Does the productivity of labour influence credit risk? New evidence from South Korea

LIM, Hyoung-Joo and MALI, Dafydd

Table 1 Model Selection

Panel A: Selection of Proxies

Key determinants of CR	Proxies
Firm performance	**OI**, NI, CPS, ROA, ROS, ROE
Size	**Total assets**, Sales Revenue, Market value of equity
Liquidity risk	**Current ratio**, quick ratio, cash ratio
Cash risk	**CFO to TL,** CFO to O.E, CFO to TA
Lev	**Total liabilities/total owners' equity** Total liabilities/total assets
Loss	**Negative NI**, Negative OI
Accrual based earnings management	DAMJ (from modified jones modes, 1995) DAKO (from performance adjusted model, 2005) **ABMJ (Absolute value of DAMJ)** ABKO (Absolute value of DAKO)
Real earnings management	**TRM (Real earnings management measures)**
Monitoring	**Big4**
	Foreign investor Institutional investors

Panel B: Variable definitions

Dependent Variable	Sign	Definition
CR_t+1		Credit ratings at time t+1
Variables of Interest		
Productivity	-	Natural logarithm of Labor productivity, measured by Sales revenue / number of full time equivalents
Control Variables		
1. Firm performance & Size		
Performance	+	Profitability measured by operating income/Total assets
Size	+	Natural logarithm of prior year total assets
2. Business Risk		
Liquidity risk	+	(Current assets - Current liabilities) / Total assets
Cash risk		Cashflow from operation / Total liabilities
LEV	-	debt ratio (=total liabilities / total owner's equity)
LOSS	-	A dummy variable that takes 1 if a firm's net income is negative, 0 otherwise
3. Earnings Management		
AEM	-	Absolute value of discretionary accruals suggested by Dechow et al.(1995)
REM	-	AbCFO*(-1) + AbProd + AbSGA*(-1) suggested by Roychowdhury(2006)
4. Monitoring		
Big4	?	A dummy variable that takes 1 if a firm's auditor is Big4, 0 otherwise
Fore	+	Foreign investors' share holdings(%)
5. Fixed effect		
ID		Industry fixed effect
YD		Year fixed effect

Table 2 Sample Selection

Panel A: Productivity of labor and CR sample from 2002-2013

Initial CR Sample	2080
Excluding Post periods	362
Potential Sample	1718
Excluding firms with no financial data available	62
Final Sample	1666

Panel B: Sample selection by credit ratings

CR scores	CR	Obs	CR sores	CR	Obs
17	AAA	88	8	BBB-	153
16	AA+	70	7	BB+	61
15	AA	82	6	BB	67
14	AA-	159	5	BB-	70
13	A+	163	4	B+	42
12	A	170	3	B	28
11	A-	183	2	B-	16
10	BBB+	152	1	Below B-	36
9	BBB	126	Total		1644

Table 3 Descriptive statistics and Pearson product-moment correlation

Panel A: Descriptive statistics and mean(median) difference test

	1) Full(Obs: 1,666)			*2) IG(Obs: 915)*			*3) NIG(Obs: 751)*			*2)-3)*
Var	Mean (Med)	Max (Min)	S.D.	Mean (Med)	Max (Min)	S.D.	Mean (Med)	Max (Min)	S.D.	t (z)
CR_t+1	10.57 (11)	17 (1)	3.81	13.38 (13)	17 (11)	1.89	7.16 (8)	10 (1)	2.55	57.03*** (35.28)***
Prod	6.74 (6.60)	9.78 (4.95)	0.99	6.91 (6.67)	9.78 (5.09)	1.09	6.53 (6.52)	8.92 (4.95)	0.82	8.02*** (6.29)***
Size	20.67 (20.57)	24.39 (17.58)	1.60	21.30 (21.18)	24.84 (18.37)	1.46	19.90 (19.71)	23.33 (17.34)	1.42	19.62*** (17.58)***
Liquidity	0.05 (0.05)	0.48 (-0.41)	0.18	0.07 (0.07)	0.43 (-0.30)	0.15	0.03 (0.02)	0.51 (-0.47)	0.20	4.21*** (4.17)***
Profit	0.21 (0.20)	0.75 (-0.63)	0.28	0.30 (0.27)	0.77 (-0.03)	0.27	0.09 (0.09)	0.51 (-0.84)	0.24	16.69*** (19.98)***
Cash Risk	14.73 (9.84)	102.26 (-17.84)	32.27	20.91 (14.19)	143.4 (-14.62)	40.84	7.20 (5.53)	56.88 (-20.61)	13.27	8.83*** (14.13)***
Lev	1.53 (1.15)	8.54 (0.39)	1.95	1.06 (0.90)	4.37 (0.04)	0.89	2.09 (1.48)	14.06 (0.18)	2.63	-11.17*** (-14.79)***
AEM	0.06 (0.04)	0.36 (0.00)	0.06	0.05 (0.03)	0.27 (0.00)	0.05	0.06 (0.04)	0.36 (0.00)	0.07	-4.56*** (-3.96)***
REM	0.03 (0.21)	0.54 (-0.35)	0.21	-0.06 (-0.04)	0.60 (-9.36)	0.24	0.01 (-0.00)	0.49 (-0.41)	0.17	-7.67*** (-7.38)***
Loss	0.16 (0)	1 (0)	0.36	0.07 (0)	1 (0)	0.25	0.26 (0)	1 (0)	0.44	-10.96*** (-10.59)***
Big4	0.80 (1)	1 (0)	0.40	0.89 (1)	1 (0)	0.31	0.68 (1)	1 (0)	0.46	11.22*** (10.82)***
Foreign	0.15 (0.08)	0.73 (0)	0.17	0.21 (0.15)	0.86 (0)	0.18	0.08 (0.02)	0.67 (0)	0.13	14.81*** (17.33)***

