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The effect of credit risk on the cross-section of equity returns

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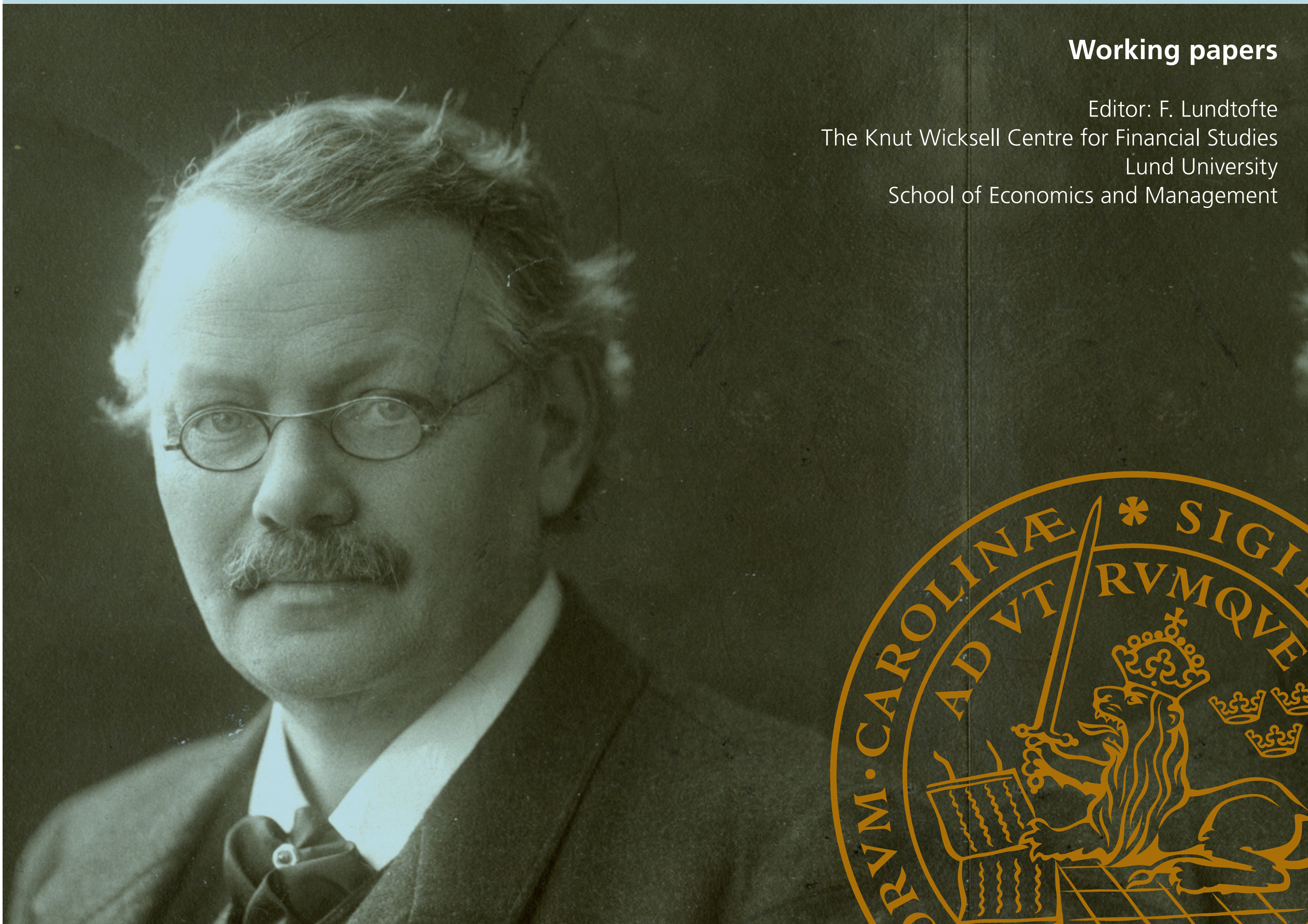

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Hidden in the factors? The effect of credit risk on the cross-section of equity returns[☆]

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Abstract

This paper disentangles the complexity of the distress risk premium in stock returns using the risk-neutral measure of credit risk (valued by CDS spread) and investigates the relationship between credit risk and the market β, size, value, and momentum effects. Consistent with the argument for a negative distress premium, firms with higher credit risk have lower stock returns, and a positive value effect is concentrated in high credit quality firms. However, credit risk is positively priced in returns on stocks that won the most in the past year and that, during crisis, co-moved the most with the market. A positive momentum effect is concentrated in high credit risk firms. Furthermore, the size effect, but not the value effect, could be attributed to a positive credit risk effect.

Keywords: Asset pricing; equity returns; size effect; value effect; momentum effect; credit risk effect; credit default swap

JEL classification: G01; G11; G12

The capital asset pricing model (CAPM) developed by Sharpe (1964) and Lintner (1965) has paved the way for how people think about stock returns and market risk. However, in empirical research, there exist portfolios not included in the CAPM, the "anomalies", that successfully explain average stock returns. One typical example is the success of the zero-investment portfolios *SMB* (small-minus-big) and *HML* (high-minus-low) from Fama and French (1993), and *WML* (winners-minus-losers) from Carhart (1997) based on the one-year momentum effect of Jegadeesh and Titman (1993).[1]

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[1]*SMB*, *HML* and *WML* refer to, respectively, the difference in returns on portfolios of small and big stocks, of value stocks (high book-to-market ratio (B/M)) and growth stocks (low book-to-market ratio), and of winners and losers in the last year.

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Fama and French (1992, 1993, 1995, and 1996) state that the stocks with smaller size (market capitalization, stock price times number of shares outstanding) and with higher B/M (value stocks, where B/M is the ratio of a common stock's book value to its market value) earn higher expected returns. As Fama and French (1993) suggest, the reasons for these size and value effects lie in the association of size and B/M with financial distress. Small and value stocks are compensated due to their high sensitivities to state variables, although these two state variables are not identified. In addition, Avramov et al. (2007) show that momentum profitability is large among low-grade firms: this poses more questions regarding the distress risk premium.

Whether firms with higher distress risk are rewarded, cross-sectionally, with higher stock returns remains a puzzle. Some studies (e.g. Chan et al., 1985; Ferguson and Shockley, 2003; Vassalou and Xing, 2004; Chan-Lau, 2006; Chava and Purnanandam, 2010; Friewald et al., 2014) find a positive link between distress risk and equity returns, a possible explanation of the size or value effect. Meanwhile, others (e.g. Dichev, 1998; Campbell et al., 2008; Avramov et al., 2009; Griffin and Lemmon, 2002) reveal a negative distress premium, a so-called "distress puzzle", or mispricing argument relating to the value effect.

This disagreement among the findings of previous research appears to result from using different proxies for financial distress. Unlike previous literature, we use the credit risk under the risk-neutral measure revealed by the five-year credit default swap (CDS) market. A CDS is a contract of protection against the reference entity's default. The protection buyer pays periodic premiums to the protection seller in exchange for compensation in the event of default by the reference entity. As a result, in contrast to accounting-based measures, the CDS spread is a market-based measure of credit risk: we consider this to be the most intuitive and informative measure of financial distress.

While disentangling the "distress puzzle" or the opposite, i.e. the existence of a positive relation between a firm's credit risk and its expected cross-sectional return on equity, we investigate whether market β[2], size, value, and momentum effects are attributed to a positive credit risk effect. In addition, the sample (from January 2004 to September 2014) covers the recent financial crisis when distress risk affects the market the most. Meanwhile, the CDS market became more alert due to the crisis; as a result, the cross-section of the CDS spread became more divergent. These properties of the sample add more aspects by studying the issue across the different periods, as well as greater challenges to the extent of a positive relation between credit risk and stock returns, if it exists.

Consistent with the argument regarding the negative distress premium, we find that firms with

[2]Market β is the slope of the regression line of a stock's excess return relative to the market excess return.

higher credit risk have lower stock returns and a positive value effect is concentrated in high credit quality firms. However, we also detect the existence of a positive credit risk effect, as well as support for an association of β and size effects with credit risk. Credit risk is positively priced in returns on the stocks that won the most in the past year and that, during crisis, co-moved the most with the market. One possible explanation could be that, for these stocks, the market expects that shareholders would recover or, by strategically defaulting on their debt, may recover part of the residual firm value upon the resolution of financial distress, as modelled by Garlappi and Yan (2011). We also find that a positive momentum effect is concentrated in high credit risk firms.

