

Table 5 presents the descriptive statistics for the different groups of firms over the period 2004-2011. For reasons of comparison the sample is separated into three groups: the IT material weakness firms, non-IT material weakness firms and firms with no material weakness at all. The mean and the standard deviation of the variables provide information on how the variable is distributed and whether there are abnormal values. Also the mean can be used to compare the different groups to look for possible patterns that can be explained by theories. The third statistic is the t-statistic, which is the result of a t-test for differences between the means of two independent sample groups; the specific material weakness firms are compared with the no-material weakness firms. When the means of the specific groups are significantly different the t-statistic has “\*\*” to indicate a p-value of <0.05 for the test of differences.

***Table 5: Descriptive statistics: IT material weakness vs material weakness vs no weakness firms***

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variables | ITMW firms (1) N=669 | | | NON-ITMW firms (2) N=2749 | | | No MW firms (3) N=34812 | |
|  | Mean | Std Dev. | t-stat (1)<>(3) | Mean | Std Dev. | t-stat (2)<>(3) | Mean | Std Dev. |
| INDFRAUD | 0.342 | 0.475 | 3.867\*\* | 0.289 | 0.453 | 2.065\*\* | 0.269 | 0.444 |
| INDCOMP | 0.964 | 0.186 | -0.642 | 0.972 | 0.166 | 1.044 | 0.968 | 0.175 |
| RESTRUCTD | 0.200 | 0.399 | -1.535 | 0.175 | 0.380 | -6.729\*\* | 0.227 | 0.419 |
| RESTRUCTP | 0.440 | 0.497 | -1.594 | 0.380 | 0.485 | -9.989\*\* | 0.480 | 0.499 |
| RESTRUCTC | 1.375 | 2.773 | -1.523 | 1.174 | 2.574 | -7.586\*\* | 1.569 | 2.924 |
| SIZE | 8.352 | 1.302 | -10.428\*\* | 8.061 | 1.418 | -31.556\*\* | 8.945 | 1.064 |
| AGE log | 0.694 | 0.589 | -9.365\*\* | 0.629 | 0.577 | -26.105\*\* | 0.939 | 0.519 |
| LEV | 2.498 | 22.647 | 0.545 | 9.539 | 112.544 | 3.933\*\* | 1.045 | 25.638 |
| ROA | -1.361 | 12.580 | -2.000\*\* | -3.817 | 47.065 | -4.104\*\* | -0.107 | 4.482 |
| FORTRANS | 0.357 | 0.480 | 0.188 | 0.303 | 0.459 | -6.039\*\* | 0.358 | 0.479 |
| SEGNUM | 3.124 | 3.531 | -0.408 | 3.009 | 3.811 | -2.601\*\* | 3.195 | 3.557 |
| BIG4 | 0.490 | 0.500 | -11.418\*\* | 0.47 | 0.499 | -26.984 | 0.740 | 0.440\*\* |

***p < 0.05 = \*\****

***p < 0.10 = \****

Looking at the results in table 5 it appears that all means have relatively normal values and there are no abnormally high standard deviations. Only the variables leverage (LEV) and return on assets (ROA) have higher standard deviations, because these variables reflect nominal values and do not have a logistic scale, like firm size and age.   
The results of the industry differences variables show a mixed result. Firstly the industry differences based on fraud opportunities (INDFRAUD) show a significantly different mean for the IT material weakness firms (t=3.867, p<0.05) in comparison with the no material weakness group. This is also the case for the non-IT material weakness group (t=2.065, p<0.05). However, the industry differences based on competitiveness (INDCOMP) are not significantly different for both the IT and non-IT material weakness firms (-0.642, p>0.10; 1.044, p>0.10). A comparison of the means of INDCOMP shows a difference between IT and non-IT material weakness firms, but it is very small.  
  
The restructuring variables results are consistent for all three variables (RESTRUCTD, RESTRUCTP and RESTRUCTC). The t-statistic for IT material weakness firms shows no significant difference with the no material weakness group for all restructuring variables (-1.535, p>0.10; -1.594, p>0.10; -1.523, p>0.10). The non-IT material weakness group shows different results, because all means of the restructuring variables are significantly different from the no material weakness firm (-6.729, p<0.05; -9.989, p<0.05; -7.586, p<0.05). It seems that restructuring has a greater effect on the overall internal control quality than on IT control quality.   
  
The results of the control variables show that for the IT material weakness group the firm size (SIZE), firm age (AGE), the return on assets (ROA) and big 4 audits (BIG4) have significantly different means in comparison with the no-material weakness firms (-10.428, p<0.05; -9.365, p<0.05; -2.000, p<0.05; -11.418, p<0.05). The different means reveal that IT material weakness firms are significantly smaller and younger, have worse results and are less often audited by the big 4. This is different for the non-IT material weakness firms, where all control variables (SIZE, AGE, LEV, ROA, FORTRANS and SEGNUM) except big 4 audits have significantly different means. These differences indicate that IT material weakness firms have other problems and firm characteristics than non-IT material weakness firms.

Table 6 presents the distribution between the different industries. Just like Li et al. (2012) the categorization of the industries is based on the two-digit SIC codes. The third and sixth column contains the number of material IT control weaknesses per industry for the period 2004-2011. Also the number of non-IT material weaknesses per industry is presented in order to compare the different categories of material weaknesses.

***Table 6: Industry distribution***

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| SIC 2-digit |  | ITMW | Non-ITMW | SIC 2-digit |  | ITMW | Non-ITMW |
| 10 | Metal Mining | 8 | 99 | 48 | Communications | 44 | 112 |
| 12 | Coal Mining | 6 | 15 | 49 | Electric, Gas, And Sanitary Services | 21 | 71 |
| 13 | Oil And Gas Extraction | 30 | 96 | 50 | Wholesale Trade-durable Goods | 7 | 36 |
| 14 | Mining Nonmetallic Minerals | 1 | 10 | 51 | Wholesale Trade-non-durable Goods | 4 | 35 |
| 15 | Building Construction General | 4 | 10 | 52 | Building Materials, Hardware | 0 | 1 |
| 16 | Heavy Construction Other | 3 | 6 | 53 | General Merchandise Stores | 4 | 12 |
| 17 | Construction Special Trade | 2 | 6 | 54 | Food Stores | 4 | 12 |
| 20 | Food And Kindred Products | 18 | 71 | 55 | Automotive Dealers And Gasoline | 3 | 10 |
| 21 | Tobacco Products | 0 | 2 | 56 | Apparel And Accessory Stores | 4 | 20 |
| 22 | Textile Mill Products | 2 | 3 | 57 | Home Furniture, And Equipment Stores | 0 | 13 |
| 23 | Apparel And Fabrics And Similar Materials | 2 | 13 | 58 | Eating And Drinking Places | 0 | 22 |
| 24 | Lumber And Wood Products | 2 | 19 | 59 | Miscellaneous Retail | 21 | 59 |
| 25 | Furniture And Fixtures | 2 | 11 | 60 | Depository Institutions | 13 | 169 |
| 26 | Paper And Allied Products | 2 | 3 | 61 | Non-depository Credit Institutions | 13 | 47 |
| 27 | Printing, Publishing, And Allied Industries | 2 | 8 | 62 | Security And Commodity Brokers | 3 | 23 |
| 28 | Chemicals And Allied Products | 64 | 285 | 63 | Insurance Carriers | 13 | 55 |
| 29 | Petroleum Refining And Related Industries | 1 | 8 | 64 | Insurance Agents, Brokers, And Service | 7 | 0 |
| 30 | Rubber/ Plastics Products | 1 | 25 | 65 | Real Estate | 5 | 32 |
| 31 | Leather And Leather Products | 0 | 1 | 67 | Holding And Other Investment Offices | 12 | 76 |
| 32 | Stone, Clay, Glass, And Concrete Products | 2 | 4 | 70 | Hotels, and Other Lodging Places | 1 | 9 |
| 33 | Primary Metal Industries | 24 | 51 | 72 | Personal Services | 6 | 14 |
| 34 | Fabricated Metal Products | 8 | 44 | 73 | Business Services | 88 | 314 |
| 35 | Industrial,Commercial And Computer Equipment | 39 | 119 | 75 | Automotive Repair, Services, And Parking | 0 | 1 |
| 36 | Electronics, Except Computer Equipment | 83 | 246 | 76 | Miscellaneous Repair Services | 0 | 0 |
| 37 | Transportation Equipment | 17 | 68 | 78 | Motion Pictures | 9 | 25 |
| 38 | Measuring, Analyzing, And Controlling Instruments; | 26 | 178 | 79 | Amusement And Recreation Services | 1 | 19 |
| 39 | Miscellaneous Manufacturing Industries | 3 | 21 | 80 | Health Services | 9 | 36 |
| 40 | Railroad Transportation | 0 | 4 | 81 | Legal Services | 0 | 0 |
| 41 | Public (land) Transportation | 0 | 0 | 82 | Educational Services | 2 | 20 |
| 42 | Motor Freight Transportation And Warehousing | 2 | 11 | 83 | Social Services | 2 | 0 |
| 44 | Water Transportation | 1 | 10 | 87 | Engineering, Accounting, Related Services | 6 | 33 |
| 45 | Transportation By Air | 5 | 14 | 89 | Miscellaneous Services | 1 | 2 |
| 46 | Pipelines, Except Natural Gas | 0 | 2 | 90 | Government | 2 | 0 |
| 47 | Transportation Services | 4 | 6 | 99 | Nonclassifiable Establishments | 0 | 2 |

