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A value relevance study of the effects of the credit crunch

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Abstract

Prior research generally suggests that deferred tax assets are value relevant and that the credit crunch has had a negative influence on their value relevance. This study shows that the suspected value relevance of deferred tax assets and the negative influence of the credit crunch may be caused by an intervening variable that has previously not been included in value relevance models. The results of this study show that deferred tax assets are not value relevant and that the credit crunch has not had a negative influence on the value relevance of deferred tax assets. Also, the results show that the VIX-index, a measure for expected market volatility, acts as a moderator in the relationship between deferred tax assets and share prices and appears to be the intervening variable. The results of this study shed new light on the value relevance of deferred tax assets and on how financial crises influence the value relevance of accounting information. The implication of these findings is that the expected market volatility should be included as a variable in future value relevance research.

Keywords: deferred tax asset, taxation, value relevance, credit crunch, crisis, VIX

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1. Introduction

"The west is fucked. We fucked it up. Oh, not just you and me. All of us. The west, it's done. It's over. You want to call it a game?"– James Cromwell as Hank Paulson (United States of America Treasury Secretary between 2006 and 2009) in the movie "The last days of Lehman Brothers" (IMDB, n.d).

The above quote says it all. The credit crunch (2007-2008) was one of the greatest financial crises after the Second World War. However, unlike other post-war crises the credit crunch has had an impact on the very core of the western economic system (Duchin, Ozbas & Sensoy, 2010; Mizen, 2008; Iyer, Da-Rocha-Lopes, Peydró & Schoar, 2014). It has led to an unprecedented global recession and a lack of trust in the economic system (Carrigan & Pelsmacker, 2009; Parkinson, Ball, Blake & Key, 2009). According to the Netherlands Bureau for Economic Policy Analysis [CPB] the credit crunch has led to the largest post-war recession for the Netherlands (CPB, 2009). This shows that the credit crunch has had an impact far beyond the original source of the crisis, namely the subprime housing market in the United States (Demyanyk & Van Hemert, 2008).

Prior research has investigated the effect of financial crises on the value relevance of financial reporting to investors. For example, Bauman and Das (2004) have investigated the effect the dot-com bubble has had on the value relevance of deferred tax assets. Bauman and Das (2004) have discovered that the value relevance of deferred tax assets in the financial statements of dot-com companies had increased after the dot-com bubble. The value relevance of tax related information in financial statements is however still an under investigated area and has, according to Graham, Raedy and Shackelford (2012), thus far come up with mixed results. This, combined with the effect of financial crises, was the trigger for this study.

According to Arthur, Tang and Lin (2015) investors have become more critical of the quality of financial reporting after the credit crunch. This would suggest that the value relevance of financial reporting has declined after the credit crunch. However, this would be contrary to the prior research carried out by Bauman and Das (2004). Recent research from Badenhorst and Ferreira (2016) into the value relevance of deferred tax assets after the credit crunch has also been inconclusive. Badenhorst and Ferreira (2016) have used samples from both the United Kingdom

and Australia. They have discovered a decline in the value relevance of deferred tax assets after the credit crunch for companies listed in Australia. Contradictory, they did not find an effect of the credit crunch on the value relevance of deferred tax assets in their sample of companies listed in the United Kingdom. According to Badenhorst and Ferreira (2016) these mixed results were caused by differences in the regulatory environment between the two countries. This calls into question the generalisability of their results.

Furthermore, prior research into the effects of financial crises has mainly measured difference-in-differences effects using dummy variables (before and after the crisis) to measure the effects of the financial crises. Examples are the studies from Arthur, Tang and Lin (2015), Chor and Kalina (2012) and Badenhorst and Ferreira (2016). This is however a rather crude method to measure financial crises. Potentially this could lead to validity issues when year dummy variables are not able to validly measure financial crises, thereby ignoring other underlying variables that could be the actual cause of year on year effects. In other research areas for example a country's Gross National Product [GNP] (Rose & Spiegel, 2009; Lane & Milesi-Ferretti, 2010) has been used to measure the economic situation in each year and to analyse the effects of financial crises. This could potentially be a more valid measure to study the effects of financial crises.

In this study the influence of the credit crunch on the value relevance of deferred tax assets is investigated. A sample of companies listed on the Amsterdam stock exchange is used. This study has scientific relevance since it adds to the understanding of the effects of financial crises on the value relevance of financial reporting to investors. Specifically, this study has scientific relevance since tax-related information is an under investigated research area (Kenny & Larson, 2018). Most prior value relevance studies have focussed on specific balance sheet items or earnings-related items (Bauman & Das, 2004). The focus on earnings-related items is at odds with the findings of Ball and Brown (1968). They have found that the earnings for the year account for only 20 percent of the information communicated to investors in the month of an earnings release. Their conclusion that 80 percent of the information does not relate to earnings justifies the focus of this study on deferred taxes.

Also, this study has scientific relevance since few value relevance research has been conducted into companies listed in the Netherlands. Thus far, most value relevance research has been carried out in Anglo-Saxon countries. The only study that has investigated the value relevance of deferred tax assets of Dutch listed companies is Naarding and Langendijk (2007). However, they did not include

the influence of financial crises in their study. By using a sample from one country, between country-effects are eliminated, thereby eliminating effects due to differences in the regulatory environment, as encountered by Badenhorst and Ferreira (2016). By investigating a sample of Dutch listed companies this study adds to the generalisability of value relevance research. The use of Dutch listed companies has specifically scientific relevance since the Netherlands is often considered to be a tax-haven due to its favourable tax climate for multinational companies (Gravelle, 2015). This has caused considerable debate in the Netherlands and beyond about company taxation. This study provides insight into the value relevance of deferred tax assets in what critics consider a tax-haven. Also, this study provides insight into whether the value relevance of deferred tax assets differs from other countries. This adds to the debate by providing insight in the role played by deferred taxes and by providing insight in the alignment between the relevance of company taxation for investors and the relevance for society. Finally, this study addresses a potential validity issue relating to the measurement of financial crises and thereby contributes to the validity of value relevance research.

In this study the following research question is investigated:

What is the influence of the credit crunch on the value relevance of deferred tax assets in the financial statements of companies listed on the Amsterdam stock exchange?

The next chapter (chapter two) describes the theoretical background of the above research question. Also, hypotheses are developed to answer the research question. Chapter three provides a description of the research methodology that is used. In chapter four data analysis is carried out. The findings of this study are described in detail in chapter five. Finally, in chapter six inferences are drawn based on the research carried out. The implications of the findings, the limitations of the research method used and potential avenues for future research are discussed here as well.

2. Literature review and hypothesis development

In the 1970's around 80 percent of a company's market value was explained by its tangible and financial assets (IIRC, 2011). This percentage has been on a steady decline since then. In 2009 on average only 19 percent of a company's market value was still explained by its tangible and financial fixed assets. These days more than 80 percent of a company's market value is explained by other factors. This marks significant changes in what investors consider relevant.

Despite these changes a company's financial statements are still an important source of information for investors (Bruinette, 1998; IIRC, 2017). The shape and form of reporting has changed in recent years and will likely continue to evolve (Adams, 2015). Further digitalisation and developments like big data (Warren, Moffitt & Byrnes, 2015) and continuous reporting (Gibbins & Pomeroy, 2007) may change reporting to investors (and other stakeholders) even more dramatically. However, financial information will remain a part of the information that is provided to investors. A specific type of financial information that not only holds information about a company's historical performance, but also potentially holds information about its future performance is provided by deferred tax assets.

2.1 Deferred taxes

Deferred tax assets and deferred tax liabilities are assets and liabilities that are recorded in financial statements to account for temporary timing differences relating to corporate income tax (IAS 12.5). These timing differences influence the moment when a company's accounting profits are taxed. The aim of accounting for these timing differences is to provide investors with an understanding of when taxation leads to tax related cash flows. However, critics argue that investors are more interested in a company's tax policies rather than in the timing of tax cash flows (Deller, 2018).

Deferred tax assets and deferred tax liabilities are first recorded when there is a difference between the commercial and the fiscal book value of assets and/or liabilities, and therefore a difference between a company's commercial result and its taxable result (IAS 12.5). These differences are accounted for in the financial statements by multiplying the difference between the commercial and the fiscal book value of assets and/or liabilities by the applicable tax rate (IAS 12.5). Depending

on whether these differences cause earlier or later taxation, deferred tax assets or deferred tax liabilities are recorded in the financial statements (IAS 12.59).

Second, deferred tax assets are also recorded when a company has realised fiscal losses and it is likely that these losses can and will be off-set against future fiscal profits (IAS 12.34). Deferred tax assets relating to these compensable losses are recorded in the financial statements by multiplying the amount of losses that is likely to be off-set against future fiscal profits by the applicable tax rate (IAS 12.47). Unlike US GAAP and especially unlike SFAS No. 109, a deferred tax valuation allowance is not recorded under International Financial Reporting Standards [IFRS] for losses that cannot be off-set against future fiscal profits. For a discussion about the deferred tax valuation allowance under SFAS No. 109 refer to Christensen, Paik and Stice (2008) and Graham, Raedy and Shackelford (2012). Instead a company assesses the amount of fiscal losses that will be off-settable and only recognises a deferred tax asset for that amount multiplied by the applicable tax rate. Fiscal losses that cannot be off-set are therefore not recorded in the financial statements and are kept off-balance under IFRS.

The Dutch corporate income tax regime allows companies with fiscal losses to off-set these losses with fiscal profits in other fiscal years. The Dutch tax laws provide companies with a one year carry back option and a nine year carry forward option for loss compensation. This provides companies with the ability to off-set fiscal losses with fiscal profits over a period of in total ten years. The statutory tax rate in the Netherlands ranges from 20 percent up to 25 percent (Government of the Netherlands, n.d). Deferred tax assets, especially relating to compensable losses, are of interest in this study since these assets have economic value and provide investors with valuable information.

2.2 The economic value of deferred tax assets

The economic value of deferred tax assets is twofold. First, deferred tax assets are caused by a timing difference between accounting profits and taxable profits. Therefore, there is a timing difference with a cash flow effect. Due to the time value of money the timing difference has economic value to a company (Amir, Kirschenheiter & Willard, 2001). However, according to existing literature the economic value due to these timing differences in cash flows is limited. According to Chludek (2011) 70 percent of the deferred tax balances persist over time and the actual cash flow implications are therefore negligible. This would also suggest that the economic value of deferred tax assets is low (Guenther & Sansing, 2000).

Second, deferred tax assets relating to compensable losses have a signalling function towards investors (Badenhorst & Ferreira, 2016; Bouman & Das, 2004; Chang, Herbohn & Tutticci, 2009; Christensen, Paik & Stice, 2008). This is because of the requirement that these deferred tax assets can only be recorded when it is likely that sufficient future taxable profits will be available for off-setting (IAS 12.34). By recording a deferred tax asset, a company provides a signal towards investors that it expects to realise sufficient future taxable profits to be able to realise the deferred tax asset (Badenhorst & Ferreira, 2016; Bouman & Das, 2004; Chang, Herbohn & Tutticci, 2009).

The recognition of a deferred tax asset provides investors with information about the expected future cash flows of a company. However, it should be noted that the recognition of a deferred tax asset for compensable losses involves estimations made by the company's management. This causes an element of uncertainty regarding the realisation of deferred tax assets. Also, a recorded deferred tax asset can provide investors with potentially misleading information. This is for example highlighted by Orij (2013). The question is therefore whether deferred tax assets are relevant for the economic decisions of investors.

2.3 Value relevance and value relevance research

A complication is, however, that the relevance of accounting information for investors is not directly observable. Therefore, accounting information is considered relevant for investors when accounting information has an influence on a company's market value (Kargin, 2013; Ohlson, 1995). When accounting information influences the company's share price it is considered 'value relevant', since it has led to economic decisions by investors. The information is therefore relevant information for investors. Value relevance research is the research area that investigates the linkages between financial reporting and economic decisions by investors, mainly by examining the influence financial information has on share prices.

However, there are also value relevance studies that have focussed on abnormal returns (the difference between expected returns and actual returns) instead of share prices and market value (price levels) to study the value relevance of financial reporting (Aboody, Hughes and Liu, 2002). An example is Ball and Brown (1968). The choice between these two approaches (the price levels approach and the returns approach) depends on the research question of a study. The price levels approach (using share prices) is considered the best fitting approach for this study, since this study investigates the value relevance of a specific balance sheet item.

Ball and Brown (1968) were the first to introduce empirical research in value relevance research. This has led to an abundance of value relevance research. However, this has mainly centred around specific balance sheet and earnings-related items (Bauman & Das, 2004). Especially the seminal work of Ohlson (1995) has been the driving force for much of the value relevance research. Ohlson (1995) has demonstrated that the market value of a company is determined by the company's accounting profits and the book value of its shareholders' equity. This is based on a traditional accounting theory, often attributed to Williams (1938), that states that the theoretical value of a company can be measured using the company's discounted cash flow of future dividends. Ohlson (1995) demonstrated this using the following formula:

$$P_t = y_t + \alpha_1 x_t^a + \alpha_2 v_t.$$

The formula from Ohlson (1995) details that a company's market value (P_t = share price) is determined by the book value of its equity adjusted for its current profitability ($\alpha_1 x_t^a$) and other information that influences the company's future profitability ($\alpha_2 v_t$). Ohlson (1995) has applied this formula because Feltham and Ohlson (1995) had discovered that a company's market value equals the book value of its equity plus the present value of all future free cash flows from operating activities. The formula forms the basis of much of the value relevance research that has been carried out since. Many studies after Ohlson (1995) have used this general formula and have provided further specifications of the formula.

For example, Ayers (1998) has further specified the formula by tailoring it to its study of changes in deferred tax accounting. He amended the formula to be able to measure the incremental effect of the introduction of the SFAS 109 accounting standard in the United States. Ayers (1998) has used the following formula in his study:

$$MVE = \beta_0 + \beta_1 BVA + \beta_2 BVL + \beta_3 APB11 + \beta_4 CUMEFF109 + \beta_5 PENSION + \beta_6 OPEB + \varepsilon$$

In this formula MVE is the market value of a company's equity. Ayers (1998) has measured the book value of assets (BVA) and the book value of liabilities (BVL) separately instead of using one measure for shareholders' equity, like Ohlson (1995) did. He also added other specific variables to the formula for his study to further specify the "other information" component included in Ohlson's formula. By doing so Ayers (1998) further developed Ohlson's formula.