Our contribution is to use the credit risk under the risk-neutral measure revealed by the CDS market to disentangle the complexity of the distress risk premium in stock returns. We investigate the pricing of credit risk in equity returns and the relationship between credit risk and other firm characteristics, i.e. market β, size, B/M, and momentum. This study considers portfolios and individual stocks, and uses a sample covering the recent financial crisis. In addition, it adds more perspectives on the link between equity and credit markets, which is valuable for asset management in terms of rebalancing traditional portfolios using information about the CDS market.

The study proceeds as follows. Section 1 contains a review of existing literature. Section 2 describes the original data. Section 3 summarizes the data on the firm characteristics, i.e. market β, size, B/M, momentum, and credit risk, and on the risk factors we construct. Section 4 investigates the relationship between stock returns and firm characteristics by portfolio groupings. Section 5 applies Fama-MacBeth (1973) regressions to individual stocks to examine the explanatory power of the firm characteristics in the cross-section of stock returns, as well as the relationship between credit risk and the other characteristics. Section 6 studies the relationship between factor loadings and credit risk, and conducts asset-pricing tests for models which include different risk factors. Section 7 concludes the paper.

1. Literature review

Empirically, some studies find a positive relationship between a firm's distress risk and the expected returns on its stock, or the positive distress risk premium explanation of the size and/or value effects. Chan et al. (1985) measure default risk by the credit spread between low-grade bonds and long-term government bonds; they find that it explains a large proportion of the size effect. Vassalou and Xing (2004) employ the default probability, based on Merton's (1974) option pricing model, as the proxy for individual firms' default risk. They conclude that both the size and value effects can be viewed as default effects and that *SMB* and *HML* appear to contain additional information which is not related to default risk. Chan-Lau (2006) uses a systematic default-risk measure extracted from collateralized debt obligations, referring to standardized North America investment-grade credit-derivative indices. He finds that the systematic default risk is an important determinant of equity returns, aside from the three Fama-French factors (market excess return, *SMB*, and *HML*). Chava and Purnanandam (2010) use ex ante estimates of expected returns based on the implied cost of capital (instead of ex post realized returns) and apply both hazard-rate estimation and expected default frequency to measure default risk. They find a positive relationship between expected stock returns and default risk. Friewald et al. (2014) estimate risk premiums from CDS forward curves of the referred firms and find that firms' stock returns increase along with their credit risk premiums.

However, others reveal a negative distress premium, the "distress puzzle", or a mispricing argument for the value effect. Dichev (1998) shows that bankruptcy risk, measured by Altman's (1968) Z-score and Ohlson's (1980) O-score, is not rewarded by higher stock returns. Campbell et al. (2008) estimate bankruptcy risk using a dynamic logit panel model and state that financially distressed stocks have delivered anomalously low returns. Ferguson and Shockley (2003) model the missing beta risk of a firm's debt claim in addition to that of its equity claim, where the latter is from the equity-only proxy for the market portfolio in the CAPM. They find empirical support to suggest that stocks with high sensitivities to a distress factor (low-minus-high for distress risk, i.e. high-minus-low for Altman's (1968) Z-score) have higher returns, although their model cannot explain the high return on a high-distress-risk low-leverage portfolio. Avramov et al. (2009) use credit ratings and find higher stock returns for low credit risk firms than for high credit risk firms. Griffin and Lemmon (2002) apply Ohlson's (1980) O-score as a proxy for distress risk. They demonstrate that the value effect appears among firms with the highest distress risk and that this value premium is due to the mispricing of high-distress-risk stocks rather than there being a risk-based explanation.

Theoretical models exist which try to reconcile the contradiction between these empirical results. Garlappi and Yan (2011) use the argument of shareholder recovery (applying the expected default frequency from Moody's KMV in the empirical tests) to simultaneously explain lower returns for financially distressed stocks, stronger value effects for firms with high default likelihood, and the concentration of momentum profits among low credit quality firms. Ozdagli (2013) models cross-sectional differences in the exposure of cash flows to systemic risk. He argues that the positive value premium stemming from financial distress risk and the negative distress premium result from using the risk-neutral and real default probability, respectively.

Unlike the aforementioned studies, we use the risk-neutral measure of credit risk, as revealed from the most liquid five-year CDS contracts. The choice of measuring distress risk is also motivated by the studies which demonstrate that the CDS market is more important in revealing credit risk information than the bond market (Longstaff et al., 2003; Blanco et al., 2005; Norden and Weber, 2009; Forte and Peña, 2009), by the observation that equity traders have tended to turn their attention to the CDS market first, before trading, especially during the recent financial crisis (Gaffen, 2008), as well as by the findings of information flows from the CDS market to the stock markets (Acharya and Johnson, 2007; Ni and Pan, 2011; Han and Zhou, 2011).

2. Data

We obtained data for all non-financial firms in the U.S. market with common stocks listed and to which available USD-denominated CDS contracts refer. The sample period is January 2004[3] to September 2014: starting when the CDS market was mature, and covering the recent financial crisis. The data set is the intersection of daily common stock data on major stock exchanges (NYSE, AMEX, and NASDAQ), quarterly fundamentals, and daily CDS data from Credit Market Analysis (CMA), all collected from Standard & Poor's Capital IQ. It consists of 489 firms with matched data. Stock returns are holding-period returns adjusted for all distributions such as: dividends, splits, rights offerings and spin-offs. All monthly excess returns are returns in excess of the one-month U.S. Treasury Bill rate which is collected from Kenneth R. French's home page,[4], as are the market excess returns and Fama and French's data on three zero-investment portfolios (SMB_{FF}, HML_{FF}, and WML_{FF}).

The firm characteristics, i.e. market β, size, B/M, momentum, and CDS spread, are month-end observations. Market β is the past 60-month β with at least 24-month stock prices available. Size is a stock's market capitalization at the end of each month. Momentum return is a stock's cumulative return from $t-11$ to $t-1$.

B/M is the ratio of total common equity to market capitalization at the end of each month. Normally, firms are required to file Form 10-Q quarterly reports, within 40 or 45 days, and Form 10-K annual reports, within 75 or 90 days, with the Securities and Exchange Commission. To ensure that the book-to-market ratio is publicly available, we assign a two-month information lag for fiscal quarters one, two and three, and a three-month lag for fiscal quarter four.[5] For example, if a firm's first fiscal quarter ends in March, then its B/M at the end of March will be used as the

[3]Additional five-year monthly stock prices are collected before January 2004 in order to calculate momentum returns and market βs.

[4]http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/

[5]Standard & Poor's analysis also uses these lags (http://www.standardandpoors.com).

firm's characteristic at the end of May.

It should be noted that the first size decile in the sample is approximate to the fifth and sixth size deciles in the Fama-French sample for June 2009 and June 2014 respectively. This is because not many CDS contracts which refer to very small firms. However, this is not the case for the other characteristics in the sample. This property of the sample could influence the analysis of the size effect.

The CDS spread is the mid-spread[6] of the most liquid five-year senior CDS which refers to each firm. The prices of the same security from different data sources, such as CMA, GFI, Fenics, Reuters EOD, Markit, and JP Morgan, differ to some degree. Mayordomo et al. (2010) use the most liquid single-name five-year CDS of the components of iTraxx and CDX to compare the six major data sources above and find that the CMA database quotes lead the price discovery process in comparison to the other data sources.

3. Characteristics and risk factors

As the sample covers the recent financial crisis and the crisis has been significantly reflected in the CDS market, the sample is divided into three sub-samples: pre-crisis (January 2004 to November 2007), during crisis (December 2007 to June 2009), and after crisis (July 2009 to September 2014).[7]

Table 1 summarizes the data for the whole sample and for the three sub-samples. Unlike the pre-crisis and after crisis periods, the crisis period is characterized by a negative average of the market excess returns and of the momentum returns, and, in comparison, by more volatile stock returns with a lower average, smaller minimum size, more variation in book-to-market ratios, and more volatile and higher CDS spreads. It should be noted that the range of CDS spreads is much wider during and after the crisis, compared to the pre-crisis period. This reflects that the CDS market has become more alert following the occurrence of the crisis.

