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THE FINANCIAL CHARACTERISTICS OF LARGE AND SMALL FIRMS BEFORE AND AFTER THE 2008 STOCK MARKET CRASH

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ABSTRACT

The financial crisis of 2008, and the associated bear market lasting from October 2007 to March 2009, has had a significant impact on a broad cross section of firms in the global economy. Of particular interest to us in this study is the effect of this time period on the financial characteristics of firms, with extra focus on debt-related ratios. Using a large sample of U.S. firms from the COMPUSTAT database, we find that firms, on average, come out of the financial crisis with less insolvency and bankruptcy risk, more efficient asset utilization, and more attractive market valuations.

JEL: G00, G01, G32

KEYWORDS: Financial Crisis, Financial Ratios

INTRODUCTION

The 2008 stock market crash is the most important stock market crash and the 2007-2009 bear market is the most important bear market in U.S. history since the Great Depression. U.S. stocks lost about 55 percent of their value during the October 9, 2007-March 9, 2009 period. Wang et al. (2010, 2011) find that technical insolvency risk and bankruptcy risk were the most significant determinants of stock returns in the 2008 stock market crash. After seeing that a well-known investment banking firm, Lehman Brothers, went bankrupt, the insurance giant AIG and the automotive giant General Motors were having financial difficulties, investors were concerned that the crisis could result in widespread bankruptcies. Therefore, firms with higher debt ratios lost more value in the crash compared with those with low debt ratios. Do corporate managers learn a lesson from a stock market crash? In this paper, we will test this general hypothesis with pre- and post-2008 crash data. Specifically, since firms with low liquidity ratios and high debt ratios lost more value during the crash, the hypotheses we will test are that firms raised their liquidity levels (i.e. lowered their technical bankruptcy risk) and lowered their debt ratios (i.e., lowered their bankruptcy risk) after the crash. We will not limit our analysis to the liquidity and indebtedness ratios, but we will study all the changes in the firms' financial characteristics from before the crash to after the crash. We will divide our sample into two groups in terms of firm size and study if the changes were significantly different in large vs. small firms. The remainder of this paper is organized as follows: The next section examines the related literature and sets the stage for this study. Following, we detail our data sample and methodology, and then discuss our empirical results. We close with concluding comments and suggestions for future research.

LITERATURE REVIEW

Firm size, as a determinant of stock returns, has received considerable attention in finance. Earlier studies presented empirical evidence for the small-firm effect on stock returns and questioned the validity of Sharp's capital asset pricing model, which has the beta as the only risk measure and sole determinant of stock returns (see: Christie and Hertzel, 1981; Reinganum, 1981, 1982, 1983; Berges et al., 1982; Cook and Rozeff, 1982; Lakonishok and Shapiro, 1982; Basu, 1983; Blume and Stambaugh, 1983; Brown et al., 1983; Keim, 1983; Roll, 1983; Schultz, 1983; Schwert, 1983). Friend and Lang (1987) conclude that the

size effect on stock returns is simply a risk effect not adequately reflected by the capital asset pricing model. Fama and French (1992, 1993) present a three-factor capital asset pricing model that includes size as one of the three determinants of stock returns along with the capital asset pricing model beta and the market-to-book ratio. Lo and MacKinlay (1990) and Richardson and Peterson (1999) provide evidence that large firm stock returns respond faster to new information compared with small firm stock returns and that large firm stock returns lead small firm stock returns. Wang et al. (2009) confirm this by using data for eight major stock market crashes during the 1987-2001 period. They find that large firm stock returns respond faster to stock market crashes and to post-crash market reversals. They demonstrate that large firm stock returns lead small firm stock returns in the downward direction in stock market crashes and in the upward direction in post-crash market reversals. In a more recent study, Wang et al.

(2013) also find that large firm stock returns responded faster to the 2008 stock market crash and to the post-crash market reversal and they lead small firm stock returns both during the crash and during the market reversal. Because of large amounts of mortgage-backed securities (so-called toxic assets) in their assets whose market values were difficult to determine, banks refused to make loans to business firms in the fall of 2008. As a result, an important characteristic of the 2008 financial crisis was a severe liquidity shortage for business firms (Greenlaw et al., 2008). Therefore, firms with low liquidity ratios lost more value and those with high liquidity ratios lost less value during the crash. Another significant determinant of stock prices in the 2008 crash was the debt ratio. We use the debt ratio as a measure of bankruptcy risk, in line with numerous empirical studies (see: Mitton, 2002; Baek et al., 2004; Bonfim, 2009).

DATA AND METHODOLOGY

The data for this study are sourced from the COMPUSTAT database. We start with the universe of firms included in the database for 2006 and 2010, including variables as listed in Table 1, using annual data. We then calculate a number of key financial ratios, as shown in Table 2. Most of the ratios are commonly used and need no introduction. Among the more esoteric ones we have the depreciation to sales and the fixed assets to total assets ratios, both as measures of fixed operating costs, degree of operating leverage, and business risk; EBIT to EBT ratio, an inverse relative of the more common interest coverage ratio, as a measure of financial risk; and earnings to price ratio, also known as the earnings yield, which is the inverse of the price to earnings (P/E) ratio. After calculating all the target ratios, we exclude observations with missing values and winsorize extreme outliers at the 1% level, using robust median-based measures of center and scale. Our final sample consists of 7009 observations, of which 2000 are small firms and 1815 are large firms from 2006, 1505 are small firms and 1689 are large firms from 2010. The size bins for the firms were created by partitioning along the median of total assets (AT). Summary statistics for the financial ratios for our sample are shown in Table 3.

