FINANCIAL DISTRESS COMPARISON ACROSS THREE GLOBAL REGIONS

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ABSTRACT

Globalization has precipitated movement of output and employment between regions. We examine factors related to corporate financial distress across three continents. Using a multidimensional definition of financial distress we test three hypotheses to explain financial distress using historical financial data. A null hypothesis of a single global model was rejected in favor of a fully relaxed model which created individual financial distress models for each region. This result suggests that despite other indications of worldwide convergence, international differences in accounting rules, lending practices, managements skill levels, and legal requirements among others has kept corporate decline from becoming commoditized.

I. INTRODUCTION

As companies move production offshore they face a growing risk of supply-chain disruption caused by the possible financial distress of foreign suppliers. Receiving a 12 month early warning of impending supplier difficulties provides buying companies the opportunity to either remediate the supplier's condition or to contract with another supplier. The choice of actions may depend upon the capacity utilization in that particular sector or the availability of other suppliers. A supplier early warning system for manufacturing firms is analogous to bankruptcy models that alert lenders or investors that an offending firm is unable to service its long-term debt. Unlike investment analysts for whom obtaining advance warning of bankruptcy is sufficient, corporate purchasers require advance warning of supplier *financial distress*, a condition which normally precedes bankruptcy by some period of time.

There has been substantial bankruptcy prediction research; in contrast, few analysts have created models to forecast financial distress. In this globally connected world it is essential that there be a framework for evaluating financial distress risk. Platt and Platt (2006) recently developed a financial distress model for U.S. based companies that demonstrated an ability to predict the onset of financial distress for a sample of companies in manufacturing industries. No similar model exists for companies in other global regions. Globalization blurs international differences between countries. Are these similarities limited to areas such as technological adoption, arts and culture, and cuisine? Or, are business practices essentially universal now. This paper looks at one area, financial distress, where similarities may exist between global regions. Three global regions are considered: Asia (including Australia), Europe and the US. Profound differences between regions in accounting rules, legal practices, environmental laws, and business

practices among others may limit the degree of convergence in the area of financial distress. This paper explores that question by developing a financial distress model across three global regions.

II. LITERATURE REVIEW

Bankruptcy has been rigorously studied since the pioneering work of Beaver (1966). Altman (1968) and Ohlson (1980) accelerated interest in the field by applying standard statistical techniques to predict bankruptcy outcomes. More recent innovations (Altman, Marco and Varetto, 1994; Yang, Platt and Platt, 1999; and Shumway, 2001) have extended the field by introducing newer methodologies. While there are variations across models, factors that often are found to be predictive of bankruptcy filings include debt load, profitability, liquidity, operating performance and growth.

A company either files for Chapter 11 bankruptcy protection from creditors because it finds itself in a difficult financial, operating or legal situation or is forced to do so by creditors because the firm's performance is so deficient that it can no longer honor commitments made to lenders. Regardless of the initiating event, companies in bankruptcy must work through the courts to restructure their operations and/or financial structure to emerge from the process as a viable company. Companies in financial distress, by contrast, are not yet so severely disabled that legal recourse is required. Often, companies in financial distress do take steps to remedy their precarious situation, including hiring turnaround managers, disposing of assets, and improving working capital management (See Hofer, 1980).

The literature focusing on financial distress tends to examine financial restructurings (John, Lang and Netter, 1992; Gilson, John & Lang, 1990; Wruck, 1990; Brown, James & Mooradian, 1992, and Asquith, Gernter and Scharfstein , 1994) or management turnover during distress

(Gilson, 1989). John *et al*. (1992) note that failing firm managers are replaced despite their delivering performance on par with their peers; in contrast, Asquith, *et al.* (1994) observe that distressed firm's managers underperform peers. Inconsistencies between studies may result from using samples drawn over different time periods or comprised of different firms.

Most prediction studies with the words "financial distress" in their title actually model bankruptcy, see (Frydman, Altman and Kao, 1985; Theodossiou, Kahya and Philippatos, 1996; Lin, Ko and Blocher, 1999). True models of financial distress are far less common [See Schipper (1977); Lau (1987); Hill *et al*. (1996); Platt and Platt, (2002)]. Schipper (1977) examined private colleges with imbalanced finances, Lau (1987) and Hill *et al*. (1996) moved beyond just bankruptcy to consider multiple states of corporate decline including financial distress, and Platt and Platt (2002) modeled financial distress among auto suppliers. More recently Platt and Platt, (2006) built a multi-industry model of financial distress for U.S. companies. Their most interesting finding was that bankruptcy and financial distress are not simply two sequential steps in the same process. Instead companies experience financial distress following poor operating results or as a consequence of external forces while bankruptcy is an action companies take to protect their assets often as a result of balance sheet issues.

Perhaps the reason that financial distress is studied less frequently than bankruptcy is that financial distress lacks a specific definition while formal bankruptcy, by contrast, takes place in a court of law and has a definite start date. It is unclear when financial distress begins or ends or even, for that matter, what it is. Moreover, there are various degrees of financial distress ranging from companies bordering on bankruptcy to those that are less troubled. Researchers have adopted a variety of financial distress definitions. Some are multidimensional so that only severely

distressed firms are included while others are more narrowly defined. The best known academic descriptions of financial distress are:

- Evidence of layoffs, restructurings, or missed dividend payments, used by Lau (1987).
- A low interest coverage ratio, used by Asquith, Gertner and Scharfstein (1994).
- Cash flow less than current maturities of long-term debt, used by Whitaker (1999).
- The change in equity price or a negative EBIT, used by John, Lang, and Netter (1992).
- Negative net income before special items, used by Hofer (1980).