In order to investigate any potential linkage between credit risk and the characteristics used to explain the cross-section of stock returns in the literature, i.e. market β, size, B/M, and momentum, this paper will begin by studying their correlations.

Table 2 displays the cross-sectional correlation coefficients among the time-series averages of stock returns, market βs, sizes, B/Ms, and CDS spreads for all the individual stocks in the sample.

[6]We have used spreads which are all from actual trades or contributors' quotes. The data including only spreads from actual trades produce qualitatively the same results.

[7]The National Bureau of Economic Research defines the contraction period as December 2007 to June 2009.

Table 1: Summary statistics of the data

Panel A: Whole sample period (129 months)					Panel B: Pre-crisis period (47 months)				
VARIABLES	Mean	Std. Dev.	Min.	Max.	VARIABLES	Mean	Std. Dev.	Min.	Max.
expected stock return	0.60	10.13	-130.50	152.20	expected stock return	0.84	7.22	-70.30	45.57
MK	0.60	4.26	-17.23	11.35	MK	0.56	2.34	-4.83	4.54
market β	1.13	0.73	-1.18	5.66	market β	0.90	0.70	-1.18	5.58
B/M	0.50	0.36	0.00	7.34	B/M	0.44	0.25	0.00	4.02
size	25.65	45.61	0.02	613.80	size	23.14	39.89	0.25	513.40
ln(size)	2.36	1.34	-3.97	6.42	ln(size)	2.36	1.21	-1.38	6.24
CDS spread	155	279	1	8854	CDS spread	80	109	1	1988
ln(CDS spread)	4.43	1.05	0.04	9.09	ln(CDS spread)	3.85	0.99	0.04	7.60
momentum	7.98	35.63	-347.50	329.80	momentum	15.14	24.56	-166.90	150.30
Panel C: During crisis (19 months)					**Panel D: After crisis (63 months)**				
VARIABLES	Mean	Std. Dev.	Min.	Max.	VARIABLES	Mean	Std. Dev.	Min.	Max.
expected stock return	-2.04	17.84	-130.50	152.20	expected stock return	1.26	8.38	-74.06	71.43
MK	-2.08	6.84	-17.23	10.19	MK	1.49	3.97	-7.89	11.35
market β	1.19	0.67	-0.22	5.40	market β	1.28	0.73	-0.09	5.66
B/M	0.60	0.57	0.00	7.34	B/M	0.52	0.34	0.00	6.35
size	21.23	40.17	0.02	511.90	size	29.04	50.89	0.08	613.80
ln(size)	2.08	1.46	-3.97	6.24	ln(size)	2.46	1.37	-2.49	6.42
CDS spread	294	555	12	8854	CDS spread	169	212	11	6203
ln(CDS spread)	5.02	1.05	2.48	9.09	ln(CDS spread)	4.70	0.88	2.41	8.73
momentum	-30.94	47.93	-347.50	155.50	momentum	14.89	29.75	-227.90	329.80

This table summarizes the data on stock return (in percentages), market excess return (MK, in percentages), market β, size (billions of dollars), book-to-market, momentum returns (in percentages), and CDS spread (basis points) for the whole sample and the three sub-samples.

Table 2: Cross-sectional correlation of time-series averages

	market β	size	B/M	momentum	CDS spread
market β	1				
size	-0.02	1			
	(0.63)				
B/M	0.24	-0.21	1		
	(0.00)	(0.00)			
momentum	-0.12	0.08	-0.29	1	
	(0.02)	(0.10)	(0.00)		
CDS spread	0.21	-0.26	0.41	-0.57	1
	(0.00)	(0.00)	(0.00)	(0.00)	

The figures in parentheses represent the corresponding p-values (for the null hypothesis that the correlation is zero).

The CDS spread is significantly negatively correlated with size or momentum return, and positively correlated with market β or B/M across stocks. This is consistent with the beliefs that smaller stocks tend to have higher book-to-market ratios, which results from their poor prospects, and that smaller firms carry higher financial distress, which results in a higher CDS spread to pay for protection against their defaults. It also shows that small stocks tend to be past losers and co-move more with the market.

In order to study how these relationships between the firm characteristics play a role in explaining the risk premiums in stock returns, we construct zero-investment portfolios mimicking the risk factors in stock returns in relation to size, B/M, momentum, and CDS spread, in the same way as Fama and French (1993) have done. We perform two-pass 2×3 independent sorts[8] on size (bottom 50% and top 50%) and one of the other characteristics (bottom 30%, middle 40%, and top 30%), i.e. B/M, momentum, and CDS spread. For example, for portfolios sorted on size and B/M, at the end of each month, all stocks are allocated into two size portfolios (small (S) and big (B)) according to the size breakpoints determined using the market capitalizations of all stocks. Then each size portfolio is subdivided into three B/M portfolios (growth (G), medium (M), and value (V)) based on the B/M breakpoints, which have been determined by using all firms.[9] The intersection of these independent 2×3 sorts on size and B/M produces six value-weighted portfolios: *SG*, *SM*, *SV*, *BG*, *BM*, and *BV*. The size factor, *SMB* (small-minus-big), is the equally weighted average of the returns on the three small-stock portfolios (*SG*, *SM*, and *SV*) minus that of the returns on the three big-stock portfolios (*BG*, *BM*, and *BV*). The value factor, *HML* (high-minus-low), is the equally weighted average of the returns on the two value-stock portfolios (*SV* and *BV*) minus that of the returns on the two growth-stock portfolios (*SG* and *BG*). In the same way that *HML* was constructed, the risk factors for momentum and CDS spread, i.e. *WML* (winners-minus-losers) and *CHML* (high-minus-low for credit risk), are constructed from the 2×3 size-momentum sorts and the 2×3 size-CDS spread sorts, respectively.

Table 3 shows that the correlation between the risk factor, *SMB*, *HML*, or *WML*, and the same factor from the Fama-French sample, SMB_{FF}, HML_{FF}, or WML_{FF}, is higher than 0.5, especially for the momentum factor. Statistically (Panel B), they are not dramatically different, except for the size factor during the crisis period and across the whole time span. This is because there are not any very small firms in this sample, as mentioned in Section 2. Since the focus here is on credit risk, and the risk factor for credit risk (*CHML*) can only be constructed in this sample, we use this data for the other risk factors (*SMB*, *HML*, and *WML*) in the rest of the analysis.

[8]The intersection of the independent 3×3 sorts produces qualitatively the same results.

[9]The firms with negative B/M are not included.

Table 3: Statistics of risk factors and their correlations

Panel A: Correlations between factors

	MK	SMB	HML	WML	$CHML$	SMB_{FF}	HML_{FF}	WML_{FF}
MK	1							
SMB	0.62	1						
HML	0.46	0.58	1					
WML	-0.28	-0.55	-0.45	1				
$CHML$	0.70	0.76	0.63	-0.52	1			
SMB_{FF}	0.46	0.65	0.24	-0.12	0.45	1		
HML_{FF}	0.32	0.40	0.52	-0.21	0.33	0.15	1	
WML_{FF}	-0.32	-0.58	-0.53	0.93	-0.57	-0.07	-0.33	1

Panel B: Summary statistics of factors

	whole sample period					before crisis			
Factors	Mean	Std. Dev.	Min.	Max.	Factors	Mean	Std. Dev.	Min.	Max.
MK	0.63	4.26	-17.23	11.35	MK	0.55	2.36	-4.83	4.54
SMB	0.35	2.86	-10.62	17.13	SMB	0.25	1.87	-3.30	4.13
HML	0.08	2.16	-10.02	11.69	HML	0.24	1.53	-2.46	4.32
WML	-0.05	4.52	-30.65	8.93	WML	0.64	2.73	-4.61	5.71
$CHML$	0.15	4.37	-14.28	26.78	$CHML$	0.08	2.21	-4.97	6.26
SMB_{FF}	0.11	2.26	-4.28	5.78	SMB_{FF}	-0.07	2.17	-4.00	5.32
HML_{FF}	0.14	2.31	-9.86	7.57	HML_{FF}	0.37	1.70	-2.99	4.52
WML_{FF}	0.03	4.68	-34.70	12.53	WML_{FF}	0.48	2.31	-5.36	5.25
	during crisis					after crisis			
Factors	Mean	Std. Dev.	Min.	Max.	Factors	Mean	Std. Dev.	Min.	Max.
MK	-2.03	7.07	-17.23	10.19	MK	1.48	3.98	-7.89	11.35
SMB	0.05	5.80	-10.62	17.13	SMB	0.50	2.09	-4.22	5.73
HML	-0.33	4.06	-10.02	11.69	HML	0.09	1.74	-3.78	4.25
WML	-2.10	9.60	-30.65	8.93	WML	0.06	2.82	-9.23	8.77
$CHML$	-0.74	8.78	-14.28	26.78	$CHML$	0.47	3.58	-10.91	8.08
SMB_{FF}	0.63	2.50	-3.64	5.35	SMB_{FF}	0.10	2.26	-4.28	5.78
HML_{FF}	-0.44	3.83	-9.86	5.42	HML_{FF}	0.15	2.12	-4.37	7.57
WML_{FF}	-1.32	10.56	-34.70	12.53	WML_{FF}	0.09	2.86	-8.89	6.64

The mimicking risk factors are MK (market excess returns over risk-free rates), SMB (small-minus-big for size), HML (high-minus-low for book-to-market), WML (winners-minus-losers for momentum return), and $CHML$ (high-minus-low for credit risk). SMB_{FF}, HML_{FF} and WML_{FF} denote the risk factors using the Fama-French sample. This table displays statistics (in percentages) for the factors and their correlations.