Most value relevance studies that have been carried out since have followed the same approach of tailoring Ohlson's (1995) formula depending on the study's area of interest. An example is Baboukardos and Rimmel (2016) who have used a revised version of Ohlson's (1995) formula to investigate the relative value relevance of different types of accounting information when companies issue integrated reports. Baboukardos and Rimmel (2016) have discovered that when companies do this, reported net assets are less value relevant to investors. According to Baboukardos and Rimmel (2016) this indicates that investors use the other information in the integrated report to account for risks and unrecorded liabilities that influence the company's market value. Another example is Bauman and Das (2004), which will be discussed in more detail in paragraph "2.6 The influence of financial crises on value relevance". Bauman and Das (2004) have used Ohlson's (1995) formula by including measures that are relevant to study the value relevance of accounting information provided by internet companies.

The body of value relevance research has led to corroboration and further development of Ohlson's (1995) formula. This has led to numerous value relevance studies that confirm the value relevance of accounting information (Aboody, Hughes and Liu, 2002). However, for example Dontoh, Radhakrishnan and Ronen (2004) have argued that accounting information has generally become less value relevant over the years because of the shift from traditional capital-intensive economies towards technology and service orientated economies. There has also been criticism on value relevance research. For example, Holthausen and Watts (2001) have argued that value relevance research has had little impact on standard setting practices since underlying descriptive theories have not been developed for this research area. According to Holthausen and Watts (2001) "there can be little assurance that the inferences drawn in the literature are valid" (p. 63). Holthausen and Watts (2001) also state that the results of value relevance research are merely associations. This concern is largely shared by Graham, Raedy and Shackelford (2012).

However, the criticism of Holthausen and Watts (2001) and of Graham, Raedy and Shackelford (2012) can be countered using the efficient market hypothesis. This hypothesis describes how markets quickly react to new publicly available information and how the information is quickly reflected in security prices (Fama, 1970). According to the efficient market hypothesis, security prices reflect "the collective knowledge and information-processing expertise of investors" (Scott, 2015, p. 120). This view is shared by for example Francis and Schipper (1999). The efficient market hypothesis would support the value relevance research that has been carried out. The efficient market hypothesis itself has also been scrutinised since there are various security market

anomalies that suggest that security markets are not entirely efficient. Also, Howden (2009) and Campos Dias de Sousa and Howden (2015) argue that causal inferences based on the efficient market hypothesis cannot be drawn because the hypothesis does not include directly testable assumptions and that the efficient market hypothesis is based on conjecture. This would again support the criticism of Holthausen and Watts (2001).

As discussed by for example Healy and Palepu (2001), Fama (1970), Jensen (1978) and Dimson and Mussavian (1998), security markets are not entirely efficient. Also, value relevance is not a directly observable phenomenon and value relevance research may not lead to causal inferences. However, the efficient market hypothesis seems to be the most suitable theory to study how markets react because there are no alternatives that appear to be more suitable. According to Aboody, Hughes and Liu (2002) value relevance studies implicitly assume that security markets are efficient in the semi-strong form. Also, Aboody et al. have demonstrated that value relevance studies that use the price levels approach are not influenced greatly by security market inefficiencies. This suggests that value relevance research does not assume security markets are entirely efficient, countering much of the criticism on the theoretical underpinning of value relevance research. Also, this suggests that the price levels approach followed by this study is less susceptible to bias due to security market inefficiencies than the returns approach followed by some other studies (Aboody, Hughes & Liu, 2002). The efficient market hypothesis seems therefore to be the most suitable theoretical underpinning for this study. This would mean that if deferred tax assets are value relevant that this would be reflected in a company's share price.

2.4 The relevance of deferred tax assets

According to Graham et al. (2012) most studies have relied on price levels (market value and share prices) as a proxy for the value relevance of deferred tax assets. For example, Naarding and Langendijk (2007) have noted that recognised deferred tax assets were positively associated with the market value of firms listed on the Amsterdam stock exchange. Also, unrecognised deferred tax assets for compensable losses were negatively associated with the market value of these firms. Studies by Chang, Herbohn and Tutticci (2009) and Ayers (1998) yielded similar results for Australian and American listed firms. These studies suggest that deferred tax assets are value relevant. This is also supported by the studies of Amir (2001) and Lynn, Seethamraju and Seetharaman (2008), suggesting that deferred tax assets provide investors with additional information.

However, Chludek (2011) argues that investors do not consider deferred tax assets value relevant since deferred tax assets have minimal impact on a company's cash flows. Also, Chludek (2011) notes that the realisation of deferred tax assets is often surrounded with uncertainty. This is also argued by Sarkar (2013), who has noted that the fair value of a deferred tax asset can be significantly lower than its book value. Furthermore, Guenther and Sansing (2000) suggest that the expected timing of the reversal of deferred tax assets does not affect a company's value. This would suggest that deferred tax assets are not value relevant.

Citing the criticism of Holthausen and Watts (2001), Graham et al. (2012) conclude that whether deferred tax assets are value relevant remains open to debate. Graham et al. (2012) thereby entirely ignore the studies that have used what they call the levels approach (market value and share prices). In doing so, Graham et al. (2012) ignore an entire research area and the efficient market hypothesis. Prior value relevance research generally appears to suggest that deferred tax assets are value relevant. However, markets are not entirely efficient as for example Healy and Palepu (2001) and Fama (1970) have argued. It is especially interesting to investigate under which conditions deferred tax assets are value relevant. Thereby adding to the theoretical framework in this area, as argued by Graham et al. (2012). The question is for example what the influence of financial crises is on the value relevance of deferred tax assets.

2.5 The impact of the credit crunch on the economy

The most recent and probably the most profound financial crisis in modern history was the 2007-2008 financial crisis, also known as the credit crunch. The crisis was caused by a lack of confidence between banks, creditors, investors and companies. This lack of confidence led to market parties re-examining their credit portfolio's and their willingness to provide other parties with credit. This left credit in short supply and the effects quickly spread to other parts of the global economy (Duchin, Ozbas & Sensoy, 2010; Mizen, 2008; Iyer, Da-Rocha-Lopes, Peydró & Schoar, 2014). The credit crunch especially spread to other parts of the global economy because of its impact on international trade (Chor & Kalina, 2012; Rose & Spiegel, 2009).

What followed, according to Iyer et al. (2014), was the greatest financial crisis after the Great Depression (1929-1939). What started in the subprime mortgage market in de United States, led to the collapse of several banks and an unprecedented global recession that rocked the very core of the western economic system. It led to a lack of trust in the western economic system. A more detailed overview of the events that have unfolded can be found in for example Brunnermeier

(2008), Carrigan and Pelsmacker (2009), Demyanyk and Van Hemert (2008) and Parkinson, Ball, Blake and Key (2009). The question is however what impact the credit crunch has had on the value relevance of deferred tax assets.

2.6 The influence of financial crises on value relevance

To date the number of studies that have investigated the influence of the credit crunch on the value relevance of deferred tax assets is very limited. The only prior study that has investigated this area is Badenhorst and Ferreira (2016). They have used the market value of equity from listed companies in Australia and the United Kingdom between 2005 and 2011 to investigate the value relevance of deferred tax assets before and after the credit crunch. They have discovered that the credit crunch has had a negative influence on the value relevance of deferred tax assets.

Because Badenhorst and Ferreira (2016) have used samples from both the United Kingdom and Australia they have pooled these samples. For example, Hassler and Thadewald (2003) have been very critical of the pooling of heterogenous samples since this could lead to biased correlations. This would explain why Badenhorst and Ferreira (2016) discovered a negative effect of the credit crunch in their pooled sample and the sample from Australia. However, they did not find an effect in their sample of companies listed in the United Kingdom. Badenhorst and Ferreira (2016) have already pointed out that these results may have been caused by differences in the regulatory environment of these countries. This points towards heterogenous samples and therefore calls into question the generalisability of their results.

Bauman and Das (2004) have investigated the value relevance of deferred tax assets before and after another financial crisis. They have investigated the value relevance of deferred tax assets around the dot-com bubble in 2000 using a sample of internet companies included in the Internet Stock List. Bauman and Das (2004) found that deferred tax assets were more value relevant to investors after the dot-com bubble. Also, they found that accounting information in general was more relevant to investors after the dot-com bubble. The increased value relevance after the dot-com bubble contradicts with the findings of Badenhorst and Ferreira (2016).

This shows that the research on the influence of financial crises on value relevance is inconclusive. These contradictory findings are surprising since Arthur, Tang and Lin (2015) and Tapia (2004) have noted that investor confidence has declined during both the credit crunch and the dot-com bubble. A decrease in investor confidence could suggest that financial reporting in general has

become less value relevant. Therefore, a similar relationship between financial reporting and value relevance would be anticipated for different financial crises. However, Bepari, Rahman and Mollik (2013) have discovered that the influence of financial crises on the value relevance of financial reporting can be more intricate.

Bepari et al. (2013) have investigated the value relevance of earnings and cash flows from operations prior and during the credit crunch. They have discovered that the value relevance of earnings had increased during the credit crunch when compared to the years before the crisis. More interestingly, they have discovered that cash flows from operations had become less value relevant. Devalle (2012) also found that earnings had become more value relevant after the credit crunch than before the credit crunch. This suggests that financial crises can have different effects on the value relevance of different types of financial information. Also, this could suggest that deferred tax assets have become less value relevant after the credit crunch in favour of other information.

Prior value relevance research generally suggests that deferred tax assets are value relevant to investors (refer to paragraph "2.4 The relevance of deferred tax assets"). The first hypothesis tested is therefore as follows:

> H1: When the credit crunch is not taken into consideration the amount of deferred tax assets in financial statements has a positive influence on a company's share price.

Existing research that has investigated the influence of financial crises on the value relevance of deferred tax assets is inconclusive. However, the studies of Badenhorst and Ferreira (2016), Bepari et al. (2013) and Devalle (2012) suggest that deferred tax assets may have become less value relevant after the credit crunch. This could be explained by the decline in confidence in the economic system after the credit crunch. The second hypothesis is therefore:

> H2: The credit crunch has had a negative influence on the value relevance of deferred tax assets.

Furthermore, the studies of Bepari et al. (2013) and Devalle (2012) suggest that earnings may have become more value relevant to investors while the value relevance of deferred tax assets has declined since the credit crunch. This has led to the following third hypothesis:

> H3: The value relevance of earnings has increased since the credit crunch while deferred tax assets have become less value relevant to investors.

2.7 Conceptual model

The following conceptual model is used to investigate these hypotheses:

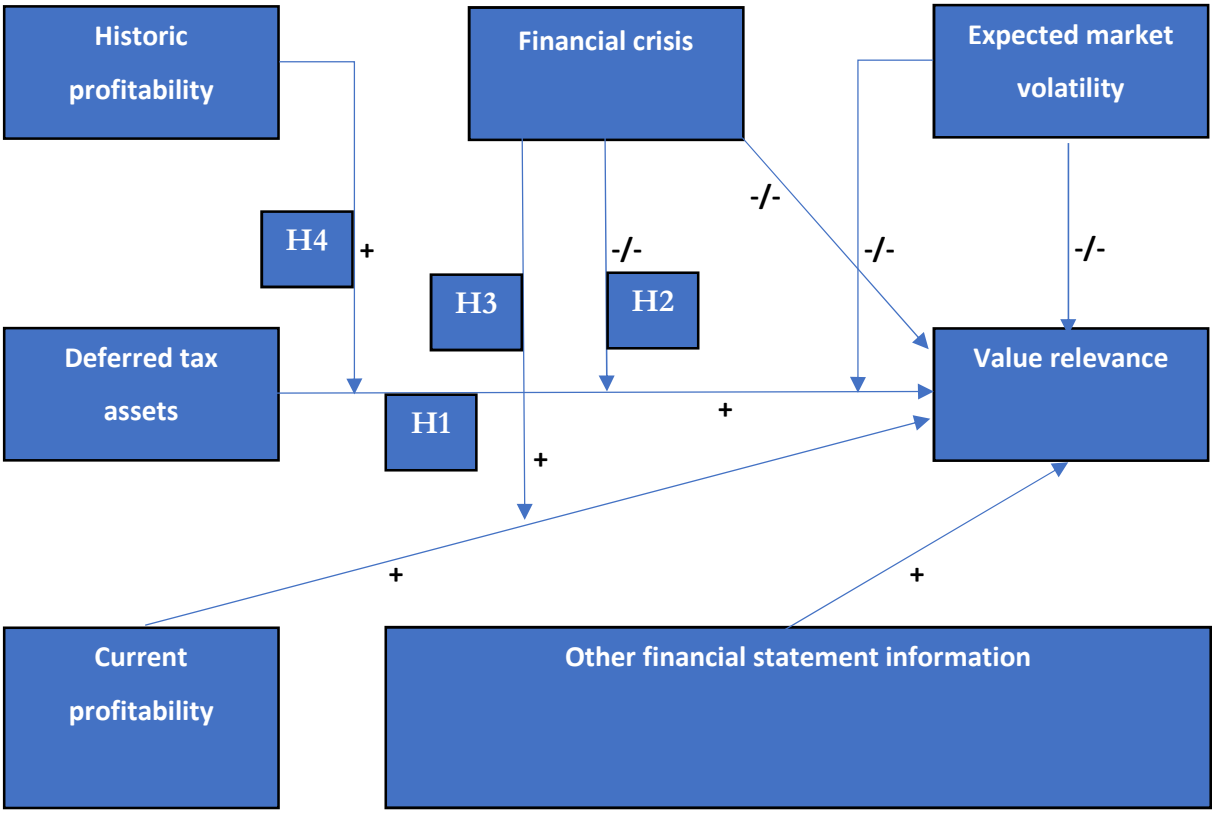

Figure 1: Conceptual model.

The conceptual model is based on Badenhorst and Ferreira (2016) and on Bauman and Das (2004). Both have used share prices as a proxy for value relevance. Also, both have applied the same general formula (based on Ohlson, 1995 and Ayers, 1998) to test their hypotheses, namely:

$$P = \alpha 1\ Ni + \alpha 2\ BV + \alpha 3\ Other\_info\ +\ \varepsilon$$

In this formula P is the share price, Ni is Net Income, BV is the book value of the deferred tax assets and Other_info comprises all other information in the financial statements. For this study the concepts "historic profitability" and "expected market volatility" are added to the model. The reason for doing so is that deferred tax assets can be recorded for both temporary differences and compensable losses (IAS 12.5; IAS 12.34). If a company has deferred tax assets for compensable losses a historically profitable firm could be viewed by investors as more likely to realise its deferred tax assets, while historically loss-making firms could be viewed as less likely to realise their deferred tax assets. This could potentially influence the value relevance of deferred tax assets. However, there is no existing research on the subject. The fourth hypothesis tested in this study is therefore as follows:

H4: The deferred tax assets of historically profitable firms are more value relevant to investors than the deferred tax assets of historically loss-making firms.

The concept "expected market volatility" is added to the model since (expected) uncertainty in the financial markets is reflected in the volatility of share prices (Bekaert & Hoerova, 2014; Goh, Li, Ng & Yong, 2015). The concept is added to the model to isolate the influence of the credit crunch from other market wide developments that may influence the value relevance of financial information. This is necessary to be able to determine whether the credit crunch has had an influence on the value relevance of deferred tax assets or whether any changes in the value relevance of deferred tax assets reflect uncertainty in the stock market.