Panel B: Pearson Correlations

	1.	*2.*	*3.*	*4.*	*5.*	*6.*	*7.*	*8.*	*9.*	*10.*	*11.*
1. CR_t+1	1										
2. Productivity	0.19***	1									
3. Size	0.52***	0.37***	1								
4. Liquidity risk	0.11***	-0.09***	-0.21***	1							
5. Profitability	0.48***	0.01	0.16***	0.26***	1						
6. Cash risk	0.26***	-0.06**	0.05**	0.23***	0.32***	1					
7. Lev	-0.34***	0.09***	0.00	-0.28***	-0.39***	-0.19***	1				
8. AEM	-0.19***	0.01	-0.07***	0.01	-0.16***	-0.07***	0.23***	1			
9. REM	-0.21***	0.22***	-0.13***	0.00	-0.15***	-0.13***	0.08***	0.01	1		
10. Loss	-0.31***	-0.06*	-0.11***	-0.19***	-0.32***	-0.16***	0.29***	0.18***	0.07***	1	
11. Big4	0.30***	0.15***	0.36***	-0.08***	0.12***	0.06**	-0.06**	-0.04*	-0.06***	-0.03	1
12. Foreign	0.43***	0.43***	0.44***	0.08***	0.31***	0.33***	-0.16***	-0.07***	-0.24***	-0.18***	0.21***

t indicates t value for mean-difference test.
z indicates wilcoxon z value for median-difference test.
*, **, *** indicate significance level at 10%, 5%, 1% respectively.
See Table 2 for variable definitions.

Table 4 Results of ordered Probit Regression analysis

Model: $CR_{i,t+1} = \gamma_0 + \gamma_1 Productivity_{i,t} + \gamma_2 Size_{i,t} + \gamma_3 LiquidityRisk_{i,t} + \gamma_4 Profitability_{i,t} + \gamma_5 CashRisk_{i,t} + \gamma_6 Lev_{i,t} + \gamma_7 AEM_{i,t} + \gamma_8 REM_{i,t} + \gamma_9 Loss_{i,t} + \gamma_{10} Big4_{i,t} + \gamma_{11} Foreign_{i,t} + ID + YD + \varepsilon_{i,t}$

	Sign	Full	IG	NIG
Productivity	+/-	0.06***	0.06***	-0.07***
		(5.93)	(5.22)	(-5.47)
Size	+	0.34***	0.19***	0.38***
		(16.78)	(6.71)	(10.84)
Liquidity Risk	+	0.69***	0.43*	0.48**
		(4.37)	(1.66)	(2.30)
Profitability	+	0.86***	0.57***	1.91***
		(4.52)***	(4.16)	(9.30)
Cash Risk	+	0.003***	0.00***	-0.00
		(4.07)***	(3.02)	(-0.43)
Lev	-	-0.15***	-0.07	-0.07***
		(-7.74)	(-1.53)	(-3.40)
AEM	-	-1.40***	-2.92***	-0.54
		(-3.41)	(-4.42)	(-0.96)
REM	-	-0.71***	-0.72***	0.29
		(-5.57)	(-4.51)	(1.24)
Loss	-	-0.32***	-0.31**	-0.08
		(-4.27)***	(-2.16)	(-0.86)
Big4	+	0.34***	0.09	0.17**
		(4.99)	(0.78)	(1.96)
Foreign	+	0.68***	1.08***	0.29
		(3.88)***	(4.75)***	(0.96)
Industry		*Included*	*Included*	*Included*
Year		*Included*	*Included*	*Included*
Chi2		1197.40***	256.99***	323.64***
Pseudo R2		0.1346	0.0745	0.1026
Obs.		1666	915	751

*, **, *** indicate significance level at 10%, 5%, 1% respectively.
See Panel B of Table 1 for variable definitions.