4. Portfolio excess returns and characteristics

We now explore the link between stock returns and firm characteristics, and investigate the drivers of this link by constructing portfolio groups.

The portfolios in Table 4 are constructed from a one-way sort on CDS spread, market β, size, B/M, or momentum return. At the end of each month, stocks are sorted into five groups, according to one of their characteristics, from low to high. Then, for each quintile portfolio, its expected value-weighted and equally weighted excess returns are calculated, as well as its post-ranking market β, and the average values of firm characteristics for the following month. For example, the portfolios in Panel A are formed by assigning stocks to groups from low CDS spread firms (*CDS-Low*) to high CDS spread firms (*CDS-High*) according to the quintile breakpoints of the CDS spreads for all the individual firms at the end of the month. For portfolios formed on credit risk, the αs based on the Fama-French three-factor and Carhart four-factor models are also shown.

Panel A reveals that the relationship between CDS spread and expected stock excess return is not monotonic, and the second and fourth quintile portfolios have relatively high excess returns, especially for the value-weighted portfolios. Consistent with the picture of the raw excess returns, the value-weighted portfolio with the highest credit risk delivers the lowest profit, with a significantly negative α. This “distress puzzle” is more pronounced for the equally weighted portfolios. However, the fourth quintile value-weighted portfolio has a positive and relatively high α, which might stem from a positive distress risk premium.

Again, the CDS spread is negatively correlated with size and momentum, and positively correlated with B/M and market β. The variation of market β or size among CDS-spread-quintile portfolios is large, compared to its variation among β- or size-quintile portfolios in Panel B or C respectively. This suggests that there is a strong correlation between CDS spread and market β or size: the credit risk effect could be associated with a market β or size effect.

Panels B to E show that there are weak β, size, and value effects for value-weighted portfolios. There are large variations in CDS spread among these β- or size-quintile portfolios, compared to its variation in Panel A. This indicates that credit risk could be one of the underlying drivers for the β or size effect.

Next, we use two-pass sorted portfolios to control any effect of credit risk or of any other characteristic, so as to identify which characteristic contributes to the performance of the portfolios.

We construct portfolios by the independent 3×3 (bottom 33.3%, middle 33.3%, and top 33.3%) sorts on CDS spread and one of the other firm characterisitics, i.e. market β, size, B/M, and momentum, in the same manner as constructing the risk factors in Section 3. The only difference

Table 4: Portfolios formed on each characteristic

	Panel A: Portfolios formed on CDS spread							
	CDS-Low	2	3	4	CDS-High		High-Low	Newey-West *t*
Excess return (value-weighted)	0.69	0.93	0.79	1.12	0.72		0.03	(0.06)
3-fac. α (value-weighted)	0.29	0.45	0.20	0.37	-0.43		-0.72	
Newey-West *t*	(3.62)	(5.32)	(1.40)	(3.11)	(-2.03)		(-3.38)	
4-fac. α (value-weighted)	0.29	0.43	0.19	0.36	-0.40		-0.69	
Newey-West *t*	(3.69)	(5.96)	(1.40)	(2.98)	(-1.97)		(-3.16)	
Excess return (equally weighted)	0.59	0.72	0.59	0.59	-0.01		-0.60	(-0.94)
3-fac. α (equally weighted)	0.12	0.17	-0.08	-0.28	-1.36		-1.48	
Newey-West *t*	(1.41)	(1.67)	(-0.75)	(-2.22)	(-6.19)		(-7.05)	
4-fac. α (equally weighted)	0.11	0.15	-0.09	-0.30	-1.34		-1.45	
Newey-West *t*	(1.59)	(2.00)	(-0.90)	(-2.85)	(-5.93)		(-6.88)	
Market β	0.80	0.92	1.10	1.37	2.09			
Size	68.49	30.52	15.12	9.29	4.80			
B/M	0.32	0.43	0.49	0.56	0.71			
Momentum	11.82	12.34	10.45	7.77	-2.49			
CDS spread	34	54	89	152	454			
	Panel B: Portfolios formed on market β							
	β-Low	2	3	4	β-High		High-Low	Newey-West *t*
Excess return (value-weighted)	0.67	0.90	0.82	0.96	0.89		0.23	(0.42)
Excess return (equally weighted)	0.47	0.58	0.61	0.40	0.41		-0.06	(-0.11)
Market β	0.63	0.93	1.18	1.48	2.04			
Size	39.61	35.28	26.81	14.77	12.46			
B/M	0.41	0.45	0.48	0.55	0.62			
Momentum	8.94	9.58	9.29	7.03	5.28			
CDS spread	83	103	111	167	313			
	Panel C: Portfolios formed on size							
	Small	2	3	4	Big		Small-Big	Newey-West *t*
Excess return (value-weighted)	1.33	1.14	1.15	1.00	0.66		0.68	(1.28)
Excess return (equally weighted)	0.30	0.54	0.65	0.58	0.40		-0.10	(-0.18)
Market β	1.95	1.34	1.13	0.98	0.87			
Size	2.13	5.44	11.04	22.14	88.48			
B/M	0.70	0.57	0.47	0.43	0.34			
Momentum	-0.94	8.69	10.30	11.12	10.98			
CDS spread	360	177	113	79	47			
	Panel D: Portfolios formed on B/M							
	Growth	2	3	4	Value	B/M-Neg.	Value-Growth	Newey-West *t*
Excess return (value-weighted)	0.53	0.86	0.90	1.03	1.00	0.81	0.48	(1.44)
Excess return (equally weighted)	0.37	0.55	0.60	0.57	0.40	-0.08	0.03	(0.08)
Market β	1.06	1.12	1.18	1.24	1.67	1.58		
Size	37.52	38.42	24.69	18.83	9.44	8.60		
B/M	0.16	0.32	0.45	0.61	0.97	-0.83		
Momentum	11.79	11.69	11.42	7.67	-2.55	2.98		
CDS spread	117	104	127	160	273	631		
	Panel E: Portfolios formed on momentum							
	Losers	2	3	4	Winners		Winners-Losers	Newey-West *t*
Excess return (value-weighted)	0.88	0.99	0.99	0.92	0.80		-0.09	(-0.17)
Excess return (equally weighted)	0.06	0.67	0.73	0.58	0.43		0.36	(0.70)
Market β	1.78	1.25	1.07	0.98	1.17			
Size	20.10	26.91	29.13	30.61	22.18			
B/M	0.66	0.51	0.46	0.44	0.43			
Momentum	-25.32	-1.23	9.19	19.02	39.02			
CDS spread	295	131	104	107	138			

Portfolios are formed monthly on each characteristic from low to high. Stocks with negative B/M (B/M-Neg.) are excluded in Panels A, B, C, and E. This table shows the time-series average of the value-weighted and equally weighted excess returns (in percentages), of sizes (in billions of dollars), of book-to-market ratios, of momentum returns (in percentages) and of CDS spreads (in basis points), and the post-ranking market β for each of the portfolios. In addition, we have αs based on the Fama-French three-factor and Carhart four-factor models for portfolios formed on CDS spread. *High-Low* in Panels A and B, and *Small-Big*, *Value-Growth*, and *Winners-Losers* in Panels C, D and E, indicate the return differences between high- and low-CDS spread stocks, high- and low-market β stocks, small and big stocks, value and growth stocks, and past winners and losers, respectively. The figures in parentheses show the t-statistics based on heteroscedasticity and autocorrelation consistent standard errors using Newey and West (1987), with optimal truncation lag according to Newey and West (1994).

is in using 3×3 sorts instead of 2×3 sorts to produce enough variation and consequently using tertile breaks (bottom 33.3%, middle 33.3%, and top 33.3%) instead of the Fama-French breaks (bottom 30%, middle 40%, and top 30%). This is to avoid having zero stock in a portfolio, due to the small sample. Thereafter, the properties of each portfolio are calculated for the following month.