Looking at Panel 1 of Table 3, we observe that our sample of firms ranges from extremely small firms at the lower end, with a minimum total assets (TA) of 0.034 million, to very large ones, with a maximum of 360 billion. The first and third quartiles along firm size are 77 and 1954 million, respectively. The other variables as well exhibit significant variation, with total liabilities (LT) ranging from 0.152 million to 228 billion; shares outstanding (CSHO), from 0.001 million to 13.9 billion; net income (NI), from -6.2 billion to 39.5 billion. Notably, more than half of all observations in our sample pay no dividends (dvpsp_f), and over a quarter have negative net income (NI).

A sizable fraction of firm-years show a loss on the income statement - just over a quarter of the observations in the sample show a negative net income (2149 observations), and just under a quarter show negative EBIT (1724 observations). Thus, we eschew the more commonly used P/E ratio as a measure of firm valuation, in favor of its inverse, the E/P ratio (ep) (also known as earnings yield). While the P/E ratio is discontinuous around zero, and is not a sensible measure when earnings drop into the negative territory, its inverse, the earnings yield, is continuous and quite reasonable regardless of the sign of net

income. Thus we don't have to eliminate observations with negative earnings, which would skew our results given that small firms are much more heavily represented in the subset of firms with a loss (1666 small firm-years and 483 large firm-years have negative NI).

Table 1: Compustat Variables

Variable Code	Description
LCT	Current liabilities
ACT	Current assets
INVT	Inventory
LT	Total liabilities
AT	Total assets
CSHO	Common shares outstanding
prcc_f	Price per share
REVT	Revenues
RECT	Total receivables
NI	Net income
DP	Depreciation
EBIT	Earnings before Interest and Taxes
INTPN	Interest paid
dvpsp_f	Dividend per share

This table lists the COMPUSTAT data items that are used in this analysis. All items are in millions, except for per-share items, prcc_f and dvpsp_f.

Turning our attention to Panel 2 of Table 3, we can examine the pattern of the financial ratios we use for our analysis. All the ratios have quite a broad range around the median, reflecting the wide diversity of firms in our sample. The total debt ratio (tdr) ranges from 2 percent to 125 percent, with a median of about 50 percent.

Table 2: Financial Ratios

Abbreviation	Ratio	Description
	Liquidity ratios	
cr	ACT/LCT	Current ratio
qr	(ACT-INVT)/LCT	Quick ratio
	Financial leverage ratios	
tdr	LT/AT	Total debt ratio
der	LT/(CSHO*prcc_f)	Debt to market equity ratio
dc	LCT/(LT-LCT)	Debt composition ratio
	Activity ratios	
invturn	REVT/INVT	Inventory turnover
recturn	REVT/RECT	Receivables turnover
tat	REVT/AT	Total asset turnover
	Profitability ratios	
pm	NI/REVT	Profit margin
bep	EBIT/AT	Basic earning power
roe	NI/(AT-LT)	Return on equity
	Risk measures	
dps	DP/REVT	Depreciation to sales ratio
fata	(AT-ACT)/AT	Fixed asset ratio
levdeg	EBIT/(EBIT – INTPN)	Degree of financial leverage
	Market measures	
ep	(NI/CSHO)/prcc_f	Earnings to price (Earnings yield)
dy	dvpsp_f/prcc_f	Dividend yield
mktbk	(CSHO*prcc_f + LT)/AT	Market to book ratio

This table shows how the COMPUSTAT variables in Table 1 are used in the calculation of the financial ratios that are used in our analysis.

The debt to market equity ratio (der) has a similar median of 48 percent, but a somewhat wider range, from a minimum of 0.3 percent to 194 percent. Among the activity ratios, receivables turnover (recturn) medians at 6.85 times, total asset turnover (tat) at 0.91 times, and inventory turnover (invturn) at 9.7 times. The sample profit margin (pm) has a median of only about 3.6 percent; as discussed earlier, over a quarter of the observations have negative earnings, bringing our minimum pm to negative 21 percent. Our earnings to price (ep) ratio has a median of just under 4 percent for the sample, with a minimum of -12.8 percent, and a maximum of 20.7 percent. Our research plan is to analyze the differences between large and small firms both before and after crash, and subsequently to look at the changes over time within small and large firm subsamples spanning the crash period. In all cases we will initially conduct univariate ANOVA tests for the financial ratios in our sample, then expand the analysis using multivariate ANOVA, logistic regression, and linear models.