Table 5 Comparative analysis of IG vs NIG group

Model: $CR_{i,t+1} = \gamma_0 + \gamma_1 Productivity_{i,t} + \gamma_2 IG_{i,t} + \gamma_3 Productivity * IG_{i,t} + \gamma_4 Size_{i,t} + \gamma_5 LiquidityRisk_{i,t} + \gamma_6 Profitability_{i,t} + \gamma_7 CashRisk_{i,t} + \gamma_8 Lev_{i,t} + \gamma_9 AEM_{i,t} + \gamma_{10} REM_{i,t} + \gamma_{11} Loss_{i,t} + \gamma_{12} Big4_{i,t} + \gamma_{13} Foreign_{i,t} + ID + YD + \varepsilon_{i,t}$

	Sign	Model 1	Model 2	Model 4
Intercept	?	-9.38***	-1.57**	-1.86**
		(-9.05)	(-2.08)	(-2.47)
Productivity	-	0.00***	0.00**	0.02***
		(5.41)	(2.27)	(5.93)
IG	+		4.95***	4.37***
			(40.97)	(33.43)
*Productivity*IG*				0.03***
				(6.74)
Size	+	0.94***	0.43***	0.49***
		(18.03)	(11.06)	(12.61)
Liquidity	+	2.09***	0.65**	0.77***
		(4.95)	(2.16)	(2.61)
Profit	-	-2.73*	-0.32	-0.47
		(-1.84)	(-0.30)	(1.46)
Cashrisk	-	0.01***	0.01***	0.01***
		(5.92)	(4.50)	(4.26)
Lev	-	-0.41***	-0.21***	-0.19***
		(-10.76)	(-7.56)	(-6.91)
AEM	+	-4.69***	-3.64***	-4.25***
		(-4.27)	(-4.70)	(-5.52)
REM	-	-1.96***	-1.09***	-0.54**
		(-5.81)	(-4.57)	(-2.24)
Loss	-	-1.49***	-0.60***	-0.62***
		(-6.78)	(-3.85)	(-4.01)
Big4		0.96***	0.30**	0.41***
		(5.35)	(2.32)	(3.20)
Foreign		2.29***	1.48***	1.38***
		(4.81)	(4.42)	(4.13)
Industry		*Included*	*Included*	*Included*
Year		*Included*	*Included*	*Included*
F value		141.18***	400.56***	376.01***
Adj R2		0.4842	0.7422	0.7454
Obs.		1666	1666	1666

*, **, *** indicate significance level at 10%, 5%, 1% respectively.
See Panel B of Table 1 for variable definitions.

Table 6 Additional Analysis by Industry

Model: $CR_{i,t+1} = \gamma_0 + \gamma_1 Productivity_{i,t} + \gamma_2 Size_{i,t} + \gamma_3 LiquidityRisk_{i,t} + \gamma_4 Profitability_{i,t} + \gamma_5 CashRisk_{i,t} + \gamma_6 Lev_{i,t} + \gamma_7 AEM_{i,t} + \gamma_8 REM_{i,t} + \gamma_9 Loss_{i,t} + \gamma_{10} Big4_{i,t} + \gamma_{11} Foreign_{i,t} + ID + \varepsilon_{i,t}$

Positive industry		Negative industry	
Wholesale business	0.00(4.11)***	Transportation	-0.00(-3.79)***
Food & Beverage	0.02(3.48)***	Biomedical	-0.05(-2.21)**
Non-metallic minerals	0.00(3.28)***	Electricity	-0.00(-2.10)**
Construction	0.01(2.32)**		
Chemicals	0.00(4.27)***		

Table 7 Partitioning sample into expansion and recession time periods for IG/NIG firms

Model: $CR_{i,t+1} = \gamma_0 + \gamma_1 Productivity_{i,t} + \gamma_2 Size_{i,t} + \gamma_3 LiquidityRisk_{i,t} + \gamma_4 Profitability_{i,t} + \gamma_5 CashRisk_{i,t} + \gamma_6 Lev_{i,t} + \gamma_7 AEM_{i,t} + \gamma_8 REM_{i,t} + \gamma_9 Loss_{i,t} + \gamma_{10} Big4_{i,t} + \gamma_{11} Foreign_{i,t} + ID + YD + \varepsilon_{i,t}$