Table 5: Portfolios formed by two-pass sorts on market β, size, B/M or momentum, and CDS spread

Panel A: Average excess return of value-weighted portfolio

	All	CDS-Low	CDS-Medium	CDS-High	High-Low	Newey-West t
All		0.73	0.88	1.05	0.32	0.81
Portfolios sorted on market β and CDS spread						
β-Low	0.69	0.64	0.87	0.50	-0.14	-0.29
β-Medium	0.95	0.86	1.10	1.07	0.21	0.85
β-High	0.89	0.63	0.49	1.00	0.36	0.89
High-Low	0.19	-0.01	-0.38	0.49		
Newey-West t	0.51	-0.03	-1.23	0.99		
Portfolios sorted on size and CDS spread						
Small	0.43	0.79	0.61	0.30	-0.40	-0.75
Medium	0.60	0.83	0.71	0.09	-0.74	-1.72
Big	0.45	0.54	0.25	0.33	-0.18	-0.34
Small-Big	-0.02	0.22	0.35	-0.09		
Newey-West t	-0.05	0.74	2.10	-0.18		
Portfolios sorted on B/M and CDS spread						
Growth	0.70	0.68	0.81	0.87	0.19	0.39
Medium	0.88	0.81	1.04	0.99	0.18	0.56
Value	0.95	1.01	0.71	0.96	-0.04	-0.08
Value-Growth	0.24	0.33	-0.10	0.10		
Newey-West t	0.99	1.12	-0.43	0.22		
Portfolios sorted on momentum and CDS spread						
Losers	0.98	0.87	1.09	0.79	-0.08	-0.17
Medium	0.93	1.01	0.76	1.01	0.00	0.00
Winners	0.82	0.74	0.97	0.68	-0.06	-0.13
Winners-Losers	-0.16	0.06	0.17	-0.19		
Newey-West t	-0.37	0.35	0.66	-0.51		

Panel B: Average excess return of equally weighted portfolio

	All	CDS-Low	CDS-Medium	CDS-High	High-Low	Newey-West t
All		0.65	0.56	0.27	-0.38	-0.79
Portfolios sorted on market β and CDS spread						
β-Low	0.48	0.57	0.59	-0.05	-0.63	-1.23
β-Medium	0.65	0.78	0.71	0.40	-0.38	-1.29
β-High	0.35	0.43	0.27	0.21	-0.22	-0.39
High-Low	-0.13	-0.14	-0.32	0.27		
Newey-West t	-0.31	-0.33	-0.98	0.68		
Portfolios sorted on size and CDS spread						
Small	0.44	0.71	0.65	0.26	-0.15	-0.26
Medium	0.55	0.91	0.55	0.19	-0.72	-1.82
Big	0.47	0.55	0.30	0.52	-0.06	-0.08
Small-Big	-0.04	0.04	0.34	-0.35		
Newey-West t	-0.08	0.09	1.80	-0.51		
Portfolios sorted on B/M and CDS spread						
Growth	0.44	0.58	0.52	0.09	-0.50	-1.17
Medium	0.62	0.66	0.63	0.43	-0.23	-0.61
Value	0.43	0.90	0.49	0.21	-0.69	-1.19
Value-Growth	-0.01	0.32	-0.03	0.12		
Newey-West t	-0.04	1.75	-0.16	0.38		
Portfolios sorted on momentum and CDS spread						
Losers	0.32	0.74	0.61	-0.14	-0.88	-1.47
Medium	0.69	0.89	0.65	0.60	-0.29	-0.65
Winners	0.47	0.62	0.51	0.16	-0.46	-0.83
Winners-Losers	0.16	-0.12	-0.10	0.29		
Newey-West t	0.39	-0.37	-0.36	0.43		

Panel C: Average CDS spread

	All	CDS-Low	CDS-Medium	CDS-High
All		40	90	338
Portfolios sorted on market β and CDS spread				
β-Low	90	39	85	300
β-Medium	117	41	90	280
β-High	259	45	96	370
Portfolios sorted on size and CDS spread				
Small	289	47	99	382
Medium	119	45	90	249
Big	58	38	81	207
Portfolios sorted on B/M and CDS spread				
Growth	111	38	86	337
Medium	129	42	91	292
Value	228	46	93	362
Portfolios sorted on momentum and CDS spread				
Losers	233	40	94	391
Medium	108	40	89	265
Winners	125	41	89	274

Portfolios are formed monthly by independent 3×3 sorts on CDS spread and market β, size, B/M or momentum. This table shows the time-series average of the value- and equally weighted excess returns (in percentages) and CDS spreads (basis points) for each of the double-sorted portfolios, as well as for each of the portfolios sorted only on one characteristic (*All*). *High-Low* in the horizontal and vertical bars represents the return differences between high- and low-CDS spread stocks, and high- and low-market β stocks, respectively. *Small-Big*, *Value-Growth*, and *Winners-Losers* indicate the return differences between small and big stocks, value and growth stocks, and past winners and losers, respectively. The figures in parentheses are t-statistics based on heteroscedasticity and autocorrelation consistent standard errors using Newey and West (1987), with optimal truncation lag according to Newey and West (1994).

Table 5 displays the time-series averages of the value- and equally weighted excess returns and of the CDS spreads for each portfolio. For one-way sorted (*"All"*) value-weighted portfolios (Panel A), there is a monotonic relationship between excess return and CDS spread, or B/M. However, this is not the case for the equally weighted portfolios (Panel B).

Being long in *Value* stocks and short in *Growth* stocks makes a positive profit for the value-weighted portfolios with low credit risk; this profitability becomes significant at the 10% level for the equally weighted portfolios. Among those stocks with a medium credit risk, there are significantly positive profits from being long *Small* stocks and short *Big* stocks in the value- and equally weighted portfolios, and there is a slight variation in average CDS spread among these portfolios (Panel C). After controlling for size, there is a significantly negative distress risk premium among stocks of medium size.

In short, the value effect is concentrated within stocks with low credit risk; the credit risk could contribute to the size effect within CDS-medium portfolios.

5. Individual stock returns and characteristics

The research on the relationship between firm characteristics and stock returns starts from the point that firm characteristics explain individual stock returns cross-sectionally. Hence, we investigate this hypothesis using the sample where credit risk is an additional characteristic, so as to shed light on the relationship between credit risk and other characteristics when explaining stock returns.

We apply Fama-MacBeth's (1973) regression approach.[10] Each month, the cross-sectional expected stock returns are regressed on variables, which are hypothesized to explain expected returns. Following this, the time-series average, of the cross-sectional regression slopes for each explanatory variable, tests whether the variable is on average priced. Table 6 displays the results for the whole sample and pre-crisis sub-sample, as well as Table 7 for the during crisis and after crisis sub-samples.

A glimpse of Tables 6 and 7 shows that, as expected, small and value stocks have higher returns; there is a positive momentum effect during the pre-crisis period. It is also not surprising that stocks loading more onto the market returns have lower expected returns, since the sample covers a severe financial crisis. However, stocks with high credit risk have lower returns, i.e. the "distress puzzle". Nevertheless, by investigating the significant interaction terms, we find a positive credit risk effect for some particular stocks.

[10]Tests, according to Petersen (2009), verify that the residuals in this study are correlated across firms instead of across time; this supports the use of Fama-MacBeth's (1973) approach here.

For the whole sample (specification (4)), as long as $ln(CDSspread)$ is one standard deviation higher than its mean, i.e. CDS spread is above 239.85 bp (see Table 1), there is a negative value premium. The same applies to the pre-crisis sub-sample (specifications (4), (7) and (8)), when $ln(CDSspread)$ is two standard deviations higher than its mean: i.e. CDS spread is above 340.36 bp.