This distribution shows clear differences between the various industries. There are industries that have many weaknesses and other industries with almost no weaknesses. The industries with more than 25 material IT control weaknesses are: Oil/gas extraction (SIC 13), Chemical products (SIC 28), Industrial/Computer equipment (SIC 35), Electronics (SIC 36), Measuring instruments (SIC 38), Communications (SIC 48) and Business services (SIC 73). Because this study uses the same categorization as Li et al. (2012), the results can be compared. However, it is important to note that the sample period (2004-2006) of Li et al. (2012) was shorter. The industries with the most material IT control weaknesses identified by Li et al. (2012) are: Measuring instruments (SIC 38), Chemical industries (SIC 28), Electric industries (SIC 49) and Business services (SIC 73). So the three industries that clearly have the most material IT control weaknesses in this research study and in the results of Li et al. (2012) are: Measuring instrument industries (SIC 38), Chemical industries (SIC 28) and Business services industries (SIC 73).

Table 7 presents a correlation matrix, which is important for identifying possible highly inter-correlated variables. In this matrix the first value is the Pearson correlation, showing how much the variables are correlated and the second value is the p-value, which shows the significance of the correlation. The correlations above/below the |0.350| are highlighted.

***Table 7: Pearson correlation matrix***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Pearson Correlation Matrix | | IND FRAUD | IND COMP | RESTRUCTD | RESTRUCTC | RESTRUCTP | SIZE | AGE | LEV | ROA | SEG NUM | FOR TRANS | BIG 4 |
| ITMW | Pearson Corr. | .021\*\* | .003 | -.008 | -.007 | -.008 | -.062\*\* | -.054\*\* | .003 | -.010 | -.002 | .001 | -.065\*\* |
|  | Sig. (2-tailed) | .000 | .521 | .140 | .145 | .113 | .000 | .000 | .586 | .061 | .683 | .851 | .000 |
| INDFRAUD | Pearson Corr. |  | -.110\*\* | .058\*\* | .054\*\* | .063\*\* | -.046\*\* | .008 | .019\*\* | -.011\* | .085\*\* | -.062\*\* | .033\*\* |
|  | Sig. (2-tailed) |  | .000 | .000 | .000 | .000 | .000 | .106 | .000 | .027 | .000 | .000 | .000 |
| INDCOMP | Pearson Corr. |  |  | .019\*\* | .021\*\* | .021\*\* | .004 | .041\*\* | -.003 | .003 | -.004 | -.059\*\* | .035\*\* |
|  | Sig. (2-tailed) |  |  | .000 | .000 | .000 | .406 | .000 | .558 | .504 | .403 | .000 | .000 |
| RESTRUCTD | Pearson Corr. |  |  |  | .988\*\* | .570\*\* | .175\*\* | .173\*\* | -.010\* | .007 | .246\*\* | .096\*\* | .200\*\* |
|  | Sig. (2-tailed) |  |  |  | 0.000 | 0.000 | .000 | .000 | .047 | .143 | 0.000 | .000 | 0.000 |
| RESTRUCTC | Pearson Corr. |  |  |  |  | .565\*\* | .213\*\* | .186\*\* | -.011\* | .009 | .264\*\* | .104\*\* | .214\*\* |
|  | Sig. (2-tailed) |  |  |  |  | 0.000 | 0.000 | .000 | .034 | .090 | 0.000 | .000 | 0.000 |
| RESTRUCTP | Pearson Corr. |  |  |  |  |  | .215\*\* | .228\*\* | -.020\*\* | .019\*\* | .283\*\* | .052\*\* | .283\*\* |
|  | Sig. (2-tailed) |  |  |  |  |  | 0.000 | 0.000 | .000 | .000 | 0.000 | .000 | 0.000 |
| SIZE | Pearson Corr. |  |  |  |  |  |  | .361\*\* | -.122\*\* | .120\*\* | .217\*\* | .159\*\* | .533\*\* |
|  | Sig. (2-tailed) |  |  |  |  |  |  | 0.000 | .000 | .000 | 0.000 | .000 | 0.000 |
| AGE | Pearson Corr. |  |  |  |  |  |  |  | -.050\*\* | .055\*\* | .216\*\* | .079\*\* | .260\*\* |
|  | Sig. (2-tailed) |  |  |  |  |  |  |  | .000 | .000 | 0.000 | .000 | 0.000 |
| LEV | Pearson Corr. |  |  |  |  |  |  |  |  | -.546\*\* | -.017\*\* | -.013\* | -.045\*\* |
|  | Sig. (2-tailed) |  |  |  |  |  |  |  |  | 0.000 | .001 | .011 | .000 |
| ROA | Pearson Corr. |  |  |  |  |  |  |  |  |  | .018\*\* | .017\*\* | .049\*\* |
|  | Sig. (2-tailed) |  |  |  |  |  |  |  |  |  | .000 | .001 | .000 |
| SEGNUM | Pearson Corr. |  |  |  |  |  |  |  |  |  |  | .218\*\* | .203\*\* |
|  | Sig. (2-tailed) |  |  |  |  |  |  |  |  |  |  | 0.000 | 0.000 |
| FORTRANS | Pearson Corr. |  |  |  |  |  |  |  |  |  |  |  | -.010 |
|  | Sig. (2-tailed) |  |  |  |  |  |  |  |  |  |  |  | .056 |
| \*\*. Correlation is significant at the 0.01 level (2-tailed). | | | | |  |  |  |  |  |  |  |  |  |
| \*. Correlation is significant at the 0.05 level (2-tailed). | | | | |  |  |  |  |  |  |  |  |  |

The correlations in table 7 of the variable ITMW show roughly the same results as the descriptive statistics, which means that the INDFRAUD is the only explanatory variable with a significant correlation (Pearson Corr.= 0.021, p<0.05). Most control and explanatory variables show significant, but small inter-correlations. However, there are also more exceptional correlations highlighted in table 7. The first high correlation (0.361) is firm size (SIZE) with firm age (AGE), implying that older firms are also more likely to be bigger in size. This is not a surprising correlation and can be ignored. The next high correlation is between firm size and big 4 audits (0.533), but this is also a very logical relation. The two financial performance variables, leverage (LEV) and return on assets (ROA), are also highly correlated (-0.546), which means that a firm with a high leverage is more likely to have a lower return on assets. This is consistent with the theory that a lower leverage implies a better financial health of the company and thus more profitability. Slightly more worrying inter-correlations exist between the restructuring variables. In itself this is logical because these variables measure the same phenomenon in a different way. The highest correlation of 0.988 is between RESTRUCTC and RESTRUCTD, which means that the existence of restructuring (RESTRUCTD) is correlated with the amount of the restructuring costs (RESTRUCTC). This may cause a potential bias and therefore in section 6.3 of this chapter the multi-collinearity is tested and an adjusted multinomial logistic regression is presented.

