Comparing logit model with discriminant analysis for predicting bankruptcy in Portuguese hospitality sector

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Abstract

Portugal's tourism sector is on permanent expansion and contributes significantly to the Portuguese economy. However, it has been facing the problem of business failure. The main goal of this paper is to develop an econometric and a multivariate model for forecasting business failure in the hospitality industry using logit and discriminant analysis. The present paper does not explore the causes of business failure but rather aims to propose a model that may help anticipate failure, so that decision makers can minimize the negative effects of this phenomenon. The results confirm that the models for forecasting business failure contribute positively to setting macroeconomic policies and tourism development support programs and are relevant for investors, stockholders, and decision makers.

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Introduction

In the last three years, Portugal has been assisted financially by the European Central Bank, European Commission, and International Monetary Fund. Currently, Portugal still faces a serious economic and financial crisis, with a public debt that is around 130% of the country's gross domestic product (GDP).

Similar to exports, the tourism industry is frequently held up as a strategic alternative for

sustained development because the tourism industry is believed to bring "economic, environmental, social and cultural benefits through its support of job creation, improvements to infrastructures and cultural understanding" (Martínez & Bosque, 2013, p. 5). Moreover, even in a context of crisis, Portuguese tourism has experienced very interesting growth rates. The subsector of hospitality stands out given its economic importance and its influence on the value

chain. In 2010, the tourism sector contributed about 9.2% to the GDP (Turismo de Portugal, 2015). Unfortunately, a lot of “bad end stories” also exist for Portuguese businesses in the hospitality subsector. One general explanation is the “purifying effect” of crisis (Antonová & Zapletalová, 2014, p. 15).

The main goal of this paper is to develop an econometric and a multivariate model for forecasting business failure in the hospitality industry using logit and discriminant analysis. The present paper does not explore the causes of business failure but rather aims to propose a model that may help anticipate failure so that decision makers can minimize the negative effects of this phenomenon.

Research background

The economic and social importance of small businesses to the economy is widely recognized (Altman & Sabato, 2007; Ayranci, 2014; Shaw, 2014). Their impact on employment rates, social unity, and economic growth are acknowledged by all political ideologies. Therefore, the more entrepreneurship in a society, the more social and economic development expected for this society. However, statistics on entrepreneurship failure are quite disappointing for those who take the risk (Olaison & Sorensen, 2014). On the other hand, there is no theoretical answer to the question: “Why do some businesses succeed and others fail?” (Lussier & Halabi, 2010, p. 360). Yet, the relevance of this question is quite obvious; the better we understand business failure, the easier it is to prevent it. The literature recognizes the financial crisis as an important risk element for businesses in addition to internal and sectoral factors (Kutukiz, Öncü, & Akcan, 2012). Since the second half of 2008, the global economy has become embroiled in one of the worst recessions in decades. Thus, the economic expectations are quite reserved.

In Portugal, small enterprises represent 96% of all enterprises. Most of them face high operational and financial risk (Tseng & Lin, 2005) and have not managed well enough to reverse the national financial crisis. The Portuguese geographic location and climate, together with other distinguishing character-

istics like cultural resources, environmental sustainability, tourist infrastructure, safety, and residents’ attitude toward tourists, make Portugal a highly competitive tourist destination. Indeed, the strategic role of tourism in the Portuguese economy has been recognized by policy makers who have devoted to this sector significant domestic and European Union (EU) financial funds. The prediction of bankruptcy for financial firms has been extensively researched since the late 1960s (Altman, 1968). To overcome the limitations of Altman’s initial model, stronger methodologies have been tried (Balcaen and Ooghe, 2006; Bellovary, Giacomino, and Akers, 2007)

Material and methodology

In the present paper, and as the response variable is dichotomous (binary), two statistical models were applied and compared: the logit model, which is a generalized linear model with binomial response, and having as link function the natural logarithm of the odds that the dependent variable equals one of the categories, and the linear discriminant analysis.