For the whole sample (specification (6)) and the after crisis sub-sample (specifications (6) and (7)), as long as $ln(CDSspread)$ is higher than its mean, there is a positive momentum effect. For the whole sample (specification (6)), the pre-crisis sub-sample (specification (6)), and the after crisis sub-sample (specifications (6) and (7)), for stocks where the past momentum returns are at least two standard deviations higher than the mean, there is a positive credit risk effect.

In contrast, during the crisis, the only interaction term that explains expected return is that of market β and credit risk. Specifications (6) and (8) state that when market β is extremely large, greater than 4.97, there is a positive credit risk effect.

Consistent with the findings in Section 4, the positive value effect is concentrated within the firms with a high credit quality. There is a positive credit risk effect for the stocks that won the most in the past year and that load the most onto the market during crisis, which could be explained by the market's expectation for a positive recovery of the value of these stocks. The positive momentum effect is concentrated in firms with a low credit quality. Moreover, there is a strong link between size and credit risk, such that the size effect only shows up when credit risk is also considered in order to explain the cross-sectional stock returns.

Table 6: Fama-MacBeth regressions of expected stock returns on firm characteristics: the whole sample and pre-crisis sub-sample

Panel A: Whole sample	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
market β	-0.37	-0.18	-0.15	-0.18	-0.20	-0.40		-0.72
	(0.31)	(0.26)	(0.26)	(0.26)	(0.27)	(0.64)		(0.66)
ln(size)	0.02	-0.19**	-0.56**	-0.19**	-0.19***	-0.19***	-0.18**	-0.40
	(0.10)	(0.08)	(0.22)	(0.08)	(0.07)	(0.07)	(0.07)	(0.26)
B/M	0.12	0.29	0.30	1.79**	0.28	0.28	1.22	0.59
	(0.22)	(0.22)	(0.20)	(0.88)	(0.21)	(0.21)	(1.15)	(1.00)
momentum	0.01	0.01	0.00	0.01	-0.02	-0.03*	-0.02	-0.03*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)
ln(CDS spread)		-0.60***	-0.78***	-0.47**	-0.62***	-0.62***	-0.58**	-0.76***
		(0.18)	(0.22)	(0.21)	(0.14)	(0.17)	(0.25)	(0.28)
ln(size)*ln(CDS spread)			0.09					0.06
			(0.06)					(0.07)
(B/M)*ln(CDS spread)				-0.34*			-0.23	-0.10
				(0.19)			(0.24)	(0.21)
momentum*ln(CDS spread)					0.01**	0.01***	0.01**	0.01**
					(0.00)	(0.00)	(0.00)	(0.00)
(market β)*ln(CDS spread)						0.02		0.10
						(0.09)		(0.09)
Constant	0.52	3.51***	4.31***	2.95***	3.58***	3.65***	3.32***	4.24***
	(0.45)	(0.70)	(0.83)	(0.90)	(0.53)	(0.67)	(0.92)	(1.15)
Observations	36,213	36,213	36,213	36,213	36,213	36,213	36,213	36,213
Number of months	129	129	129	129	129	129	129	129
F	0.849	3.994	3.954	3.175	5.972	4.994	3.382	2.388
p(F)	0.497	0.00212	0.00116	0.00615	1.58e-05	5.04e-05	0.00396	0.0156
avg. R-squared	0.129	0.139	0.152	0.148	0.151	0.158	0.128	0.175

Panel B: Pre-crisis sub-sample	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
market β	-0.15	-0.06	-0.05	-0.04	-0.06	0.17		-0.03
	(0.24)	(0.25)	(0.25)	(0.24)	(0.25)	(0.33)		(0.38)
ln(size)	0.05	-0.08	-0.43***	-0.07	-0.09	-0.09	-0.06	-0.29*
	(0.16)	(0.14)	(0.11)	(0.13)	(0.13)	(0.13)	(0.13)	(0.15)
B/M	0.18	0.37	0.42	3.78***	0.44	0.43	4.10***	3.55***
	(0.51)	(0.51)	(0.46)	(1.12)	(0.47)	(0.46)	(1.45)	(1.19)
momentum	0.02***	0.02***	0.02***	0.02***	-0.00	-0.01	0.00	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
ln(CDS spread)		-0.29**	-0.49**	0.01	-0.42***	-0.42**	-0.07	-0.28
		(0.11)	(0.20)	(0.16)	(0.15)	(0.16)	(0.17)	(0.29)
ln(size)*ln(CDS spread)			0.10*					0.05
			(0.06)					(0.06)
(B/M)*ln(CDS spread)				-0.75**			-0.80**	-0.69**
				(0.31)			(0.38)	(0.32)
momentum*ln(CDS spread)					0.01	0.01*	0.00	0.00
					(0.00)	(0.00)	(0.00)	(0.00)
(market β)*ln(CDS spread)						-0.05		-0.01
						(0.10)		(0.10)
Constant	0.45	1.71***	2.50***	0.43	2.25***	2.29***	0.71	1.62*
	(0.57)	(0.45)	(0.50)	(0.81)	(0.53)	(0.49)	(0.93)	(0.92)
Observations	13,467	13,467	13,467	13,467	13,467	13,467	13,467	13,467
Number of groups	47	47	47	47	47	47	47	47
F	2.110	2.936	5.267	4.189	1.956	1.723	2.314	2.266
p_F	0.0949	0.0221	0.000335	0.00193	0.0918	0.127	0.0490	0.0340
avg. R-squared	0.108	0.118	0.125	0.127	0.128	0.134	0.115	0.148

This table shows, for the whole sample (Panel A) and pre-crisis sub-sample (Panel B), the average of intercepts and slopes from the month-by-month Fama-MacBeth cross-sectional regressions of individual stock returns (in percentages) on market β, size (billions of dollars), book-to-market, momentum return (in percentages), CDS spread (basis points), and interaction terms of CDS spread and other characteristics during the previous month. Stocks with a negative book-to-market are not included in the tests. The figures in parentheses are heteroscedasticity and autocorrelation consistent standard errors, using Newey and West (1987). *, **, and *** indicate statistical significance at the 10% , 5%, and 1% levels, respectively.

Table 7: Fama-MacBeth regressions of expected stock returns on firm characteristics: during crisis and after crisis

Panel A: During crisis	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
market β	-1.92	-1.35	-1.29	-1.34	-1.41	-4.25**		-4.42**
	(1.12)	(0.95)	(0.93)	(0.94)	(0.96)	(1.59)		(1.85)
ln(size)	0.13	-0.46***	-0.39	-0.46***	-0.43**	-0.45**	-0.42**	0.46
	(0.34)	(0.15)	(0.77)	(0.16)	(0.16)	(0.17)	(0.18)	(0.63)
B/M	-0.23	0.05	0.10	-0.28	-0.07	-0.08	-2.10	-1.17
	(0.42)	(0.38)	(0.29)	(1.54)	(0.33)	(0.32)	(1.43)	(1.64)
momentum	-0.02	-0.03*	-0.03	-0.03	-0.06	-0.09	-0.05	-0.12*
	(0.02)	(0.02)	(0.02)	(0.02)	(0.05)	(0.06)	(0.05)	(0.06)
ln(CDS spread)		-1.75***	-1.61**	-1.76***	-1.34**	-1.55***	-1.83**	-1.16
		(0.58)	(0.74)	(0.55)	(0.47)	(0.49)	(0.69)	(0.78)
ln(size)*ln(CDS spread)			-0.03					-0.20
			(0.17)					(0.15)
(B/M)*ln(CDS spread)				0.07			0.34	0.17
				(0.28)			(0.25)	(0.29)
momentum*ln(CDS spread)					0.00	0.01	0.00	0.01*
					(0.01)	(0.01)	(0.01)	(0.01)
(market β)*ln(CDS spread)						0.47**		0.50**
						(0.18)		(0.23)
Constant	-1.25	7.81***	7.17**	7.84***	5.43***	6.71***	6.55***	4.85
	(1.36)	(1.88)	(2.84)	(1.62)	(1.60)	(1.64)	(1.67)	(3.04)
Observations	5,535	5,535	5,535	5,535	5,535	5,535	5,535	5,535
Number of groups	19	19	19	19	19	19	19	19
F	1.153	4.613	1.612	3.901	3.315	4.905	2.978	2.500
p_F	0.364	0.00695	0.201	0.0114	0.0223	0.00304	0.0336	0.0468
avg. R-squared	0.189	0.201	0.217	0.210	0.212	0.220	0.200	0.238