**IT material weakness development over the years**

The information technology within companies has been in constant development in the past years. New information systems, Enterprise Resource Planning Systems and the integration of IT in the entire organization have made it necessary to look at IT controls to determine the quality of internal control systems. This research study wants to investigate whether the trend of an increasing dependence on IT, is also reflected in the number of disclosed IT control weaknesses. There are two different expectations to consider the trend in IT control weaknesses disclosures. The first is that the trend shows an increase in IT control weaknesses, because firms are more dependent on information systems (like ERP systems) and also because the framework and regulations become more extensive and more strict. The second is suspecting a negative trend in the number of IT control weaknesses, assuming that the quality of internal control systems has improved due to better information technology, making automated controls and authorizations easier to control.

Table 8 presents the absolute number of the different types of material weaknesses for each year. The first column shows the sample years 2004 till 2011. The second column presents the total number of firms’ observations in that year.

***Table 8: Distribution of (non-) ITMW firms in the period 2004-2011***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Year** | **Total firms** | **ITMW firms** | **Non-ITMW firms** | **Total MW firms** |
| 2004 | 2244 | 72 | 275 | 347 |
| 2005 | 3348 | 76 | 344 | 420 |
| 2006 | 3909 | 78 | 307 | 385 |
| 2007 | 5296 | 133 | 356 | 489 |
| 2008 | 5801 | 99 | 365 | 464 |
| 2009 | 5944 | 87 | 344 | 431 |
| 2010 | 6129 | 66 | 384 | 450 |
| 2011 | 5559 | 58 | 374 | 432 |
| Total | 38230 | 669 | 2749 | 3418 |

The most surprising result in table 8 is the increase of firms in the year 2007. Also the increase of the material IT control weaknesses in the third column is a remarkable finding, certainly because the number of non-IT material weaknesses stayed relatively on the same level.

Table 9 presents the relative measures to correct for fluctuations in the total number of firms in one year. This scaling on the basis of the number of total firms is presented in the second and third column, where the IT and non-IT material weaknesses percentages can be compared. The fourth and fifth column present the earlier discussed relative measures to assess the share of material IT control weaknesses within the total number of material weaknesses disclosures in a year.

***Table 9: Percentage of (non-) ITMW firms/ to total firms and total material weakness firms***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Year** | **% ITMW firms/ total firms** | **% Non ITMW firms/ total firms** | **% ITMW/ total MW firms** | **% Non-ITMW/ total MW firms** |
| 2004 | 3.21% | 12.25% | 20.75% | 79.25% |
| 2005 | 2.27% | 10.27% | 18.10% | 81.90% |
| 2006 | 2.00% | 7.85% | 20.26% | 79.74% |
| 2007 | 2.51% | 6.72% | 27.20% | 72.80% |
| 2008 | 1.71% | 6.29% | 21.34% | 78.66% |
| 2009 | 1.46% | 5.79% | 20.19% | 79.81% |
| 2010 | 1.08% | 6.27% | 14.67% | 85.33% |
| 2011 | 1.04% | 6.73% | 13.43% | 86.57% |
| Total | 1.75% | 7.19% | 19.57% | 80.43% |

The first four columns of table 9 are reflected in diagrams one and two.

|  |
| --- |
| ***Diagram 1: Yearly trend of disclosed IT related material weaknesses*** |
|  |
| ***Diagram 2: Percentage of IT-related material weaknesses relative to total MW firms*** |
|  |

The results in table 9 show that the percentage of IT material weakness firms relative to total firms has a downward trend, with the exception of the year 2007. This can also be seen in diagram 1. The downward trend is much clearer for the non-IT material weaknesses, showing a decrease from 12.25% in 2004 to a steady 6% after 2007.   
The trend of the material IT control weaknesses relative to the total number of material weaknesses is similar to the trend in the first column percentages, but as diagram 2 shows the differences between the years are more pronounced. In this trend there is also a peak in the year 2007, which is interesting because after 2007 the trend continues downwards. A possible explanation for the peak of material IT control weaknesses in 2007 is the introduction of COBIT 4.0 and 4.1 in the period of 2005-2007. Even though COBIT 4.0 was introduced in December 2005, the increase may be explained by this introduction, because the implementation takes time and the first audits on basis of COBIT 4.0 were in the year 2007.



## Multivariate analysis

In this section multiple results from the regression analysis are being presented. The main analysis is done by conducting multinomial logistic regressions. The reason for conducting logistic regressions is that the dependent variable material IT control weaknesses is a dummy variable and therefore a logistic regression is more appropriate. For the first regression the explanatory variables industry differences and restructuring are regressed separately from the other variables. This is done to analyse the standalone effect of the explanatory variables on (IT-) material weaknesses. The second analysis is a full multinomial logistic regression with all explanatory variables and control variables. All result tables contain the results of two dependent variables, namely the IT material weakness variable and the non-IT material weakness variable. This is done to compare the different types of internal control weaknesses and to analyse whether IT material weakness firms have different characteristics.

**Multinomial logistic regressions / Analysis per main explanatory variable**

Table 10 show the logistic regression on the two industry difference variables (INDFRAUD and INDCOMP). In this table the coefficient, the p-value and the odds ratio (effect size) is included. The model Chi-square explains if the regression model is significant in explaining the dependent variable. Finally also the pseudo R-square is included to see what the explanatory power is of the model.

***Table 10: Model 1: only industry differences variables***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Logistic regression model 1 | 1) ITMW = α0 + α1 INDFRAUD + α2 INDCOMP + ԑ 2) NON- ITMW = α0 + α1 INDFRAUD + α2 INDCOMP + ԑ | | | | | |
| Dependent variable: | ITMW |  |  | NON-ITMW |  |  |
| Observations (N): | 669 |  |  | 2749 |  |  |
| Independent variables | Coefficient (B) | Sig. value | Odds ratio | Coefficient (B) | Sig. value | Odds ratio |
| INDFRAUD | .350 | .000\*\* | 1.419 | .088 | .045\*\* | 1.092 |
| INDCOMP | .245 | .247 | 1.278 | .093 | .438 | 1.097 |
| Intercept | 3.793 | .000\*\* |  | 2.492 | 0.000\*\* |  |
| Model Chi-square | 17.463 | .000\*\* |  | 4.983 | 0.0827\* |  |
| Pseudo R-square (Nagelkerke) | 0.003 |  |  | .000 |  |  |

***p < 0.05 = \*\*  
p < 0.10 = \****

The first result of INDFRAUD is a significant association with ITMW (b=0.350, p<0.01). It is a positive relation, which means that when a firm is in the technology, health care or financial services industry, there is a higher change of finding an IT material weakness. INDFRAUD is also significant for non-ITMW, but has a much lower coefficient, which is also reflected in the effect size (odd ratio 1.419 vs. 1.092) and is only significant for p<0.05. For the other industry difference measure INDCOMP, there is no significant relation for both IT and non-IT material weaknesses. The coefficient of INDCOMP for ITMW is positive, which supports hypothesis 1b in the sense that non-competitive industries have more material IT control weaknesses.

