



**The equity-holder abandonment option
A comparison between voluntary and involuntary
bankruptcy petitions**

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Biographical Note

João Soares was born on June 21, 1985, in Penafiel, Portugal. He earned his Bachelor's degree in Business Management from the Faculty of Economics and Business Management at the University Lusíada of Porto in 2007. On September 2007, he started to work on a financial department in a national construction company. In September 2008, he enrolled as a graduate in the Masters in Finance at the School of Economics and Management, at the University of Porto (FEP-UP) having finished the curricular part of his Master's degree. In March 2010 he started to work as a Junior Relationship Manager in a multinational bank. In May 2015 he started to work on a financial department in a national IT company. In the summer of 2015 he decided to go back to University of Porto to finish his Master's degree, starting again in September of the same year.

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Abstract

This study aims to compare the equity-holder's abandonment option from companies that voluntarily initiated bankruptcy proceedings with the equity-holders abandonment option from companies that involuntarily initiated the bankruptcy proceedings. The firm exit under the form of bankruptcy is usually referred in literature as a decision of the creditors or as a result of the threat of creditors. Using a sample of Portuguese privately held companies in bankruptcy process and, under the same assumptions for all companies, we have compared the abandonment option value and the time of its exercise between the two groups of companies under analysis. An empirical example is presented. The file for bankruptcy, either made by equity or debtholders, is an option exercise, is a trade-off on the firm value, which can worth more dead than alive. Supported by previous studies, e.g. Berger et al. (1996), Barth et al. (1998), on the abandonment option and the explanatory power of book values, we can conclude in this study that there is not a significant difference in the option value and at the time of its exercise between the two groups. When are the equity-holders to exercise the option to start the bankruptcy process, the companies worth more and are bigger than when are the debtholders to initiate the bankruptcy process. Evidence suggests that when the equity-holders exercise the abandonment option, this is more out of the money when compared to the equity-holders abandonment option of companies that involuntarily initiated the bankruptcy process. However we only obtained statistical significance on some cases, so the results are not conclusive.

Key-words: Insolvency, Bankruptcy, Financial distress, Abandonment option.

JEL Codes: G33, G32.

Resumo

Este estudo tem como objetivo comparar a opção de abandono dos detentores do capital próprio de empresas que iniciaram voluntariamente o processo de insolvência com a opção de abandono dos detentores do capital próprio de empresas que iniciaram involuntariamente o processo de insolvência. A entrada de uma empresa no processo de insolvência é habitualmente referida na literatura como uma decisão dos credores ou como resultado da ameaça dos credores. Utilizando uma amostra de empresas portuguesas não cotadas em processo de insolvência e, sob os mesmos pressupostos, comparamos o valor da opção de abandono e o momento do seu exercício entre os dois grupos de empresas em análise. É apresentado um exemplo empírico. O pedido de insolvência, feito pelos detentores do capital próprio ou pelos credores, é análogo ao exercício de uma opção, é uma escolha sobre o valor da empresa, que pode “*valer mais morta que viva*”. Suportados por estudos anteriores, por exemplo Berger et al. (1996), Barth et al. (1998), sobre a opção de abandono e o poder explanatório dos valores do balanço, podemos concluir que neste estudo não existe uma diferença significativa no valor da opção e no momento do seu exercício. Quando são os detentores do capital próprio a exercer a opção de iniciar o processo de insolvência, a empresa é mais valiosa e maior do que quando são os credores a iniciar o processo de insolvência. A evidência sugere que quando os detentores de capital próprio exercem a opção de abandono, esta está mais *out-of-the-money* quando comparada com a opção de abandono dos detentores do capital próprio das empresas que entram involuntariamente no processo de insolvência, mas apenas obtivemos significância estatística em alguns casos, pelo que os resultados não são conclusivos.

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Acronyms

CAPM – Capital Asset Pricing Model

CCF – Capital Cash Flows

CIRE – (Código de Insolvência e Recuperação de Empresas) is the Portuguese insolvency and corporate recovery code.

INE – Instituto Nacional de Estatística

NACE – (Nomenclature statistique des activités économiques dans la Communauté européenne) is the statistical classification of economic activities in the European Community.

PVCF – Present Value of Cash Flows

SMEs – Small and medium-sized enterprises

1. Introduction

Most of the existing studies are focused on public firms and on other economies than the Portuguese, due to the limitations the Portuguese market and private firm's approaches represent. However, we considered that these limitations cannot be the reason not to try to develop a study with this reality. The vast majority of firms in Portugal are privately held corporations and its importance to the economy should not be underestimated. Thus, private firms are an important, but often neglected, part of the economy (Cooper and Priestley (2016)). The business reality in Portugal is mainly the family, small and medium sized enterprises (SME's). In Portugal, as in other countries, SME's represent more than 90% of total enterprises (Cull et al. (2006), Gunasekaran et al. (2011)). According to Muller et al. (2015) on the Annual Report on European SMEs 2014/2015, relating to 2014, the share of SMEs in the total enterprise population is about 99,9% in Portugal, being responsible for 80,5% of employment in non-financial sector and has a contribution of 57,1% to turnover (INE (2016)). As the authors refer, "*SMEs are the backbone of the European economy*".

In the aftermath of the global financial crisis, the recent years have been economically and socially challenging in Portugal, with firms in financial and/or economic distress, and with insolvent firms being liquidated. According to IGNIOS (2016)¹, with data accumulated until June 2016, in 2016 alone, 2.209 entities declared insolvency, in which 942 were debtholders petitions and 1015 were equity-holders petitions. The corporate failure has substantial economic and social costs with investors, creditors, management, and employees being significantly affected by business failure (Charitou et al. (2007)).

