The Effects of the Financial Crisis on the Creditworthiness of Banks

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1 Introduction

The financial crisis that started in 2010 in Europe led to a number of adverse outcomes for the affected countries' economies. Since the crisis began as a credit crisis, the financial system's cash drainage put the banks of some Eurozone countries (i.e. Greece, Portugal, Spain and Italy) in a very difficult position. A number of the macroeconomic measures taken were targeted at providing support to the financial system since a collapse would fuel a dramatic downward spiral for these countries' economies. As Blankespoor et al. (2013) argued accounting fundamentals may provide information on the prediction of financial distress, thus helping investors avoid pitfalls.

Previous studies have provided evidence on the presence of a number of accounting fundamentals that affect credit ratings. Among those are return

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C. Floros and I. Chatziantoniou (eds.), *The Greek Debt Crisis*,
DOI 10.1007/978-3-319-59102-5_4

on equity, leverage, size and operating cash flows which have been found to provide information on future credit risk (i.e. Edwards 2011; White 2014). However, apart from those fundamentals another accounting fundamental that is specifically related to the financial crisis and is likely important for banks are deferred tax assets. Specifically, one key aspect of the financial crisis was the big losses suffered by the affected banks and, as a result of these losses, the recording of significant deferred tax assets, especially for the banks domiciled in the affected countries. However, this kind of asset is not useful in the likely event of a bank's poor financial performance (Gallemore 2012).

Given the debate on the usefulness of banks' deferred tax assets, especially during periods of poor financial performance, a relevant research question emerges: How useful are deferred tax assets in increasing banks' creditworthiness? In contrast with other asset increases, which may signify a better capital structure and in turn higher creditworthiness, deferred tax assets are not considered useful because they do not protect banks in the case of insolvency (Gallemore 2012). In a relevant US study, Edwards (2011) showed that increases in valuation allowance lead to decreases in firms' creditworthiness. According to the author, this is because of increases in the valuation allowance, which shows the portion of deferred tax assets that the firm does not expect to realise, in turn, signal more persistent future losses and, thus, lower creditworthiness. Therefore, deferred tax assets provide useful information about firms' creditworthiness, as they reveal information about changes in the cost of equity.

The scope of the chapter is to examine the relationship between changes in creditworthiness and accounting fundamentals with special interest on deferred tax assets for a sample of banks domiciled in the Eurozone. In this respect, the research setting aims to examine if any portion of the decrease in banks' creditworthiness during the financial crisis is related to increases in deferred tax assets. The study is motivated by previous studies and media reports, which have sparked a debate on the usefulness of deferred tax assets, especially for banks (Gallemore 2012).

The study results reveal that while the ratio of deferred tax assets to total assets is not significant in explaining future credit risk, a dummy variable that ranks firms based on the level of the change in deferred tax

assets in relation to the total assets is significant and has a positive coefficient for future credit risk (or a negative coefficient for creditworthiness). However, banks domiciled in crisis-affected countries that have a high increase in deferred tax assets have a lower future credit risk. This result may imply that investors see this as a signal of future profitability, since in order to record the deferred tax assets, a firm should expect future profitability in order to offset these assets. Moreover, additional analysis shows some indications of increased future credit risk for banks domiciled in crisis-affected countries, especially for highly leveraged banks with high increases in deferred tax assets. Therefore, in this case, the contemporaneous presence of an increase in deferred tax assets and high leverage likely indicates that the high deferred tax assets may not provide any protection in the case of default.

The rest of the chapter is organised as follows: Sect. 2 provides the literature review and the development of the research hypothesis; Sect. 3 provides the methodological framework; Sect. 4 reports the sample description and the empirical results analysis; and Sect. 5 offers the study conclusion.

2 Literature Review

The recent financial crisis brought risk to the epicentre, especially for banks. The crisis began as a debt crisis with rapidly escalated sovereign spreads (De Santis 2012). This was followed by several countries' credit down-ratings, which in turn led to credit problems in the economy, and in particular, the banking systems of the countries that were most heavily influenced by the crisis. These circumstances made the crisis-affected banking systems more volatile, so much so that their respective governments had to take measures to support the banks. Moreover, another question emerged: Which accounting measures could be used to predict credit risk? Blankespoor et al. (2013) argued that accounting fundamentals may provide information for predicting financial distress, thus helping investors avoid pitfalls.