Using a similar layout as table 10, table 11 presents the results focussing on the restructuring variables.

***Table 11: Model 2: only restructuring variables***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Logistic regression model 2 | 1. ITMW = α0 + α1 RESTRUCTD + ԑ / NON- ITMW = α0 + α1 RESTRUCTD + ԑ 2. ITMW = α0 + α1 RESTRUCTC + ԑ / NON- ITMW = α0 + α1 RESTRUCTC + ԑ 3. ITMW = α0 + α1 RESTRUCTP + ԑ / NON- ITMW = α0 + α1 RESTRUCTP + ԑ | | | | | |
| Dependent variable: | ITMW |  |  | NON-ITMW |  |  |
| Observations (N): | 669 |  |  | 2749 |  |  |
| Independent variables | Coefficient (B) | Sig. value | Odds ratio | Coefficient (B) | Sig. value | Odds ratio |
| RESTRUCTD | -.144 | .140 | 0.866 | -.320 | .000\*\* | .726 |
| Intercept | 4.150 | .000\*\* |  | 2.814 | .000\*\* |  |
| Model Chi-square | 2.234 | .135 |  | 40.435 | .000\*\* |  |
| Pseudo R-square (Nagelkerke) | .000 |  |  | .003 |  |  |
| RESTRUCTC | .020 | .145 | 1.021 | .051 | .000\*\* | 1.052 |
| Intercept | 3.998 | .000\*\* |  | 2.488 | .000\*\* |  |
| Model Chi-square | 2.184 | .139 |  | 49.158 | .000\*\* |  |
| Pseudo R-square (Nagelkerke) | .000 |  |  | .003 |  |  |
| RESTRUCTP | -.125 | .113 | .883 | -.394 | .000\*\* | .674 |
| Intercept | 4.096 | .000\*\* |  | 2.784 | .000\*\* |  |
| Model Chi-square | 2.524 | .112 |  | 95.916 | .000\*\* |  |
| Pseudo R-square (Nagelkerke) | .000 |  |  | .006 |  |  |

***p < 0.05 = \*\*  
p < 0.10 = \****

The second model presented in table 11 only looks at the restructuring variables and it presents a clear difference between IT and non-IT material weakness firms. The difference is that none of the restructuring variable is significant for ITMW, while for NON-ITMW all restructuring variables are significant. Firstly the RESTUCTD, which is a dummy variable for the existence of a restructuring, has a negative non-significant coefficient (b=-0.144, p=0.140). This is not consistent with the assumption that restructuring results in more ITMW (which would imply a positive coefficient). For NON-ITMW the variable RESTRUCTD has a highly significant negative coefficient (b= -0.320, p<0.01). This is not consistent with the results of Doyle et al. (2007). RESTRUCTP has a negative coefficient for both ITMW (b=-0.125, p=0.113) and NON-ITMW (b= -0.394, p<0.01). This is not consistent with the theory and the findings of Stoel and Muhanna (2007), indicating that a restructuring in the sample period results in more (IT) material weaknesses. Finally RESTRUCTC, that represent the scaled restructuring costs, is only significant for NON-ITMW, just like RESTRUCTD. With a positive coefficient (b=0.051, p<0.01), this is consistent with Doyle et al. (2007).

In table 12 the full multinomial logistic regression is shown, including all the industry differences, restructuring variables and control variables.

***Table 12: Model 3: full model with all control variables***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Logistic regression model 3 | 1. ITMW = α0 + α1 INDFRAUD + α2 INDCOMP + α3 RESTRUCTD + α4 RESTRUCTC + α5 SIZE + α6 AGE + α7 LEV+ α8 ROA + α9 SEGNUM + α10 FORTRANS + α11 BIG4 + ԑ 2. NON-ITMW = α0 + α1 INDFRAUD + α2 INDCOMP + α3 RESTRUCTD + α4 RESTRUCTC + α5 SIZE + α6 AGE + α7 LEV+ α8 ROA + α9 SEGNUM + α10 FORTRANS + α11 BIG4 + ԑ | | | | | |
| Dependent variable: | ITMW |  |  | NON-ITMW |  |  |
| Observations (N): | 669 |  |  | 2749 |  |  |
| Independent variables | Coefficient (B) | Sig. value | Odds ratio | Coefficient (B) | Sig. value | Odds ratio |
| INDFRAUD | 0.287 | 0.001\*\* | 1.333 | 0.004 | 0.928 | 1.004 |
| INDCOMP | 0.424 | 0.048\*\* | 1.528 | 0.018 | 0.891 | 1.018 |
| RESTRUCTD | -1.477 | 0.017\*\* | 0.228 | -0.430 | 0.245 | 0.650 |
| RESTRUCTP | 0.231 | 0.029\*\* | 1.260 | 0.080 | 0.153 | 1.084 |
| RESTRUCTC | -0.281 | 0.015\*\* | 0.804 | -0.073 | 0.186 | 0.930 |
| SIZE | 0.176 | 0.000\*\* | 1.192 | 0.444 | 0.000\*\* | 1.559 |
| AGE | 0.518 | 0.000\*\* | 1.679 | 0.552 | 0.000\*\* | 1.737 |
| LEV | 0.001 | 0.371 | 1.001 | 0.000 | 0.263 | 1.000 |
| ROA | 0.001 | 0.663 | 1.001 | 0.006 | 0.008\*\* | 1.006 |
| SEGNUM | -0.028 | 0.016\*\* | 0.972 | -0.048 | 0.000\*\* | 0.953 |
| FORTRANS | 0.103 | 0.256 | 1.109 | -0.040 | 0.409 | 0.961 |
| BIG 4 | -0.732 | 0.000\*\* | 0.481 | -0.459 | 0.000\*\* | 0.632 |
| Intercept | 3.614 | 0.000\*\* |  | -0.878 | 0.027\*\* |  |
| Model Chi-square | 242.938 | 0.000\*\* |  | 1704.781 | 0.000\*\* |  |
| Pseudo R-square (Nagelkerke) | 0.042 |  |  | 0.114 |  |  |

***p < 0.05 = \*\*  
p < 0.10 = \****Table 12 shows that both industry difference variables have become significant for the IT material weakness firms. INDFRAUD has a significant positive coefficient (b=0.287, p<0.01), which is consistent with the assumption of hypothesis 1a and supports the theory of Beasley et al. (2000) that Technology, Health care and Financial service industries are more likely to have control problems due to complexity of the financial reporting. The INDCOMP variable is significant and has a positive coefficient (b=0.424, p<0.05); this is consistent with hypothesis 1b and has roughly the same odds as INDFRAUD (1.528 vs. 1.333). The theory of the industry differences based on competitiveness (Giroud and Mueller, 2007) is supported for the existence of material IT control weaknesses by showing a significant correlation between non-competitive industries and the occurrence of IT control weaknesses. The results for industry differences on the NON-ITMW group are not significant, but have positive coefficients (b=0.004, p=0.928; b=0.018, p=0.891) and roughly the same effect size (odds ratio 1.004 vs. 1.018).