2.8 Causal model

Bauman and Das (2004) have used the gross margin and shareholders' equity to measure other information in financial statements. Given that internet companies are their area of interest, Bauman and Das (2004) have also used specific measures relating to information provided by these companies. These measures are not used in this study since they are specific to internet companies. Here, a more varied sample of companies listed on the Amsterdam stock exchange is used, which makes these measures irrelevant. The following causal model is therefore used in this study:

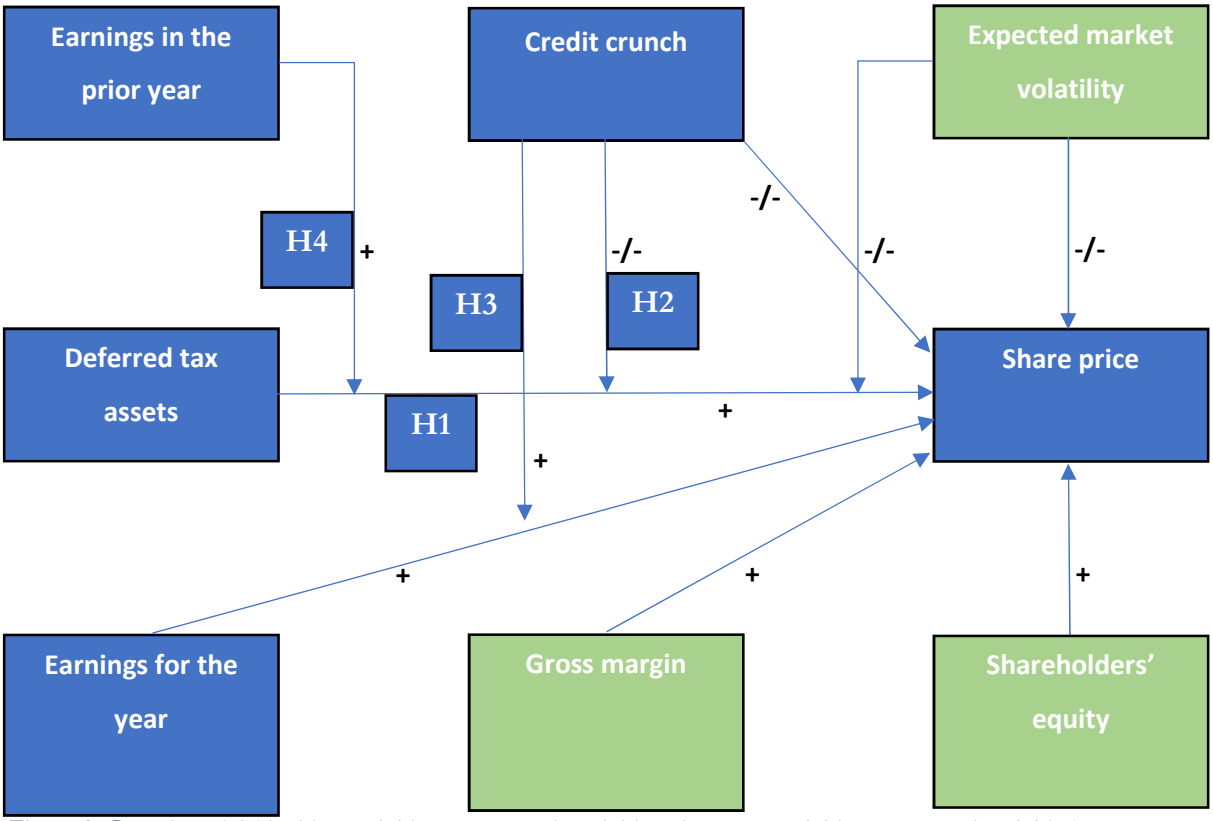

Figure 2: Causal model (the blue variables are research variables; the green variables are control variables).

2.9 Operationalisation

The variables are operationalised as follows:

2.9.1 Research variables

Deferred tax assets

Deferred tax assets are measured as the total amount of deferred tax assets in euros as reported in a company's financial statements at the end of the fiscal year. The operationalisation used is in line with for example Badenhorst and Ferreira (2016) and Bauman and Das (2004).

Credit crunch

Most prior studies that have investigated financial crises have used dichotomous variables such as year dummies to measure these financial crises. Examples are Badenhorst and Ferreira (2016), Bauman and Das (2004), Bepari et al. (2013) and Wang and Jahangir Ali (2013). However, potentially the use of year dummies could lead to validity issues when there are other underlying factors that influence the results. In other research areas a country's Gross National Product [GNP] (Rose & Spiegel, 2009; Lane & Milesi-Ferretti, 2010) has been used to measure whether there is a financial crisis.

In this study the first operationalisation of the credit crunch that is used is one using dichotomous variables. According to Badenhorst and Ferreira (2016) and most other prior research the years before 2007 are considered pre-crisis years (1= 1997 up until 2006; 0 = 2007 up until 2016). In line with Badenhorst and Ferreira (2016) separate crisis (1 = 2007 and 2008; 0 = otherwise) and post-crisis (1= 2009 up until 2016; otherwise = 0) indicator variables are used. The second operationalisation of the credit crunch that is used is the year on year development of the Gross National Product [GNP] in euros as reported by Statistics Netherlands [CBS]. The results of both approaches will be compared to determine whether there is a sign that there are validity issues. Also, this will be used as a robustness test.

Earnings for the year

Earnings for the year is measured as earnings per share in euros as reported in a company's financial statements at the end of the fiscal year. Contrary to Badenhorst and Ferreira (2016) and Bauman and Das (2004) earnings per share is used instead of net income to prevent multicollinearity. This is in line with the study of Baboukardos and Rimmel (2016).

Earnings in the prior year

Since there is no prior research on the influence of historic profitability on the value relevance of deferred tax assets historic profitability is measured using the earnings in the prior year. The amount of earnings before interest, taxation, depreciation and amortisation (EBITDA) in the prior year as reported in a company's financial statements is used to generate a dichotomous variable (0 = loss in the prior year; 1 = profit in the prior year). A dichotomous variable is used to reduce potential multicollinearity.

Share price

Share prices are measured using the closing share prices of the Amsterdam stock exchange at December 31 of each calendar year. This approach is in line with Badenhorst and Ferreira (2016) and Bauman and Das (2004).

2.9.2 Control variables

Expected market volatility

The expected market volatility is measured using the VIX-index (Bekaert & Hoerova, 2014; Goh et al., 2015). The VIX-index is commonly used to measure the market volatility expected by investors. The VIX-index (Goh et al., 2015) is based on a panel of S&P 500 option contracts and reflects the stock market uncertainty and the variance risk premium (p.1). To align the VIX-index data with the data on share prices the VIX-index as at December 31 of each year is used for this study. The VIX-index is used even though it is based on the S&P 500, instead of the Amsterdam stock exchange. Since the VIX-index is a commonly used measure and the credit crunch has had a global impact this is not expected to influence the results.

Gross margin

Bauman and Das (2004) have used the amount of gross margin as a control variable. This study measures gross margin using the gross margin percentages reported in company financial statements. By using a percentage instead of the gross margin amount potential bias due to company size is eliminated and the risk of multicollinearity is reduced.

Shareholders' equity

Ayers (1998), Badenhorst and Ferreira (2016) and Bauman and Das (2004) have measured shareholders' equity by separating shareholders' equity in a variable for the book value of assets and a variable for the book value of liabilities. Contrary to these studies, assets and liabilities are

not measured separately for practical reasons. Instead shareholders' equity is measured as the total amount of shareholders' equity in euros at the end of the fiscal year, thereby following the approach of Baboukardos and Rimmel (2016). However, in line with Badenhorst and Ferreira (2016) and Bauman and Das (2004), total shareholders' equity is adjusted for deferred tax assets to prevent multicollinearity.

2.9.3 Operational model

Based on the above operationalisation the operational model used in this study is as follows:

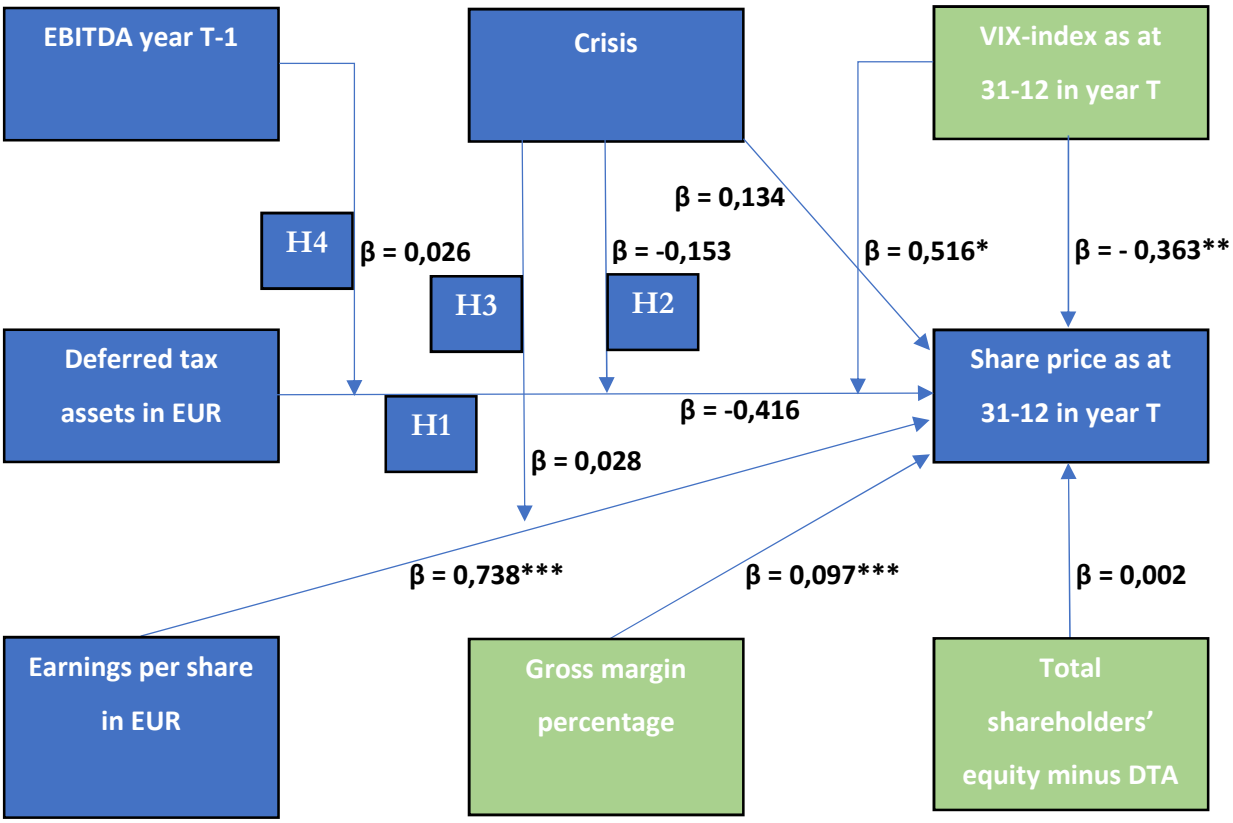

*Figure 3: Operational model including the relevant standardised regression coefficients and significance levels. For the full regression results refer to Table 11 on page 38. * = Significant at the 0,05 level (1-tailed), ** = Significant at the 0,01 level (1-tailed) and *** = Significant at the 0,001 level (1-tailed).*

For more detailed information about the operationalisation of the variables refer to "Appendix A: Overview of variables and definitions".

3. Research design

The research design used in this study is as follows:

3.1 Data collection method

The data used for this study is mainly collected from the Thomson Reuters Datastream database. Datastream is an international database containing company and financial information. The database contains the data of more than 10 million timeseries from 162 markets (Thomson Reuters, n.d). The obtained data consists of the company financial information of 125 companies listed on the Amsterdam stock exchange for a twenty-year period between 1997 and 2016. The sample contains all shares listed on the Amsterdam stock exchange that are included in the Thomson Reuters Datastream database. A twenty-year period is selected to obtain sufficient data before and after the credit crunch.

Additional data is collected from the StatLine database of Statistics Netherlands [CBS]. Statistics Netherlands (n.d). is the official Dutch administrative body that is charged with the publication of statistical information relating to the Netherlands. The StatLine database is the official Statistics Netherlands database and contains all data published by Statistics Netherlands (n.d). The obtained data from StatLine consists of data on the Dutch Gross National Product [GNP] of the Netherlands between 1997 and 2016.

Finally, the data for the VIX-index is obtained from the Chicago Board Options Exchange [CBOE] (2004). Using the obtained data from these sources, a dataset is generated. An overview of the variables contained in the dataset can be found in "Appendix B: Overview of variables included in the dataset".

3.2 Data analysis method

After data collection univariate, bivariate and multivariate analyses are performed on the dataset. These analyses are carried out using IBM SPSS Statistics (IBM, n.d). The analyses include initial assessments of the normality of the variables, multicollinearity, homoscedasticity and linearity of the regression models. Where necessary data transformations are made. To test the hypotheses

multiple regression analyses (Ordinary Least Squares) are carried out. This includes testing for potential moderating effects. Finally, robustness tests are carried out to verify the robustness of the results. The tests are described in more detail in chapter "4. Data analysis".

3.3 External validity

The dataset contains data on all the active companies on the Amsterdam stock exchange included in the Thomson Reuters Datastream database. The dataset is therefore representative for all the companies listed on the Amsterdam stock exchange when the data was gathered (november and december 2017). The dataset does not, however, contain data on 'dead companies'. These are companies that have gone bankrupt, that have been delisted, that have merged or that have moved from one stock exchange to another. The data of these companies, if they have been active between 1997 and 2016, is not included in the data obtained from the Thomson Reuters Datastream database. It is not likely this can be corrected, because for example Brückner (2013) and Ince and Porter (2006) have noted that the lists of dead companies in Thomson Reuters Datastream are often incomplete. However, exclusion of these 'dead companies' is unlikely to influence the results of this study since there are only a few of these companies.

4. Data analysis

After having obtained the data, it is analysed using the data analysis method described earlier in paragraph "3.2 Data analysis method". This chapter details the data analysis procedures that are carried out on the dataset and the outcomes of these analyses. First, the descriptive statistics and the transformations that are carried out on the data are described in paragraph "4.1 Descriptive statics". In paragraph "4.2 Preliminary tests" preliminary tests are carried out to determine whether the data is suitable for analysis using multiple regression analysis. Finally, the data is analysed in more detail in paragraph "4.3 Inferential statistics".