Table 3: Summary Statistics

Variable	Min	1st Qu.	Median	Mean	3rd Qu.	Max	SDev
Panel 1: COMPUSTAT data items							
ACT	0.0050	34.205	168.00	1335.7	690.61	142940	5370.2
LCT	0.0320	17.238	76.657	948.63	380.51	130389	4300.7
INVT	0.0010	4.481	28.884	314.49	155.35	36318	1281.7
LT	0.1520	29.169	173.86	2448.1	1076.6	228349	9702.4
AT	0.0340	77.846	404.67	4183.1	1954.0	360297	16365
CSHO	0.0010	17.132	40.134	146.04	98.810	13981	475.14
prcc_f	0.0001	3.740	13.270	22.391	30.540	3100.0	67.663
REVT	0.0020	66.491	363.73	3513.6	1741.6	420016	14746
RECT	0.0010	8.106	44.475	475.90	212.63	78776	2317.7
NI	-6203.0	-1.862	10.906	256.24	93.719	39500	1375.3
DP	0.0000	2.438	14.800	182.81	75.500	23713	866.56
EBIT	-1910.0	0.0970	23.504	406.22	167.76	56939	1819.8
INTPN	-60.692	0.3000	2.824	55.103	27.325	5533.5	207.83
dvpsp_f	0.0000	0.0000	0.0000	0.3087	0.2964	35.000	0.8911
Panel 2: Calculated financial ratios							
cr	0.0049	1.212	1.823	2.150	2.821	5.021	1.295
qr	0.0020	0.8285	1.270	1.552	2.049	3.701	1.003
tdr	0.0209	0.3418	0.5071	0.5349	0.6763	1.249	0.2685
der	0.0035	0.2211	0.4874	0.7073	1.031	1.948	0.6123
dc	0.0180	0.4585	1.087	1.878	3.455	4.685	1.712
invturn	0.0167	5.750	9.705	14.752	25.230	33.246	11.325
recturn	0.0137	4.979	6.858	8.382	10.628	17.245	4.672
tat	0.0001	0.5561	0.9153	1.066	1.435	2.776	0.6891
pm	-0.2137	-0.0299	0.0365	0.0203	0.0883	0.2867	0.1269
bep	-0.1799	0.0016	0.0665	0.0503	0.1173	0.3128	0.1150
roe	-0.3252	-0.0180	0.0879	0.0704	0.1743	0.5011	0.2138
dps	0.0000	0.0225	0.0405	0.0544	0.0766	0.1374	0.0413
fata	0.0000	0.3411	0.5344	0.5271	0.7239	0.9925	0.2408
levdeg	0.6259	0.9984	1.046	1.091	1.231	1.467	0.2292
ep	-0.1281	-0.0305	0.0394	0.0185	0.0671	0.2069	0.0857
dy	0.0000	0.0000	0.0000	0.0094	0.0118	0.0699	0.0179
mktbk	0.2717	1.158	1.511	1.781	2.237	3.464	0.8224

In this table we show summary statistics for our data set. Included are the minimum, first quartile, median, mean, third quartile, maximum, and standard deviation. Panel 1 provides descriptive statistics for the COMPUSTAT variables from Table 1. All COMPUSTAT data items are in millions, except for per-share items, prcc_f and dvpsp_f. Panel 2 provides descriptive statistics for the financial ratios described in Table 2.

RESULTS AND DISCUSSION

We begin our analysis with univariate ANOVA statistics testing for differences between small and large firms in 2006, then expand these results with multivariate ANOVA, logistic regression classification, and

a linear model. These results are shown in Tables 4, 5, and 6, respectively. We repeat this approach for 2010 data. Subsequently, we examine the changes over time in small and large firm subsamples, using both univariate and multivariate ANOVA, as well as the logistic regression framework.

Small vs. Large Firms, 2006

Table 4: Univariate and Multivariate ANOVA, Small Firms vs. Large Firms, 2006

Panel 1: Univariate ANOVA				
Ratio	**Mean and SD**		**F value**	**p value**
	Small	**Big**		
cr	2.316 (1.486)	1.882 (0.9885)	110.58***	0.0000
qr	1.690 (1.148)	1.318 (0.7734)	135.41***	0.0000
tdr	0.5154 (0.3169)	0.5686 (0.2095)	36.754***	0.0000
der	0.5952 (0.5987)	0.7323 (0.5734)	51.961***	0.0000
dc	2.451 (1.791)	1.329 (1.391)	460.45***	0.0000
invturn	14.353 (11.948)	15.317 (10.861)	6.743***	0.0095
recturn	7.622 (4.581)	8.987 (4.567)	84.799***	0.0000
tat	1.020 (0.7074)	1.175 (0.6821)	47.006***	0.0000
pm	-0.0249 (0.1462)	0.0624 (0.0861)	492.29***	0.0000
bep	0.0005 (0.1314)	0.1018 (0.0770)	823.17***	0.0000
roe	0.0217 (0.2499)	0.1254 (0.1670)	222.57***	0.0000
dps	0.0561 (0.0438)	0.0480 (0.0364)	38.223***	0.0000
fata	0.4676 (0.2538)	0.5830 (0.2077)	233.51***	0.0000
levdeg	1.037 (0.2227)	1.153 (0.2261)	255.21***	0.0000
ep	-0.0123 (0.0906)	0.0440 (0.0633)	486.13***	0.0000
dy	0.0061 (0.0171)	0.0122 (0.0175)	119.00***	0.0000
mktbk	1.992 (0.9188)	1.766 (0.6941)	72.393***	0.0000
Panel 2: Multivariate ANOVA				
MANOVA:			96.662***	0.0000

In this table we analyze the differences between small and large firm subsamples for 2006, using the ratios described in Table 2. Panel 1 provides the univariate ANOVA test statistics for individual financial ratios. Shown for each ratio are the mean and standard deviation (in parentheses) for large and small subsets, the F statistic, and the p value. Panel 2 provides the MANOVA test statistics. Shown are the F statistic and the p value.

We observe from Panel 1 of Table 4 that there is a significant difference between small and large firms in our sample in 2006, in all of the financial ratios, at the univariate level. Large firms have lower liquidity (cr, qr), higher leverage (tdr, der), higher activity measures (invturn, recturn, tat), and higher profitability (pm, bep, roe). From the debt composition ratio (dc), we see that large firms have a greater fraction of long term debt in their liabilities mix. Though large firms tend to have lower depreciation to sales ratio (dps), they rely more on fixed assets overall (fata), and have a higher degree of flow-based financial leverage (levdeg). Small firms tend to have more optimistic market valuations, having both a higher market to book ratio (mktbk), and a lower earnings yield (ep). Since a large number of small firms pay no dividends, they also lose out to large firms, on average, in terms of dividend yield (dy).