The results of the restructuring variables are different from the model 2 regression. Table 11 indicates that restructuring is only significant for NON-ITMW firms, but the full model in table 12 shows opposite results, because the restructuring variables are only significant for the ITMW group. This difference can be explained by the inter-correlation between the restructuring variables therefore in section 6.3 the restructuring variables are separated into different regression equations. The dummy variable RESTRUCTD for ITMW has a negative coefficient (b=-1.477, p<0.05) and a small effect size (odds ratio=0.228). This means that the existence of restructuring results in fewer ITMW and this is not in accordance with hypothesis 2a. The second dummy variable RESTRUCTP, indicating that the firm has had a restructuring in the sample period, shows a significant positive coefficient for ITMW (b=0.231, p<0.05) with a large effect size of 1.260. This is consistent with the assumptions of hypothesis 2c. Also the RESTRUCTC is significant for ITMW firms, but just like RESTRUCTD it has a negative coefficient (b=-0.281, p<0.05); this is not consistent with hypothesis 2b. For the NON-ITMW group all restructuring variables are not significant and RESTRUCTD and RESTRUCTD have also a negative coefficient (b=-0.430, p=0.245; b=-0.073, p=0.186).  
  
Looking at the associations of the control variables and the ITMW / NON-ITMW variables, there seems to be some overlap between the correlations of table 7 and the results of table 12. This is because the correlated control variables firm size, firm age and big 4 audits are now also significantly associated with material IT control weaknesses. SIZE has a positive significant coefficient (b=0.176, p<0.01), which means that larger firms have more ITMW. This is not consistent with the results of Doyle et al. (2007) and Li et al. (2012) that showed a negative correlation between firm size and material IT control weaknesses, which means that smaller firms have more weaknesses. AGE also has a positive significant coefficient (b=0.518, p<0.01); so older firms are more likely to have ITMW. Stoel and Muhanna (2011) did also find a positive association between ITMW and firm age, but the positive association is not consistent with the assumption and results of Doyle et al. (2007) that younger firms have more (internal control) weaknesses. Big 4 audits have a significant association and a negative coefficient (b=-0.732, p<0.01). This implies that ITMW firms more often have a non-Big 4 auditor. This is consistent with the results of Li et al. (2007) that also found a negative association. Other research papers (Li et al., 2012; Stoel and Muhanna, 2011) did include BIG 4 proxies, but did not find a significant relation. Not only the correlated control variables, but also the number of segments has a significant negative coefficient (b=-0.028, p<0.05). This is a very small coefficient and it may imply that ITMW firms have fewer segments, which is not consistent with the predicted sign, assuming that more segments cause more ITMW.   
The significant control variables of the NON-ITMW group also have significantly different means in the descriptive statistics (table 5). These control variables are: firm size (SIZE), firm age (AGE), return on assets (ROA) and number of segments (SEGNUM). All have the same sign as the control variables in the ITMW group. In this analysis also the big 4 audits (BIG4) have a significant effect with the same sign as the ITMW group.

## Robustness checks

In a multinomial logistic regression it is possible that multicollinearity between the variables causes biases affecting the robustness of the results. This bias can be measured by looking at the tolerance and the VIF score. When a variable has multicollinearity problems the value of tolerance is below 0.10 and the VIF score is above 10. In the table below the results are shown for the original model with all variables and for a model in which one multicollinearity variable is excluded.

***Table 13: Collinearity robustness test***

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Collinearity Model 1 | | Collinearity Model 2 | | Collinearity Model 3 | | Collinearity Model 4 | |
|  | Tolerance | VIF | Tolerance | VIF | Tolerance | VIF | Tolerance | VIF |
| INDFRAUD | .964 | 1.037 | .965 | 1.036 | .965 | 1.036 | .965 | 1.036 |
| INDCOMP | .979 | 1.022 | .979 | 1.021 | .979 | 1.021 | .979 | 1.021 |
| RESTRUCTD | .021 | 47.317 | .903 | 1.107 | - | - | - | - |
| RESTRUCTP | .625 | 1.600 | - | - | .851 | 1.175 | - | - |
| RESTRUCTC | .021 | 47.500 | - | - | - | - | .887 | 1.128 |
| AGE | .83 | 1.204 | .838 | 1.193 | .831 | 1.204 | 0.91 | 1.099 |
| SIZE | .593 | 1.687 | .627 | 1.596 | .627 | 1.595 | .624 | 1.601 |
| LEV | .698 | 1.434 | .698 | 1.433 | .698 | 1.433 | .698 | 1.433 |
| ROA | .698 | 1.432 | .698 | 1.432 | .698 | 1.432 | .698 | 1.432 |
| SEGNUM | .827 | 1.21 | .850 | 1.176 | .840 | 1.191 | .847 | 1.181 |
| FORTRANS | .91 | 1.099 | .911 | 1.098 | .913 | 1.095 | .911 | 1.098 |
| BIG 4 | .667 | 1.499 | .681 | 1.468 | .669 | 1.496 | .682 | 1.466 |

The results of the multicollinearity test show that the original model contains variables with a tolerance below 0.1 and a VIF score above 10. These variables are RESTRUCTD and RESTUCTC. An explanation for these results is that the variables are highly inter-correlated, which can result in a bias.In order to correct this problem the restructuring variables are separated in three models to see if the multicollinearity problem disappears. In model 2 RESTRUCTP and RESTRUCTC are excluded to see the separate effect of RESTRUCTD. Model 3 contains only the RESTRUCTP variable and model 4 has only RESTRUCTC as proxy for restructuring. As expected the results of the separated models show that there is no collinearity issue any more; all tolerance values are above 0.1 and the VIF scores are below 10. Therefore these adjusted models are tested again in a multinomial logistic regression to see if the results are affected by the bias (see table 14).