Platt and Platt (2006) adopt a multidimensional interpretation of financial distress in which they denote a firm as financially distressed only when it meets three of the criteria noted above. These three measures are:

- Negative EBITDA interest coverage (similar to Asquith, Gertner and Scharfstein (1994)).
- Negative EBIT (similar to John, Lang, and Netter (1992)).
- Negative net income before special items (similar to Hofer (1980)).

To be included as financially distressed a company needed to fail all three tests in two consecutive years. Companies classified as not financially distressed did not meet any of the three criteria in the two consecutive years. Interestingly, the negative EBITDA to interest coverage and the negative EBIT measures are less correlated than one might expect.

All three screens are correlated, but not perfectly, with correlation coefficients ranging from 0.38 (not significant) to 0.98 (highly significant). As a result, by using the intersection of three separate financial distress definitions fewer firms are labeled as financially distressed than would be the case with any single screen (Platt and Platt, 2006). That is, it is less likely that a non-financially distressed company is labeled as financially distressed when the intersection of three screens is employed. The use of three screens provides a multidimensional view of which companies are financially distressed. This definition appeals to purchasers high up the supply-chain

who may be reluctant to confront a long-time supplier with an inaccurate financial distress accusation.

Given the success of Platt and Platt (2006) in modeling financial distress using US manufacturing companies and given the exponential growth in manufacturing worldwide, this study examines the question of whether factors (i.e., financial ratios) found to predict financial distress in the US also predict financial distress in Europe and in Asia. There are many reasons why it may be necessary to search for different financial ratios than those used by Platt and Platt (2006) to model financial distress in Europe or Asia. For example, differences in industrial development, technological adoption, manufacturing strategies, and access to capital markets could conceivably affect a firm's financial decisions and influence its resulting financial ratios.

This study relies on accounting information to distinguish between companies that are not financially distressed and those that might succumb to financial distress. Another concern is that differences in international accounting standards may affect our ability to characterize companies (See PricewaterhouseCoopers, 2001). For example, both US GAAP accounting and the International Accounting Standard (IAS) allow LIFO and FIFO treatment of inventories; in contrast, UK GAAP only allows the FIFO standard. Likewise, US GAAP accounting has four specific criteria used with revenue recognition while the other two accounting standards use fewer criteria. Accounting differences themselves will not lead to financial distress though their application may obfuscate international data comparisons. We controlled for this issue in two ways. First, we made certain that the distribution of ratios utilized in our study were similar across global regions. Second, qualitative (dummy) variables tested for uncontrolled regional variation.

Our research hypothesis expressed as a null hypothesis, is:

H_0: A global model will accurately predict financial distress in manufacturing companies in the US, Europe and Asia.

The alternate hypothesis has two variations. The first is:

H_a: A global model exists in which there are commonalities across regions in how factors affect financial distress though there are broad regional differences.

The second alternate hypothesis is:

H_b: There is no global model of financial distress. Different processes entirely explain financial distress in various locations.

Being unable to reject H_0 would allow for a single explanation of how firms succumb to financial distress in different locations. Not being able to reject H_a, the first variation of the alternate explanation, would modify the single global model with differential regional intercepts and slopes as needed while seeking to maintain the maximum degree of similarity across regions. Finally, not rejecting H_b would relax all constraints so that the explanation of financial distress on each region would have separate factors explaining that region's financial distress process.

III. METHODOLOGY

Data

Financial data from 1999 – 2001 for US companies were obtained from S&P's Research Insight Compustat Database. Comparable data from audited financial statements for European and Asian companies were obtained from the S&P's Research Insight Global Vantage Database. Only companies surviving throughout the three year period are included in the sample. This data was divided into two groups: just 1999 and then both 2000 and 2001. Methodologically we followed a two step procedure. In the first step, the 2000 and 2001 data were used to categorize companies by status: financially distressed and non-financially distressed. Companies were placed in the

financially distressed group when they failed three tests for financial distress in both years. By contrast, a company was categorized as non-financially distressed if all three metrics (EBDITDA to interest coverage, EBIT, and net income before special items) were positive in both 2000 and 20001. Then financial ratios were created with the earlier data from 1999. These ratios were used in the second step to predict financial distress among companies (both financially distressed and non-financially distressed) whose performance in 2000 and 2001 was reviewed in the first step. The two year gap between the year when companies are classified as financially distressed or not and the data used to explain that classification is necessary so that companies are not classified and modeled with the same data or ratios. Table 1 contains the composition of sample firms used to build the statistical models by region and industry. Table 2 contains individual items and ratios used to bifurcate the sample into financially distressed and non-financially distressed groups with the means and medians of the three screening metrics by region, financial status for the largest industry classifications in the sample. Table 2 demonstrates that the three metrics clearly differentiate between the two sample groups, non-financially distressed versus financially distressed companies. Like other researchers in this area, we did not track companies in years beyond 2001 to determine their future status.

Insert Tables 1 and 2 about here

Dependent Variable: Financial Distress Defined

Following Platt and Platt (2006), we adopt a multidimensional interpretation of financial distress in which a firm is categorized as financially distressed only when it meets all three of the following criteria for two consecutive years:

- Negative EBITDA interest coverage (similar to Asquith, Gertner and Scharfstein (1994)).

- Negative EBIT (similar to John, Lang, and Netter (1992)).
- Negative net income before special items (similar to Hofer (1980)).

By using the intersection of three separate financial distress definitions fewer firms are labeled as financially distressed than would be the case with any single screen. That is, it is less likely that a non-financially distressed company is labeled as financially distressed when the intersection of three screens are employed; though, as a consequence, more financially distressed companies may be incorrectly described This outcome is preferred when the cost of misidentifying a non-financially distressed company as financially distressed is higher than the alternative misclassification. Financially distressed firms were defined as those that had negative values for the three screening criteria in both 2000 and 2001. A two year approach was followed to avoid calling as financially distressed companies having just a single bad year. By contrast, non-financially distressed firms were defined as those whose three screen metrics were positive for both years.