Given the extremely high significance of all the measures at the univariate level, it is no surprise that the MANOVA results shown in Panel 2 of Table 4 confirm the general finding of there being a significant difference along these measures between small and large firms, in a multivariate framework.

To disentangle the significance of the individual ratios in a multivariate framework, we repeat the analysis in a logistic regression setting, using an indicator variable for size (set to 1 for large firms and 0 to small firms) as the response variable and all the financial measures as predictors. Our core model is as follows:

$$\begin{aligned} SizeDummy = {} & \beta_0 + \beta_1 cr + \beta_2 qr + \beta_3 tdr + \beta_4 der + \beta_5 dc + \beta_6 invturn \\ & + \beta_7 recturn + \beta_8 tat + \beta_9 pm + \beta_{10} bep + \beta_{11} roe + \beta_{12} dps \\ & + \beta_{13} fata + \beta_{14} levdeg + \beta_{15} ep + \beta_{16} dy + \beta_{17} mktbk + \varepsilon \end{aligned} \quad (1)$$

where *SizeDummy* is the response variable, *cr…mktbk* are the predictor variables, β_0 is the intercept term, $\beta_1 \ldots \beta_{17}$ are the parameters, and ε is the error term. The results of this model are shown in Table 5. The two liquidity ratios are significant but show opposite signs, with current ratio (cr) having a negative sign, while the quick ratio (qr) has a positive coefficient. As these two measures are highly correlated, we are seeing the effects of the residual components, suggesting that large firms have less liquidity but also less inventory, on a scaled basis. The total debt ratio (tdr) and debt to equity ratio (der) are insignificant in this model, but the debt composition (dc) coefficient retains significance and sign from the univariate model, suggesting that large firms tend to have less current liabilities as a fraction of total debt. Similar to the univariate results, large firms show higher receivables and total asset turnover (recturn, tat), but lower inventory turnover (invturn), and also exhibit higher profitability in terms of profit margin (pm) and basic earning power (bep).

Table 5: Logit Model, Small Firms Vs. Large Firms, 2006

	Estimate	SE	z value	p value
(intercept)	0.7673	0.5211	1.472	0.1409
cr	-0.9610	0.1190	-8.077***	0.0000
qr	0.8676	0.1442	6.014***	0.0000
tdr	0.4407	0.3733	1.180	0.2378
der	0.0310	0.1369	0.2266	0.8207
dc	-0.4228	0.0401	-10.533***	0.0000
invturn	-0.0453	0.0054	-8.360***	0.0000
recturn	0.0352	0.0106	3.308***	0.0009
tat	0.4421	0.1004	4.404***	0.0000
pm	3.552	0.7045	5.042***	0.0000
bep	8.435	0.6728	12.537***	0.0000
roe	0.3341	0.2959	1.129	0.2589
dps	-3.257	1.460	-2.231**	0.0257
fata	0.4531	0.3782	1.198	0.2309
levdeg	0.3053	0.1793	1.702*	0.0887
ep	-2.754	0.9883	-2.786***	0.0053
dy	-0.9864	2.285	-0.4317	0.6659
mktbk	-0.4163	0.0889	-4.685***	0.0000

*This table shows the results of a logistic regression discriminating between small and large firms in 2006, with firm size dummy as the response variable (set to 1 for large firms), and all ratios, as defined above in Table 2, used as additive independent variables. For each ratio, we show the coefficient estimate, the standard error, the z-value, and the p-value. ***, **, * indicate significance at the 1, 5, and 10 percent levels, respectively.*

The other significant coefficients are also confirmatory, with large firms having lower depreciation to sales (dps), higher operating leverage (levdeg), and lower market to book (mktbk) ratios. Interestingly, the

earnings yield (ep) is negatively associated with firm size, all else equal. The earnings yield is rather strongly positively correlated with profit margin and basic earning power, both of which are positively associated with size. This suggests that the residual component, likely related to the market price of equity, is driving this coefficient, implying that for a given level of accounting-based profitability, large firms are less attractively priced.

As another robustness check, Table 6 shows the results of a regular linear regression model, with log of total assets as the response variable, and the ratios as predictors. When we take a continuous variable and convert it into a binary one, we lose some information, and effectively force all observations into one of two extremes. Arguably, using the full information available to us in the continuous size variable, as we do here with the linear model, would give a more accurate result on the relationship between size and the covariates. Depending on the characteristics of the data in the meaty middle of the size spectrum, we can expect to see some changes in the coefficients, compared to the stark binary large/small measure. These results are largely consistent with the logistic regression model. The salient differences are that total debt ratio (tdr) and debt to market equity ratio (der) gain significance, pointing in opposite directions; return on equity (roe) gains marginal significance at the 10 percent level, suggesting a negative association with size all else equal; and dividend yield coefficient is strongly significant and positively associated with size.

