Macroeconomic variables in financial distress: A non parametric method

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Abstract. A number of authors suggested that the impact of the macroeconomic factors on the incidence of the financial distress, and afterward in case of failure of companies. However, macroeconomic factors rarely, if ever, appear as variables in predictive models that seek to identify distress and failure; modellers generally suggest that the impact of macroeconomic factors has already been taken into account by financial ratio variables. This article presents a systematic study of this domain, by examining the link between the failure of companies and macroeconomic factors for the French companies to identify the most important variables and to estimate their utility in a predictive context. The results of the study suggest that several macroeconomic variables are strictly associated to the failure, and have a predictive value by specifying the relation between the financial distress and the failure.

Keywords: financial distress, macroeconomic variable, partial least squares (PLS)

JEL classification: E20, G33, C14

1 Introduction

Since the crisis of the 1930 and the early work of writers such as Fitzpatrick (1932) the problem of failure has become a field of investigation of research in its own right. According to Franks and Sussman (2005), a firm is defined as being in distress once the local branch or regional credit manager decides to transfer a status report to the monitoring unit of economic enterprises or responsible financial diagnosis. Such decisions may occur, especially for SMEs, in the case of violations of certain terms (non-payment of interest exceeding the overdraft limit ...), or following a poor assessment of the future of the firm by directors of credit (by reference to
indicators such as high debt and low profitability), this article suggests analyzing the role of the macroeconomic variables in the financial distress of the French companies.

2 Financial distress

Logic suggests that the major factor affecting company failure rate would be the overall economic circumstances within which companies are operating. On the macroeconomic level, there are a link between bankruptcy and crisis cycle.

Previous studies have showed clearly that macroeconomic aggregates can be used to explain business failure. Altman (2006) assumes that macroeconomic conditions may intervene in any important way, in the phenomenon of failure. Altman (1983) argues that the failure rate increases during recessions and decreases during periods of expansion. In the same context, Sung et al (1999) examined the characteristics of these periods (recession and expansion) and the possibility of their use for the explanation of corporate failures recorded on the basis of a sample of firm Korean industrial. EL Hennawy and Morris (1983) had deduced that all companies are vulnerable to a greater or lesser degree at different stages in economic cycles and that companies operating in different industries are more at risk at particular points.

Bunn and Redwood (2003) use probabilistic models in which they introduce the monthly growth rate of industrial production as an indicator of economic conditions. They found that the company is bound to fail during periods of recession in the economic cycle. Altman (2006) argues that when the number of start-ups increases, bankruptcies are increasing too. Koeing (1985) showed that 50% of bankruptcies are the result of business with fewer than five years of age. Dunne et al (1989) lead to the conclusion that activities with the entry rate highest are also those rates out stronger. Agrawal and Taffler (2003) and Bunn( 2003), Koopman and Lucas (2003) have demonstrated a strong during co-cyclicality between credit and default cycles and Gross Domestic product(GPD) at frequencies of six years and a significant co-cyclicality between GPD and business failure over a frequency of eleven years. Malecot (1981) shows that the relationship between economic conditions and the business market failure is usually based on a tightening of banking, the credit crunch or rising interest rates.
Altman (1983) finds that firms rarely marginal state, their failure as the loans are available to him. The measures have been chosen to reflect the conditions of credit and liquidity in the money supply, reserves and interest rates. Therefore, increasing the interest rate is rarely tolerated by businesses, especially the most vulnerable. Sharabany (2004) argues that the evolution of exchange rates and credit policy has an effect on business failure. In France, Malécot (1991) believes that the bankruptcy resulted from a series of competitive forces that compel the company to adopt a standard production compatible with them. And therefore the problem of bankruptcy is related to the concept of marginal enterprise: Enterprises that are unable to sell enough to cover their costs are bound to make losses, and then disappear.

3 Methodology

3.1 PLS regression

PLS united diverse regression is a nonlinear model between a single dependent variable Y to a set of independent variables quantitative or qualitative $X_1... X_k$ (Wold 1983). It can be achieved by following simple and multiple regressions. By exploiting the statistical tests associated with linear regression, it is possible to select the significant explanatory variables to keep in the PLS regression and to choose the number of PLS components to retain.