Mathematically, the logit model for p predictors, estimates a regression function defined as the probability

$$P(Y = 1) = \frac{1}{1 + \exp(-X \cdot B)}$$

and the Fisher linear discriminant function estimates the discriminant score as a linear combination of the predictors plus a constant,

$$D = X \cdot B$$

where $X = [1, x_1, x_2, \dots, x_p]$ is the vector of the p predictors plus one (to accommodate the constant term), and $B = [\beta_0, \beta_1, \dots, \beta_p]^T$ is the vector of the $p + 1$ coefficients to be estimated.

The data set used in this study was obtained from the SABI database - Iberian Balance Sheet Analysis System (2013), which includes a sample for the hospitality sector comprising

67 Portuguese business failures and 230 Portuguese companies not failed in the hospitality sector for 2009-2013. This sample was later subdivided into two other samples, a test sample, comprising 49 randomly selected business failures and 195 non-failures, and another validation sample with the remaining companies.

In the present paper, bankrupt hotels were defined as those meeting one of the following conditions: insolvency proceedings have occurred or the courts have declared as such or the firm was merged or acquired by a third company as part of bankruptcy proceedings. The variable selection was performed drawing on economic and financial ratios and based on incremental use and significance level obtained in several published studies on this subject. The 30 selected ratios were calculated based on information from the balance sheet and income statement.

Results and discussion

Table 1 shows the discriminant function coefficients from the linear discriminant analysis.

As shown in table 1, the discriminant function emphasizes firm's financial performance, both short- and long-term liquidity ratios. However, economic performance of the firm, measured through the ratio "Operating profit/Operating costs", is also one discriminant variables.

The higher the z-score for a particular company, the less risk of failure. The test

sample achieved a 99% level of overall accuracy, and type II error (healthy company considered failed) equal to 0%. Type I error was 4%. To classify each company of the various samples, we used a cut-off value of zero. In the validation sample, the overall accuracy remained high (96%). Type I error was 6% and type II error was 3%.

Applying the model to the overall sample, to the second and third years before failure, type II error remained low and type I error increased significantly (37% for the second and 40% for the third year). The estimation of logit relied on a stepwise forward Wald procedure. Two explanatory variables were included (Operating profit/Operating costs and Working capital/Total assets) (Table 2).

As exhibited in table 2, logistic model highlights indicators of economic performance of the firm. Like discriminant function, "Operating profit/Operating costs" is the most important variable of the model. The model has a high percentage of correct classifications in the sample test (0.5% type II error, 8% type I error, and 99% overall accuracy). The validation sample shows a type II error increase to 3% and a decrease in type I error to 6%.

Similar to the discriminant analysis, the logit model also shows a decrease in predictive capability as one moves away from the year the model was estimated. The overall accuracy was equal in the second and third years prior to failure (87%). Type I error was lower than the one obtained with discriminant analysis (34% in

Table 1. Coefficients B of the variables in the linear discriminant function

Variables	Coefficients
(constant)	-4,611
Current assets/Short-term liabilities	0,234
Cash/Current liabilities	0,953
Cash flow/Total liabilities	3,385
Operating profit/Operating costs	4,686

Table 2. Coefficients B of the variables in the logistic model

Variables	Coefficients	P-Value
Operating profit/Operating costs	12.821	< 0.001
Working capital/Total assets	-2.630	0.006
(constant)	-13.086	< 0.001

the second and 36% in the third year). Type II error was 6.5% in both years, a value higher than the error from discriminant analysis (3% and 4%, respectively).

The results obtained by both models were superior to those achieved by Pacheco (2015) for the same sector. But, although the results show that the two models are equally effective in predicting restaurant bankruptcy, like Kim and Gu (2006), we consider the logit model is preferred for hospitality bankruptcy prediction because of its theoretical soundness. Even though the reliability of data determines the quality and usefulness of the models, at this time one cannot avoid bias. Indeed, the manipulation of accounting data is a serious problem (Johnson *et al.*, 2000; Jones, 2011). The existence of audited accounts and the content of reports are qualitative variables that should be incorporated in future research.