Table 6: Linear Model, 2006

	Estimate	SE	t value	p value
(intercept)	7.993	0.3651	21.895***	0.0000
cr	-0.8730	0.0817	-10.690***	0.0000
qr	0.8246	0.1012	8.147***	0.0000
tdr	-0.7753	0.2489	-3.115***	0.0019
der	0.2115	0.0943	2.242**	0.0250
dc	-0.3552	0.0264	-13.474***	0.0000
invturn	-0.0282	0.0037	-7.711***	0.0000
recturn	0.0286	0.0075	3.836***	0.0001
tat	-0.4670	0.0699	-6.679***	0.0000
pm	3.045	0.4737	6.429***	0.0000
bep	7.039	0.4384	16.055***	0.0000
roe	-0.3320	0.1869	-1.777*	0.0757
dps	-0.9141	1.001	-0.9132	0.3612
fata	0.1845	0.2513	0.7344	0.4628
levdeg	0.3009	0.1400	2.149**	0.0317
ep	-0.8070	0.6844	-1.179	0.2384
dy	6.120	1.780	3.438***	0.0006
mktbk	-0.3999	0.0545	-7.338***	0.0000

*This table shows the results of a linear regression for all firms for 2006, with the natural logarithm of total assets as the response variable, and all ratios, as defined above in Table 2, used as additive independent variables. For each ratio, we show the coefficient estimate, the standard error, the t-value, and the p-value. ***, **, * indicate significance at the 1, 5, and 10 percent levels, respectively.*

Small vs. Large Firms, 2010

Table 7 shows the analysis for differences between small and large firms for 2010. The pattern of univariate differences is the same as in 2006, with large firms having lower liquidity, higher leverage, higher profitability, and more attractive equity prices.

Table 7: Univariate And Multivariate ANOVA, Small vs Large Firms, 2010

Panel 1: Univariate ANOVA				
Ratio	**Mean and SD**		**F value**	**p value**
	Small	**Big**		
cr	2.391 (1.496)	2.026 (1.058)	64.437***	0.0000
qr	1.743 (1.139)	1.472 (0.8343)	59.590***	0.0000
tdr	0.4949 (0.3068)	0.5575 (0.2140)	45.434***	0.0000
der	0.7030 (0.6535)	0.8172 (0.6087)	26.142***	0.0000
dc	2.428 (1.812)	1.300 (1.429)	385.24***	0.0000
invturn	13.963 (11.564)	15.319 (10.774)	11.757***	0.0006
recturn	8.040 (4.821)	8.936 (4.601)	28.825***	0.0000
tat	0.9918 (0.6887)	1.071 (0.6603)	10.976***	0.0009
pm	-0.0187 (0.1438)	0.0634 (0.0869)	390.53***	0.0000
bep	0.0069 (0.1243)	0.0926 (0.0706)	590.40***	0.0000
roe	0.0187 (0.2343)	0.1151 (0.1629)	185.24***	0.0000
dps	0.0603 (0.0448)	0.0541 (0.0391)	17.208***	0.0000
fata	0.4711 (0.2567)	0.5873 (0.2129)	195.24***	0.0000
levdeg	1.021 (0.2127)	1.150 (0.2207)	279.27***	0.0000
ep	-0.0048 (0.1001)	0.0482 (0.0661)	317.36***	0.0000
dy	0.0058 (0.0163)	0.0137 (0.0192)	158.88***	0.0000
mktbk	1.730 (0.9315)	1.593 (0.6532)	23.593***	0.0000
Panel 2: Multivariate ANOVA				
MANOVA:			79.316***	0.0000

In this table we analyze the differences between small and large firm subsamples for 2010, using the ratios described in Table 2. Panel 1 provides the univariate ANOVA test statistics for individual financial ratios. Shown for each ratio are the mean and standard deviation (in parentheses) for large and small subsets, the F statistic, and the p value. Panel 2 provides the MANOVA test statistics. Shown are the F statistic and the p value.

We do observe some differences from 2006 once we move to a multivariate logit model (Equation 1), the results of which are shown in Table 8. The coefficients on total debt ratio (tdr) and debt to market equity ratio (der) are now significant, and point in the opposite directions. Large firms are associated with higher *tdr* and lower *der*. This is in line with larger firms having lower market valuations relative to accounting measures. Larger firms also show significantly higher reliance on fixed assets (fata), and higher dividend yields (dy).

Table 8: Logit Model, Small Firms vs. Large Firms, 2010

	Estimate	SE	z value	p value
(intercept)	-0.1475	0.5379	-0.2742	0.7839
cr	-0.7604	0.1241	-6.127***	0.0000
qr	0.7258	0.1500	4.839***	0.0000
tdr	1.477	0.4096	3.605***	0.0003
der	-0.4108	0.1376	-2.985***	0.0028
dc	-0.3678	0.0411	-8.956***	0.0000
invturn	-0.0355	0.0058	-6.151***	0.0000
recturn	0.0054	0.0111	0.4857	0.6272
tat	0.5226	0.1075	4.862***	0.0000
pm	4.188	0.7348	5.700***	0.0000
bep	7.829	0.7267	10.773***	0.0000
roe	-0.1295	0.3469	-0.3733	0.7089
dps	-4.175	1.580	-2.643***	0.0082
fata	1.099	0.3947	2.785***	0.0054
levdeg	0.7482	0.2052	3.647***	0.0003
ep	-2.996	0.9663	-3.100***	0.0019
dy	6.899	2.531	2.725***	0.0064
mktbk	-0.5068	0.0976	-5.191***	0.0000

*This table shows the results of a logistic regression discriminating between small and large firms in 2010, with firm size dummy as the response variable (set to 1 for large firms), and all ratios, as defined above in Table 2, used as additive independent variables. For each ratio, we show the coefficient estimate, the standard error, the z-value, and the p-value. ***, **, * indicate significance at the 1, 5, and 10 percent levels, respectively.*

It is also interesting to examine the linear model specification with the log of total assets as the response variable, for 2010 (shown in Table 9), and compare with the results of 2006 (Table 6). We observe that the signs of all the coefficients remain the same, but several change significance. The positive debt to market equity (der) coefficient loses significance in 2010, as does the coefficient for receivables turnover (recturn), and the negative coefficient on return on equity (roe).