There are several versions of the algorithm of univariate regression PLS1. They differ at the level of the normalizations (standardizations) and the intermediate calculations, but they give quite the same regression. According to Bastien, Esposito and Tenenhaus (2005). The algorithm can be decomposed as follows:

We construct first a component PLS $t_1$:

$$ t_1 = w_{11} X_1 + ... + w_{1k} X_k $$

where:
\[
    w_{ij} = \frac{\text{cov}(Y, X_j)}{\sqrt{\sum_{j=1}^{k} \text{cov}(Y, X_j)^2}}
\]

These coefficients are then normalized:

\[
    w_{ij}^* = \frac{w_{ij}}{\sqrt{\sum_{j=1}^{k} (w_{ij})^2}}
\]

Then we perform a simple regression of \( Y \) on \( t_1 \):

\[
    \hat{Y} = c_i t_i + Y_i
\]

where are the regression coefficient and the vector \( Y_1 \) residue. Hence a first regression equation:

\[
    \hat{Y} = c_1 w_{11} X_1 + \ldots + c_i w_{ik} X_k + Y_i
\]

whose coefficients are easily interpretable.

However if one considers that the explanatory power of this model is low, it seeks a second component, a linear combination of \( X_j \), unlinked and explaining to the residue \( Y_1 \).

This component is a linear combination of residuals of regression variables \( X_j \) on the component:

\[
    \text{With: } x_{ij} = X_j - p_{ij} t_i
\]

and

\[
    p_{ij} = \frac{\text{cov}(X_j, t_i)}{\text{var}(t_i)}
\]

Then obtained \( t_2 \):

\[
    t_2 = w_{21} x_{11} + \ldots + w_{2k} x_{1k}
\]
where:

\[ w_{2j} = \frac{\text{cov}(x_{ij}, Y_i)}{\sqrt{\sum_{j=1}^{k} \text{cov}^2(x_{ij}, Y_i)}} \]

This is followed by a multiple regression of \( Y \) on \( t_1, t_2 \):

\[ \hat{Y} = c_1 t_1 + c_2 t_2 + Y_2 \]

Where \( c_1 \) and \( c_2 \) are the regression coefficients \( Y_2 \) and the vector of residuals.

\( \hat{Y} \) written as a function of variables by replacing components \( t_1 \) and \( t_2 \) by their values based on \( X_j \):

\[ \hat{Y} = c_1 \sum_{j=1}^{k} w_{1j} X_j + c_2 \sum_{j=1}^{k} w_{2j} (X_j - p_{ij} \sum_{j=1}^{k} w_{1j} X_j) \]

We can iterate this process using the same manner the residues \( Y_2, X_{21}, \ldots, X_{2k} \) regressions of \( Y, X_1, \ldots, X_k \) on \( t_1, t_2 \).

The number of components to retain is usually determined by cross validation.

For each value \( h \), we compute predictions of the variable interest \( Y \). Specifically we calculate the prediction \( \hat{Y}_h \) of \( Y_i \) using all individuals and \( \hat{Y}_{h(-i)} \) without using individual “i”. Then we calculate the criteria \( \text{RSS}_h \) (Residual Sum of Squares) and \( \text{PRESS}_h \) (Prediction Error Sum of Squares) defined by:

\[ \text{RSS}_h = \sum_{i=1}^{n} (Y_i - \hat{Y}_h)^2 \]

and

\[ \text{PRESS}_h = \sum_{i=1}^{n} (Y_i - \hat{Y}_{h(-i)})^2 \]
According Umetri (1996) the component $t_h$ will be withheld if:

$$\sqrt{PRESS_h} \leq 0.95 \leq \sqrt{RSS_{h-1}}$$

3.2 Data

We try to explain the monthly number of failures of the French companies (NF) by a set of the explanatory variables stemming from the financial literature. For this, the theoretical choice of variables will be based on the work of: Altman (1984), Graves and Smith (2002), Liu and Smith (2007).

The variables chosen for our analysis are summarized as follows: The number of creation of the new companies (NCE), consumer prices index (IPC), Industrial Product Price Index (IPPI), M2 money supply, Producer Price Index (PPI). The research results are based on data from the National Institute of Statistics (INSEE) over the period 1999-2008.