4.1 Descriptive statics

This paragraph provides details on the descriptive statistics of the variables that are used and the transformations that are carried out to prepare the data for further analysis. The descriptive statistics of the metric variables are detailed in subparagraph "4.1.1 Metric variables". Paragraph "4.1.2 Non-metric variables" provides details on the non-metric variables that are used.

4.1.1 Metric variables

The most relevant descriptive statistics of the metric variables that are ultimately used in this study are displayed in the tables below:

Variable / Descriptive	Deferred tax assets	Share price	Earnings per share	Gross National Product development in EUR
n	1.115	1.862	1.347	2.500
Mean (M)	9,862	2,575	0,075	968,750
Standard deviation (SD)	2,605	1,482	1,344	796,136
Median	9,699	2,629	0,122	993,000
Mode	8,520	1,791	-0,994	-1.502,000
Minimum	0,000	-3,218	-4,605	-1.502,000
Maximum	16,431	14,631	11,127	2.031,000
Skewness	0,015	0,812	0,498	- 1,272
Kurtosis	-0,362	6,635	5,291	2,257

Table 1: Descriptive statistics of the metric variables after transformations.

Variable / Descriptive	Gross margin %	Total shareholders' equity (X € 1.000)	VIX-index %	
n	1.677	1.505	2.500	
Mean (M)	22,699	3.603.449,054	2,987	
Standard deviation (SD)	222,447	12.397.660,147	0,309	
Median	28,250	318.713,000	3,016	
Mode	100,000	4.316,000	2,447	
Minimum	-5.766,670	-2.643.400,000	2,447	
Maximum	272,650	163.265.508,000	3,688	
Skewness	-20,976	7,430	0,042	
Kurtosis	479,590	68,670	-0,388	

Table 2: Descriptive statistics of the metric variables after transformations (continued).

In the following subparagraphs the descriptive statistics of these variables and the transformations are discussed in detail.

4.1.1.1 Deferred tax assets

Before transformations are carried out on the original variable obtained from the Datastream database (in thousands of euros), univariate analysis shows that the average amount of deferred tax assets on the balance sheet of companies listed on the Amsterdam stock exchange is € 209.360.950 (n=1.116; M=209.360,950; SD=792.583,470). An inspection of the frequency table shows that the variable contains one negative value of € 30.357 negative. This is not logical since the variable only relates to assets and does not relate to liabilities. To confirm the negative value is onerous the amount is reconciled with the financial statements of that company. These show that the value is in fact onerous, since the company had no deferred tax assets at that time. The value is therefore recorded as a missing value.

Also, univariate analysis of the original variable in the dataset shows that the variable is both very skewed and very peaked (Skewness=8,481; Kurtosis=97,737). To resolve this an LN-transformation is carried out on the variable to transform it to a logarithm. After the LN-transformation the variable (n=1.115; M=9,862; SD=2,605) has a rather normal distribution, since the skewness and kurtosis both do not exceed -1 or +1 (Skewness=0,015; Kurtosis=-0,362). Additional transformations are therefore deemed not to be necessary.

4.1.1.2 Share price

The dependent variable of this study, share price, is a metric variable obtained from the Datastream database. Univariate analysis of the variable (before transformations) shows that the average share

price of the companies included in the sample is € 13,87 (n=1.862; M=13,872; SD=52.518,548). Also, the analysis shows that the variable is both skewed and peaked (Skewness=42,794; Kurtosis=1.840,868). To resolve this an LN-transformation is carried out on the variable to transform it to a logarithm. After the LN-transformation the variable (n=1.862; M=2,575; SD=1,482) is significantly less skewed (Skewness=0,812). However, the transformed variable is still rather peaked (Kurtosis=6,635). Since this could potentially influence the reliability of results obtained using multiple regression analysis the impact of the distribution of the variable is reviewed in more detail in paragraph "4.2.1 Normality of the dependent variable".

4.1.1.3 Earnings per share

The earnings per share variable is obtained from the Datastream database. Univariate analysis of the original variable (n=1.347; M=41,685; SD=1.618,251) shows that on average the earnings per share of companies in the sample amount to € 41,68. Also, univariate analysis shows that the variable is both very skewed and very peaked (Skewness=42,009; Kurtosis= 1.765,141). To resolve this an LN-transformation is carried out on the variable to transform it to a logarithm. After the LN-transformation the variable (n=1.347; M=0,075; SD=1,344) is still rather peaked since the kurtosis still exceeds +1 (Skewness=0,498; Kurtosis=5,291). Since the variable is not a dependent variable and the kurtosis of the variable could only potentially lead to results that are too conservative, additional transformations are not deemed to be necessary.

4.1.1.4 Gross National Product development

The year on year development of the Gross National Product (one of the variables for the credit crunch) is obtained using data from the StatLine database of Statistics Netherlands (n.d). Univariate analysis of the variable shows that the average year on year change in Gross National Product is € 968,75 between 1997 and 2016 (n=2.500; M=968,750; SD=796,136). Also, univariate analysis shows that the variable is both skewed and peaked since both the skewness and kurtosis both exceed -1 respectively +1 (Skewness=-1,272; Kurtosis=2,257). Since it is to be expected that the variable has both negative and positive values, no further transformations are carried out on the variable (Minimum=-1.502,000; Maximum=2.031,000).

4.1.1.5 Gross margin percentage

The variable gross margin percentage is obtained from the Datastream database. Univariate analysis of the variable shows that on average the companies in the sample have a gross margin percentage of around 22,7 percent (n=1.677; M=22,699; SD=222,447). Also, univariate analysis shows that

the variable is both very skewed and very peaked since both the skewness and kurtosis both exceed -1 respectively +1 (Skewness=-20,976; Kurtosis=479,590). No further transformations are carried out on the variable since it is logical the variable has both negative and positive values (Minimum= -5.766,670; Maximum=272,650). It is not anticipated this will influence the results since the variable is a control variable.

4.1.1.6 Total shareholders' equity

Total shareholders' equity is a variable that is obtained from the Datastream database. The variable is measured in thousands of euros. Univariate analysis of the variable shows that on average the companies in the sample have € 3.812.810.007 in shareholders equity (n=1.961; M=3.812.810,007; SD=12.967.060,580). Also, the variable is skewed and peaked (Skewness=8,478; Kurtosis=91,087). In line with Badenhorst and Ferreira (2016) and Bauman and Das (2004) the variable is adjusted for deferred tax assets to prevent multicollinearity. This is done by subtracting the amount of deferred tax assets for each company from its total shareholders' equity. After this adjustment the average shareholders' equity amounts to € 3.603.449.054 (n=1.505; M=3.603.449,054; SD=12.397.660,147). Also, the adjusted variable is still skewed and peaked (Skewness=7,430; Kurtosis=68,670). This is not adjusted since the variable is a control variable and because a large range of both positive and negative values is logical for this variable. No further transformations are therefore carried out.

4.1.1.7 VIX-index

The VIX-index data is obtained from the Chicago Board Options Exchange (2004). Univariate analysis of the original variable shows that the average VIX-index between 1997 and 2016 was 20,804 percent (n=2.500; M=20,804; 6,598). However, the variable has a slight kurtosis (Skewness=0,928; Kurtosis=1,299). A LN-transformation is carried out to resolve this. After the LN-transformation the variable (n= 2.500; M= 2,987; SD=0,309) has a rather normal distribution (Skewness=0,042; Kurtosis=-0,388). Further transformations are determined not to be necessary.

4.1.2 Non-metric variables

The most relevant descriptive statistics of the non-metric variables that are ultimately used in this study are displayed in the next table:

Variable	Category	Frequency	Percentage of n
EBITDA year T-1	1 = profit in the prior year	1.532	86,7%
	0 = loss in the prior year	235	13,3%
	Total	1.767	100,0%
Crisis	1 = 2007 and 2008	250	10,0%
	0 = otherwise	2.250	90,0%
	Total	2.500	100,0%
Post-crisis	1 = 2009 up until 2016	1.000	40,0%
	0 = otherwise	1.500	60,0%
	Total	2.500	100,0%

Table 3: Descriptive statistics of the non-metric variables after transformations.

In the following subparagraphs the descriptive statistics of these variables and the transformations are discussed in detail.

4.1.2.1 EBITDA year T-1

The variable EBITDA year T-1 (historic profitability) is generated from EBITDA data obtained from the Datastream database. The original variable is a numerical variable for EBITDA in the prior year (n=1.767; M=928.380,527; SD=3.823.883,334). To prevent multicollinearity, the variable is transformed into a dichotomous variable (0 = loss in the prior year; 1= profit in the prior year). The descriptive statistics of the variable are displayed in "Table 3: Descriptive statistics of the non-metric variables after transformations". No other transformations are carried out on the variable.

4.1.2.2 Credit crunch dummy variables

The credit crunch dummy variables (crisis and post-crisis) are generated using data from the Datastream database indicating the fiscal year of the financial statements. The descriptive statistics of these variables are displayed in "Table 3: Descriptive statistics of the non-metric variables after transformations". No other transformations are carried out.

4.2 Preliminary tests

After univariate analyses have been performed, preliminary tests are carried out to determine whether the data is suitable for analysis using multiple regression analysis. The procedures are described in more detail in the next subparagraphs.

4.2.1 Normality of the dependent variable

The univariate analyses in paragraph "4.1.1.2 Share price" indicate that the dependent variable, share price, is still rather peaked after it is transformed to a logarithm (Skewness=0,812; Kurtosis=6,635). An inspection of the histogram also indicates a non-normal distribution of the variable. To verify the non-normal distribution of the dependent variable the Kolmogorov-Smirnov test is performed. This confirms that the variable has a non-normal distribution (D=0,081; df=1.862; p<0,001). However, since the dependent variable is peaked instead of skewed, this could only potentially lead to too conservative results. This is therefore considered to be a potential limitation of this study.

4.2.2 Association between the variables

After univariate analysis is carried out on the variables, bivariate analysis is performed on the variables. The associations between the variables are assessed using the Pearson Product Moment Correlations between the predictive variables and the dependent variable, share price.

First the associations between the non-crisis variables are assessed. The results are displayed in the following correlation matrix:

	Deferred tax assets	Earnings per share	Gross margin %	Total shareholders' equity	EBITDA year T-1	VIX-index
Deferred tax assets	1					
Earnings per share	0,129 ***	1				
Gross margin %	0,038	0,140 ***	1			
Total shareholders' equity	0,432 ***	0,094 ***	-0.011	1		
EBITDA year T-1	0,200 ***	0,031	0,117 ***	0,071 **	1	
VIX-index	0,020	0,003	0,031	-0,013	0,078 **	1
Share price	0,190 ***	0,779 ***	0,010	0,120 ***	0,096 ***	-0,044 *

* = Significant at the 0,05 level (1-tailed), ** = Significant at the 0,01 level (1-tailed) and *** = Significant at the 0,001 level (1-tailed)

Table 4: Correlation matrix.

Second, the associations between the crisis variables and the other variables are assessed. The results are displayed in the next correlation matrix:

	Gross National Product development	Crisis	Post-crisis
Deferred tax assets	-0,023	-0,052 *	0,030
Earnings per share	0,042	0,096 ***	-0.018
Gross margin %	0,011	0,015	0,001
Total shareholders' equity	-0,023	-0,003	0,064 **
EBITDA year T-1	0,136 ***	0,013	-0,101 ***
VIX-index	0,119 ***	0,446 ***	-0,258 ***
Share price	0,113 ***	-0,009	-0,095 ***
Gross National Product development	1	0,327 ***	-0,683 ***
Crisis	0,327 ***	1	--0,272 ***
Post-crisis	-0,683 ***	--0,272 ***	1
* = Significant at the 0,05 level (1-tailed), ** = Significant at the 0,01 level (1-tailed) and *** = Significant at the 0,001 level (1-tailed)			

Table 5: Correlation matrix (continued).

4.2.2.1 Research variables

The correlation matrix in Table 4 shows that there is a weak positive correlation (r=0,190; p<0,001; 1-tailed) between deferred tax assets (n=1.115; M=9,862; SD=2,605) and share prices (n=1.862; M=2,574; SD=1,482). This suggests, when the other variables are excluded, that an increase in the amount of deferred tax assets leads to an increase in share prices. This is consistent with the prediction of the causal model.

Earnings per share (n=1.347; M=0,075; SD=1,344) has a strong positive correlation (r=0,779; p<0,001; 1-tailed) with share prices (n=1.862; M=2,574; SD=1,482). This suggests, when the other variables are excluded, that an increase in the amount of earnings per share leads to an increase in share prices. This is consistent with the prediction of the causal model.

The indicator variable EBITDA year T-1 (0 = loss in the prior year; 1= profit in the prior year) has a very weak but significant positive correlation (r=0,096; p<0,001; 1-tailed) with share prices (n=1.862; M=2,574; SD=1,482). This suggests, when the other variables are excluded, that if a company has a positive historic profitability (a profit in the prior year) this leads to an increase in its share price. This would support the prediction of the causal model.

The correlation matrix in Table 4 shows that there is a very weak but significant negative correlation (r= -0,044; p<0,05; 1-tailed) between the VIX-index (n= 2.500; M= 2,987; SD=0,309) and share prices (n=1.862; M=2,574; SD=1,482). This suggests that an increase of expected market volatility leads to a decrease in share prices. This would support the prediction of the causal model.

Table 5 shows that the two crisis variables and the post-crisis variable have a very weak negative correlation with share prices. However, the correlation between the indicator variable crisis (1= 2007 up until 2008; otherwise = 0) and share prices is not significant (r=-0,009; not significant; 1-tailed). This correlation could therefore be coincidence. The Gross National Product development variable (n=2.500; M=968,750; SD=796,136) has a weak positive correlation (r=0,113; p<0,001; 1-tailed) with share prices (n=1.862; M=2,574; SD=1,482). This suggests that an increase in Gross National Product leads to higher share prices. The post-crisis variable (1= 2009 up until 2016; otherwise = 0) has a weak negative correlation (r= -0,095; p<0,001; 1-tailed) with share prices. This indicates that after the credit crunch share prices have decreased when compared to the period before the credit crunch.

4.2.2.2 Control variables

Table 4 also shows that the control variable gross margin percentage (n=1.677; M=22,699; SD=222,447) has no significant correlation (r=0,010; not significant; 1-tailed) with share prices (n=1.862; M=2,574; SD=1,482). The very weak positive influence of the gross margin percentages on share prices could therefore be based on coincidence. As predicted by the causal model, total shareholders' equity (n=1.505; M=3.603.449,054; SD=12.397.660,147) has a weak positive influence (r=0,120; p<0,001; 1-tailed) on share prices (n=1.862; M=2,574; SD=1,482). This indicates that an increase in shareholders' equity leads to higher share prices.