Table 9: Linear Model, 2010

	Estimate	SE	t value	p value
(intercept)	7.973	0.3764	21.183***	0.0000
cr	-0.7842	0.0873	-8.986***	0.0000
qr	0.6464	0.1071	6.035***	0.0000
tdr	-0.6548	0.2687	-2.437**	0.0149
der	0.1057	0.0956	1.106	0.2690
dc	-0.3987	0.0279	-14.269***	0.0000
invturn	-0.0246	0.0040	-6.149***	0.0000
recturn	0.0046	0.0079	0.5791	0.5625
tat	-0.4919	0.0750	-6.563***	0.0000
pm	3.115	0.4950	6.293***	0.0000
bep	7.163	0.4787	14.964***	0.0000
roe	-0.3366	0.2145	-1.570	0.1166
dps	-0.8624	1.110	-0.7771	0.4372
fata	0.3944	0.2687	1.468	0.1423
levdeg	0.5919	0.1567	3.776***	0.0002
ep	-1.232	0.6644	-1.855*	0.0637
dy	12.878	1.819	7.081***	0.0000
mktbk	-0.3763	0.0615	-6.116***	0.0000

*This table shows the results of a linear regression for all firms for 2010, with the natural logarithm of total assets as the response variable, and all ratios, as defined above in Table 2, used as additive independent variables. For each ratio, we show the coefficient estimate, the standard error, the t-value, and the p-value. ***, **, * indicate significance at the 1, 5, and 10 percent levels, respectively.*

These changes suggest that small and large firms became more similar in their operations along these metrics, likely as a result of all firms across the board having to increase focus on solvency and operational efficiency. The negative association of earnings to price (earnings yield, ep) gains significance in 2010, in line with the logit model. This suggests that large firms have become priced higher relative to their earnings, compared to smaller firms, possibly as a result of investors' reduced appetite for risk and fleeing toward the comparative safety of large companies post-crisis.

Changes in Small Firms from 2006 To 2010

Now we examine the changes in small firms between 2006 and 2010. Our first empirical analysis is presented in Table 10, showing univariate ANOVA for each of the ratios in Panel 1. The results indicate that, on average, firms have reduced book debt ratios (tdr) but increased debt to market equity ratios (der). This suggests a partial deleveraging, with an even stronger drop in market equity valuations. In line with the above, firms also have decreased their operating leverage (levdeg), and streamlined their receivables collection, with a significant increase in receivables turnover (recturn).

Table 10: Univariate and Multivariate ANOVA, Small Firms, 2006 vs. 2010

Panel 1: Univariate ANOVA				
Ratio		**Mean and SD**	**F value**	**p value**
	2006	**2010**		
cr	2.316 (1.486)	2.391 (1.496)	2.197	0.1384
qr	1.690 (1.148)	1.743 (1.139)	1.827	0.1766
tdr	0.5154 (0.3169)	0.4949 (0.3068)	3.667*	0.0556
der	0.5952 (0.5987)	0.7030 (0.6535)	25.720***	0.0000
dc	2.451 (1.791)	2.428 (1.812)	0.1475	0.7010
invturn	14.353 (11.948)	13.963 (11.564)	0.9412	0.3320
recturn	7.622 (4.581)	8.040 (4.821)	6.846***	0.0089
tat	1.020 (0.7074)	0.9918 (0.6887)	1.423	0.2330
pm	-0.0249 (0.1462)	-0.0187 (0.1438)	1.560	0.2117
bep	0.0005 (0.1314)	0.0069 (0.1243)	2.122	0.1453
roe	0.0217 (0.2499)	0.0187 (0.2343)	0.1284	0.7201
dps	0.0561 (0.0438)	0.0603 (0.0448)	7.772***	0.0053
fata	0.4676 (0.2538)	0.4711 (0.2567)	0.1645	0.6851
levdeg	1.037 (0.2227)	1.021 (0.2127)	4.414**	0.0357
ep	-0.0123 (0.0906)	-0.0048 (0.1001)	5.422**	0.0199
dy	0.0061 (0.0171)	0.0058 (0.0163)	0.2964	0.5862
mktbk	1.992 (0.9188)	1.730 (0.9315)	68.770***	0.0000
Panel 2: Multivariate ANOVA				
MANOVA:			9.326***	0.0000

In this table we analyze the changes in small firms between 2006 and 2010, using the ratios described in Table 2. Panel 1 provides the univariate ANOVA test statistics for individual financial ratios. Shown for each ratio are the mean and standard deviation (in parentheses) for large and small subsets, the F statistic, and the p value. Panel 2 provides the MANOVA test statistics. Shown are the F statistic and the p value.

Additionally, there is an increase in earnings yield (ep) and a decrease in market to book ratio (mktbk), both in line with a general drop in market equity prices. A significantly higher depreciation to sales (dps) ratio indicates a higher reliance on capital assets in the firms' production mix. The MANOVA model results shown in Panel 2 of Table 10 indicate that, in the multivariate setting as well, there is a strongly significant change in the financial characteristics of small firms between 2006 and 2010.