Following the financial crisis, many researchers studied credit rating determinants. This may be because of the important role credit ratings

play in valuation and contracting (Edwards 2011). Among these determinants, according to Collin-Dufresne et al. (2001), are changes in leverage and return on equity, which should be positively and negatively related, respectively, to credit spreads. Recent studies also highlight that book-tax differences seem to be related to credit risk, as large book-tax difference signal negative firm qualities (Edwards 2011). Crabtree and Maher (2009) found that firms at both extremes regarding their tax planning (either low or high management of taxable income in relation to book income) had lower credit ratings. Ayers et al. (2010) provided additional support for the negative relationship between credit rating changes and book-tax differences, revealing that such findings are related to lower earnings quality. On the one hand, the likely relationship between deferred tax assets and risk may also be related to earnings management, as proposed by Skinner (2008) and others, who found that banks may use discretionary deferred tax assets to present a better financial picture. On the other hand, Wilson (2009, 2010), in his discussions on Crabtree and Mahers's (2009) and Ayers et al.'s (2010) research, called for additional research on the matter.

In many instances, the large losses suffered by the banks led them to record deferred tax assets in their financial statements. As a result, deferred tax assets constituted a significant portion of their balance sheets. Deferred tax assets stem from either deductible temporary differences, carryforward of unused losses or carryforward of unused tax credits (IAS 12, par. 5). Moreover, any benefits related to deferred tax assets may be realised only if the bank has future taxable profits to offset these assets.

As explained above, the distinctive nature of deferred tax assets may make them less useful than other assets in acting as a buffer against the negative effects of financial turmoil. Therefore, it is not surprising that such an asset may be related to risk, as Henry (2014) found. Amir and Sougiannis (1999) argued that even though investors positively value deferred tax assets stemming from loss carryforwards, as they represent future tax reductions, these assets may also signal deteriorating financial conditions. This happens because recording deferred tax assets is triggered by the presence of losses, which in turn may signal a higher likelihood of future losses.

White (2014) attempted to respond to Wilson's (2009, 2010) call for additional research on the relationship between book-tax differences and credit risk by examining whether deferred tax assets are related to credit risk changes. His results indicate a negative relationship, likely because analysts do not see deferred tax assets as assets. Gallemore (2012) offered additional support by showing that banks that recorded deferred tax assets during the financial crisis had a higher likelihood of financial distress. He argues that deferred tax assets are not useful, as they provide no protection in the unfavourable event of default. In such a case, banks are not able to realise these deferred tax assets unless they have future profits to offset them. The discussion inspired this study's first research hypothesis, which aims to examine the effects of recording deferred tax assets on credit ratings especially for banks. Specifically, following White (2014), we hypothesise that increases in deferred tax assets may partly explain future credit risk faced by financial institutions. Therefore, the first research hypothesis is as follows:

H_1 Increases in deferred tax assets are positively related to future credit risk.

We specifically aim at examining future credit risk due to the fact that credit analysts may need time in order to incorporate changes in accounting fundamentals into their predictions and thus current credit risk may not include this type of information in a timely manner (White 2014).

The next research hypothesis is related to banks' leverage level and the contemporaneous presence of deferred tax assets. We hypothesise that any negative influence of deferred tax assets on banks' creditworthiness will be enhanced if the bank is highly leveraged. In other words, highly leveraged banks that have recorded large amounts of deferred tax assets have a higher likelihood of future credit risk compared to less-leveraged banks; this effect is due to the combined effects of leverage and deferred tax asset recording. This is expected, as recorded deferred tax assets do not provide any protection in the case of insolvency. Therefore, for banks with a significant change of deferred tax assets, credit risk may increase faster when combined with likely capital problems. Therefore, our second research hypothesis is as follows:

H_2 In the case of highly leveraged banks, a large change of deferred tax assets leads to higher future credit risk.