Independent Variables

Table 3 contains the financial ratios that were tested as independent variables for modeling purposes. The financial ratios represent measures of profitability, financial leverage, liquidity, operating efficiency and growth, all of which are factors frequently included in models predicting either financial distress or bankruptcy.

Insert Table 3 about here

A common problem in empirical studies occurs when information is drawn from companies across many industries in order to create a larger sample. The problem created by that decision is that the sample mean value of financial ratios may then vary depending on the mix of industries from which sample firms are drawn. In other words, another sample is likely to have different sample mean values and different coefficient estimates. The industry-relative framework pioneered

by Altman and Izan (1984) and later used and rationalized by Platt and Platt (1990, 1991) mitigates this problem. The industry-relative framework transforms data to be relative to the industry's average value. The transformation of company ratios into industry-relative ratios is described in equation (1).

$$\text{Industry - Relative Ratio}_{i,j} = \frac{Firm\ i's\ Ratio\ (r)}{Mean\ Ratio\ in\ Industry_{j}} * 100 \qquad (1)$$

where firm i is a member of industry j and 100 adjusts percentage ratios to scalar values greater than 1.0. The transformation starts with a company's ratio and then divides that quotient by the value of that same ratio for the average firm in the industry. The industry relative data adjustment is also performed in this study for each continent separately.

Model Development, Specification and Comparison

A global model of financial distress (Model 1) is developed using financial ratios contained in Table 3. Companies from the three regions are pooled together. Data are drawn from a firm's 1999 fiscal year.[1] Initially, one ratio from each group in Table 3 was selected to minimize potential multicollinearity. Because several variables in each category could potentially discriminate between the two groups of firms (financially distressed and non-financially distressed), various combinations of predictors across the eight categories were tested. It was expected that financial distress would be negatively related to profit margin, profitability, liquidity, growth from 1998 to 1999 and operating efficiency. Alternatively, financial distress would be positively related to operating or financial leverage. [2]

[1] Data from 1998 were also collected to allow measurement of growth rates from 1998 to 1999.
[2] This approach is analogous to the well-known paradigm used by many researchers to predict bankruptcy with prior year data. In our case, instead of bankrupt companies we use those that are severely financially distressed as defined by

The world-wide modeling process began with the variables found to be statistically significant determinants of financial distress for US companies in Platt and Platt (2006). Using an iterative process, a core group of predictors was developed to which additional predictors were added individually. The core set of variables expands as additional factors yield a coefficient with the expected sign, statistical significance, and improved classification accuracy. This approach concentrates on the explanatory power of variables. The selection of the final set of financial and operating ratios was based on their conformity to a priori sign expectations, the statistical significance of estimated parameters and on model classification results.

Model 1 which assumes a single world-wide financial distress prediction framework is compared to a global model that also contains region dummy variables as well as interaction terms of the dummy variables with the financial ratios contained in the model. The model with the additional variables is referred to as Model 2. To test which model specification is best, we use the F-test for nested models (Kmenta, 1986, p. 594). In effect, the two competing models can be characterized as:

Model 1: $\mathbf{y = X_1 ß_1 + \varepsilon}$

Model 2: $\mathbf{y = X_1 ß_1 + X_2 ß_2 + \varepsilon}$

Where X_1 is the set of factors contained in the global model and X_2 is the set of region dummies and the interaction terms which when added to the global model creates Model 2. The null hypothesis states that $\mathbf{ß_2 = 0}$**;** alternatively, $\mathbf{ß_2 \neq 0}$**.** If the null hypothesis cannot be rejected, then the global model is the best specification regardless of global location. However, if the null hypothesis is rejected, then different specifications for each region is best.

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a two-year three-screen approach. That is, the technique looks for characteristics in prior year data that distinguishes between future severely financially distressed and non-financially distressed companies.

Model building utilizes logit regression analysis because of its flexibility and statistical power in modeling (McFadden, 1984; Lo, 1986). A non-linear maximum-likelihood estimation procedure obtained estimates of the parameters of the logit model shown in equation (2).

$$P_i = \frac{1}{[1 + \exp^{-(B_0 + B_1X_{i1} + B_2X_{i2} + \ldots + B_nX_{in})}]} \qquad (2)$$

where: P_i = probability of financial distress of the ith firm,

X_{ij} = j^{th} variable of the ith firm, and

B_j = estimated coefficient for the jth variable.

With logit regression, it is possible to test the significance of individual estimated coefficients which is not the case with other estimation methods such as multiple discriminate analysis.

IV. RESULTS

Table 4 presents the means of three key financial ratios by region, financial status and industry. In the interest of brevity, only the three largest industries are presented: chemicals and allied products, industrial machinery and equipment and electrical and electronic equipment. Table 4 shows that companies categorized as financially distressed not only have lower cash flow to sales and lower EBITDA to total assets, but the average ratio is negative across all three regions and across all three industries. By contrast, firms not categorized as financially distressed have higher ratios.

The pattern for total debt to total assets is not as easily described. For all three industries in the US, financially distressed firms had more debt, on average, than reasonably non-financially distressed firms. However, in Europe and in Asia, mixed results were found. In some industries, non-financially distressed firms were found to have more debt than financially distressed firms.

Thus, it is more difficult to make a generalizable statement about debt. It may be that in these regions healthier firms can attract more debt because of their financial strength, whereas weaker firms cannot and thus show less debt. This somewhat counter intuitive result may be characteristic of the chemical industry outside of the US where non-financially distressed firms are able to borrow more to invest in their substantial plant and facilities.