Panel B: After crisis	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
market β	-0.06	0.08	0.12	0.07	0.06	0.33		-0.11
	(0.26)	(0.25)	(0.24)	(0.25)	(0.25)	(0.67)		(0.74)
ln(size)	-0.03	-0.20**	-0.70*	-0.19*	-0.20**	-0.20**	-0.20**	-0.74*
	(0.10)	(0.09)	(0.36)	(0.10)	(0.09)	(0.09)	(0.09)	(0.40)
B/M	0.18	0.31	0.26	0.93	0.27	0.27	0.07	-1.09
	(0.23)	(0.23)	(0.23)	(1.38)	(0.22)	(0.22)	(1.73)	(1.29)
momentum	0.01	0.00	0.00	0.00	-0.02*	-0.03**	-0.04*	-0.03*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
ln(CDS spread)		-0.48***	-0.75***	-0.43**	-0.55***	-0.49**	-0.58**	-1.00**
		(0.10)	(0.24)	(0.18)	(0.14)	(0.19)	(0.28)	(0.39)
ln(size)*ln(CDS spread)			0.12					0.13
			(0.10)					(0.11)
(B/M)*ln(CDS spread)				-0.15			0.02	0.26
				(0.28)			(0.34)	(0.27)
momentum*ln(CDS spread)					0.01	0.01**	0.01*	0.01
					(0.00)	(0.00)	(0.00)	(0.00)
(market β)*ln(CDS spread)						-0.05		0.05
						(0.11)		(0.12)
Constant	1.11***	3.56***	4.80***	3.36***	4.01***	3.74***	4.29***	6.01***
	(0.34)	(0.47)	(0.92)	(0.96)	(0.68)	(1.00)	(1.27)	(1.62)
Observations	17,211	17,211	17,211	17,211	17,211	17,211	17,211	17,211
Number of groups	63	63	63	63	63	63	63	63
F	0.468	6.234	2.740	1.823	4.658	3.459	2.650	2.071
p_F	0.759	9.59e-05	0.0200	0.109	0.000572	0.00344	0.0237	0.0459
avg. R-squared	0.126	0.135	0.152	0.144	0.150	0.158	0.117	0.176

This table shows, for both the during crisis (Panel A) and after crisis (Panel B) sub-samples, the average of intercepts and slopes from the month-by-month Fama-MacBeth cross-sectional regressions of individual stock returns (in percentages) on market β, size (billions of dollars), book-to-market, momentum return (in percentages), CDS spread (basis points), and interaction terms of CDS spread and other characteristics during the previous month. Stocks with a negative book-to-market are not included in the tests. The figures in parentheses are heteroscedasticity and autocorrelation consistent standard errors using Newey and West (1987). *, **, and *** indicate statistical significance at the 10% , 5%, and 1% levels, respectively.

6. Asset pricing

It is argued that firm characteristics explain the differences in average returns across stocks because they proxy for sensitivities to the underlying common risk factors in stock returns. Could credit risk be one of these common risk factors? To test this hypothesis, we conduct asset pricing tests on the models, considering an additional credit risk factor and using the risk factors constructed in Section 3.

First, we run time series regressions of equity excess returns on factors:

$$R_{i,t} = a_i + \beta_i' f_t + \varepsilon_{i,t} \tag{1}$$

to get estimates of a_i and β_i, where R stands for excess return and f is a vector of risk factors in the model.

Next, we run cross-sectional regression of the average equity excess returns on estimated risk sensitivities β_i:

$$E_t(R_{i,t}) = \lambda\beta_i + \alpha_i \tag{2}$$

to get risk premium λ and pricing errors α_i.

6.1. Factor loadings

In order to investigate whether some of the risk premiums of the firm characteristics stem from the fact that they proxy for financial distress, this section assesses the relationship between credit risk and the factor loadings in the model, including all the risk factors: *MK*, *SMB*, *HML*, *WML*, and *CHML*. For each firm, we obtain the time-series average value of each characteristic and the loading of its stock excess returns on each risk factor. Then the firms are cross-sectionally allocated into five groups based on the time-series averages of each characteristic from low to high. The averages of the risk sensitivities for each group are presented in Table 8. This helps to cross-sectionally identify the relationship between firm characteristics and risk sensitivities.

Similar to the non-linear relation between stock excess returns and CDS spread in Table 4, there is no linear relationship between credit risk and any factor loading (Panel A). Panels B and C verify that there is a strong monotonic relationship between credit risk and size, or between credit risk and market β. The high-β group and small-stock group load much more on credit risk than do the low-β group and big-stock group, respectively. Thus, the size and market β effects could be attributed to a positive credit risk effect. However, this is not the case for book-to-market or momentum.

Table 8: Factor loadings

Panel A: Stocks with different CDS spreads					
	CDS-Low	2	3	4	CDS-High
CDS spread	37	63	105	175	468
β_{MK}	0.859	0.914	1.020	2.130	1.140
β_{SMB}	-0.205	0.057	0.201	-1.109	0.813
β_{HML}	0.013	0.270	0.289	6.279	0.494
β_{WML}	0.032	0.076	0.033	4.542	0.000
β_{CHML}	-0.094	-0.025	0.086	-0.172	0.397
Panel B: Stocks with different market βs					
	β-Low	2	3	4	β-High
market β	0.41	0.79	1.06	1.39	2.07
CDS spread	86	98	144	219	298
β_{CHML}	-0.111	-0.218	0.018	0.230	0.272
Panel C: Stocks with different sizes					
	Small	1.00	2.00	3.00	Big
size	2.21	5.28	10.18	20.27	87.91
CDS spread	341	188	143	114	57
β_{CHML}	0.177	-0.015	0.015	0.006	0.002
Panel D: Stocks with different B/Ms					
	Growth	2	3	4	Value
B/M	0.17	0.34	0.46	0.61	0.90
CDS spread	117	139	142	167	281
β_{CHML}	-0.116	0.061	0.120	0.148	-0.026
Panel E: Stocks with different momentums					
	Losers	2	3	4	Winners
momentum	-9.72	4.66	8.77	12.77	22.66
CDS spread	362	156	104	92	129
β_{CHML}	0.114	-0.013	-0.089	0.048	0.126

This table demonstrates the cross-sectional averages of each characteristic and of the factor loadings of the stocks within each quintile portfolio, which is formed according to the time-series average of the characteristic. β_{MK}, β_{SMB}, β_{HML}, and β_{CHML} stand for the factor loadings of stocks on the mimicking risk factors: *MK*, *SMB*, *HML*, *WML*, and *CHML*, which are included in the model. Size is in billions of dollars, CDS spread is in bp, and momentum is in percentages.

6.2. Test models

The next step is to test different models and examine risk premiums, as in Equation 2. Table 9 displays the results of the cross-sectional regressions of equity excess returns on factor loadings for the whole sample as well as the three sub-samples.

The tests are based on three benchmark models: i.e. the CAPM, the Fama-French three-factor model, and the Carhart four-factor model. They are also based on augmented versions of the three-factor and four-factor models, using the credit-risk factor *CHML* as an additional factor, and a model including only *CHML*.

The risk premium of β_{MK} or β_{SMB} only shows up positive and significant after the crisis. This supports the argument that the market β and size effects are attributed to a positive credit risk effect, which should not be negative during the non-crisis period, and when the CDS market is more alert and developed after the occurrence of the crisis. β_{HML} carries a significantly positive risk premium for the whole sample without the credit risk factor in the model, and a significantly negative risk premium during and after crisis. This is consistent with the statement that the value effect is concentrated within the stocks with a high credit quality, and it is not pronounced when credit risk is high during and after the crisis. The risk premium of β_{WML} is never significantly negative. This is also consistent with the previous analysis that the positive momentum effect is concentrated within stocks with a low credit quality and that there is a positive credit risk effect for stocks that won the most in the past year.

In short, there is a negative distress premium, but the market β and size effects could partly stem from a positive credit risk premium which is more pronounced after the crisis, when the CDS market becomes more developed. The concentration of the positive value effect in low credit risk stocks, and of the positive momentum effect in high credit risk stocks, results in that investments in past winners are more profitable than are those in value stocks when there is a crisis.