3 Research Methodology

The study's research methodology aims to uncover the financial crisis's effects on credit risk, with respect to certain attributes. We focus on the variables that were found to be related to credit risk in previous studies (i.e. Kaplan and Urwitz 1979; Edwards 2011; White 2014). Specifically, following Edwards (2011; see also White 2014), our base model relates future credit ratings with current credit ratings, the number of consecutive periods with losses, leverage, profitability (using the return on assets ratio), size, the book-to-market ratio, the interest coverage ratio and the ratio of deferred tax assets to total assets. In algebraic terms, the following ordered logistic regression is estimated using period-fixed effects:

$$\begin{aligned} CR\_Rate_{i,t+1} = f(&\alpha_0 + \alpha_1 CR\_Rate_{i,t} + \alpha_2 Loss_{i,t} + \alpha_3 SIZE_{i,t} \\ &+ \alpha_4 ROA_{i,t} + \alpha_5 LEV_{i,t} + \alpha_6 BtM_{i,t} + \alpha_7 CFO_{i,t} \\ &+ \alpha_8 INTER\_COVER_{i,t} \\ &+ \alpha_9 CGIIPS_{i,t} + \alpha_{10} DTAtoTA_{i,t} + \varepsilon_{i,t+1}) \end{aligned} \quad (1)$$

where *CR_Rate* is the assessment of the risk class assigned by Bloomberg for bank *i* at the end of year *t*; *Loss* is an indicator variable that takes the value of 1 if bank *i* experiences a loss in year *t* and 0 otherwise; *SIZE* is a proxy for size, calculated as the natural logarithm of total assets of bank *i* at year *t*; *ROA* is a proxy for profitability, calculated as the ratio of net income to opening total assets of bank *i* at year *t*; *LEV* is a proxy for leverage, calculated as the ratio of long-term debt to total assets of bank *i* at year *t*; *BtM* is the ratio of book value of equity to market capitalisation of bank *i* at year *t*; *CFO* is the ratio of operating cash flows to opening total assets of bank *i* at year *t*; *INTER_COVER* is the interest coverage ratio (in a logarithmic form), calculated as earnings before interest and tax to total interest expenses of bank *i* at year *t*; *CGIIPS* is a dummy variable that takes the value of 1 for crisis-affected countries (Cyprus, Greece, Italy, Ireland, Portugal and Spain) and 0 otherwise; and *DTAtoTA* is the ratio (in

a percentage form) of deferred tax assets to total assets of bank i at year t. *CR_Rate* is provided by Bloomberg in a 22-scale format, and we assigned the higher values of the variable to the higher ratings. In turn, higher values of this variable signify lower credit risk.

Moreover, in our robustness checks, we also used Bloomberg's five-year credit default swap spread (denoted as *CDS*_Spread), which shows the likelihood of default, as implied by Bloomberg's Default Risk model. However, in this case, the credit risk is directly related to the dependent variable. Put differently, the higher the *CDS*_Spread, the higher the credit risk, and the lower the bank's creditworthiness. The regressions using *CDS*_Spreads are estimated using ordinary least squares with robust standard errors and period effects.

The second model examines the effects of the financial crisis, the recording of deferred tax assets and their combined effects on banks' creditworthiness. For the task at hand, we used a difference in differences research methodology (see Ashenfelter and Card 1985), where the first difference concerns cases where a country has been influenced by the financial crisis and the second concerns cases where a bank belongs to the higher 50% of the banks grouped by the ratio of the change in the deferred tax assets to total assets. Therefore, the model is as follows:

$$\begin{aligned} CR\_Rate_{i,t+1} = f(&\beta_0 + \beta_1 CR\_Rate_{i,t} + \beta_2 Loss_{i,t} + \beta_3 SIZE_{i,t} \\ &+ \beta_4 ROA_{i,t} + \beta_5 LEV_{i,t} + \beta_6 BtM_{i,t} + \beta_7 CFO_{i,t} \\ &+ \beta_8 INTER\_COVER_{i,t} \\ &+ \beta_9 CGIIPS_{i,t} + \beta_{10} DTA\_Dummy_{i,t} \\ &+ \beta_{11} CGIIPS_{i,t} \times DTA\_Dummy_{i,t} + \omega_{i,t+1}) \end{aligned} \quad (2)$$

where *DTA_Dummy* is a dummy variable that takes the value of 1 if a bank belongs to the higher 50% of banks in a given year, ranked by the ratio of the change in deferred tax assets to total assets ratio, and 0 otherwise, and the rest of the variables are estimated as described above.