Insert Table 4 about here

The global model (Model 1), shown in Table 5, contains seven variables, one variable each representing profit margin (CF/Sales), profitability (EBITADA/TA), liquidity (CA/CL), operating efficiency (Sales/WC), and operating leverage (DA/EBIT). There are also two financial leverage variables (short term: NP/TA and total: TD/TA). With financially distressed firms arbitrarily coded as 1, negative (positive) coefficients describe an inverse (direct) relationship with financial distress. It is not unreasonable to expect *a priori* that higher cash flow margins (CF/Sales), greater profitability (EBITDA/TA) and greater working capital turnover (Sales/WC) reduce the risk of financial distress; whereas, higher operating leverage (DA /EBIT) and higher financial leverage (short term: NP/TA, total: TD/TA) are likely to increase the risk of financial distress. The remaining variable, liquidity (CA/CL), is more difficult to assess. On the one hand finance textbooks argue that having more liquidity is associated with improved corporate health. On the other hand, a global company that holds too many of its assets (relative to its current liabilities) as current assets is reducing its investment in more profitable fixed assets which may reduce its profitability. Over investment in current assets relative to current liabilities may increase the risk of financial distress.

Insert Table 5 about here

All estimated coefficient receive the expected signs. The current ratio receives a positive coefficient which says that overinvestment in current assets increases the risk of financial distress. Platt and Platt (1991a) found that companies with too many of their assets invested in fixed assets have higher financial distress risk. Our new finding supports the earlier discovery by saying that companies must not over invest in either fixed assets or current assets; there is an appropriate investment level for each.

Further, all but one estimated coefficient is statistically significant beyond the .05 level. The measure of operating leverage, DA/EBIT, is not significant, but was retained in the model because it improved the percentage of firms correctly classified, both overall and for financially distressed firms.

The global financial distress prediction model had an overall correct classification rate of 94.5 percent, as shown in Panel B of Table 5. For the distressed group, the model correctly classified 82.1 percent of companies; for the non-distressed group, 96.4 percent of companies.

Extending the Model to Other Regions

To test whether the factors predictive of financial distress are the same across the three regions in question, we added two region dummy variables to Model 1 as well as interaction terms between the two dummy variables and the seven variables included in the model, yielding 23 total predictors in Model 2. Table 6 presents the Model 2 results, as well as the results for Model 1 for comparison purposes.

Insert Table 6 about here

Estimated coefficient comparisons between the two models show that all main effects continue to have the same relationship to financial distress except for DA/EBIT. In Model 2,

DA/EBIT is now marginally significant, but with a negative relationship to financial distress; that is, the greater the operating leverage (use of fixed assets), the lower the likelihood of financial distress. Further, two variables, NP/TA and Sales/WC, are not statistically significant as main effects, but do impact financial distress as interaction terms with one of the region dummy variables.

An F-statistic is used to test whether the additional dummy variables and interaction terms contain significant real explanatory power. Again, the null hypothesis states that region locale has no effect on the model, thus $\boldsymbol{ß_2 = 0}$ where $\boldsymbol{ß_2}$ represents the additional variables found in Model 2. The particular equation for the F-statistic is shown in equation 3 below.

$$F_{(K_2, n-K_1-K_2)} \approx \frac{(SSE_1 - SSE_2)/K_2}{SSE_2/(n-K_1-K_2)} \tag{3}$$

According to Kmenta (1986, p. 594), Model 1 is best if the F-statistic is less than 1.0. Otherwise, Model 2 is preferred. The calculation indicated an $F_{(23, 3901)} = 4.698$, with $SSE_1 = 154.35$, $SSE_2 = 150.19$, $n = 3931$, $K_1 = 7$, and $K_2 = 23$. Thus, the null hypothesis that the regional location has no effect is rejected. Based on this result, the specific region does affect factors predicting financial distress.

Using the results in Table 6, a marginal change in six of the seven predictors in Model 2 results in differential effects in Europe as compared to the US or Asia. For example, the partial derivative of the probability of financial distress with respect to cash flow to sales is -0.732 for firms in Europe, as compared to -0.096 for US firms and -0.201 for firms in Asia. This finding suggests that a marginal decline in cash flow to sales in Europe has a far more substantial impact in moving that firm toward financial distress than is the case in the US and Asia. Similar differential effects are found for four other variables: return on operating assets before depreciation and amortization, notes payable to total assets, the current ratio, and sales to working capital.

For the operating leverage variable, depreciation and amortization to EBIT, the results have the opposite sign. Europe continues to diverge from Asia and the U.S, but now a marginal increase in operating leverage results in an increase in the probability of financial distress for European firms. By contrast, for companies in the US and Asia, increases in operating leverage are related to reductions in the probability of financial distress. European firms have outsourced much of their manufacturing capacity to emerging markets, such as Eastern Europe, and Asia. Given the outsourcing of manufacturing capacity, increases in operating leverage may indicate a departure from the strategic deployment of assets and thus may be a signal of financial distress.