However, these tests are limited due to the small sample and short time span. However, the results demonstrate that it is important to control for credit risk. This is especially important during the crisis, as the pricing error of the four-factor model combined with the additional credit risk factor is essentially zero.

Table 9: Asset pricing tests

Panel A: Whole sample period

	CAPM	*CHML*	3-fac. model	4-fac. Model	3-fac. and *CHML*	4-fac. and *CHML*
β_{MK}	-0.86***		-1.24***	-0.68*	-1.12***	-1.14***
	(0.19)		(0.23)	(0.35)	(0.25)	(0.23)
β_{SMB}			-0.36**	-0.24*	-0.37***	-0.12
			(0.14)	(0.13)	(0.13)	(0.11)
β_{HML}			0.14	0.41**	-0.10	-0.17
			(0.14)	(0.20)	(0.19)	(0.21)
β_{WML}				-0.46		0.47
				(0.38)		(0.31)
β_{CHML}		-0.73***			-0.41*	-0.40
		(0.21)			(0.23)	(0.27)
Constant	1.45***	1.08***	1.72***	1.03***	1.66***	1.59***
	(0.20)	(0.21)	(0.21)	(0.35)	(0.24)	(0.21)
Observations	373	373	373	373	373	371
chi2	21.38	12.09	39.33	15.26	35.62	29.30
Prob > chi2	3.77e-06	0.000507	1.48e-08	0.00419	3.47e-07	2.03e-05
adj. R-squared	0.150	0.135	0.219	0.122	0.189	0.187

Panel B: Pre-crisis period

	CAPM	*CHML*	3-fac. model	4-fac. Model	3-fac. and *CHML*	4-fac. and *CHML*
β_{MK}	-0.25		-0.35*	0.09	-0.27	-0.48**
	(0.22)		(0.21)	(0.25)	(0.25)	(0.21)
β_{SMB}			-0.44**	-0.29*	-0.26	-0.18
			(0.17)	(0.17)	(0.17)	(0.16)
β_{HML}			0.15	0.17	0.09	-0.01
			(0.12)	(0.14)	(0.13)	(0.13)
β_{WML}				0.42**		0.73***
				(0.21)		(0.17)
β_{CHML}		-0.21			-0.05	-0.06
		(0.27)			(0.22)	(0.17)
Constant	0.84***	0.72***	1.10***	0.61**	0.96***	1.08***
	(0.20)	(0.17)	(0.18)	(0.24)	(0.23)	(0.18)
Observations	342	342	340	340	340	338
chi2	1.266	0.575	14.01	9.120	3.554	27.80
Prob > chi2	0.260	0.448	0.00289	0.0582	0.470	3.98e-05
adj. R-squared	0.00727	0.00351	0.0901	0.130	0.0584	0.193

Panel C: During-crisis period

	CAPM	*CHML*	3-fac. model	4-fac. Model	3-fac. and *CHML*	4-fac. and *CHML*
β_{MK}	-1.31***		-1.44***	-0.37	-0.16	-1.43***
	(0.39)		(0.42)	(0.47)	(0.61)	(0.46)
β_{SMB}			-0.48	-0.60***	-0.61***	-0.53**
			(0.35)	(0.19)	(0.17)	(0.22)
β_{HML}			-0.76***	-0.69***	-0.54***	-0.66***
			(0.17)	(0.19)	(0.15)	(0.19)
β_{WML}				1.22***		0.67
				(0.37)		(0.46)
β_{CHML}		-1.31**			-1.16***	-1.11***
		(0.59)			(0.38)	(0.36)
Constant	-1.04*	-1.63**	-0.90**	-1.96***	-2.22***	-0.76
	(0.54)	(0.66)	(0.43)	(0.68)	(0.75)	(0.54)
Observations	325	325	320	317	317	309
chi2	11.51	4.861	33.19	18.81	19.11	15.84
Prob > chi2	0.000692	0.0275	2.94e-07	0.000858	0.000747	0.00733
adj. R-squared	0.156	0.155	0.227	0.163	0.133	0.234

Panel D: After-crisis period

	CAPM	*CHML*	3-fac. model	4-fac. Model	3-fac. and *CHML*	4-fac. and *CHML*
β_{MK}	0.24		0.45**	0.26	0.45	0.33
	(0.15)		(0.20)	(0.30)	(0.29)	(0.30)
β_{SMB}			-0.03	0.15*	0.17**	0.24***
			(0.08)	(0.09)	(0.07)	(0.07)
β_{HML}			-0.08	-0.21	-0.22*	-0.29**
			(0.14)	(0.13)	(0.12)	(0.12)
β_{WML}				0.27		0.45**
				(0.26)		(0.18)
β_{CHML}		-0.07			-0.48***	-0.45***
		(0.11)			(0.13)	(0.15)
Constant	1.18***	1.52***	1.02***	1.18***	1.02***	1.12***
	(0.15)	(0.11)	(0.17)	(0.25)	(0.25)	(0.26)
Observations	317	317	314	311	311	311
chi2	2.478	0.367	5.067	12.85	30.35	33
Prob > chi2	0.115	0.544	0.167	0.0120	4.16e-06	3.77e-06
adj. R-squared	0.0129	-0.00148	0.0383	0.0270	0.141	0.143

This table shows cross-sectional regressions of Equation 2 for the CAPM, the Fama-French three-factor model, the Carhart (1997) four-factor model, the augmented three-factor and four-factor models with an additional factor *CHML*, and the model only including *CHML*, for the whole sample as well as for the three sub-samples. Stocks with a negative book-to-market are not included in the tests. The figures in parentheses are bootstrapped standard errors. *, **, and *** indicate statistical significance at the 10% , 5%, and 1% levels, respectively.

7. Conclusion

This article examines the distress risk puzzle in the context of a natural experiment, the financial crisis, when distress risk hits the market the most and when there is a developing process whereby the CDS market becomes more alert, due to the occurrence of the financial crisis. This crisis brings challenges in terms of finding a positive cross-sectional relationship between credit risk and stock returns, if it exists. However, the CDS market is more and more informative in measuring firms' credit risk. Therefore, we apply the spread of a five-year senior CDS contract as a proxy for the distress risk of the firm, as referred to in the contract. Through revisiting the research on how traditional firm characteristics, i.e. market β, size, book-to-market ratio, and momentum return in the past year, explain stocks' expected returns cross-sectionally, we are able to disentangle the relationships between these characteristics and the firms' credit risk in explaining stock returns. In addition, we conduct the examination mainly on the basis of individual stocks, as well as portfolios.

Consistent with the argument for the negative distress premium, firms with higher credit risk have lower stock returns; a positive value effect is concentrated in high credit quality firms. However, we also detect the existence of a positive credit risk effect for the stocks that won the most in the past year and those that, during crisis, co-moved the most with the market. A possible explanation could be the positive expected shareholder recovery for these stocks modelled by Garlappi and Yan (2011). In addition, we find a positive momentum effect concentrated in high credit risk firms. Furthermore, the positive market β and size effects could be attributed to a positive credit risk effect; however, credit risk is not the underlying common factor for the value effect.

The asset-pricing tests confirm these results and reveal that it is important to control for credit risk in the models. However, more thorough tests should be performed on a much larger sample available in the future. Since the sample in this paper only consists of stocks with a market capitalization larger than about the median of the Fama-French sample, the results in this study have limited implications. Nevertheless, the results are important for asset management, especially in terms of using the information from the CDS market in equity trading.

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Hidden in the factors?

The effect of credit risk on the cross-section of equity returns

CAREN YINXIA NIELSEN

This paper disentangles the complexity of the distress risk premium in stock returns using the risk- neutral measure of credit risk (valued by CDS spread) and investigates the relationship between credit risk and the market β, size, value, and momentum effects. Consistent with the argument for a negative distress premium, firms with higher credit risk have lower stock returns, and a positive value effect is concentrated in high credit quality firms. However, credit risk is positively priced in returns on stocks that won the most in the past year and that, during crisis, co-moved the most with the market. A positive momentum effect is concentrated in high credit risk firms. Furthermore, the size effect, but not the value effect, could be attributed to a positive credit risk effect.

JEL Codes: G01; G11; G12
Keywords: Asset pricing; equity returns; size effect; value effect; momentum effect; credit risk effect; credit default swap

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