3.3 Results of Univariate and multivariate regression

The results of univariate regression are presented in the following table:

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>Adjusted R square</th>
<th>Coefficient</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCE</td>
<td>0.947</td>
<td>0.158</td>
<td>0.000</td>
</tr>
<tr>
<td>IPI</td>
<td>0.952</td>
<td>34.576</td>
<td>0.000</td>
</tr>
<tr>
<td>IPC</td>
<td>0.956</td>
<td>36.339</td>
<td>0.000</td>
</tr>
<tr>
<td>M2</td>
<td>0.881</td>
<td>416.104</td>
<td>0.000</td>
</tr>
<tr>
<td>PPI</td>
<td>0.958</td>
<td>33.532</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Table 1: Results of univariate regression
This table shows that all variables are significant with 5% risk with a high regression coefficient for M2 variable.

To explain the evolution of the number of bankruptcy (NF), we introduce all variables in the analysis:

\[ NF = \beta_1 NCE + \beta_2 IPI + \beta_3 IPC + \beta_4 M2 + \beta_5 PPI + \epsilon \]

The results found are summarized in the following table:

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>Coefficient</th>
<th>Statistics t</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNE</td>
<td>0,055</td>
<td>2,762</td>
<td>0,007</td>
</tr>
<tr>
<td>IPI</td>
<td>1,007</td>
<td>0,144</td>
<td>0,886</td>
</tr>
<tr>
<td>IPC</td>
<td>15,813</td>
<td>0,557</td>
<td>0,578</td>
</tr>
<tr>
<td>M2</td>
<td>-31,150</td>
<td>-0,932</td>
<td>0,353</td>
</tr>
<tr>
<td>PPI</td>
<td>6,842</td>
<td>0,232</td>
<td>0,817</td>
</tr>
</tbody>
</table>

**Table 2:** Results of multivariate regression

In the multivariate model, only the consumer prices index is significant with 5% risk. The Adjusted R Square is around 95.7%; hence our explanatory variables are adequate to explain the number of bankruptcy. Other variables are declared not significant at the risk of 5%, in spite of are him when they are separately taken, this problem is due to the strong correlation between all variables, and the same signs of regression coefficients are inconsistent with the work of Altman (1984). Hence the interest of the PLS1 regression that links the variable to explain to all variables.

### 3.4 Results of PLS regression

Having identified one component by cross validation, our new regression equation is:

\[ NF = 0,124NCE + 0,044IPI + 0,093IPC + 0,066M2 + 0,0874PPI \]
The regression coefficient of variable creation of new enterprises is positive, that’s mean that more new Companies, more there are bankruptcies. The results found confirm the work of Altman (1983) even if we did not use the same transformations or the same number of observations than the latter. We can confirm this result we appeal to the method of Wold (1983), which uses the VIP (Variable Importance for Projection variable) to measure the contribution of every variable to the process of the failure, with a minimum important threshold equal to 0.8.

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>Factor 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNE</td>
<td>1,4259</td>
</tr>
<tr>
<td>IPC</td>
<td>1,0671</td>
</tr>
<tr>
<td>PPI</td>
<td>0,9979</td>
</tr>
<tr>
<td>M2</td>
<td>0,7541</td>
</tr>
<tr>
<td>IPI</td>
<td>0,5132</td>
</tr>
</tbody>
</table>

Table 3: Variable importance in projection

We can conclude that the number of creation of the new companies to the largest impact on business failure, say the work of Altman (1984, 2006) that established a systematic correlation between bankruptcy and economic crisis. Similarly the variable IPC ranks second in the process of financial distress. The index of producer prices (PPI) occurs at the third position as an indicator of economic growth and general health of the economy, joining studies of Tirapat and Nittayagasetwat (1999), Bunn and Redwood (2003). These authors use probabilistic models in which they introduce the monthly growth rate of industrial production as an indicator of economic conditions. They found that the company is closely linked to the failure during periods of recession in the economic cycle: the current financial crisis, as noted Malecot (1991).

4 Summary

In the term of this work, the phenomenon of failure of companies can be explained by several macroeconomic factors. However, these factors must be handled with caution, because the effects of the macroeconomic factors do not show themselves on all the companies. Indeed,
when the situation is favorable, we always find in the same business sector of the companies which remain successful and the others who declare their cessation of payments; in this domain, there is no fate.

The failure should so be, rather, considered the resultant of outside data and the behavior of the firm. These macroeconomic factors are not thus, often decisive in the phenomenon of failure of companies. They must be considered, rather, as catalysts. They are not only enough, to make the company precipitate towards the ruin when she is managed well. Everything depends, internal and specific factors to every company.

5 References