Comparing the Global Model with Regional Indicators to Three Distinct Regional Models

The estimated coefficients in Model 2 indicate that the relationship between the likelihood of financial distress and all of the variables except TD/TA are significantly different for Europe when compared to the US or to Asia. This result suggests that it may be beneficial to explore whether three *different* models would be superior when predicting financial distress. That is, because manufacturing strategies may differ among the three regions, perhaps based upon indigent industries, their relative size or age, we may find that pooling across the three regions masks key differences that could be exploited during the modeling process. In effect, we can test the following two hypotheses:

H_1: A global model with regional indicators and interaction terms is best [same variables, possibly different coefficients]

H_2: Three separate models by region are best [different variables]

To test the above hypotheses, separate models will be constructed for each of the three regions: US, Europe and Asia. J-tests (Davidson and McKinnon, 1981) will be used to examine whether the

incremental information contained in the different, non-nested model specifications is significant. The specific equation considered is:

$$Y = (1-\alpha)\,\mathbf{X_1\beta_1} + \alpha\,\mathbf{X_2\beta_2} + \varepsilon \qquad (4)$$

where H_1 and H_2 above are indicated by their respective variables and coefficients. Thus, testing H_1 is basically testing whether or not $\alpha = 0$. Because α is not identified, the J-test replaces $\boldsymbol{\beta}_2$ with $\hat{\boldsymbol{\beta}}_2$, where $\hat{\boldsymbol{\beta}}_2$ is the simple least squares estimator defined as $\hat{\boldsymbol{\beta}}_2 = (\mathbf{X}_2'\mathbf{X}_2)^{-1}\mathbf{X}_2'\mathbf{y}$. When H_1 is true, α divided by its standard error is distributed N(0,1). A second test is also performed because of the asymmetry of H_1 and H_2. That is, when we test H_1, we use H_2 to challenge the validity of H_1. However, when we reject H_1, it may be some other model other than H_2 that has caused us to reject H_1. To make a statement about H_2, we conduct a second J-test to test α in the following equation:

$$Y = (1-\alpha)\,\mathbf{X_2\beta_2} + \alpha\,\mathbf{X_1}\,\hat{\boldsymbol{\beta}}_2 + \varepsilon \qquad (5)$$

which in effect is testing H_2 against H_1. Consistent inferences from the two tests would indicate which of the two models is preferred. Inconsistent results would indicate that neither model is useful to predict financial distress or that the data cannot discriminate between the models.

To construct the individual models for each region, the modeling process began with the ratios in Table 3. An iterative modeling process was used to create the three regional models similar to that used to create the global model. As before, coefficient sign and significance as well as the classification accuracy of the model were important criteria for model assessment. The three individual models are presented in Table 7 and the classification accuracy for each model is presented in Table 8.

Insert Tables 7 and 8 about here

Most notably, all three models contain cash flow margin, EBITDA to total assets and some debt to total asset ratio. Further, the same relationship exists between these variables and the

likelihood of financial distress in all three cases; namely, a negative relationship for the profit margin and profitability measures and a positive relationship for the financial leverage ratio.

After that point, there are some similarities between pairs of models, such as both the US and Europe models include a liquidity ratio. As found with Model 1, the higher the liquidity, the more likely the firm is to be financially distressed in both cases. This result may be somewhat counter intuitive, but the multivariate nature of the model requires that all other components are held constant before one assesses the independent effect of liquidity. Thus, holding all other factors constant, firms that do not adequately control their cash or liquid assets do not benefit from returns on those assets which makes it more likely than not that they experience financial distress. It may be a signal that senior management is not deploying liquid assets for the optimal benefit of the firm.

Also, cash flow growth is negatively related to financial distress in both Europe and Asia. It is statistically significant in Europe, but marginally so in Asia. The variable was kept in the Asia model, despite its marginal significance because it substantially improved classification accuracy rates. The Europe model also contains sales growth as a significant factor. As with cash flow growth, sales growth has a negative relationship to financial distress. Thus, greater sales growth is associated with a decreased likelihood of financial distress.

Further, sales turnover is found to be a significant predictor of financial distress for Europe and Asia. In both models, the faster the turnover, the less likely a firm is financially distressed. The Europe and Asia models also include Depreciation and Amortization to EBIT, a measure of operating leverage. While the estimated coefficient for Europe is positive, that for Asia is negative. This discrepancy may indicate a difference in maturity and operating realities of the sample companies. That is, manufacturing firms in Europe most likely are conducting much of their actual operations in off-shore plants in Eastern Europe, India and Asia. Thus, European companies with

high operating leverage are more likely to become financially distressed. By contrast, firms in Asia are more likely the source of manufacturing plants; thus, those with high operating leverage are positioned to reap the benefits of increased scale, thereby improving profitability and thus reducing the likelihood of financial distress.

Finally, the Asia model required two country dummy variables, one for Japan (not significant, but improves classification) and one for Singapore (statistically significant). These indicator variables suggest that there is a higher likelihood of financial distress for firms in these countries, before the effects of specific predictors are considered. In the case of Japan, slight increases in EBITDA/TA have substantially larger effects on the likelihood of financial distress than is the case for other Asian countries. More specifically, the large, negative, significant estimated coefficient for the interaction between the Japan dummy variable and EBITDA/TA suggests that slight increases in EBITDA/TA there produce greater reductions in the probability of financial distress as compared to other Asian countries. Given Japan's tenuous economic condition at the turn of the 21st century, it makes sense that any improvement in a company's profitability was a significant signal of financial health.

As discussed above, J-tests are used to test which model specification, if any, is best to predict financial distress among firms across the three regions. The first J-test compared the global model (with interactions and dummy variables) to the separate models for each region. Specifically, the test estimated α in the following equation:

$$Y = (1-\alpha)M_1 + \alpha\hat{M}_2 \tag{6}$$

where M_1 is the global model and M_2 are the separate regional models. The estimated α parameter was 8.475, with p-value of 0.000. Thus, the null hypothesis that α = 0 is rejected, indicating that

M_2, separate models, is best for predicting Y, financial distress. The second J-test was conducted to estimate α in the following equation:

$$Y = (1-\alpha)M_2 + \alpha\hat{M}_1 \tag{7}$$

To test this model specification, individual regional regressions were run. The estimated α parameter for the US model was 1.136 with p-value of 0.396; for Europe, 1.122, with p-value of 0.482; and for Asia, 2.576 with p-value of 0.077. In all three cases, the null hypothesis that α = 0 cannot be rejected; hence, M_2 or separate models is best for predicting Y, financial distress. Thus, both J-test results indicate that separate regional models are best for predicting financial distress.