We next move on to a multivariate logit model with the response variable being the time dummy (set to 1 for 2010 and 0 to 2006) and the regressors as above,

$$\begin{aligned} TimeDummy = {} & \gamma_0 + \gamma_1 cr + \gamma_2 qr + \gamma_3 tdr + \gamma_4 der + \gamma_5 dc + \gamma_6 invturn \\ & + \gamma_7 recturn + \gamma_8 tat + \gamma_9 pm + \gamma_{10} bep + \gamma_{11} roe + \gamma_{12} dps \\ & + \gamma_{13} fata + \gamma_{14} levdeg + \gamma_{15} ep + \gamma_{16} dy + \gamma_{17} mktbk + \theta \end{aligned} \quad (2)$$

where *TimeDummy* is the response variable, *cr…mktbk* are the predictor variables, γ_0 is the intercept term, $\gamma_1 \ldots \gamma_{17}$ are the parameters, and θ is the error term.

Table 11: Logit Model, Small Firms, 2006 vs. 2010

	Estimate	SE	z value	p value
(intercept)	0.7431	0.4152	1.790*	0.0735
cr	-0.1634	0.0889	-1.837*	0.0662
qr	0.2366	0.1102	2.148**	0.0317
tdr	-0.4766	0.2827	-1.686*	0.0918
der	0.3864	0.1053	3.671***	0.0002
dc	0.0045	0.0279	0.1606	0.8724
invturn	-0.0064	0.0042	-1.536	0.1246
recturn	0.0370	0.0084	4.375***	0.0000
tat	-0.0938	0.0785	-1.194	0.2325
pm	-0.9654	0.5166	-1.869*	0.0617
bep	1.128	0.4867	2.318**	0.0204
roe	0.1744	0.2072	0.8415	0.4000
dps	5.224	1.148	4.552***	0.0000
fata	-0.8466	0.2686	-3.151***	0.0016
levdeg	-0.5417	0.1762	-3.074***	0.0021
ep	1.538	0.7358	2.090**	0.0366
dy	-2.993	2.232	-1.341	0.1800
mktbk	-0.2803	0.0581	-4.828***	0.0000

*This table shows the results of a logistic regression discriminating between small firms in 2006 and 2010, with year dummy as the response variable (set to 1 for 2010), and all ratios, as defined above in Table 2, used as additive independent variables. For each ratio, we show the coefficient estimate, the standard error, the z-value, and the p-value. ***, **, * indicate significance at the 1, 5, and 10 percent levels, respectively.*

The results are shown in Table 11 and indicate broad agreement with the univariate results. The salient differences are that now there is significance for liquidity ratios, showing a marginal decrease in current ratio (cr), but an increase in quick ratio (qr). We also observe additional significance for the drop in profit margin (pm), an increase in basic earning power (bep), suggesting that while net profitability has declined, it has been compensated for by a decrease in interest expense. Further, there is a significant decrease in fixed assets to total assets (fata).

Changes in Large Firms from 2006 to 2010

To examine the changes in large firms between 2006 and 2010, we show the univariate ANOVA results in Panel 1 of Table 12. We observe significant increases in liquidity in both current and quick ratios (cr, qr).

We also see significant increases in dividend yield (dy), earnings yield (ep), and in debt to market equity ratio (der), as well as a decrease in market to book ratio (mktbk), all consistent with a general decrease in market equity values. Further, there are decreases in total asset turnover (tat), basic earnings power (bep), and return on equity (roe), suggesting a broad decline in sales and profitability - also corroborated by a significant increase in the depreciation to sales ratio (dps). The MANOVA result in Panel 2 of Table 12 is consistent with there being significant changes in large firm financials between 2006 and 2010.

Table 12: Univariate and Multivariate ANOVA, Large Firms, 2006 vs. 2010

Panel 1: Univariate ANOVA				
Ratio		**Mean and SD**	**F value**	**p value**
	2006	**2010**		
cr	1.882	2.026	17.463***	0.0000
	(0.9885)	(1.058)		
qr	1.318	1.472	32.384***	0.0000
	(0.7734)	(0.8343)		
tdr	0.5686	0.5575	2.430	0.1191
	(0.2095)	(0.2140)		
der	0.7323	0.8172	18.066***	0.0000
	(0.5734)	(0.6087)		
dc	1.329	1.300	0.3666	0.5449
	(1.391)	(1.429)		
invturn	15.317	15.319	0.0000	0.9954
	(10.861)	(10.774)		
recturn	8.987	8.936	0.1111	0.7389
	(4.567)	(4.601)		
tat	1.175	1.071	20.941***	0.0000
	(0.6821)	(0.6603)		
pm	0.0624	0.0634	0.1061	0.7446
	(0.0861)	(0.0869)		
bep	0.1018	0.0926	13.552***	0.0002
	(0.0770)	(0.0706)		
roe	0.1254	0.1151	3.441*	0.0637
	(0.1670)	(0.1629)		
dps	0.0480	0.0541	23.344***	0.0000
	(0.0364)	(0.0391)		
fata	0.5830	0.5873	0.3620	0.5474
	(0.2077)	(0.2129)		
levdeg	1.153	1.150	0.1888	0.6640
	(0.2261)	(0.2207)		
ep	0.0440	0.0482	3.657*	0.0559
	(0.0633)	(0.0661)		
dy	0.0122	0.0137	6.392**	0.0115
	(0.0175)	(0.0192)		
mktbk	1.766	1.593	57.270***	0.0000
	(0.6941)	(0.6532)		
Panel 2: Multivariate ANOVA				
MANOVA:			10.519***	0.0000

In this table we analyze the changes in large firms between 2006 and 2010, using the ratios described in Table 2. Panel 1 provides the univariate ANOVA test statistics for individual financial ratios. Shown for each ratio are the mean and standard deviation (in parentheses) for large and small subsets, the F statistic, and the p value. Panel 2 provides the MANOVA test statistics. Shown are the F statistic and the p value.