The third model is similar to Eq. (2). However, in this case, the model replaces the *LEV* variable with a third dummy variable for leverage level. The rationale is that banks with high leverage are less capitalised and thus, the existence of high deferred tax assets may have more pronounced positive effects for future credit risk. The model is as follows:

$$
\begin{aligned}
CR\_Rate_{i,t+1} = f(&\gamma_0 + \gamma_1 CR\_Rate_{i,t} + \gamma_2 Loss_{i,t} + \gamma_3 SIZE_{i,t} \\
&+ \gamma_4 ROA_{i,t} + \gamma_5 BtM_{i,t} + \gamma_6 CFO_{i,t} \\
&+ \gamma_7 INTER\_COVER_{i,t} \\
&+ \gamma_8 CGIIPS_{i,t} + \gamma_9 LEV\_Dummy_{i,t} + \gamma_{10} DTA\_Dummy_{i,t} \\
&+ \gamma_{11} CGIIPS_{i,t} \times LEV\_Dummy_{i,t} \\
&+ \gamma_{12} CGIIPS_{i,t} \times DTA\_Dummy_{i,t} \\
&+ \gamma_{13} LEV\_Dummy_{i,t} \times DTA\_Dummy_{i,t} \\
&+ \gamma_{14} CGIIPS_{i,t} \times LEV\_Dummy_{i,t} \times DTA\_Dummy_{i,t} + \upsilon_{i,t+1})
\end{aligned}
\tag{3}
$$

where *LEV_Dummy* is a dummy variable that takes the value of 1 if a bank belongs to the higher 50% of banks ranked by the leverage ratio and 0 otherwise.

The last model is based on White (2014) and in this case the variables are used in changes in order to examine how changes in the credit risk attributes affect future credit ratings. The model is as follows:

$$
\begin{aligned}
\Delta CR\_Rate_{i,t+1} = f(&\delta_0 + \delta_1 Loss_{i,t} + \delta_2 \Delta SIZE_{i,t} \\
&+ \delta_3 \Delta ROA_{i,t} + \delta_4 \Delta LEV_{i,t} + \delta_5 \Delta BtM_{i,t} \\
&+ \delta_6 \Delta CFO_{i,t} + \delta_7 \Delta INTER\_COVER_{i,t} \\
&+ \delta_8 CGIIPS_{i,t} + \delta_9 \Delta DTAtoTA_{i,t} \\
&+ \delta_{10} CGIIPS_{i,t} \times \Delta DTAtoTA_{i,t} + \psi_{i,t+1})
\end{aligned}
\tag{4}
$$

where all variables are estimated as changes of the respective variables reported above. A similar regression is also estimated using ordinary least squares with robust standard errors and period effects for future *CDS*_Spread.

4 The Sample and Empirical Results

4.1 The Sample

The primary data sources were Compustat Global, which provided the accounting data, except for the deferred tax assets data, which was unavailable; and Bloomberg, which provided the credit rating, CDS

spreads, stock prices and deferred tax assets data. The sample comprised banks domiciled in Eurozone countries, and the data spanned from 2005 to 2015. Moreover, we deleted two types of observations from our sample. First, observations corresponding to banks with a negative book value of equity in a certain year were deleted from the sample. Second, observations corresponding to the upper and lower 1% of the distribution of each variable were deleted to avoid outlier effects in our results.

The number of observations and banks in the final sample are reported in Tables 3–8. The values range from 366 to 400 observations and 68 to 73 banks, depending on the estimation model. The Appendix provides definitions for the study's main variables. Table 1 provides descriptive statistics for the sample and indicates that the deletion of the extreme observations was likely successful. Table 2 presents the correlation coefficients, along with their statistical significance. The results indicate that both the deferred tax asset variables (*DTAtoTA* and *DTA_Dummy*) have the expected correlation coefficients with the lead credit risk measures (negative for *CR_Rate* and positive for *CDS*_Spread). These results provide some first indications on the likely negative relation between deferred tax assets and creditworthiness.