Model Robustness

The three distinct regional models of financial distress have variables in common and variables that are distinct. Clearly the models are heterogeneous but are their predictions and their predictive abilities different? The underlying issue is whether the models are fundamentally different or whether their differences are cosmetic. This question is examined by considering how well each model predicts financial distress at companies in regions other than their own.

For each region, 20 random companies (60 companies in total) are selected from the existing model building data base. In each region ten non-financially distressed companies and ten financially distressed companies are chosen. The data for these companies is then input into the models built for the other two regions. For example, Asian data is input into the European and U.S. models. This process is repeated for all three regions. The analysis considers the robustness of the models and their abilities to evaluate companies from other regions.

None of the models appear to be robust, as seen in Table 9. Focusing primarily on predictions of financial distress, only US data resulted in reasonably good classification accuracy in

both the European and Asian models. That is, US data produced classification accuracies for financially distressed firms that were significantly different from chance (Asia Model) or marginally so (Europe Model). Inputting data from either Asia or Europe into the other two models produced classification accuracies that were not significantly different from chance (about 50% classification accuracy).

These results are consistent with the pooling hypothesis test above. That is, the findings suggest that a regional model cannot accurately predict a company's status if that company comes from outside the region. Nonsimilarity between the models implies that financial distress occurs for different reasons around the world. For example, US firms in financial distress tend to struggle with managing their long-term debt load and interest payments. European firms in financial distress have issues with working capital deployment, operating leverage and growth. Finally, Asian companies experiencing financial distress suffer from low turnover, too little operating leverage and high total debt. By contrast, all of the models performed very well with data from other regions with respect to correctly classifying non-financially distressed companies. Companies that are doing well appear to have similar characteristics regardless of location.

Insert Table 9 here

V. CONCLUSION

The outcomes of globalization from dramatically higher rates of imports and exports to the movement of jobs between countries are appearing everywhere more rapidly than most analysts had expected. The typical consumer in America buys cars made in Korea, wine produced in Chile, and fashions from Italy. Likewise consumers in Korea bank at American institutions, people in Chile buy American computers, and consumers in Italy buy wine from California. Given this rapid

and overwhelming flow of goods and services between countries, it is not unreasonable to expect that firms across the globe have begun to adopt the same principles for inventory control, working capital management, hiring and firing, and factory utilization. In other words, one might expect firms to behave similarly regardless of which country they might reside.

Corporate similarity might begin with firm formation and continue through to financial distress and bankruptcy. This study examined the tail end of that series of connections. It looks at whether firms on three regions had similar forces affecting them as they moved from strength to financial distress. Using a methodology based upon a multidimensional definition of financial distress the study compiled a list of companies on three regions that were financially distressed. Then using data from two years prior various explanations were tested of how the corporate decline occurred.

The study posed three hypotheses concerning the form of the models explaining financial distress on the three regions. The null hypothesis assumed that a single global model would explain financial distress on each region. The two alternate hypotheses relaxed this assumption in various degrees. The null hypothesis was rejected in favor of a fully relaxed model which created individual financial distress models for each region.

That globalization has not resulted in similar factors influencing corporate financial strength has macroeconomic implications. Differences between companies in the three regions and their operating ratios are shown in the paper to be dramatic. Factory age and efficiency, unionization, benefit payments as a supplement to wage levels, relationships with lenders and vendors are just some of the many differences one notes across regions. For example, as more production is moved to factories in Asia there is reason to be concerned about the health of the global economy due to the factors related to financial distress in Asian companies. Our results suggest that Asian

companies are more likely to become financially distressed when they do not have sufficient operating leverage to support sales volume or do not generate sufficient cash flow or operating earnings before depreciation charges.

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Table 1
Distressed and Not Distressed Companies in 14 Industries

Industry SIC Code	Industry Name	US		Europe		Asia		Total	
		H	***FD***	***H***	***FD***	***H***	***FD***	***H***	***FD***
2200	Textile Mill Products	19	4	37	4	71	11	127	19
2300	Apparel & Other Textile	54	7	38	1	45	3	137	11
2600	Paper & Allied Products	63	5	50	1	65	2	178	8
2800	Chemicals	87	14	145	20	320	10	552	44
2900	Petroleum & Coal	27	4	20	0	32	4	79	8
3000	Rubber	69	9	48	3	85	6	202	18
3100	Leather	19	2	7	1	7	2	33	5
3200	Stone, Clay, Glass & Concrete	35	2	94	2	100	12	229	16
3300	Primary Metals	88	12	82	1	135	7	305	20
3400	Fabricated Metals	79	6	59	4	90	8	228	18
3500	Industrial Machinery & Equipment	164	83	167	22	286	21	617	126
3600	Electrical & Electronic Equipment	217	46	148	33	310	18	675	97
3700	Transportation Equipment	80	27	79	4	156	6	315	37
3800	Instruments & Related Products	234	137	94	22	73	4	401	163
	Totals	*1235*	*358*	*1068*	*118*	*1775*	*114*	*4078*	*590*

Table 2
Variables Used to Define Financial Status – Values for Select Industries by Continent