***Table 14: Adjusted Multinomial logistic regression***

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model 4 | RESTRUCTD | | | RESTRUCTC | | | RESTRUCTP | | |
| Dependent var. | ITMW (1) |  |  | ITMW (3) |  |  | ITMW (5) |  |  |
| Observations(N) | 669 |  |  | 669 |  |  | 669 |  |  |
| Independent variables | Coeff. (B) | Sig. value | Odds ratio | Coeff.(B) | Sig. value | Odds ratio | Coeff. (B) | Sig. value | Odds ratio |
| INDFRAUD | .293 | .001\*\* | 1.341 | .292 | .001\*\* | 1.124 | .286 | .001\*\* | 1.331 |
| INDCOMP | .441 | .040\*\* | 1.555 | .439 | .041\*\* | 1.019 | .436 | .042\*\* | 1.546 |
| RESTRUCTD | .122 | .265 | 1.130 | Excl. | Excl. | Excl. | Excl. | Excl. | Excl. |
| RESTRUCTP | Excl. | Excl. | Excl. | Excl. | Excl. | Excl. | .215 | .019\*\* | 1.240 |
| RESTRUCTC | Excl. | Excl. | Excl. | -.024 | .140 | .979 | Excl. | Excl. | Excl. |
| SIZE | .154 | .001\*\* | 1.166 | .156 | .000\*\* | 1.169 | .159 | .000\*\* | 1.172 |
| AGE | .503 | .000\*\* | 1.654 | .505 | .000\*\* | 1.657 | .523 | .000\*\* | 1.686 |
| LEV | .001 | .390 | 1.001 | .001 | .387 | 1.001 | .001 | .386 | 1.001 |
| ROA | .001 | .634 | 1.001 | .001 | .639 | 1.001 | .001 | .630 | 1.001 |
| SEGNUM | -.033 | .003\*\* | .967 | -.032 | .004\*\* | .968 | -.030 | .008\*\* | .970 |
| FORTRANS | -.095 | .296 | .909 | -.094 | .303 | .911 | -.103 | .255 | .902 |
| BIG 4 | .697 | .000\*\* | 2.007 | .702 | .000\*\* | 1.169 | .726 | .000\*\* | 2.066 |
| Intercept | 1.322 | .001\*\* |  | 1.429 | .000\*\* |  | 1.232 | .002\*\* |  |
| Model Chi-2 | 233.306 |  |  | 234.219 | .000\*\* |  | 237.555 |  |  |
| Pseudo R2 (Nk) | .040 |  |  | .040 |  |  | .041 |  |  |
| Dependent var. | NON-ITMW (2) | |  | NON- ITMW (4) | |  | NON-ITMW (6) | |  |
| Observations(N) | 2749 |  |  | 2749 |  |  | 2749 |  |  |
| Independent variables | Coeff. (B) | Sig. value | Odds ratio | Coeff.(B) | Sig. value | Odds ratio | Coeff. (B) | Sig. value | Odds ratio |
| INDFRAUD | .006 | .905 | 1.006 | .006 | .908 | 1.006 | .005 | .923 | .915 |
| INDCOMP | -.013 | .918 | .987 | -.014 | .911 | .986 | -.013 | .918 | .767 |
| RESTRUCTD | .098 | .092\* | .984 | Excl. | Excl. | Excl. | Excl. | Excl. | Excl. |
| RESTRUCTP | Excl. | Excl. | Excl. | Excl. | Excl. | Excl. | .098 | .042\*\* | 1.103 |
| RESTRUCTC | Excl. | Excl. | Excl. | -.016 | .063\* | .967 | Excl. | Excl. | Excl. |
| SIZE | .437 | .000\*\* | 1.548 | .438 | .000\*\* | 1.550 | .439 | .000\*\* | 1.550 |
| AGE | .547 | .000\*\* | 1.728 | .547 | .000\*\* | 1.728 | .553 | .000\*\* | 1.739 |
| LEV | .000 | .278 | 1.000 | .000 | .275 | 1.000 | .000 | .273 | 1.000 |
| ROA | .006 | .007\*\* | 1.006 | .006 | .008\*\* | 1.006 | .006 | .007\*\* | 1.006 |
| SEGNUM | -.049 | .000\*\* | .952 | -.049 | .000\*\* | .952 | -.049 | .000\*\* | .952 |
| FORTRANS | .043 | .380 | 1.043 | .043 | .376 | 1.044 | .038 | .434 | 1.039 |
| BIG 4 | .448 | .000\*\* | 1.566 | .450 | .000\*\* | 1.568 | .457 | .000\*\* | 1.579 |
| Intercept | -1.766 | .000\*\* |  | -1.676 | .000\*\* |  | -1.767 | .000\*\* |  |
| Model Chi-2 | 1701.216 | .000\*\* |  | 1701.832 | .000\*\* |  | 1702.527 | .000\*\* |  |
| Pseudo R2 (Nk) | .113 |  |  | .114 |  |  | .114 |  |  |
| 1) ITMW = α0 + α1 INDFRAUD + α2 INDCOMP + α3 RESTRUCTD + α4 SIZE + α5 AGE + α6 LEV + α7 ROA + α8 SEGNUM + α9 FORTRANS + α10 BIG4 + ԑ | | | | | | | | | |
| 2) NON-ITMW = α0 + α1 INDFRAUD + α2 INDCOMP + α3 RESTRUCTD + α4 SIZE + α5 AGE + α6 LEV + α7 ROA + α8 SEGNUM + α9 FORTRANS + α10 BIG4 + ԑ | | | | | | | | | |
| 3) ITMW = α0 + α1 INDFRAUD + α2 INDCOMP + α3 RESTRUCTC + α4 SIZE + α5 AGE + α6 LEV + α7 ROA + α8 SEGNUM + α9 FORTRANS + α10 BIG4 + ԑ | | | | | | | | | |
| 4) NON-ITMW = α0 + α1 INDFRAUD + α2 INDCOMP + α3 RESTRUCTC + α4 SIZE + α5 AGE + α6 LEV + α7 ROA + α8 SEGNUM + α9 FORTRANS + α10 BIG4 + ԑ | | | | | | | | | |
| 5) ITMW = α0 + α1 INDFRAUD + α2 INDCOMP + α3 RESTRUCTP + α4 SIZE + α5 AGE + α6 LEV + α7 ROA + α8 SEGNUM + α9 FORTRANS + α10 BIG4 + ԑ | | | | | | | | | |
| 6) NON-ITMW = α0 + α1 INDFRAUD + α2 INDCOMP + α3 RESTRUCTP + α4 SIZE + α5 AGE + α6 LEV + α7 ROA + α8 SEGNUM + α9 FORTRANS + α10 BIG4 + ԑ | | | | | | | | | |

***p < 0.05 = \*\*  
 p < 0.10 = \****

The new multinomial logistic regression results (after the correction based on the collinearity test) are presented in table 14. These regression models are different because the highly inter-correlated variable RESTRUCTC, RESTRUCTD and RESTRUCTP are separated into new regression equations. As expected the results of the ITMW regression have changed and the most relevant difference is that RESTRUCTD (b=0.112, p=0.265) and RESTRUCTC (b=-0.024, p=0.140) have become insignificant, while the results in table 12 indicate significant correlations. The only explanation for this difference is that the multicollinearity between RESTRUCTD and RESTRUCTC causes a bias in the results. The only significant restructuring variable is RESTRUCTP with a positive coefficient (b=0.098, p<0.05) and a relatively large effect size (odds ratio=1.103). Thereby RESTRUCTP is the only restructuring variable supporting hypothesis 2, which is based on the assumption that restructuring a company leads to more material IT control weaknesses. This result is also consistent with the findings of Stoel and Muhanna (2011) using a similar proxy for restructuring. They also find a positive relation between the existence of restructuring in the sample period and the occurrence of material IT control weaknesses. The other significant associations found in table 12 have remained significant and have the same sign. For the ITMW group the INDFRAUD variable still has a significant positive coefficient with a large effect size. INCOMP still is significant and still supports hypothesis 1b. Also there are no changes in the significance or sign for the control variable associations; only the coefficient values are slightly different. So firm size, firm age, number of segments and big 4 audits are still significantly associated with ITMW.

The results for the NON-ITMW in table 14 have also changed in comparison with table 12. The association with restructuring has become significant (p<0.10) for all restructuring proxies. RESTRUCTD has now a significant positive coefficient (b=0.098, p<0.10), which is consistent with the findings of Doyle et al. (2007), showing that restructuring is associated with the existence of internal control weaknesses. RESTRUCTC is also significant, but it has a negative association (b=-0.016. p<0.10). This is not consistent with the RESTRUCTD results. The separate model of RESTRUCTP shows an even more significant positive relation (b=0.098, p<0.05) than the other restructuring proxies. This supports the assumption of Doyle et al. (2007) and Chaney et al. (1999) that the existence of restructurings is correlated with the occurrence of material control weaknesses. The results of the control variables (firm size, firm age, return on assets, number of segments and big 4 audits) are still significant and have the same sign. Just like the ITMW group, only the values of the statistics have slightly changed, but that does not lead to any different findings.

# Chapter 7 Conclusion and Discussion



## Conclusions

This research study shows the IT control quality has a profound effect on the business operations and performance. The literature review in chapter 2 and 3 presented the relevance, theories and empirical research of IT and internal control quality. Internal control quality research has a broad scope and is recognized as one of the most important parts of good governance. This is also reflected in regulations like SOX section 404. Since the implementation of ERP systems and the mandatory in-control statements of SOX section 404, IT controls have become more important in the internal control systems. This is also reflected in the control framework for IT controls COBIT, which is significantly expanded since 2007 with the introduction of COBIT 4.1 and more recently in 2013 with COBIT 5.0. The introduction of SOX section 404 also made it possible to study the relations between material weaknesses in the internal control system and all kinds of firm characteristics. By using the SOX section 404 reports this study establishes the influence of industry differences and restructuring on material IT control weaknesses.