Table 1 Descriptive statistics

	Mean	Median	Q1	Q3	Std. Dev.
CR_Rate_Lead	13.36	13.00	12.00	15.00	2.10
*CDS*_Spread_Lead	0.23	0.14	0.07	0.21	0.25
CR_Rate	13.56	14.00	13.00	15.00	1.99
*CDS*_Spread	0.21	0.13	0.04	0.19	0.23
LOSS	0.17	0.00	0.00	0.00	0.37
SIZE	11.12	10.99	9.04	11.88	1.72
ROA	0.00	0.00	0.00	0.01	0.01
LEV	0.17	0.15	0.07	0.30	0.12
BTM	4.21	1.48	0.76	3.95	7.04
CFO	0.01	0.01	−0.02	0.03	0.04
INTER_COVER	0.82	0.86	0.77	0.98	0.27
DTAtoTA	0.80	0.49	0.25	1.00	0.84
CGIIPS	0.56	1.00	0.00	1.00	0.50
DTA_Dummy	0.51	1.00	0.00	1.00	0.50

Notes The sample includes all banks domiciled in Eurozone countries for the period 2005–2015. Variables' definitions are provided in the Appendix

Table 2 Correlation matrix

	CR_ Rate_ Lead	*CDS_* Spread_ Lead	*CR_ Rate*	*CDS_* Spread	*LOSS*	*SIZE*	*ROA*	*LEV*	*BTM*	*CFO*	*INTER_ COVER*	*DTAtoTA*	*CGIIPS*	*DTA_ Dummy*
CR_Rate_ Lead	1.00													
*CDS_* Spread_ Lead	**−0.56**	1.00												
CR_Rate	**0.71**	**−0.38**	1.00											
*CDS_* Spread	**−0.42**	**0.70**	**−0.60**	1.00										
LOSS	**−0.34**	**0.26**	**−0.47**	**0.36**	1.00									
SIZE	−0.09	−0.02	−0.10	−0.04	−0.05	1.00								
ROA	**0.46**	**−0.24**	**0.64**	**−0.44**	**−0.65**	**−0.21**	1.00							
LEV	−0.03	0.10	0.00	0.03	0.05	**0.16**	−0.17	1.00						
BTM	**−0.32**	**0.23**	**−0.45**	**0.41**	**0.10**	**−0.25**	**−0.16**	**−0.19**	1.00					
CFO	0.10	0.03	**0.16**	−0.07	**−0.15**	0.03	**0.21**	**0.14**	0.02	1.00				
INTER_ COVER	**0.46**	**−0.20**	**0.58**	**−0.34**	**−0.61**	**−0.24**	**0.78**	**−0.21**	−0.08	**0.19**	1.00			
DTAtoTA	**−0.22**	**0.38**	**−0.32**	**0.47**	**0.32**	**0.11**	**−0.38**	**0.27**	0.01	−0.12	−0.25	1.00		
CGIIPS	−0.10	**0.43**	−0.01	**0.28**	**0.22**	0.03	**−0.20**	**0.50**	**−0.26**	0.05	**−0.20**	**0.55**	1.00	
DTA_ Dummy	**−0.14**	**0.22**	−0.09	**0.16**	**0.18**	0.01	**−0.14**	**0.28**	−0.03	**0.11**	**−0.11**	**0.36**	**0.32**	1.00

Notes The sample includes all banks domiciled in Eurozone countries for the period 2005–2015. Variables' definitions are provided in the Appendix. Correlation coefficients in bold show significance at least at the 5% level of significance

4.2 Empirical Results

The first set of results concerns the base regression, Eq. (1), which regresses the lead credit rating variable on a set of credit risk determinants. The results are provided in Table 3. The coefficient of current credit rating is positive and significant, which indicates that higher current credit ratings are related to higher future credit ratings; this result agrees with the previous literature (i.e. Edwards 2011). The *SIZE* and *BtM* ratios were both significant (at least at the 10% level of statistical significance) and negative, whereas *CGIIPS* is marginally insignificant (and negative). Therefore, based on these results, the level of deferred tax assets does not seem to affect banks' credit ratings.

To further investigate this issue, we move to the estimation of Eq. (2). The *DTA_Dummy* used in this model ranks firms according to the ratio of the change in deferred tax assets to total assets; the results are reported in Panels A and B of Table 4. Panel A shows that *SIZE* becomes insignificant, while *BtM* remains negative and significant. Moreover, *CGIIPS* becomes significant and is negative, which indicates that banks domiciled in crisis-affected countries had lower credit ratings.