Industry SIC	Financial Status	EBITDA Interest Coverage (00)[3]		EBITDA Interest Coverage (01)		EBIT (00)		EBIT (01)		Net Income before Special Items (00)[4]		Net Income before Special Items (01)	
		Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
US													
2800	NFD	986.21	144.75	1130.42	184.20	784.99	112.58	929.64	154.54	754.35	95.20	921.19	102.57
2800	FD	-23.28	-10.56	-26.89	-14.60	-23.88	-10.96	-27.62	-14.51	-25.34	-10.99	-28.98	-15.16
3500	NFD	391.24	58.07	494.30	85.49	285.93	40.26	393.14	67.13	264.32	30.36	377.36	52.29
3500	FD	-8.43	-3.36	-5.36	-2.89	-12.31	-3.49	-8.03	-3.07	-12.70	-3.77	-7.88	-3.42
3600	NFD	406.21	33.01	489.15	44.80	283.21	23.06	353.61	31.19	318.21	18.79	415.46	29.09
3600	FD	-18.88	-5.38	-16.16	-6.41	-23.21	-6.36	-19.56	-6.87	-24.70	-7.11	-20.42	-7.71
Europe													
2800	NFD	862.81	90.50	1019.17	85.90	763.04	55.20	1447.45	436.80	581.90	48.54	756.61	52.02
2800	FD	-53.68	-15.95	-50.59	-11.92	-54.16	-14.11	-55.14	-15.10	-65.94	-14.71	-56.35	-11.98
3500	NFD	309.87	32.59	373.57	43.85	283.94	36.28	572.03	54.64	190.24	18.96	266.02	26.16
3500	FD	-27.17	-13.85	-26.57	-10.09	-27.77	-11.75	-37.88	-35.01	-28.53	-14.86	-27.76	-12.66
3600	NFD	336.85	32.05	351.76	34.52	246.05	24.02	340.59	27.85	222.05	17.99	248.35	23.68
3600	FD	-31.07	-14.05	-18.96	-8.51	-24.41	-9.89	-16.11	-6.32	-40.71	-19.61	-26.97	-10.12
Asia													
2800	NFD	203.68	24.94	346.33	27.66	155.74	16.44	289.62	19.67	179.97	13.74	343.15	14.88
2800	FD	-64.00	-15.32	-80.73	-11.67	-65.50	-9.69	-76.90	-13.77	-82.27	-13.85	-159.13	-12.58
3500	NFD	408.49	9.12	507.74	12.22	322.80	7.17	392.07	9.08	386.23	6.24	424.16	7.87
3500	FD	-37.77	-2.80	-53.87	-3.68	-36.18	-3.51	-52.06	-3.97	-63.96	-3.23	-67.59	-4.31
3600	NFD	909.13	21.23	1256.42	23.18	445.39	14.24	722.10	17.12	443.61	12.58	736.53	13.46
3600	FD	-67.60	-5.58	-79.50	-5.65	-169.74	-7.45	-168.85	-6.23	-241.55	-12.55	-228.68	-6.64

[3] EBITDA – Interest expense
[4] Net income + Special items (US); Net income before extraordinary items – Extraordinary items + Special items (Non US)

Table 3
Data and Financial Ratios Employed

Individual Financial Items		Financial Ratios		
Status	Inventories (Inv)	***Profit Margin***	***Liquidity***	***Operating Efficiency***
Net Sales (S)	Inv (-1)	EBITDA/S	CA/CL	COGS/Inv
S (-1)[5]	Current Assets (CA)	NI/S	(CA-Inv)/CL	S/AR
COGS	CA (-1)	CF/S	WC/TA	S/TA
COGS (-1)	Net Fixed Assets (NFA)	***Profitability***	CA/TA	AR/TA
Deprec+Amort (DA)	NFA (-1)	EBITDA/TA	NFA/TA	S/WC
DA (-1)	Total Assets (TA)	NI/TA	***Cash Position***	S/Inv
SGA	TA (-1)	EBIT/TA	Cash/CL	AR/Inv
SGA (-1)	Accounts Payable (AP)	CF/TA	Cash/DA	(AR+Inv)/TA
EBIT	AP (-1)	NI/EQ	Cash/TA	COGS/S
EBIT (-1)	Notes Payable (NP)	***Financial Leverage***	***Growth***	SGA/S
Interest Expense (Int)	NP (-1)	TL/TA	S-Growth %	(COGS+SGA)/S
Int (-1)	Current Liabilities (CL)	CL/TA	NI/TA-Growth %	DA/S
Net Income (NI)	CL (-1)	CL/TL	CF-Growth %	DA/EBIT
NI (-1)	Long-term Debt (LTD)	NP/TA	***Miscellaneous***	S/CA
Cash	LTD (-1)	NP/TL	EBIT/Int	
Cash (-1)	Total Liabilities (TL)	LTD/TA	Int/S	
Accounts Receivable (AR)	TL (-1)	Current LTD/TA	LTD/S	
AR (-1)	Share Equity (EQ)	EQ/TA	CF/Int	
	EQ (-1)	LTD/EQ	CF/TL	
		TD/TA		
Calculated Items				
EBITDA = EBIT + DA				
EBITDA(-1) = EBIT (-1) + DA (-1)				
CF = NI + DA				
WC = CA - CL				

[5] Variable values specified as VARIABLE (-1) were collected in 1998. Otherwise, the variable value was collected in 1999. Thus, growth variables indicate growth rates from 1998 to 1999.