4.2.3 Multicollinearity

The correlation matrixes (Table 4 and Table 5) are also reviewed to determine whether there are indications of a high degree of multicollinearity between the independent variables (correlations exceeding 0,4). The variables deferred tax assets and total shareholders' equity have a reasonably strong positive correlation (r=0,432; p<0,001; 1-tailed). This is to be expected since the variable total shareholders' equity has in line with Badenhorst and Ferreira (2016) and Bauman and Das (2004) been adjusted for deferred tax assets. Since the correlation does not exceed 0,7 the multicollinearity between the two independent variables is determined to be acceptable. Also, there is a strong correlation between the Gross National Product development variable and the post-

crisis variable (r=-0,683; p<0,001; 1-tailed). This is determined to be acceptable since these variables are both crisis variables and are not used simultaneously in the regression models. Multicollinearity between these variables will therefore not be an issue.

4.3 Inferential statistics

Based on the preliminary tests the data can be analysed using multiple regression analysis. To test the hypotheses of this study several multiple regression models will be estimated. Model 1 is a model without credit crunch variables and without interactions. This is done to be able to determine whether there are any indications of moderating effects. Model 1 is as follows:

$$y_1 P = a + b1\ \textit{Deferred tax assets} + b2\ \textit{Earnings per share} + b3\ \textit{Gross margin percentage} + b4\ \textit{Total shareholders' equity} + b5\ \textit{EBITDA year T-1} + b6\ \textit{VIX-index} + e_i = \hat{y} + e_i$$

Model 1:Regression model without the credit crunch and without interactions.

Model 2 and model 3 will include crisis variables. Model 2 will include the crisis (1 = 2007 and 2008; 0 = otherwise) and post-crisis (1= 2009 up until 2016; otherwise = 0) indicator variables. Model 3 will include Gross National Product development as a variable for the credit crunch. Model 2 is as follows:

$$y_1 P = a + b1\ \textit{Deferred tax assets} + b2\ \textit{Earnings per share} + b3\ \textit{Gross margin percentage} + b4\ \textit{Total shareholders' equity} + b5\ \textit{EBITDA year T-1} + b6\ \textit{VIX-index} + \mathbf{b7\ Crisis} + \mathbf{b8\ Post\text{-}crisis} + e_i = \hat{y} + e_i$$

Model 2: Regression model with dummy variables as measures for the credit crunch (differences from the previous model are marked in blue).

Model 3 is as follows:

$$y_1 P = a + b1\ \textit{Deferred tax assets} + b2\ \textit{Earnings per share} + b3\ \textit{Gross margin percentage} + b4\ \textit{Total shareholders' equity} + b5\ \textit{EBITDA year T-1} + b6\ \textit{VIX-index} + \mathbf{b7\ Gross\ National\ Product\ development} + e_i = \hat{y} + e_i$$

Model 3: Regression model with Gross National Product development as a measure for the credit crunch (differences from the previous model are markea in blue).

After these models have been estimated the full models (model 4 and 5) will be estimated. Model 4 and 5 will include both crisis variables and interaction variables. Separate models will be used for the credit crunch indicator variables and the Gross National Product [GNP] crisis variable. Model 4 includes the crisis (1 = 2007 and 2008; 0 = otherwise) and post-crisis (1= 2009 up until 2016;

otherwise = 0) indicator variables and their respective interaction variables to test the hypotheses. Models 4 is as follows:

y_1 P = a + b1 *Deferred tax assets* + b2 *Earnings per share* + b3 *Gross margin percentage*
+ b4 *Total shareholders' equity* + b5 *EBITDA year T-1* + b6 *VIX-index* **+ b7 *Crisis***
+ b8 *Post-crisis* + b9 *Deferred tax assets X Crisis*
+ b10 *Deferred tax assets X Post-crisis* + b11 *Earnings per share X Crisis*
+ b12 *Earnings per share X Post-crisis* + b13 *Deferred tax assets X EBITDA year T-1*
+ b14 *Deferred tax assets X VIX-index* + e_i = $\hat{y}$ + e_i

Model 4: Full model with dummy variables as measures for the credit crunch (differences from the previous model are marked in blue).

With model 5 the tests carried out on model 4 will be replicated using the Gross National Product [GNP] variable and its respective interaction variables. Model 5 is therefore as follows:

y_1 P = a + b1 *Deferred tax assets* + b2 *Earnings per share* + b3 *Gross margin percentage*
+ b4 *Total shareholders' equity* + b5 *EBITDA year T-1* + b6 *VIX-index*
+ b7 *Gross National Product development*
+ b8 *Deferred tax assets X Gross National Product development*
+ b9 *Earnings per share X Gross National Product development*
+ b10 *Deferred tax assets X EBITDA year T-1* + b11 *Deferred tax assets X VIX-index*
+ e_i = $\hat{y}$ + e_i

Model 5: Full model with Gross National Product development as a measure for the credit crunch (differences from the previous model are marked in blue).

Finally, the full model with dummy variables (model 4) will be estimated without the interaction variable used for the interaction between deferred tax assets and the VIX-index. This will be done in model 6 to assess the necessity to include the VIX interaction variable in the model. Model 6 is therefore as follows:

y_1 P = a + b1 *Deferred tax assets* + b2 *Earnings per share* + b3 *Gross margin percentage*
+ b4 *Total shareholders' equity* + b5 *EBITDA year T-1* + b6 *VIX-index* **+ b7 *Crisis***
+ b8 *Post-crisis* + b9 *Deferred tax assets X Crisis*
+ b10 *Deferred tax assets X Post-crisis* + b11 *Earnings per share X Crisis*
+ b12 *Earnings per share X Post-crisis* + b13 *Deferred tax assets X EBITDA year T-1*
+ e_i = $\hat{y}$ + e_i

Model 6: Model with crisis dummy variables excluding the VIX-index interaction (differences from the previous model are marked in blue).

4.3.1 Results for the regression models

The results for each of the regression models are displayed in the table below:

Model	Description	F =	df =	p =	Adj. R^2
1	Model without crisis and interaction variables	211,736	6, 702	p<0,001	0,641
2	Model with dummy crisis variables	158,516	8, 700	p<0,001	0,640
3	Model with GNP development variable	181,267	7, 701	p<0,001	0,641
4	Full model with crisis dummy variables	91,963	14, 694	p<0,001	0,643
5	Full model with GNP development variable	115,484	11, 697	p<0,001	0,640
6	Model with crisis dummy variables excluding the VIX-index interaction	98,434	13, 695	p<0,001	0,641

Table 6: Results for the regression models.

All regression models are statistically significant at the p<0,001 level. Also, all models have an adjusted R^2 of 0,64 or higher. The models therefore have an explanatory power of the variance in share prices of over 64 percent. This is consistent with Badenhorst and Ferreira (2016). The full results for the various regression models are included in "Appendix D: Overview of regression results". The results of the regression analyses are discussed in more detail in chapter "5. Findings".

4.3.2 Multicollinearity

Using the VIF-scores of the variables used in the models without interactions (model 1 up until 3) the amount of multicollinearity is assessed:

Model / Variable	Model 1 VIF=	Model 2 VIF=	Model 3 VIF=
Deferred tax assets	1,215	1,241	1,216
Earnings per share	1,047	1,051	1,049
Gross margin percentage	1,025	1,092	1,032
Total shareholders' equity	1,213	1,228	1,214
EBITDA year T-1	1,010	1,012	1,015
VIX-index	1,009	1,702	1,009
Crisis		2,159	
Post-crisis		1,437	
Gross National Product development			1,013

Table 7: Overview of VIF-scores (excluding models with interactions).

The above table shows that nearly all variables have a VIF-score well below 2. Only the crisis variable in model two has a slightly elevated VIF-score since it has a VIF-score of 2,159. The amount of multicollinearity is determined to be acceptable since a certain amount of correlation between the crisis and post-crisis variable is logical and since there is not an exceedingly high amount of multicollinearity.

4.3.3 Normality of residuals

The normality of the residuals is assessed to determine whether the underlying assumption for multiple regression analysis that the residuals have a normal distribution hold. This is assessed by examining the skewness and kurtosis of the residuals, by examining the histograms of the residuals and by testing the normal distribution of the residuals using the Kolmogorov-Smirnov test. The results are displayed in the table below:

Descriptive	**Model 1:** Model without crisis and interaction variables	**Model 2:** Model with dummy crisis variables	**Model 3:** Model with GNP development variable	**Model 4:** Full model with crisis dummy variables	**Model 5:** Full model with GNP development variable	**Model 6:** Model with crisis dummy variables excluding the VIX-index interaction
Skewness =	0,321	0,319	0,322	0,350	0,311	0,345
Kurtosis =	3,551	3,549	3,578	3,964	3,489	3,821
D =	0,062	0,063	0,063	0,067	0,063	0,066
df =	709	709	709	709	709	709
p =	p<0,001	p<0,001	p<0,001	p<0,001	p<0,001	p<0,001

Table 8: Normality descriptives residuals.

The normality tests show that the residuals of all models are peaked, but not skewed. All residuals have a kurtosis exceeding +1. The Kolmogorov-Smirnov test also shows that the assumption that the residuals have a normal distribution should be rejected. The Kolmogorov-Smirnov test is statistically significant on the p<0,001 level for each model's residuals. This shows that the residuals have a non-normal distribution. Since the residuals are peaked instead of being skewed this could only potentially lead to results that are too conservative. This is a potential limitation of this study.

4.3.4 Homoscedasticity and linearity of the regression models

Finally, the scatterplots of the residuals are inspected to determine whether the assumptions of homoscedasticity and linearity of the regression models hold. The scatterplots are included in "Appendix E: Scatterplots of the residuals". Inspection of the scatterplots shows that the residuals are rather clustered together. This shows that there is no sign of heteroscedasticity. The scatterplots also do no show signs of non-linearity. The assumptions of homoscedasticity and linearity of the regression models are therefore not rejected.

5. Findings

In this chapter the findings of this study are discussed in detail. First, the results of the regression models without interaction variables are discussed in paragraph "5.1 The value relevance of deferred tax assets without the credit crunch". After that the results of the regression models with interaction variables are discussed in the paragraphs that follow. Finally, in paragraph "5.5 Robustness tests" the robustness of the results is discussed.

5.1 The value relevance of deferred tax assets without the credit crunch

Most prior value relevance research suggests that deferred tax assets are value relevant to investors. However, few researchers have taken the effect of financial crises into consideration. The first step is therefore to analyse the outcomes of regression models 1, 2 and 3, since these models do not include any crisis related interaction variables. In line with prior research the results for model 1 F (6, 702) =211,736 p<0,001 show that deferred tax assets have a weak positive influence (β=0,103; t=4,169; p<0,001 1-tailed) on share prices. This indicates that deferred tax assets are value relevant to investors when the effects of the credit crunch are not taken into consideration. The table below shows the regressions results for model 1:

	Variable	Expected Direction	B=	β=	t=	p= (1-tailed)	VIF
Model 1: Model without crisis and interaction variables	Deferred tax assets	+	0,041	0,103	4,169	0,000***	1,215
	Earnings per share	+	0,647	0,754	32,705	0,000***	1,047
	Gross margin percentage	+	0,005	0,099	4,342	0,000***	1,025
	Total shareholders' equity	+	0,000	0,007	0,284	0,388	1,213
	EBITDA year T-1	+	0,315	0,050	2,199	0,014*	1,010
	VIX-index	-/-	-0,546	-0,173	-7,640	0,000***	1,009
* = Significant at the 0,05 level (1-tailed), ** = Significant at the 0,01 level (1-tailed) and *** = Significant at the 0,001 level (1-tailed)							

Table 9: Results for the regression model without the credit crunch and without interactions (model 1).

When the credit crunch variables are added in model 2 (crisis and post-crisis) and model 3 (Gross National Product development) the results remain robust. In both model 2 F (8, 700) = 158,516 p<0,001 and model 3 F (7, 701) = 181,267 p<0,001 deferred tax assets have a weak positive influence (model 2: β=0,102; t=4,080; p<0,001 1-tailed; model 3: β=0,104; t=4,170; p<0,001 1-tailed) on share prices. This provides additional support that deferred tax assets are value relevant

when any moderating effects of financial crises are not taken into consideration. Hypothesis one is therefore confirmed. The other regression coefficients and significance levels also remain rather in line with model 1. Furthermore, in all three models the VIX-index has a weak negative influence on share prices (model 1: β=-0,173; t=-7,640; p<0,001 1-tailed, model 2: β=-0,162; t=-5,525; p<0,001 1-tailed, model 3: β=-0,173; t=-7,634; p<0,001 1-tailed). This indicates that an increase of the expected market volatility leads to lower share prices. The results of models 2 and 3 are displayed in the table below:

	Variable	Expected direction	B=	β=	t=	p= (1-tailed)	VIF
Model 2: Model with dummy crisis variables	Deferred tax assets	+	0,041	0,102	4,080	0,000***	1,241
	Earnings per share	+	0,647	0,754	32,634	0,000***	1,051
	Gross margin percentage	+	0,005	0,098	4,148	0,000***	1,092
	Total shareholders' equity	+	0,000	0,007	0,277	0,390	1,228
	EBITDA year T-1	+	0,320	0,050	2,223	0,013*	1,012
	VIX-index	-/-	-0,514	-0,162	-5,525	0,000***	1,702
	Crisis	-/-	-0,046	-0,016	-0,478	0,316	2,159
	Post-crisis	-/-	0,011	0,005	0,193	0,423	1,437
Model 3: Model with GNP development variable	Deferred tax assets	+	0,041	0,104	4,170	0,000***	1,216
	Earnings per share	+	0,647	0,753	32,643	0,000***	1,049
	Gross margin percentage	+	0,005	0,100	4,349	0,000***	1,032
	Total shareholders' equity	+	0,000	0,007	0,293	0,385	1,214
	EBITDA year T-1	+	0,312	0,049	2,172	0,015*	1,015
	VIX-index	-/-	-0,546	-0,173	-7,634	0,000***	1,009
	Gross National Product development	+	0,000	0,007	0,307	0,379	1,013

* = Significant at the 0,05 level (1-tailed), ** = Significant at the 0,01 level (1-tailed) and *** = Significant at the 0,001 level (1-tailed)

Table 10: Results for the regression models with crisis variables, but without interaction variables (model 2 and model 3).