Table 3 Determinants of future credit ratings

	Coef.	*z*-stat	*p*-value
CR_Rate	1.04***	9.21	0.00
LOSS	0.27	0.53	0.59
SIZE	−0.12*	−1.91	0.06
ROA	32.87	1.13	0.26
LEV	−0.61	−0.57	0.57
BtM	−0.04**	−2.25	0.02
CFO	0.82	0.29	0.77
INTER_COVER	0.70	1.10	0.27
CGIIPS	−0.49	−1.61	0.11
DTAtoTA	0.12	0.54	0.59
Pseudo R^2	0.23		
Obs		400	
Period effects		Included	

Notes The sample includes all banks domiciled in Eurozone countries and covers the period 2005–2015. *, ** and *** indicates significance at the 10%, 5% and 1% level of significance. Variables' definitions are provided in the Appendix

Table 4 Determinants of future credit ratings using the DiD approach

Panel A: *Results using CGIIPS and DTA_Dummy*				***Panel B:*** *Results using CGIIPS, DTA_Dummy and LEV_Dummy*			
	Coef.	*z*-stat	*p*-value		Coef.	*z*-stat	*p*-value
CR_Rate	1.04***	8.99	0.00	*CR_Rate*	1.06***	9.07	0.00
LOSS	0.43	0.76	0.45	*LOSS*	0.45	0.79	0.43
SIZE	−0.07	−1.16	0.25	*SIZE*	−0.08	−1.31	0.19
ROA	21.86	0.74	0.46	*ROA*	17.73	0.64	0.52
LEV	−0.40	−0.34	0.74	*BTM*	−0.03**	−2.07	0.04
BTM	−0.03**	−1.97	0.05	*CFO*	−0.05	−0.02	0.99
CFO	0.18	0.06	0.95	*INTER_COVER*	1.20*	1.74	0.08
INTER_COVER	1.18	1.62	0.11	*CGIIPS*	−1.53***	−2.82	0.00
CGIIPS	−0.91***	−2.68	0.01	*LEV_Dummy*	−0.28	−0.81	0.42
DTA_Dummy	−0.97***	−3.57	0.00	*DTA_Dummy*	−0.98***	−3.00	0.00
CGIIPS×DTA_Dummy	1.34***	2.93	0.00	*CGIIPS×LEV_Dummy*	1.04	1.62	0.11
				CGIIPS×DTA_Dummy	2.14***	2.76	0.01
				LEV_Dummy×DTA_Dummy	−0.02	−0.04	0.97
				CGIIPS×LEV_Dummy×DTA_Dummy	−1.18	−1.26	0.21
Pseudo *R*-squared		0.24		Pseudo *R*-squared		0.24	
Obs		346		Obs		348	
Period effects		Included		Period effects		Included	

Notes The sample includes all banks domiciled in Eurozone countries and covers the period 2005–2015. *, ** and *** indicates significance at the 10%, 5% and 1% level of significance. Variables' definitions are provided in the Appendix

More importantly, however, are the findings regarding the *DTA_Dummy* and its cross-term with *CGIIPS*. Specifically, the *DTA_Dummy* is negative and significant, which implies that the change in deferred tax assets (to total assets) is negatively related to credit ratings (or positively related to credit risk). This result supports research hypothesis H_1 and is in agreement with previous findings in the literature (i.e. Edwards 2011). This result provides the first indication of deferred tax assets' influence on banks' creditworthiness. However, the cross-term *CGIIPSxDTA_Dummy* is positive and significant, which implies that deferred tax assets seem to be related to higher creditworthiness (lower credit risk) among the banks in crisis-affected countries. This result may be related to the large losses recognised by banks domiciled in those countries during the crisis, which led to the recording of deferred tax assets. As Amir and Sougiannis's (1999) argue, deferred tax assets may be valued positively by investors under certain circumstances, as they may represent future tax reductions.

To shed further light on the above result, we considered the effects of high leverage. The results are provided in Panel B of Table 4 and are in agreement with the results shown in Table 3. However, in this case, the interest coverage ratio is positive and statistically significant. Therefore, thus far, the results show that deferred tax assets are negatively related to credit ratings, but for banks domiciled in crisis-affected countries, the direction of this relationship changes.

4.3 Robustness Checks and Further Tests

To examine the robustness of the results, we re-estimated Eqs. (1)–(3) by using the lead of *CDS*_Spread as the dependent variable, as well as using ordinary least squares with robust standard errors and period effects. The results are provided in Tables 5–6. It should be noted that in this case, the dependent variable is negatively related to creditworthiness (directly related to credit risk).

Table 5 and Panel A of Table 6 show that our primary conclusions about the effects of deferred tax asset levels (*DTAtoTA*) and the change in deferred tax assets (*DTA_Dummy*) continue to hold.