Table 4
Descriptive Statistics across Regions, SIC Code[6] and Status

	US		Europe		Asia	
	NFD[7]	FD	NFD	FD	NFD	FD
CF/Sales						
2800	0.087	-0.954	0.118	-6.510	0.097	-0.674
3500	0.063	-1.856	0.083	-4.444	0.068	-0.297
3600	0.192	-0.433	0.104	-2.001	0.103	-0.266
EBITDA/TA						
2800	0.120	-0.448	0.138	-0.372	0.109	-0.075
3500	0.116	-0.828	0.126	-0.100	0.086	-0.026
3600	0.132	-0.696	0.160	-0.350	0.104	-0.110
TD/TA						
2800	0.324	0.411	0.205	0.165	0.245	0.152
3500	0.240	0.356	0.208	0.196	0.227	0.383
3600	0.235	0.445	0.180	0.172	0.221	0.325

[6] SIC 2800 is the chemicals and allied products industry; SIC 3500 is the industrial machinery and equipment industry; SIC 3600 is the electrical and electronic equipment industry.
[7] NFD indicates companies that are non-financially distressed; FD indicates companies that are financially distressed.

Table 5
Estimated Coefficients for the Global Model
Dependent Variable is Categorical (1 if financially distressed and 0 otherwise)

Variables	**Estimated Coefficient**	***p*-value (two-tail)**
CF/Sales	-0.141	.001**
EBITDA/TA	-2.129	.000**
CA/CL	0.390	.000**
Sales/WC	-0.022	.028*
DA/EBIT	0.004	.447
NP/TA	0.043	.042*
TD/TA	0.471	.000**
Constant	-2.440	.000**

Nagelkerke R^2 = .702
* Significant beyond the .05 level of significance
** Significant beyond the .01 level of significance

Where:
CF/Sales = Net Cash Flow/Sales
EBITDA/TA = Earnings before interest, taxes, depreciation and amoritization/Total Assets
CA/CL = Current Assets/Current Liabilities
Sales/WC = Sales/Working Capital
DA/EBIT = Depreciation and amortization/EBIT
NP/TA = Notes Payable/Total Assets
TD/TA = Total Debt/Total Assets

Classification Results

Group Classified	**Percent Classified Correctly**
Non-financially distressed companies	96.4%
Financially Distressed companies	82.1%
All companies	94.5%

Table 6
Comparison of the Global Model (Model 1) to the
Global Model with Regional Indicators (Model 2)

	Global Model Model 1		**Global Model with Regional Indicators Model 2**	
Variable	**Estimated Coefficient**	**p-value**	**Estimated Coefficient**	**p-value**
CF/Sales	-0.141	.001***	-0.096	.012**
EBITDA/TA	-2.129	.000***	-1.992	.000***
CA/CL	0.390	.000***	0.273	.013**
Sales/WC	-0.022	.028**	-0.003	.860
DA/EBIT	0.004	.447	-0.018	.061*
NP/TA	0.043	.042**	0.031	.173
TD/TA	0.471	.000***	0.402	.002***
Dummy Europe (E)			-0.481	.414
Dummy Asia (A)			-0.571	.255
CF/Sales E			-0.636	.007***
EBITDA/TA E			0.670	.081*
CA/CL E			0.633	.027**
Sales/WC E			-0.211	.027**
DA/EBIT E			0.059	.001***
NP/TA E			0.321	.050**
TD/TA E			-0.387	.244
CF/Sales A			-0.105	.363
EBITDA/TA A			-0.396	.265
CA/CL A			0.170	.462
Sales/WC A			-0.035	.196
DA/EBIT A			0.010	.543
NP/TA A			-0.003	.983
TD/TA A			0.257	.324
Constant	-2.440	.000***	-2.245	.000***
Nagelkerke R^2		.702		.716

* Significant beyond the .10 level of significance
** Significant beyond the .05 level of significance
*** Significant beyond the .01 level of significance

Table 7
Estimated Coefficients for Asia, Europe, and U.S. Models^

Variables	**US**	**Europe**	**Asia**
CF/Sales	-0.128***	-1.090**	-0.714***
EBITDA/TA	-2.484***	-3.974***	-2.256***
Debt/TA	0.123*** (Current LTD/TA)	0.632** (NP/TA)	0.634* (TD/TA)
Interest Coverage Before Tax	-0.084		
Liquidity Ratio	0.269** ([CA-Inv]/CL)	1.820*** (CA/CL)	
Sales Turnover		-0.356* (S/WC)	-1.918** (S/TA)
DA/EBIT		0.068***	-0.338***
% Change in Sales		-0.964***	
% Change in Cash Flow		-0.082***	-0.010#
Japan Dummy			1.002
Singapore Dummy			2.384**
Japan x EBITDATA			-9.138***
Constant	-4.298***	-4.436***	-2.566***
Nagelkerke R^2	0.726	0.689	0.565

^Coefficients are scaled. All estimated coefficients are the property of BBK, Ltd.
Dependent Variable is Categorical (1 if financially distressed and 0 otherwise)
* Significant beyond the .10 level of significance, two-tailed.
** Significant beyond the .05 level of significance, two-tailed.
*** Significant beyond the .01 level of significance, two-tailed.
\# Significant beyond the .10 level of significance, one-tailed.

Table 8
Classification Accuracy in Asia, Europe, and U.S. Models

Group Classified	**US**	**Europe**	**Asia**
Non-financially distressed Companies	94.8% n = 1,127	97.0% n = 908	95.4% n = 1,056
Financially Distressed Companies	87.0% n = 276	81.2% n = 101	81.3% n = 80
All Companies	93.2% n = 1,403	95.4% n = 1,009	94.4% n = 1,136

Table 9
Comparing Model Predictions Using Data from Other Regions

Model	Source of Data	Accuracy of Financial Distress Classification	Accuracy of Non-financially distressed Classification
Asian	Europe	60%	100%
Asian	U.S.	100%	80%
European	Asia	50%	100%
European	U.S.	80%	80%
U.S.	Asia	10%	100%
U.S.	Europe	60%	100%