		Full		IG		NIG	
	Sign	Expansion	Recession	Expansion	Recession	Expansion	Recession
Productivity	+/-	0.07**	0.06***	0.06***	0.05***	-0.04***	-0.06**
		(5.48)	(2.48)	(3.63)	(3.65)	(-1.99)	(-5.25)
Size	+	0.32***	0.31***	0.18***	0.17***	0.39***	0.35***
		(10.47)	(11.36)	(4.10)	(4.44)	(7.85)	(6.95)
Liquidity Risk	+	0.48**	0.85***	0.16	0.57*	0.63**	0.35
		(2.09)	(3.93)	(0.40)	(1.76)	(2.08)	(1.19)
Profitability	+	0.68***	0.72***	0.79**	0.66***	0.56	-0.46
		(2.64)	(3.90)	(2.19)	(2.72)	(1.04)	(-0.29)
Cash Risk	+	0.004***	0.004***	0.003***	0.003**	0.005	0.001
		(4.27)	(2.74)	(2.72)	(2.03)	(1.22)	(0.31)
Lev	-	-0.20***	-0.17***	-0.10	-0.11**	-0.10***	-0.10***
		(-6.88)	(-7.23)	(-1.15)	(-2.16)	(-3.00)	(-4.05)
AEM	-	-0.79*	-2.38***	-2.23**	-3.19***	-1.55**	-1.98**
		(-1.83)	(-4.15)	(-2.19)	(-3.70)	(-1.98)	(-2.36)
REM	-	-0.92***	-0.88***	-1.04**	-0.89***	1.10**	0.46
		(-3.17)	(-3.53)	(-2.51)	(-2.81)	(2.30)	(1.00)
Loss	-	-0.47***	-0.37***	-0.49*	-0.29*	-0.29*	--0.29**
		(-3.80)	(-3.92)	(-1.68)	(-1.76)	(-1.91)	(-2.20)
Big4	+	0.15*	0.57***	-0.13	0.38**	0.13	0.26**
		(1.70)	(5.74)	(-0.90)	(1.97)	(1.08)	(2.14)
Foreign	+	0.94***	0.852***	1.41***	0.98***	0.38	0.54
		(3.68)	(3.35)	(4.05)	(3.19)	(0.91)	(1.23)
Industry		*Included*	*Included*	*Included*	*Included*	*Included*	*Included*
Year		*Included*	*Included*	*Included*	*Included*	*Included*	*Included*
Chi2		471.42***	658.89***	110.14***	147.74***	142.57***	132.43***
Pseudo R2		0.1167	0.1363	0.0762	0.0741	0.0923	0.0828
Obs.		756	910	389	526	367	384

Table 8 Sensitivity Analysis

Model: $CR_{i,t+1} = \gamma_0 + \gamma_1 Productivity_{i,t} + \gamma_2 Size_{i,t} + \gamma_3 LiquidityRisk_{i,t} + \gamma_4 Profitability_{i,t} + \gamma_5 CashRisk_{i,t} + \gamma_6 Lev_{i,t} + \gamma_7 AEM_{i,t} + \gamma_8 REM_{i,t} + \gamma_9 Loss_{i,t} + \gamma_{10} Big4_{i,t} + \gamma_{11} Foreign_{i,t} + ID + YD + \varepsilon_{i,t}$

Panel A: Investment grade firms							
Productivity	IG12	IG11	IG10	IG9	IG8	IG7	IG6
IG	0.02	0.04	0.05	0.07	0.09	0.08	0.08
	(1.55)	(3.04)***	(5.22)***	(6.55)***	(8.27)***	(7.77)***	(8.04)***
Control	*Included*	*Included*	*Included*	*Included*	*Included*	*Included*	*Included*
ID&YD	*Included*	*Included*	*Included*	*Included*	*Included*	*Included*	*Included*
Chi2	66.26***	121.34***	245.48***	352.16***	453.92***	606.41***	694.31***
Pseudo R2	0.0381	0.0479	0.0712	0.0815	0.0885	0.0997	0.1055
Obs.	562	732	915	1067	1193	1346	1407
Panel B: Non-Investment grade firms							
NIG	-0.08	-0.08	-0.07	-0.03	-0.03	-0.04	-0.04
	(-1.46)*	(-3.28)***	(-5.47)***	(-7.28)***	(-6.18)***	(-6.65)***	(-4.95)***
Control	*Included*	*Included*	*Included*	*Included*	*Included*	*Included*	*Included*
ID&YD	*Included*	*Included*	*Included*	*Included*	*Included*	*Included*	*Included*
Chi2	440.44***	323.09***	261.21***	237.24***	132.24***	101.36***	121.55***
Pseudo R2	0.0876	0.0792	0.0828	0.0990	0.0743	0.0856	0.1392
Obs.	1104	934	751	599	473	320	259