5.2 The influence of the credit crunch on the value relevance of deferred tax assets

In the previous paragraph it was demonstrated that without interaction variables deferred tax assets appear to be value relevant. However, when the crisis interaction variables and the VIX-index interaction variable are added to the models the results are astonishing. The most dramatic differences can be noticed in model 4 (adjusted R^2=0,643), the full model with dummy variables

for the credit crunch (crisis: 1 = 2007 and 2008; 0 = otherwise, post-crisis: 1= 2009 up until 2016; otherwise = 0). The results for model 4 F (14, 694) =91,963 p<0,001 are displayed in the table below:

Variable	Expected direction	B=	β=	t=	p= (2-tailed)	p= (1-tailed)	VIF
Deferred tax assets	+	-0,166	-0,416	-1,506	0,133	0,066	151,190
Earnings per share	+	0,634	0,738	19,658	0,000	0,000***	2,795
Gross margin percentage	+	0,005	0,097	4,055	0,000	0,000***	1,122
Total shareholders' equity	+	0,000	0,002	0,062	0,951	0,475	1,254
EBITDA year T-1	+	0,222	0,035	0,420	0,675	0,337	13,829
VIX-index	-/-	-1,148	-0,363	-3,122	0,002	0,001**	26,807
Crisis	-/-	0,390	0,134	1,016	0,310	0,155	34,269
Post-crisis	-/-	-0,318	-0,151	-1,397	0,163	0,081	23,120
Deferred tax assets X Crisis	-/-	-0,044	-0,153	-1,207	0,228	0,114	31,912
Deferred tax assets X Post-crisis	-/-	0,033	0,170	1,572	0,116	0,058	23,034
Earnings per share X Crisis	+	0,010	0,028	0,167	0,868	0,434	57,494
Earnings per share X Post-crisis	+	0,005	0,002	0,075	0,940	0,470	1,560
Deferred tax assets X EBITDA year T-1	+	0,033	0,026	0,763	0,446	0,223	2,385
Deferred tax assets X VIX-index	-/-	0,064	0,516	1,846	0,065	0,032*	154,801
* = Significant at the 0,05 level (1-tailed), ** = Significant at the 0,01 level (1-tailed) and *** = Significant at the 0,001 level (1-tailed)							

Table 11: Results for model 4 with crisis dummy variables as measures for the credit crunch.

The first striking difference between model 4, the previous models and prior research is that the direct effect of deferred tax assets is not significant (β=-0,416; t=-1,506; not significant). What is also striking is that the direction of the direct effect of deferred tax assets has shifted from a positive effect on share prices to a negative effect. However, since the direct effect of deferred tax assets on share prices is not significant this could be caused by coincidence. Therefore, no inferences can be drawn from this change of direction. One inference that can be drawn is that the addition of the interaction variables to the model has highlighted that there are moderating effects in model 4

that cause the direct effect of deferred tax assets on share prices to be not significant anymore. For a general discussion about moderating effects refer to Baron and Kenny (1986).

Prior research by Badenhorst and Ferreira (2016) and Bauman and Das (2004) suggests that the moderating effect noted above is caused by a financial crisis, in this case the credit crunch. However, the results for regression model 4 indicate otherwise. Both the crisis and the post-crisis variables have a weak negative (β=-0,153; t=-1,207; not significant) respectively a weak positive (β=0,170; t=1,572; not significant) effect on the value relevance of deferred tax assets. The effects are however not statistically significant. Therefore, the effects could be based on coincidence. This suggests, in contradiction with Badenhorst and Ferreira (2016), that the credit crunch has had no influence on the value relevance of deferred tax assets.

Model 5 F (11, 697) =115,484 p<0,001 provides additional support for this contention and is also a robustness test. In model 5 Gross National Product development is used to measure the credit crunch. The relationship of the Gross National Product development variable is the inverse of the relationship for the crisis dummy variables since a decline in Gross National Product from the prior year is an indication of economic down turn. The results for model 5 are displayed in the table below:

Variable	Expected direction	B=	β=	t=	p= (2-tailed)	p= (1-tailed)	VIF
Deferred tax assets	+	-0,063	-0,157	-0,651	0,515	0,257	114,382
Earnings per share	+	0,643	0,749	19,005	0,000	0,000***	3,052
Gross margin percentage	+	0,005	0,102	4,416	0,000	0,000***	1,042
Total shareholders' equity	+	0,000	0,011	0,445	0,657	0,328	1,233
EBITDA year T-1	+	0,345	0,054	0,649	0,517	0,258	13,839
VIX-index	-/-	-0,884	-0,280	-3,092	0,002	0,001**	16,076
Gross National Product development	+	-0,000	-0,071	-1,063	0,288	0,144	8,770
Deferred tax assets X Gross National Product development	+	0,351	0,086	1,225	0,221	0,110	9,624
Earnings per share X Gross National	+	0,000	0,008	0,198	0,843	0,421	3,013

Product development							
Deferred tax assets X EBITDA year T-1	+	-0,004	-0,010	-0,061	0,952	0,476	57,582
Deferred tax assets X VIX-index	-/-	0,033	0,267	1,197	0,232	0,116	97,846
* = Significant at the 0,05 level (1-tailed), ** = Significant at the 0,01 level (1-tailed) and *** = Significant at the 0,001 level (1-tailed)							

Table 12: Results for model 5 with Gross National Product development as a measure for the credit crunch.

The results for model 5 are rather similar compared to model 4. Model 5 also indicates that deferred tax assets are not value relevant (β=-0,157; t=-0,651; not significant) and that the credit crunch (β=0,086; t=1,225; not significant) has had no influence on the value relevance of deferred tax assets. Hypothesis two is therefore not supported.

The finding that the credit crunch has had no influence on the value relevance of deferred tax assets is astonishing, especially since it contradicts with prior research by Badenhorst and Ferreira (2016). Model 4 and model 5 appear to suggest an explanation for this. The VIX-index in model four has a strong positive influence (β=0,516; t=1,846; p<0,05) on the value relevance of deferred tax assets. The interaction between deferred tax assets and the VIX-index is not significant in model 5 (β=0,267; t=1,197; not significant), but inclusion of the interaction variable appears to have a similar effect on the crisis variable in the model compared to model 4. The interaction between deferred tax assets and the VIX-index moderates the value relevance of deferred tax assets in such a way that deferred tax assets are not value relevant and that the credit crunch has no significant influence on the value relevance of deferred tax assets. This is something that was not considered in the study of Badenhorst and Ferreira (2016).

One could argue that the VIX-index is in fact a measure for a financial crisis since it measures expected market volatility, a common phenomenon during a crisis. However, that the VIX-index measures a separate concept from the crisis measures (crisis, post-crisis and Gross National Product development) can statistically be supported because in paragraph "4.2.2 Association between the variables" and paragraph "4.2.3 Multicollinearity" multicollinearity between the VIX-index and the crisis measures was determined to be low. Theoretical support can also be found in for example Bittlingmayer (1998) and Mei and Guo (2002) who have argued that market volatility does not necessarily reflect financial crises but does also reflect other uncertainty, like political uncertainty. They have also argued that market uncertainty does not necessarily lead to a financial

crisis. This would suggest that expected market volatility is indeed a separate theoretical concept. Furthermore, this suggests that the interaction between the independent variable under study and the VIX-index should be considered in studies that examine the influence of financial crises on value relevance. Excluding this interaction from the model could potentially lead to invalid results.

To test whether the interaction between deferred tax assets and the VIX-index has an impact on the effect of the crisis variables on the value relevance of deferred tax assets additional testing is carried using model 6. Model 6 F (13, 695) =98,434 p<0,001 is the same as model 4 except that it does not include the interaction between deferred tax assets and the VIX-index. The results for model 6 are displayed in the table below:

Variable	Expected direction	B=	β=	t=	p= (2-tailed)	p= (1-tailed)	VIF
Deferred tax assets	+	0,007	0,016	0,112	0,911	0,455	42,483
Earnings per share	+	0,629	0,733	19,539	0,000	0,000***	2,776
Gross margin percentage	+	0,005	0,099	4,146	0,000	0,000***	1,120
Total shareholders' equity	+	0,000	0,000	0,006	0,995	0,497	1,252
EBITDA year T-1	+	0,194	0,031	0,367	0,714	0,357	13,817
VIX-index	-/-	-0,491	-0,155	-5,252	0,000	0,000***	1,730
Crisis	-/-	-0,024	-0,008	-0,078	0,937	0,468	22,538
Post-crisis	-/-	-0,424	-0,201	-1,923	0,055	0,027*	21,643
Deferred tax assets X Crisis	-/-	-0,005	-0,016	-0,154	0,878	0,439	20,927
Deferred tax assets X Post-crisis	-/-	0,043	0,216	2,056	0,040	0,020*	21,779
Earnings per share X Crisis	+	0,008	0,004	0,135	0,893	0,446	1,558
Earnings per share X Post-crisis	+	0,037	0,030	0,863	0,388	0,194	2,378
Deferred tax assets X EBITDA year T-1	+	0,013	0,039	0,229	0,819	0,409	57,428
* = Significant at the 0,05 level (1-tailed), ** = Significant at the 0,01 level (1-tailed) and *** = Significant at the 0,001 level (1-tailed)							

Table 13: Results for model 6 with dummy variables, but without the interaction between deferred tax assets and the VIX-index.

The results for model 6 confirm that the interaction between the deferred tax assets and the VIX-index suppresses the weak positive influence of the post-crisis variable on the value relevance of deferred tax assets (β=0,216; t= 2,056; p<0,05) and the weak negative influence of the post-crisis variable on share prices (β=-0,201; t=-1,923; p<0,05). These effects are statistically significant in

model 6, but not in the other models with interaction variables. This therefore confirms the contention that exclusion of the interaction between the deferred tax assets and the VIX-index from the regression model could lead to potentially invalid results regarding the influence of financial crises on the value relevance of accounting information.

5.3 The relative value relevance of deferred tax assets compared with earnings

The third hypothesis of this study is as follows:

> H3: The value relevance of earnings has increased since the credit crunch while deferred tax assets have become less value relevant to investors.

In model 4 F (14, 694) =91,963 p<0,001 the crisis (β=0,028; t=0,167; not significant) and the post-crisis (β=0,002; t=0,075; not significant) variables have a very weak positive influence on the value relevance of earnings per share. The results of model 5 F (11, 697) =115,484 p<0,001 also indicate that the Gross National Product development variable has a very weak positive influence (β=0,008; t=0,198; not significant) on the value relevance of earnings per share. These results are displayed in Table 11 and Table 12 in paragraph "5.2 The influence of the credit crunch on the value relevance of deferred tax assets". Since the effects are not statistically significant there is no support for hypothesis three.

5.4 The influence of historic profitability on the value relevance of deferred tax assets

The final hypothesis of this study is:

> H4: The deferred tax assets of historically profitable firms are more value relevant to investors than the deferred tax assets of historically loss-making firms.

In model 4 F (14, 694) =91,963 p<0,001 historic profitability (EBITDA Year T-1) has a very weak positive influence (β=0,026; t=0,763; not significant) on the value relevance of deferred tax assets. The results of model 5 F (11, 697) =115,484 p<0,001 indicate a very weak negative influence (β=-0,010; t=-0,061; not significant) of historic profitability on the value relevance of deferred tax assets. These results are displayed in Table 11 and Table 12 in paragraph "5.2 The influence of the credit crunch on the value relevance of deferred tax assets". Since the effects are not statistically significant there is no support for hypothesis four.

5.5 Robustness tests

Robustness tests are inherent to this study's research design. This is because this study compares two different operationalisations of the credit crunch to investigate the influence the credit crunch has had on the value relevance of deferred tax assets. The models that have been used to test these different operationalisations have been discussed in paragraph "5.2 The influence of the credit crunch on the value relevance of deferred tax assets". Since both full models (model 4 and model 5) produce similar results the results are robust. This also indicates that an operationalisation for a crisis that uses dummy variables may be an equally valid operationalisation compared to an operationalisation that uses Gross National Product development as a crisis measure. The results therefore do not indicate that there is a validity issue in this area.

As an additional robustness test the full model is run again without any crisis variables and without any crisis interaction variables. The results for this model F (8, 700) =158,898 p<0,001 are displayed in the table below:

Variable	Expected direction	B=	β=	t=	p= (2-tailed)	p= (1-tailed)	VIF
Deferred tax assets	+	-0,061	-0,152	-0,633	0,527	0,263	113,992
Earnings per share	+	0,648	0,755	32,718	0,000	0,000***	1,048
Gross margin percentage	+	0,005	0,099	4,335	0,000	0,000***	1,030
Total shareholders' equity	+	0,000	0,008	0,304	0,761	0,380	1,218
EBITDA year T-1	+	0,299	0,047	0,563	0,573	0,286	13,771
VIX-index	-/-	-0,890	-0,282	-3,121	0,002	0,001**	16,054
Deferred tax assets X VIX-index	-/-	0,034	0,277	1,245	0,213	0,106	97,638
Deferred tax assets X EBITDA year T-1	+	0,002	0,005	0,031	0,975	0,487	57,269
* = Significant at the 0,05 level (1-tailed), ** = Significant at the 0,01 level (1-tailed) and *** = Significant at the 0,001 level (1-tailed)							

Table 14: Results robustness test model without crisis variables and without crisis interactions.

The results for the model (adjusted R^2= 0,641) show that without the crisis variables, but with the interaction between deferred tax assets and the VIX-index deferred tax assets are not value relevant (β=-0,152; t=-0,633; not significant). The VIX-index has a weak negative influence on share prices (β=-0,282 t=-3,121; p<0,001). Combined these results confirm that deferred tax assets are not

value relevant. They also confirm that the VIX-index explains why prior studies have found support for the contention that deferred tax assets are value relevant. However, these results show that the findings of earlier research may be invalid. The robustness test confirms that the VIX-index is a relevant variable in value relevance research and may provide a more fitting explanation than the credit crunch why deferred tax assets are not value relevant.

6. Conclusion and discussion

In this study the influence of the credit crunch on the value relevance of the deferred tax assets of companies listed on the Amsterdam stock exchange was investigated. Most prior research seems to indicate that deferred tax assets are value relevant and that the credit crunch has had a negative influence on the value relevance of deferred tax assets. Examples of these studies are Amir (2001), Bauman and Das (2004) and Badenhorst and Ferreira (2016). The results of this study paint a rather different picture.

6.1 Discussion of the results

The results show that, consistent with prior research, deferred tax assets are value relevant when the effects of the credit crunch are not considered (hypothesis 1). This would suggest support for the studies carried out by for example Amir (2001) and Naarding and Langendijk (2007). Hypothesis one is therefore supported. However, the results show that the contention from prior research by Badenhorst and Ferreira (2016) that the credit crunch has had a negative influence on the value relevance of deferred tax assets cannot be supported (hypothesis 2). This study has demonstrated that a model used to investigate the influence of financial crises on the value relevance of deferred tax assets is meaningless if the VIX-index is not included as a variable for the expected market uncertainty. This would refute the findings of Bauman and Das (2004) and Badenhorst and Ferreira (2016). The results show that the VIX-index acts as a moderator for the influence of the credit crunch on the value relevance of deferred tax assets. The moderating effect of the VIX-index may be explained theoretically because it is a measure for market uncertainty. Market uncertainty appears to influence the value relevance of financial information to investors. This shows that excluding the VIX-index as a variable may lead to the invalid inference that the credit crunch has had a negative influence on the value relevance of deferred tax assets. Hypothesis two is therefore not supported.