Table 5 Determinants of future CDS spread

	Coef.	*t*-stat	*p*-value
Intercept	0.29***	2.73	0.01
*CDS_*Spread	0.52***	5.74	0.00
LOSS	−0.02	−0.42	0.67
SIZE	−0.01	−1.31	0.19
ROA	−2.11	−0.66	0.51
LEV	−0.23**	−2.22	0.03
BtM	0.00	−0.95	0.34
CFO	0.59*	1.87	0.06
INTER_COVER	−0.15	−1.55	0.12
CGIIPS	0.11***	3.97	0.00
DTAtoTA	0.00	0.11	0.91
Adjusted *R*-squared	0.57		
Obs		388	
Period effects		Included	

Notes The sample includes all banks domiciled in Eurozone countries and covers the period 2005–2015. *, ** and *** indicates significance at the 10%, 5% and 1% level of significance. Variables' definitions are provided in the Appendix

Moreover, in Panel B of Table 6, the cross-term of *CGIIPS* and *LEV_Dummy* is negative and significant, which indicates that banks with high leverage in crisis-affected countries have lower credit risk. Even though this result is surprising, Blankespoor et al. (2013) report similar findings and call for further research on this issue. Moreover, the triple integration term of *CGIIPS*, *LEV_Dummy* and *DTA_Dummy* (*CGIIPSxLEV_DummyxDTA_Dummy*) is positive and marginally significant, which offers some support to the contention that the contemporaneous presence of high leverage and high changes in deferred tax assets may lead to higher future credit risk. Moreover, this result provides some support to research hypothesis H_2.

To provide further evidence on the relationship between accounting fundamentals and future credit risk, we also estimated the model of Eq. (2) using a model in changes. The rationale was to examine if changes in accounting fundamentals, including deferred tax assets, led to a change in credit risk. The results for ΔCR_Rate and $\Delta CDS_$Spread are reported in Tables 6 and 7, respectively, and they agree with the previously reported findings. Moreover, they show that changes in leverage have a positive but statistically insignificant coefficient (Table 8).

Table 6 Determinants of future CDS spread using the DiD approach

Panel A: *Results using CGIIPS and DTA_Dummy*				***Panel B:*** *Results using CGIIPS, DTA_Dummy and LEV_Dummy*			
	Coef.	*t*-stat	*p*-value		Coef.	*t*-stat	*p*-value
Intercept	0.33**	2.47	0.01	Intercept	0.32**	2.46	0.01
*CDS_*Spread	0.53***	5.23	0.00	*CDS_*Spread	0.54***	5.28	0.00
LOSS	−0.04	−0.72	0.47	*LOSS*	−0.04	−0.82	0.41
SIZE	−0.01*	−1.73	0.08	*SIZE*	−0.01*	−1.94	0.05
ROA	−1.32	−0.34	0.74	*ROA*	−0.41	−0.10	0.92
LEV	−0.23**	−2.05	0.04	*BTM*	0.00	−0.65	0.52
BTM	0.00	−1.17	0.24	*CFO*	0.49*	1.86	0.06
CFO	0.52*	1.89	0.06	*INTER_COVER*	−0.18	−1.47	0.14
INTER_COVER	−0.18	−1.42	0.16	*CGIIPS*	0.21***	3.49	0.00
CGIIPS	0.14***	3.59	0.00	*LEV_Dummy*	0.01	0.45	0.66
DTA_Dummy	0.04**	2.09	0.04	*DTA_Dummy*	0.04	1.57	0.12
CGIIPS×DTA_Dummy	−0.07*	−1.94	0.05	*CGIIPS×LEV_Dummy*	−0.15***	−2.75	0.01
				CGIIPS×DTA_Dummy	−0.14**	−2.10	0.04
				LEV_Dummy×DTA_Dummy	−0.01	−0.37	0.71
				CGIIPS×LEV_Dummy×DTA_Dummy	0.12*	1.68	0.09
Adjusted *R*-squared		0.56		Adjusted *R*-squared		0.56	
Obs		336		Obs		338	
Period effects		Included		Period effects		Included	

Notes The sample includes all banks domiciled in Eurozone countries and covers the period 2005–2015. *, ** and *** indicates significance at the 10%, 5% and 1% level of significance. Variables' definitions are provided in the Appendix