The logistic regression, using the model in Equation 2, is shown in Table 13. We observe a decrease in current ratio (cr) and an increase in quick ratio (qr), suggesting that *ceteris paribus*, firms end up with less liquidity, but also lower inventory. The decrease in inventory turnover (invturn) however, suggests an even larger decrease in sales, corroborated by a decrease in total asset turnover (tat). Receivables turnover (recturn) has gone up, suggesting more efficient receivables management. A decrease in the debt

composition (dc) suggests a reduction in current liabilities, while an increase in depreciation to sales (dps) implies a greater reliance on long term assets. Accounting-based profitability measures (pm, bep, roe) are all insignificant in this multivariate framework. The increase in dividend yield (dy) and market to book (mktbk) both suggest a decline in equity values.

Table 13: Logit Model, Large Firms, 2006 Vs. 2010

	Estimate	SE	z value	p value
(intercept)	0.0252	0.4865	0.0518	0.9587
cr	-0.2386	0.1173	-2.035**	0.0419
qr	0.6701	0.1418	4.727***	0.0000
tdr	0.2160	0.3523	0.6130	0.5399
der	0.1682	0.1227	1.370	0.1706
dc	0.0705	0.0422	1.672*	0.0945
invturn	-0.0115	0.0051	-2.255**	0.0241
recturn	0.0432	0.0100	4.315***	0.0000
tat	-0.1875	0.0966	-1.941*	0.0523
pm	-0.4345	0.7311	-0.5942	0.5524
bep	1.009	0.7774	1.298	0.1944
roe	0.0902	0.3110	0.2901	0.7718
dps	3.863	1.375	2.809***	0.0050
fata	-0.2496	0.3798	-0.6571	0.5111
levdeg	-0.3096	0.1752	-1.768*	0.0771
ep	1.125	0.9412	1.195	0.2321
dy	5.765	2.006	2.874***	0.0041
mktbk	-0.4843	0.1005	-4.819***	0.0000

*This table shows the results of a logistic regression discriminating between large firms in 2006 and 2010, with year dummy as the response variable (set to 1 for 2010), and all ratios, as defined above in Table 2, used as additive independent variables. For each ratio, we show the coefficient estimate, the standard error, the z-value, and the p-value. ***, **, * indicate significance at the 1, 5, and 10 percent levels, respectively.*

Small vs. Large Firm Changes from 2006 to 2010

In the multivariate setting, both small and large firms have seen significant changes in liquidity ratios, with decreases in current ratio (cr) and increases in quick ratio (qr), suggesting an overall reduction in liquidity but also a compensating decrease in inventory as a fraction of current assets. All firms show a significant reduction in operating leverage (levdeg), a larger depreciation to sales ratio (dps), and an increase in receivables turnover (recturn). Further, the market-to-book ratios (mktbk) are down across the board. Small firms exhibit a significant decrease in the book value debt ratio (tdr) and an increase in debt-to-market equity ratio (der), implying some deleveraging, compensated for by a drop in market equity, while these effects are not significant for large firms. Small firms also show a decrease in profit margin (pm) and an increase in basic earning power (bep), suggesting a reduction in operating profit but a decrease in interest expense. Similar effects for large firms are not significant. For the large firm subsample we see a significant decrease in inventory and total asset turnover (invturn, tat), evidencing a decrease in revenues, and an increase in dividend yield (dy), likely from equity price declines, whereas the small firm coefficients for these variables are not significant.

CONCLUSIONS

The financial crisis of 2008 has had a significant impact on most firms in the global economy. In this study we analyze the effect of the crisis on U.S. firms, focusing on pre- and post-crisis metrics, as well as differences between large and small firms. With a significant component of the financial meltdown being

a lack of liquidity, we pay particular attention to measures of liquidity and solvency. Using a sample of firms from the COMPUSTAT database, we compare the financial characteristics of firms between 2006 and 2010, straddling the crisis time period. Our analysis shows a number of significant differences in various financial ratios. We observe that firms show changes in ratios indicating a broad decline in market valuations, with significant reductions in market to book, increases in debt to market equity, and earnings yield. We find that both large and small firms exhibit significant increases in depreciation to sales, indicating a drop in revenues, and an increase in inventory turnover, suggesting streamlining operations. Both small and large firms significantly reduce their operating leverage (interest to EBIT), while only the large firm subsample shows a significant increase in dividend yield likely due to equity price drops. Neither large nor small firms show dramatic directional changes in profitability ratios in a multivariate setting. Overall, the crisis appears to have affected firm operations across a number of metrics, regardless of firm size. Firms have streamlined their operations, reduced leverage and insolvency risk, and not seen profitability declines, while at the same time market equity valuations have become more attractive for investors. This research exhibits several limitations. First, in this study we look at the average patterns across a broad cross-section of firms. We expect that the effects we observe would vary for different industries. Further, our two size bins each include a wide variation in size, so we may see different results by focusing on finer size partitions. Additionally, we only look at U.S. firms, whereas the 2008 credit crisis has impacted the entire global economy. Investigating these issues in greater detail should be fertile ground for future research.

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