To test the influence of industry difference, this study focuses on the following research question:  
*1) What is the impact of industry differences (like complex financial reporting and competiveness level) on the disclosed IT control weaknesses under SOX section 404 in the reporting years 2004-2011?*The industry differences are separated into two proxies: industry differences based on fraud opportunities and industry differences based on the competitiveness level. The results show significant evidence that industry differences based on complex financial reporting are positively associated with the existence of material IT control weaknesses. Therefore the assumption in hypothesis 1a is supported, meaning that the technology, health care and financial services industries are more likely to report material IT control weaknesses.  
The proxy for the industry differences based on competitiveness level is also significantly and positively associated with the existence of material IT control weaknesses. This means that hypothesis 1b, assuming that non-competitive firms have more IT weaknesses, is supported. The coefficient indicates that non-competitive firms are more likely to have material IT control weaknesses than competitive. This is consistent with the theories in chapter 2.5 stating that management slack and agency problems cause more governance problems in non-competitive industries.   
The answer to the first research question is that both industry differences variables, based on complex financial reporting and the competitiveness level, have a significant impact on the disclosed IT control weaknesses under SOX section 404.

The second explanatory variable is the effect of restructuring on material IT control weaknesses. This is focusing on the following research question:   
*2) What is the influence of restructuring on the disclosed IT controls under SOX section 404 in the years 2004-2011?*To measure the influence of restructuring three proxies are chosen: the existence of a restructuring in the same year, the amount of the restructuring costs and the existence of a restructuring in the sample period 2004-2011. The (adjusted) results of the multinomial logistic regression show that only the existence of a restructuring in the sample period is significantly positively associated with disclosed material IT control weaknesses. Therefore hypothesis 2c (RESTRUCTP) is supported, stating that firms with a restructuring in the sample period are more likely to have material IT control weaknesses than other firms. Depending on the model used (only restructuring variables or a full model with control variables) the existence of a restructuring and the amount of restructuring costs show different and inconsistent results. In some cases negative coefficients appear that are not consistent with the hypothesis that a restructuring in the same year causes more material IT control weaknesses. Also the test for collinearity reveals that the restructuring variables could contain a bias. The conclusion is therefore that hypothesis 2a (RESTRUCTD) and 2b (RESTRUCTC) are not supported. The answer on the second research question is that a restructuring has only an influence on the disclosed IT control weaknesses when the company has had a restructuring in the period of 2004-2011. An explanation for the difference in significance between the restructuring proxies may be that the possible negative effects of restructuring occur later and not at the same time as the restructuring costs are reported. The RESTRUCTP variable does include the occurrence of restructuring in one or more years of the period 2004-2011, while RESTRUCTD and RESTRUCT only look at the same year.

The regression results do not only contain the tested explanatory variables, but also the correlations with the included control variables. For the group of firms with material IT control weaknesses the following significant variables are found: the firm size, firm age, number of segments and big 4 audits. This means that older and larger firms with a low number of segments and a non-big 4 auditor are more likely to have material IT control weaknesses. The same significant relations (with the same sign) are found for the non-IT material weakness group. This is consistent with the results of Stoel and Muhanna (2011), because they present a positive coefficient for age and size; so larger and older firms have more weaknesses. These results are surprising because Li et al. (2012) and Doyle et al. (2007) have found opposite results. They find that smaller, younger firms with more segments have more (IT) material weaknesses, only the big 4 control variable has the expected sign. A possible explanation for this difference is that the regression models of Li et al. (2012) and Doyle et al. (2007) have other dependent variables. Li et al. (2012) has management forecast error as dependent variable and Doyle et al. (2007) only looks at internal control weaknesses. Furthermore the variables measuring financial performance (leverage and return on assets) and the existence of foreign transactions are not significantly associated with the existence of material IT control weaknesses. These results are consistent with Li et al. (2012), since their results of comparable proxies of leverage, profitability and foreign transactions are also not significant. Apparently these variables do not explain the existence of material IT control weaknesses.

Besides the results of the regression this study also investigates the trend of the material IT control weaknesses in the period 2004-2011. The descriptive statistics indicate that there is a downward trend in the disclosed material IT control weaknesses since 2007. A remarkable finding is the peak of material IT control weaknesses in the year 2007. This peak is found in the absolute numbers but also in the relative measures, scaled to the number of observations and total number of material weaknesses. A possible explanation may be the introduction of a new IT control framework (COBIT 4.0), since the total non-IT material weakness does not show a peak in 2007.

## Discussion

This research study has multiple limitations. Firstly, the proxy for the existence of material IT control weaknesses is based on the coding of Audit Analytics. This means that the material weaknesses disclosed in SOX section 404 reports are coded and categorized by Audit Analytics. It is possible that not all weaknesses have the same severity or may be put in the wrong category (Boritz et al., 2010). Coding and interpreting a SOX section 404 reports is always based on certain assumptions and it can sometimes be a subjective judgment on what establishes a weakness or not.   
Secondly, the results of the regression analysis show that the selected measures of industry differences and restructuring could contain biases. This is clearly shown by the multicollinearity analysis, which indicated that the dummy variable of restructuring is highly correlated with the restructuring costs. Even though the selection of a certain proxy is based on prior literature, it is still possible that the proxy only partly measures the real effect of restructuring or industry differences. The limitation of the proxies in really measuring the real effect is also a problem for all variables used in this research and with more information or other proxies the results can differ just like the restructuring variables.  
The third limitation is that the restructuring measure based on the existence of a restructuring in the sample period could contain a causality problem. Hypothesis 1c is formulated in such a way that a restructuring in the period 2004-2011 causes more material IT control weaknesses. However, this assumes that the restructuring has an effect on material IT control weaknesses, but it may also be the case that an IT material weakness is already disclosed before the restructuring. It may be that IT control weaknesses cause a firm to restructure, which is opposite to the causality in the hypothesis.   
A fourth limitation is that the existence of material IT control weaknesses could be explained by other variables that were not included. This study tries to eliminate this problem by selecting multiple control variables, but still there are omitted variables that could explain the occurrence of IT control weaknesses.

For future research in the field of IT control quality, not only the existence of material IT control weaknesses should be studied, but also the more specific IT control areas and how these areas relate to certain characteristics of the firms. The research on the effects of restructuring on material IT control weaknesses can also be expanded and more differentiated to see what kind of restructuring may cause more material IT control weaknesses. To avoid causality problems a case study might give more insight on how restructuring influences the IT controls. Based on the findings on the industry differences, it can also be interesting to test other theories explaining why chemical and oil industries have relatively more material IT control weaknesses. Another idea is looking at the IT control quality of companies outside the U.S.A.; differences in culture or reporting standards may result in different conclusions on the occurrence of material IT control weaknesses. Important to note is that currently this type of research is only possible for firms reporting under SOX section 404, because (apart from the U.S.A.) there are no other countries requiring companies to report material weaknesses in the internal control system.  
A final recommendation for future research is to look also at the fluctuations between the years. The year 2007 for example shows a peak in material IT control weaknesses and it is interesting to know what may explain this sudden rise in weaknesses.

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# Appendix 1: Database variables

In this appendix all the variable definitions are presented together with the database measure used in the sample selection in table 15. The databases measures are included so the results can be replicated, it provides information which variable is used, how it is manipulated and which database is used.