Also, this study has demonstrated that deferred tax assets are not value relevant when the interaction between the credit crunch and deferred tax assets and the interaction between the VIX index and deferred tax assets are considered. The results are robust for both operationalisations that have been used for the credit crunch. The results for the model that uses dummy variables and

the model that uses Gross National Product development to measure the credit crunch are rather similar. This indicates that an operationalisation for a crisis that uses dummy variables may be an equally valid operationalisation compared to an operationalisation that uses Gross National Product development as a crisis measure. This also indicates that deferred tax assets are not value relevant. These results therefore contradict earlier research by for example Amir (2001), Ayers (1998), Chang, Herbohn and Tutticci (2009) and Naarding and Langendijk (2007). The most likely explanation for this is that these studies did not consider the influence of expected market volatility in their models.

This study also did not find support for the hypothesis that the credit crunch has had a negative influence on the value relevance of deferred tax assets and a positive influence on the value relevance of earnings (hypothesis 3). Neither did this study find support for the hypothesis that the deferred tax assets of historically profitable firms are more value relevant than the deferred tax assets of historically loss-making firms (hypothesis 4). Hypothesis three and four are therefore not supported.

6.2 Implications of the findings

These findings shed a new light on value relevance research by highlighting the necessity to include the VIX-index in models that aim to investigate the value relevance of accounting information using a price levels approach. The results show that the VIX-index, a measure for expected market volatility, acts as moderator in the relationship between accounting information and share prices. The implication is that prior research that has not used the VIX-index as a variable may have led to invalid inferences on the value relevance of accounting information. Future value relevance research that uses a price levels approach should therefore include the VIX-index as a variable.

6.3 Limitations of this study

Like any other study this study has several limitations. First, this study was carried out on companies listed on the Amsterdam stock exchange. Since this study was only carried out in the Netherlands this could potentially influence the generalisability of the results. The results could be different in countries with another legal system or another culture. Second, the VIX-index is a measure for expected market volatility that is based on S&P 500 option contracts and is not based on instruments traded on the Amsterdam stock exchange. This means the VIX-index is derived from a country with another legal system, another culture and potentially a different economic cycle. This could have influenced the results of this study. However, no indication was found for this

contention. Finally, the dependent variable share prices and the residuals of the regression models used in this study are rather peaked. The results of this study could therefore be too conservative.

6.4 Recommendations for future research

The first recommendation for future research is to further investigate the generalisability of the results by performing studies in other countries or in multiple countries with the VIX-index as a measure for expected market volatility. Also, a recommendation for future research is to investigate the robustness of the results using companies listed on the S&P 500. This will enable researcher to further develop the VIX-index as a measure for expected market volatility in value relevance research. A final recommendation is to further develop the theoretical understanding of the moderating effect the VIX-index has on the value relevance of accounting information. This will increase our understanding of the influence of market uncertainty on the value relevance of accounting information.

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Appendices

Appendix A: Overview of variables and definitions

Variable in causal model	Variable in operational model	Variable definition
Deferred tax assets	Deferred tax assets in EUR	The total amount of deferred tax assets at the end of year T in euros as recorded in a company's financial statements of year T.
Earnings for the year	Earnings per share in EUR	The amount of undiluted earnings per share in year T in euros as disclosed in a company's financial statements of year T.
Earnings in the prior year	EBITDA year T-1 in EUR	A dichotomous variable based on a company's earnings before interest, taxation, depreciation and amortisation in euros in year T-1 as disclosed in the company's financial statements (0 = loss in the prior year; 1= profit in the prior year).
Credit crunch	Credit crunch	1) Dichotomous variables based on the fiscal year of the financial statements: - Pre-crisis (1= 1997 up until 2006; 0 = 2007 up until 2016); - Crisis (1= 2007 up until 2008; otherwise = 0); - Post-crisis (1= 2009 up until 2016; otherwise = 0). 2) The year on year development in Euros of the Gross National Product (GNP) in the Netherlands as reported by Statistics Netherlands
Expected market volatility	VIX- index as at 31-12 in year T	The VIX-index measured at December 31 of year T.
Gross margin	Gross margin percentage	A company's gross margin percentage in year T as disclosed in the company's financial statements of year T.
Shareholders' equity	Total shareholders' equity minus DTA	A company's total shareholders' equity in euros at the end of year T, adjusted for the total amount of deferred tax assets at the end of year T in euros as recorded in the company's financial statements.
Share price	Share price as at 31-12 in year T	The official closing price in euros of a company's share at December 31 of year T according to the Amsterdam stock exchange.

Table A1: Overview of variables and definitions.

Appendix B: Overview of variables included in the dataset

The following variables are included in the dataset used for this study:

Variable
Company name
Year
GICS (sector code)
Total assets
Deferred taxes (debit and credit)
Deferred taxes debit
EBIT (Earnings before interest and taxation)
EBIT year T-1 (Earnings before interest and taxation)
EBITDA (Earnings before interest, taxation, depreciation and amortisation)
EBITDA year T-1 (Earnings before interest, taxation, depreciation and amortisation)
Earnings per share
Gross margin
Gross margin percentage
Net income
Total shareholders' equity
Share price
Gross National Product
Year on year Gross National Product development
Number of inhabitants of the Netherlands
Gross national product per inhabitant of the Netherlands
VIX-index

Table B1: Overview of variables included in the dataset.

Appendix C: Correlation matrix

	Deferred tax assets	Earnings per share	Gross margin %	Total shareholders' equity	EBITDA year T-1	VIX-index	Share price	Gross National Product development	Crisis	Post-crisis
Deferred tax assets	1									
Earnings per share	0,129 ***	1								
Gross margin %	0,038	0,140 ***	1							
Total shareholders' equity	0,432 ***	0,094 ***	-0.011	1						
EBITDA year T-1	0,200 ***	0,031	0,117 ***	0,071 **	1					
VIX-index	0,020	0,003	0,031	-0,013	0,078 **	1				
Share price	0,190 ***	0,779 ***	0,010	0,120 ***	0,096 ***	-0,044 *				
Gross National Product development	-0,023	0,042	0,011	-0,023	0,136 ***	0,119 ***	0,113 ***	1		
Crisis	-0,052 *	0,096 ***	0,015	-0,003	0,013	0,446 ***	-0,009	0,327 ***	1	
Post-crisis	0,030	-0.018	0,001	0,064 **	-0,101 ***	-0,258 ***	-0,095 ***	-0,683 ***	--0,272 ***	1

* = Significant at the 0,05 level (1-tailed), ** = Significant at the 0,01 level (1-tailed) and *** = Significant at the 0,001 level (1-tailed)

Table C1: Correlation matrix.

Appendix D: Overview of regression results

Model 1: Regression model without the credit crunch and without interactions

Variable	Expected direction	B=	β=	t=	p= (2-tailed)	p= (1-tailed)	VIF
Deferred tax assets	+	0,041	0,103	4,169	0,000	0,000***	1,215
Earnings per share	+	0,647	0,754	32,705	0,000	0,000***	1,047
Gross margin percentage	+	0,005	0,099	4,342	0,000	0,000***	1,025
Total shareholders' equity	+	0,000	0,007	0,284	0,776	0,388	1,213
EBITDA year T-1	+	0,315	0,050	2,199	0,028	0,014*	1,010
VIX-index	-/-	-0,546	-0,173	-7,640	0,000	0,000***	1,009
* = Significant at the 0,05 level (1-tailed), ** = Significant at the 0,01 level (1-tailed) and *** = Significant at the 0,001 level (1-tailed)							

Table D1: Results for the regression model without the credit crunch and without interactions.

Model 2: Regression model with dummy variables as measures for the credit crunch

Variable	Expected direction	B=	β=	t=	p= (2-tailed)	p= (1-tailed)	VIF
Deferred tax assets	+	0,041	0,102	4,080	0,000	0,000***	1,241
Earnings per share	+	0,647	0,754	32,634	0,000	0,000***	1,051
Gross margin percentage	+	0,005	0,098	4,148	0,000	0,000***	1,092
Total shareholders' equity	+	0,000	0,007	0,277	0,781	0,390	1,228
EBITDA year T-1	+	0,320	0,050	2,223	0,027	0,013*	1,012
VIX-index	-/-	-0,514	-0,162	-5,525	0,000	0,000***	1,702
Crisis	-/-	-0,046	-0,016	-0,478	0,633	0,316	2,159
Post-crisis	-/-	0,011	0,005	0,193	0,847	0,423	1,437
* = Significant at the 0,05 level (1-tailed), ** = Significant at the 0,01 level (1-tailed) and *** = Significant at the 0,001 level (1-tailed)							

Table D2: Results for the regression model with dummy variables as measures for the credit crunch.

Model 3: Regression model with Gross National Product as a measure for the credit crunch

Variable	Expected direction	B=	β=	t=	p= (2-tailed)	p= (1-tailed)	VIF
Deferred tax assets	+	0,041	0,104	4,170	0,000	0,000***	1,216
Earnings per share	+	0,647	0,753	32,643	0,000	0,000***	1,049
Gross margin percentage	+	0,005	0,100	4,349	0,000	0,000***	1,032
Total shareholders' equity	+	0,000	0,007	0,293	0,770	0,385	1,214
EBITDA year T-1	+	0,312	0,049	2,172	0,030	0,015*	1,015
VIX-index	-/-	-0,546	-0,173	-7,634	0,000	0,000***	1,009
Gross National Product development	+	0,000	0,007	0,307	0,759	0,379	1,013

* = Significant at the 0,05 level (1-tailed), ** = Significant at the 0,01 level (1-tailed) and *** = Significant at the 0,001 level (1-tailed)

Table D3: Results for the regression model with Gross National Product as a measure for the credit crunch.

Model 4: Full model with dummy variables as measures for the credit crunch

Variable	Expected direction	B=	β=	t=	p= (2-tailed)	p= (1-tailed)	VIF
Deferred tax assets	+	-0,166	-0,416	-1,506	0,133	0,066	151,190
Earnings per share	+	0,634	0,738	19,658	0,000	0,000***	2,795
Gross margin percentage	+	0,005	0,097	4,055	0,000	0,000***	1,122
Total shareholders' equity	+	0,000	0,002	0,062	0,951	0,475	1,254
EBITDA year T-1	+	0,222	0,035	0,420	0,675	0,337	13,829
VIX-index	-/-	-1,148	-0,363	-3,122	0,002	0,001**	26,807
Crisis	-/-	0,390	0,134	1,016	0,310	0,155	34,269
Post-crisis	-/-	-0,318	-0,151	-1,397	0,163	0,081	23,120
Deferred tax assets X Crisis	-/-	-0,044	-0,153	-1,207	0,228	0,114	31,912
Deferred tax assets X Post-crisis	-/-	0,033	0,170	1,572	0,116	0,058	23,034
Earnings per share X Crisis	+	0,010	0,028	0,167	0,868	0,434	57,494
Earnings per share X Post-crisis	+	0,005	0,002	0,075	0,940	0,470	1,560
Deferred tax assets X EBITDA year T-1	+	0,033	0,026	0,763	0,446	0,223	2,385
Deferred tax assets X VIX-index	-/-	0,064	0,516	1,846	0,065	0,032*	154,801
* = Significant at the 0,05 level (1-tailed), ** = Significant at the 0,01 level (1-tailed) and *** = Significant at the 0,001 level (1-tailed)							

Table D4: Results for the full model with dummy variables as measures for the credit crunch.

Model 5: Full model with Gross National Product as a measure for the credit crunch

Variable	Expected direction	B=	β=	t=	p= (2-tailed)	p= (1-tailed)	VIF
Deferred tax assets	+	-0,063	-0,157	-0,651	0,515	0,257	114,382
Earnings per share	+	0,643	0,749	19,005	0,000	0,000***	3,052
Gross margin percentage	+	0,005	0,102	4,416	0,000	0,000***	1,042
Total shareholders' equity	+	0,000	0,011	0,445	0,657	0,328	1,233
EBITDA year T-1	+	0,345	0,054	0,649	0,517	0,258	13,839
VIX-index	-/-	-0,884	-0,280	-3,092	0,002	0,001**	16,076
Gross National Product development	+	-0,000	-0,071	-1,063	0,288	0,144	8,770
Deferred tax assets X Gross National Product development	+	0,351	0,086	1,225	0,221	0,110	9,624
Earnings per share X Gross National Product development	+	0,000	0,008	0,198	0,843	0,421	3,013
Deferred tax assets X EBITDA year T-1	+	-0,004	-0,010	-0,061	0,952	0,476	57,582
Deferred tax assets X VIX-index	-/-	0,033	0,267	1,197	0,232	0,116	97,846

***** = Significant at the 0,05 level (1-tailed), ****** = Significant at the 0,01 level (1-tailed) and ******* = Significant at the 0,001 level (1-tailed)

Table D5: Results for the full model with Gross National Product development as a measure for the credit crunch.

Model 6: Model with crisis dummy variables and interactions, excluding the VIX-index

Variable	Expected direction	B=	β=	t=	p= (2-tailed)	p= (1-tailed)	VIF
Deferred tax assets	+	0,007	0,016	0,112	0,911	0,455	42,483
Earnings per share	+	0,629	0,733	19,539	0,000	0,000***	2,776
Gross margin percentage	+	0,005	0,099	4,146	0,000	0,000***	1,120
Total shareholders' equity	+	0,000	0,000	0,006	0,995	0,497	1,252
EBITDA year T-1	+	0,194	0,031	0,367	0,714	0,357	13,817
VIX-index	-/-	-0,491	-0,155	-5,252	0,000	0,000***	1,730
Crisis	-/-	-0,024	-0,008	-0,078	0,937	0,468	22,538
Post-crisis	-/-	-0,424	-0,201	-1,923	0,055	0,027*	21,643
Deferred tax assets X Crisis	-/-	-0,005	-0,016	-0,154	0,878	0,439	20,927
Deferred tax assets X Post-crisis	-/-	0,043	0,216	2,056	0,040	0,020*	21,779
Earnings per share X Crisis	+	0,008	0,004	0,135	0,893	0,446	1,558
Earnings per share X Post-crisis	+	0,037	0,030	0,863	0,388	0,194	2,378
Deferred tax assets X EBITDA year T-1	+	0,013	0,039	0,229	0,819	0,409	57,428

***** = Significant at the 0,05 level (1-tailed), ****** = Significant at the 0,01 level (1-tailed) and ******* = Significant at the 0,001 level (1-tailed)

Table D6: Results for model 6 with dummy variables, but without the interaction between deferred tax assets and the VIX-index.