Conclusions

The problem of business failure has several dimensions. Its causes are diverse and interactive. Naturally, we cannot reduce the socio-economic reality of an organization to a set of quantitative indicators. Nevertheless, these indicators, when based on reliable data, have significant informative power in the probable evolution of the organization.

The good performance of both discriminant analysis and logit, 96% accuracy in enterprise classification and type II error of 3% in both cases, indicates a high degree of compatibility between the model and the data, as well as its future utility with databases containing more representative data for the entire tourism sector. It is interesting to note that, in the context of European Structural Funds, the Tourism is the only economic sector in which *working capital* (one of the variables identified by logit as being determinant for business success) is eligible for funding. This shows how important this kind of research can be helpful. Indeed, "if we can understand why entrepreneurs fail, we might be able to increase the success/failure ratio" (Olaison & Sorensen, 2014, p. 196). So, policy makers involved in setting macroeconomic policy and tourism development support programs, as well as

investors in this area, can benefit from research in this field.

In future research, it would be interesting to replicate Lussier and Halabi's (2010) survey, not only because it considers diversified types of variables but also because it would allow us to compare Portuguese companies with other companies operating in different international economies.

References

- Altman, E. & Sabato, G. (2007). Modelling Credit Risk for SMEs: Evidence from the U.S. Market. *ABACUS*, 43 (3).
- Altman, E. I. (1968). Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy. *The Journal of Finance* 23(4), 589-609.
- Antonová, B., & Zapletalová, S. (2014). The economic crisis and company management: influences and consequences. *E&M Economics and Management* 1(17), 1-17.
- Ayranci, E. (2014). A study on the influence of family on family businesses and its relationship to satisfaction with financial performance. *E&M Economics and Management* 2(17), 87-105.
- Balcaen, S. & Ooghe, H. (2006). 35 years of studies on business failure: an overview of the classic statistical methodologies and their related problems, *The British Accounting Review* 38 (1) 63–93.
- Bellovary, J., Giacomino, D., & Akers, M. (2007). A Review of Bankruptcy Prediction Studies: 1930 to Present. *Journal of Financial Education* 33, 1-42.
- Johnson, S., Boone, P., Breach, A. & Friedman, E. (2000). Corporate governance in the Asian financial crisis. *Journal of Financial Economics* 58(1), 141-186.
- Jones, M. (2011). *Creative Accounting, Fraud and International Accounting Scandals*. West Sussex: John Wiley & Sons.
- Kim, H., & Gu, Z. (2006). Predicting restaurant bankruptcy: A logit model in comparison with a discriminant model. *Journal of Hospitality & Tourism Research*, 30(4), 474-49
- Kutukiz, D., Öncü, M. & Akcan, A. (2012). Changes on capital structure of the firms on the occasion crisis and situation of tourism companies traded on ISE. *Tourismos: an*

- international multidisciplinary journal of tourism* 7(2), 429-443.
- Lussier, R., & Halabi, C. (2010). A Three-Country Comparison of the Business Success versus Failure Prediction Model. *Journal of Small Business Management* 48(3), 360–377.
- Martínez, P., & Bosque, I. (2013). Perspectives and practices of CRS in the Hospitality industry: analyzing a case study. *Tourismos: an international multidisciplinary journal of tourism* 8(2), 1-19.
- Olaison, L., & Sørensen, B. (2014). The abject of entrepreneurship: failure, fiasco, fraud. *International Journal of Entrepreneurial Behaviour & Research* 20(2), 193-211.
- Pacheco, L. (2015). SMEs probability of default: the case of the hospitality sector. *Tourism & Management Studies* 11(1), 153-150.
- SABI (2013). *Base de Dados*. Bureau Van Dijk, Lisboa.
- Shaw, G. (2014). Entrepreneurial Cultures and Small Business Enterprises in Tourism. In Lew, A.A., C.M. Hall, A.M. Williams (ed). (2014). *The Wiley Blackwell Companion to Tourism* Wiley: London, 120-131.
- Tseng, F.M., & Lin, L. (2005). A quadratic interval logit model for forecasting bankruptcy. *Omega* 33, 85–91.
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