Table 7 Determinants of future change of credit ratings

	Coef.	*z*-stat	*p*-value
LOSS	0.95**	2.03	0.04
$\triangle SIZE$	−2.02	−1.25	0.21
$\triangle ROA$	22.69	0.45	0.65
$\triangle LEV$	−0.56	−0.37	0.71
$\triangle BTM$	−0.30***	−2.98	0.00
$\triangle CFO$	5.25***	2.65	0.01
$\triangle INTER\_COVER$	2.03	1.35	0.18
CGIIPS	−0.86***	−3.47	0.00
$\triangle DTAtoTA$	−1.86	−1.56	0.12
$CGIIPS \times \triangle DTAtoTA$	2.75**	2.05	0.04
Pseudo *R*-squared		0.14	
Obs		311	
Period effects		Included	

Notes The sample includes all banks domiciled in Eurozone countries and covers the period 2005–2015. *, ** and *** indicates significance at the 10%, 5% and 1% level of significance

5 Conclusions

The present study examines the financial crisis's effects on banks' creditworthiness. The sample includes banks domiciled in the Eurozone between 2005 and 2015. In particular, we aimed to assess the effects of increased deferred taxation as a result of the large losses suffered by banks domiciled in crisis-affected countries during the crisis period. The results reveal that banks that recorded high changes in deferred tax assets had higher future credit risk (lower creditworthiness). However, if these banks were domiciled in crisis-affected countries, the direction of the relationship changed. Additional analyses found some evidence that less-capitalised banks that recorded deferred tax assets during the crisis had lower creditworthiness.

This study's results extend previous studies by showing that, under certain conditions, deferred taxation holds information for assessing future risk. Moreover, it has shown that the contemporaneous presence of high leverage with high changes in deferred tax assets may lead to higher future credit risk. The results of the study shed some light on the usefulness of accounting determinants of credit risk and should prove useful for academics, regulators and practitioners.

Table 8 Determinants of future change of CDS spread

	Coef.	*t*-stat	*p*-value
Intercept	0.16***	3.94	0.00
LOSS	0.10	0.69	0.49
ΔSIZE	1.39**	2.17	0.03
ΔROA	−3.45	−0.43	0.67
ΔLEV	0.44	0.64	0.52
ΔBTM	0.05***	2.84	0.00
ΔCFO	−0.48	−0.62	0.54
ΔINTER_COVER	−0.63	−1.54	0.12
CGIIPS	0.46***	4.51	0.00
ΔDTAtoTA	0.32	1.37	0.17
CGIIPS×ΔDTAtoTA	−0.81***	−3.03	0.00
Adjusted *R*-squared	0.68		
Obs	307		
Period effects:	Included		

Notes The sample includes all banks domiciled in Eurozone countries and covers the period 2005–2015. *, ** and *** indicates significance at the 10%, 5% and 1% level of significance. Variables' definitions are provided in the Appendix

Appendix

Variable	Definition
CR_Rate	The assessment of the risk class assigned by Bloomberg for bank *i* at the end of year *t*
CDS_Spread	Bloombe rg's five-year credit default swap spread for bank i at the end of year *t*
Loss	A dummy variable that takes the value of 1 if the firm suffers a loss and zero otherwise
SIZE	Is the logarithm of total assets of bank *i* at year *t*
ROA	Is the return on assets ratio of bank *i* at year *t*
LEV	Is the ratio of long-term debt to total assets of bank *i* at year *t*
BtM	Is the Book-to-Market ratio of bank *i* at year *t*
CFO	Is the ratio of operating cash flows to opening total assets of bank *i* at year *t*
INTER_COVER	Is the ratio (in a logarithmic form) of earnings before interest and tax to total interest expenses of bank *i* at year *t*
DTAtoTA	Is the ratio (in a percentage form) of deferred tax assets to total assets of bank *i* at year *t*
CGIIPS	A dummy variable that takes the value of 1 for the crisis-affected countries (Cyprus, Greece, Ireland, Italy, Portugal and Spain) and zero otherwise

Variable	Definition
DTA_Dummy	Is a dummy variable that takes the value of one if a bank is ranked at the higher 50% based on the ratio of the change in deferred tax assets to total assets and zero otherwise
LEV_Dummy	Is a dummy variable that takes the value of one if a bank is ranked at the higher 50% based on the leverage ratio and zero otherwise

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