Appendix E: Scatterplots of the residuals

Model 1: Regression model without the credit crunch and without interactions

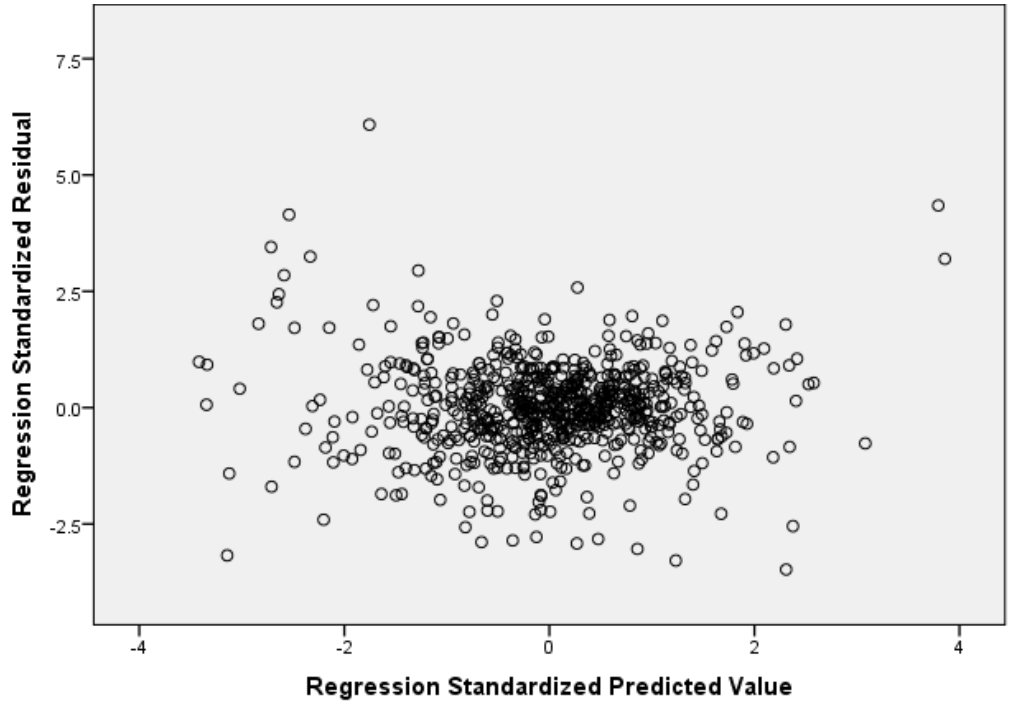

Figure E1: Scatterplot regression model without the credit crunch and without interactions.

Model 2: Regression model with dummy variables as measures for the credit crunch

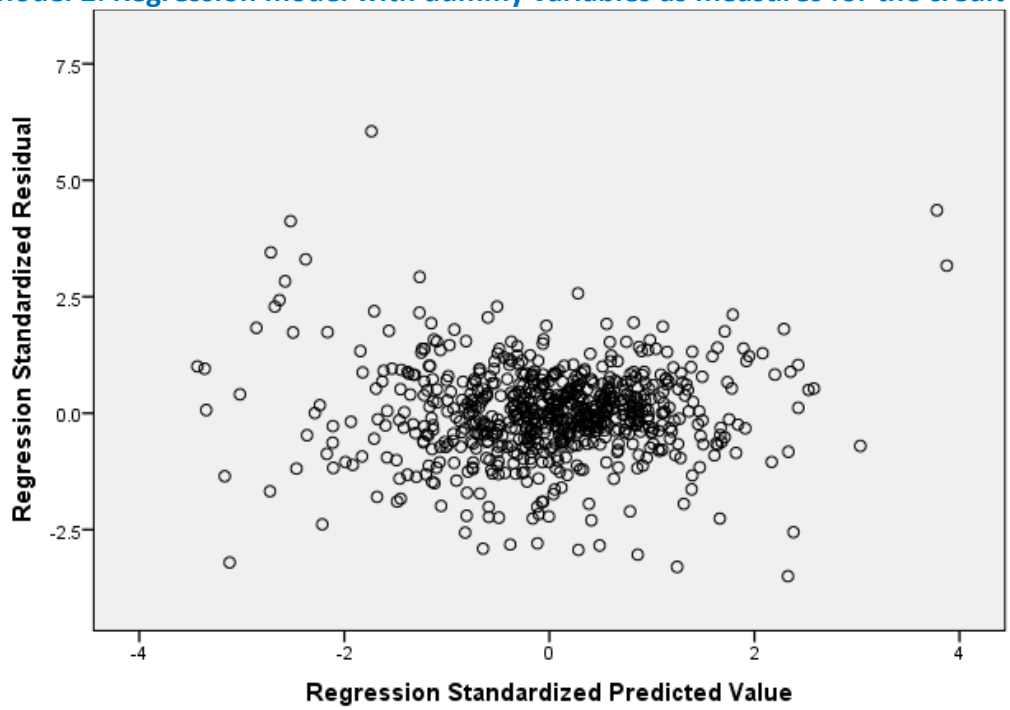

Figure E2: Scatterplot regression model with dummy variables as measures for the credit crunch.

Model 3: Regression model with Gross National Product as a measure for the credit crunch

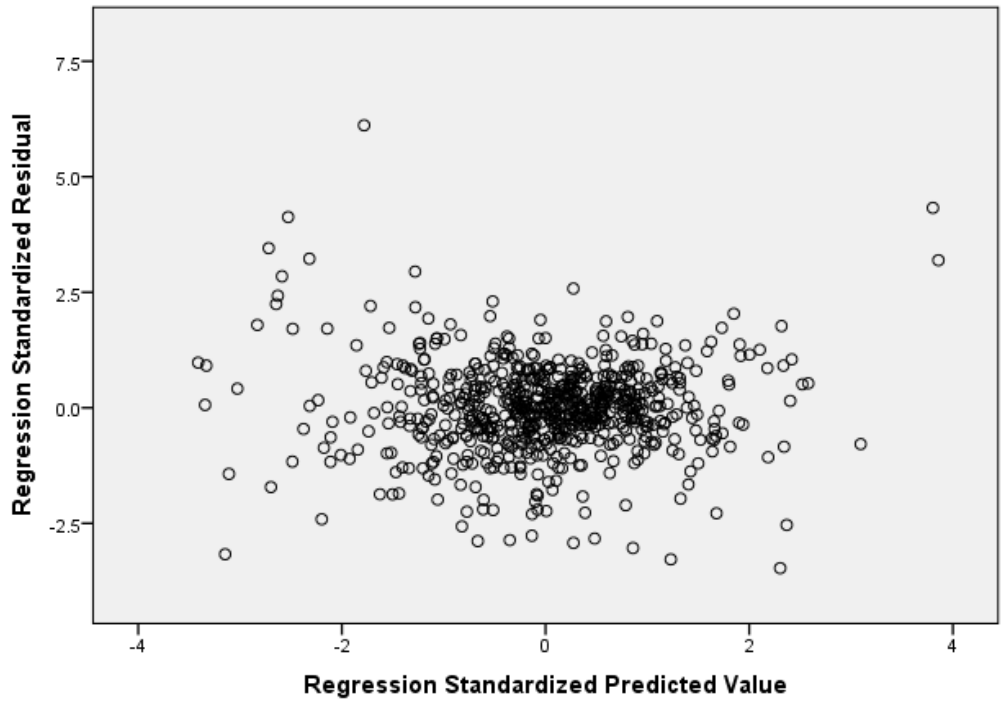

Figure E3: Scatterplot regression model with Gross National Product as a measure for the credit crunch.

Model 4: Full model with dummy variables as measures for the credit crunch

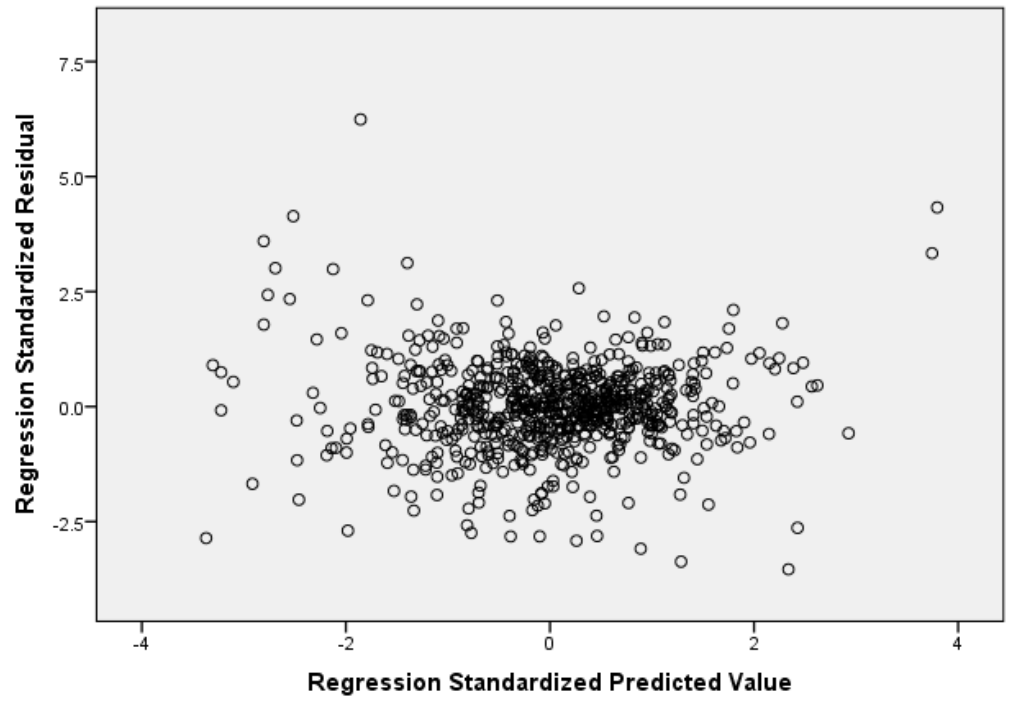

Figure E4: Scatterplot full model with dummy variables as measures for the credit crunch.

Model 5: Full model with Gross National Product as a measure for the credit crunch

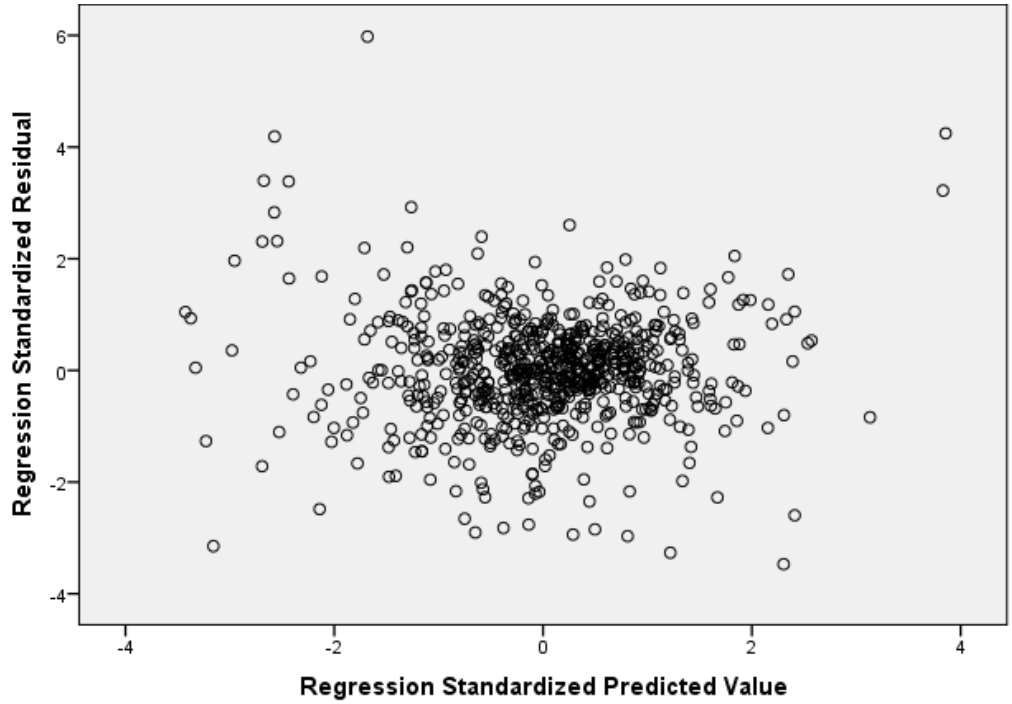

Figure E5: Scatterplot full model with Gross National Product as a measure for the credit crunch.

Model 6: Model with crisis dummy variables excluding the VIX-index interaction

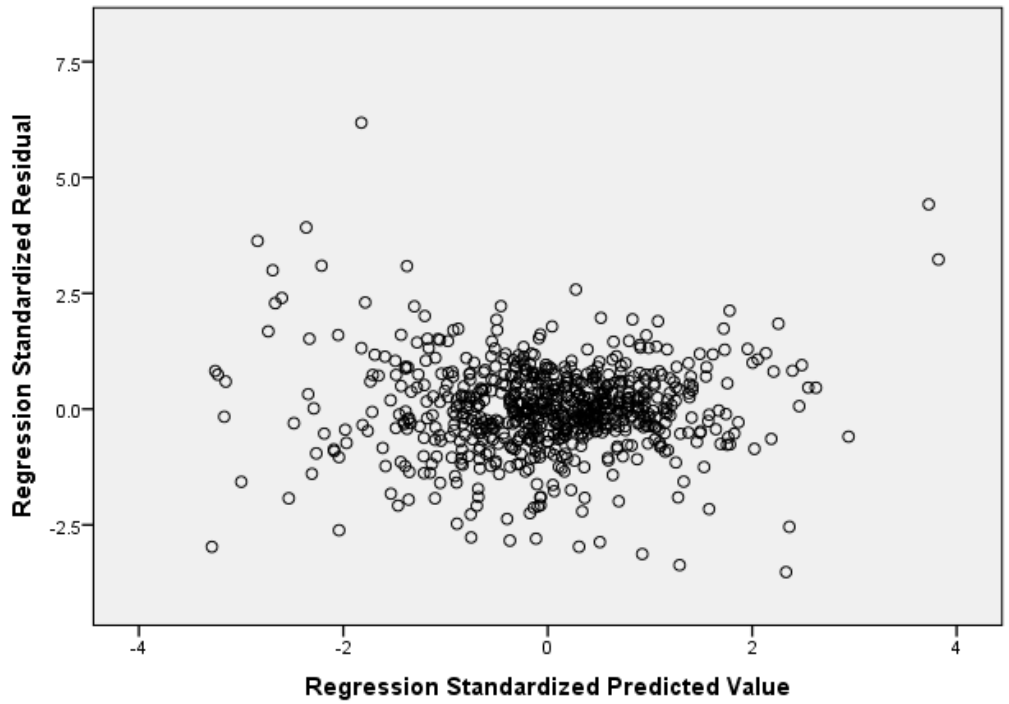

Figure E6: Scatterplot model with crisis dummy variables excluding the VIX-index interaction.