***Table 15: Variable definitions with Database measure***

|  |  |  |
| --- | --- | --- |
| **Variable name** | **Definition variable** | **Database measure** |
| ITMW | Dummy variable; value 1 for firms with IT related material weakness, value 0 otherwise | Information Technology deficiencies in Audit Analytics, all “OTHERMWKEY” with the number 22. |
| INDFRAUD | Dummy variable; value 1 for firm in technology, health care or financial services industry, value 0 otherwise | Industries with 2-digit SIC codes: 80 (health services), 73, 62, 63, 64, 67 (business service/ financial services) and 35, 36 (technology, computer, software companies) |
| INDCOMP | Dummy variable; value 1 for firm in industry with a >33% Herfindahl index (non-competitive), value 0 otherwise | Firms with a 2-digit SIC code of an industry with a Herfindahl index (market shares/ sales from Compustat) above the 33% is classified as non-competitive industry firm. |
| RESTRUCTD | Dummy variable; value 1 for firm with non-zero value for restructuring costs , value 0 otherwise | The restructuring costs before taxes Compustat |
| RESTRUCTC | Ratio variable; the restructuring costs scaled against the total assets | The total restructuring costs before taxes dividend by total assets from Compustat |
| NON-ITMW | Dummy variable; value 1 for firms with non-IT related material weakness, value 0 otherwise | Material weaknesses disclosed – IT related weaknesses in Audit Analytics |
| SIZE | Continuous variable; the log of the total assets | Total assets from Compustat |
| AGE | Continuous variable; the log of the firm age based on current year- founding year | The fiscal year of observation – first year in the CRSP-Compustat database |
| FINHEALTH | Ratio variable; Leverage (total liabilities/total assets) | Total liabilities and total assets from Compustat |
| ROA | Ratio variable: Return on Assets (Net income/ total assets) | Net income and total assets from Compustat |
| SEGNUM | Continuous variable; the number of business units | Number business segments from Compustat |
| FORTRANS | Dummy variable: value 1 for firms with non-zero value foreign currency transaction, value 0 otherwise | Foreign currency transactions from Compustat |
| BIG4 | Dummy variable: value 1 for firms audited by BIG 4 audit firms, value 0 otherwise | BIG 4 variable from Audit Analytics |

# Appendix 2: Example of a sample selection

Audit Analytics database: In this database it is specified what kind of internal controls weaknesses are disclosed. There are 21 categories of internal control weaknesses and for this research the category of Information Technology (security, access control and software) is the most relevant. The table below contains an example of the data needed to do the analysis, in this case IBM in the period of 2004-2011 from the Audit Analytics database. The first column shows the company f-key which is the CIK identification code, with this code the datasets of Audit Analytics and Compustat are merged. In the second part there is the column “Not effective other reason keys” under is column the material IT control weaknesses are disclosed and the key for IT weaknesses is 22. In the last column the Standard Industry Code is presented this is important for the industry differences measures, where only the first two digits are needed, in this case it is SIC code 35.



Part 2:



# Appendix 3: Herfindahl Index

In order to measure the industry differences based on the competitiveness level the Herfindahl index for each industry needed to be calculated. In table 16 all Herfindahl indexes for the year 2011 are presented including the dummy variable INDCOMP that has a value 1 for industries above 33% (non-competitive) and a value 0 for industries with an index equal or below the 33% (competitive).

***Table 16: Herfindahl Index per 2-digit SIC Industry***

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| SIC 2-digit |  | Herfindahl index | IND COMP | SIC 2-digit |  | Herfindahl index | IND COMP |
| 10 | Metal Mining | 12.3% | 0 | 48 | Communications | 3.4% | 0 |
| 12 | Coal Mining | 39.8% | 1 | 49 | Electric, Gas, And Sanitary Services | 1.1% | 0 |
| 13 | Oil And Gas Extraction | 11.6% | 0 | 50 | Wholesale Trade-durable Goods | 4.6% | 0 |
| 14 | Mining Nonmetallic Minerals | 21.2% | 0 | 51 | Wholesale Trade-non-durable Goods | 12.5% | 0 |
| 15 | Building Construction General | 7.4% | 0 | 52 | Building Materials, Hardware | 39.6% | 1 |
| 16 | Heavy Construction Other | 42.5% | 1 | 53 | General Merchandise Stores | 34.8% | 1 |
| 17 | Construction Special Trade | 19.6% | 0 | 54 | Food Stores | 16.2% | 0 |
| 20 | Food And Kindred Products | 5.0% | 0 | 55 | Automotive Dealers And Gasoline | 7.4% | 0 |
| 21 | Tobacco Products | 48.2% | 1 | 56 | Apparel And Accessory Stores | 7.2% | 0 |
| 22 | Textile Mill Products | 34.1% | 1 | 57 | Home Furniture, And Equipment Stores | 36.7% | 1 |
| 23 | Apparel And Fabrics And Similar Materials | 7.9% | 0 | 58 | Eating And Drinking Places | 9.5% | 0 |
| 24 | Lumber And Wood Products | 26.5% | 0 | 59 | Miscellaneous Retail | 10.5% | 0 |
| 25 | Furniture And Fixtures | 43.0% | 1 | 60 | Depository Institutions | 3.1% | 0 |
| 26 | Paper And Allied Products | 7.9% | 0 | 61 | Non-depository Credit Institutions | 16.7% | 0 |
| 27 | Printing, Publishing, And Allied Industries | 7.5% | 0 | 62 | Security And Commodity Brokers | 8.3% | 0 |
| 28 | Chemicals And Allied Products | 2.8% | 0 | 63 | Insurance Carriers | 4.0% | 0 |
| 29 | Petroleum Refining And Related Industries | 13.6% | 0 | 64 | Insurance Agents, Brokers, And Service | 15.0% | 0 |
| 30 | Rubber/ Plastics Products | 15.2% | 0 | 65 | Real Estate | 16.3% | 0 |
| 31 | Leather And Leather Products | 19.1% | 0 | 67 | Holding And Other Investment Offices | 1.6% | 0 |
| 32 | Stone, Clay, Glass, And Concrete Products | 24.1% | 0 | 70 | Hotels, and Other Lodging Places | 6.3% | 0 |
| 33 | Primary Metal Industries | 8.8% | 0 | 72 | Personal Services | 11.5% | 0 |
| 34 | Fabricated Metal Products | 7.2% | 0 | 73 | Business Services | 2.6% | 0 |
| 35 | Industrial,Commercial And Computer Equipment | 6.5% | 0 | 75 | Automotive Repair, Services, And Parking | 18.8% | 0 |
| 36 | Electronics, Except Computer Equipment | 4.2% | 0 | 76 | Miscellaneous Repair Services | 74.0% | 1 |
| 37 | Transportation Equipment | 9.1% | 0 | 78 | Motion Pictures | 11.8% | 0 |
| 38 | Measuring, Analyzing, And Controlling Instruments; | 3.8% | 0 | 79 | Amusement And Recreation Services | 15.9% | 0 |
| 39 | Miscellaneous Manufacturing Industries | 10.7% | 0 | 80 | Health Services | 7.1% | 0 |
| 40 | Railroad Transportation | 16.8% | 0 | 81 | Legal Services | 100% | 1 |
| 41 | Public (land) Transportation | 100% | 1 | 82 | Educational Services | 9.3% | 0 |
| 42 | Motor Freight Transportation And Warehousing | 35.2% | 1 | 83 | Social Services | 39.1% | 1 |
| 44 | Water Transportation | 11.5% | 0 | 87 | Engineering, Accounting, Related Services | 6.3% | 0 |
| 45 | Transportation By Air | 7.6% | 0 | 89 | Miscellaneous Services | 85.8% | 1 |
| 46 | Pipelines, Except Natural Gas | 25.5% | 0 | 90 | Government | 100% | 1 |
| 47 | Transportation Services | 13.3% | 0 | 99 | Nonclassifiable Establishments | 50.8% | 1 |

1. AICPA differs from PCAOB in several ways, first the institute is an institute founded by the certified public accountants themselves in 1887, and secondly the standards provided by AICPA are not based on a law. Still the standards provided by AICPA are important on how the auditor should apply the mandatory tasks of the SOX act in practice. [↑](#footnote-ref-1)
2. This is surprising because Li et al. (2012) and Doyle et al. (2007) found significant results for these variables. [↑](#footnote-ref-2)