Under the Portuguese law, the insolvency process is a procedure that aims the creditor's payment, based on company recovery or on company liquidation if this is the most appropriate option. To start these proceedings, it has to be shown that the debtor is unable to meet their liabilities as they fall due or, where legal people and autonomous groups of assets are concerned, that liabilities are clearly higher than the assets. The bankruptcy

¹ The document "*Observatório – Negócios, Insolvências, Créditos Vencidos, Constituições – junho 2016*" is a monthly report done by the institution IGNIOS – Gestão Integrada de Risco S.A., which is a company specialized on business information.

petition should be requested by the debtor within thirty days following the acknowledgement of the insolvency situation, but could also be requested by any creditor. The payment to creditors is done after the process' deduction costs. For creditors' payment, there is a directive to obey. The first creditors to be paid are those who have collateral, then, are paid the privileged creditors as the state, the next to be paid, are the common creditors and lastly, the creditors, especially related to the debtor, as family and other persons which have relations with the debtor.²

The main literature on distress-related exit does not distinguish between the voluntary and involuntary bankruptcy petition. Normally, they are treated as one and the bankruptcy is commonly discussed on literature as an involuntary exit. Theory predicts that the equity-holders will not decide for bankruptcy, unless they are forced by debtholders. This is what Bulow and Shoven (1978) refer on their work, assuming that the equity-holders always seek to avoid bankruptcy and that the debtholders are less certain about the value of the firm. Private firms are also likely to be characterized by more asymmetric information, which may lead to different expectations about the value of the firm. Although much literature has treated bankruptcy as a chance event, which occurs either when the value of the equity position is zero or when the firm has a negative net worth, a negative net worth is not a sufficient condition to force a firm into bankruptcy and the authors present cases in which a firm continues operating, even though its liquidation value exceeds its present expected ongoing value and the opposite situation. White (1989) has a different perspective, defending that firms typically file for bankruptcy voluntarily, however, he also considers that firms in bankruptcy might not always be economically inefficient.

In our sample, the bankruptcy process are initiated almost in equal parts both by equity-holders and debtholders. The number of companies that filed voluntarily for bankruptcy and the number of firms that filed involuntarily for bankruptcy is almost the same, about fifty-fifty each side. Assuming that equity-holders have full information about the company situation, which may not happen with the debtholders, under the *CIRE*, always are the equity-holders who initiate the bankruptcy process. Finding that the bankruptcy

² *CIRE* (Código de Insolvência e Recuperação de Empresas) is the Portuguese insolvency and corporate recovery code.

petitions are requested by both equity-holders and debtholders, we can analyze the equity-holders decision as an exercise of an abandonment option. This abandonment option is analogous to an American Put Option. If market conditions decline severely, management can abandon current operations permanently and receive the resale value of capital equipment and other assets in second-hand markets (Trigeorgis (1995)), i.e., when a firm is under financial distress, there is a significant possibility that, at some point, the firm itself should be shut down and its assets put to a better use (Baird and Morrison (2001)). For Vila and Scharj (1995), the basic intuition is that a bankruptcy filing is a rational decision that preserves value for either debt or equity-holders and each part weights the gain from continued operations against the gain from liquidation. The equity and debtholders may have different incentives, and, may not be in agreement on the exit decision, which can lead the debtholders to put the firm in involuntary bankruptcy.

We have identified a number of companies that have historical positive cash-flows and positive book-value of equity among the companies that initiate the bankruptcy process. This event sparked our interest and we wanted to assess if, under the same assumptions, the equity-holders abandonment option and the timing of the option exercise was different between the group of voluntary and involuntary bankruptcies. With a sample of 63 Portuguese private companies that initiated the bankruptcy process, we have tested this hypothesis based on the relation between balance sheet information and the abandonment option value established by Berger et al. (1996). However, our work differs from the authors in two main points: we focus on privately held companies, instead publicly traded companies and we want to compare the results between two distinct groups inside bankruptcy, - group of voluntary and the group of involuntary bankruptcy petitions-, which we consider to be a contribution to the literature.

Considering the exit value as the stochastic strike price and the present value of cash flows as the stochastic value of the underlying asset, after the valuation of the selected companies, i.e., companies with positive historical capital cash flows and positive book value of equity, we determine the option value based on the relation of exit value to PVCF. Using this approach, we can determine the value of the option and the timing of bankruptcy. Assuming the ratio of exit value to PVCF, when its value is equal to one, it

indicates that the salvage value equals the company value as a going concern, i.e., the option is at-the-money; when its value is higher than one, it means that the salvage value is superior to the company value as a going concern and the option is in-the-money; when the ratio has a value lower than one, it means that the option is out of the money. The options holders can abandon the option if the exercise of the options are worthless.

The social and economic importance that SME's represent and the scarce empirical studies using SME's and real options theory motivated us to develop our study. We do not found similar studies using privately held companies and studies that distinguish between voluntary and involuntary bankruptcies.

The remaining chapters of the dissertation are structured as follows: in chapter 2, a literature review of the topic is made, including main theory about voluntary and involuntary bankruptcies, abandonment option theory and explanatory power of book values. In chapter 3 we describe the empirical approach and the methodology to achieve our goal; chapter 4 presents the sample selection and description, as also firm's characteristics. In chapter 5 we present the empirical results. Finally, in chapter 6 we present conclusions.

2. Literature Review

In this chapter we present some literature related to this subject. We analyze the voluntary and involuntary bankruptcy, the relation between the abandonment option theory and the use of book values to value the abandonment option.

The existing studies about firm exit, typically address only three types of firm exits: exit through merger, voluntary liquidation or bankruptcy. This is the approach of Schary (1991), using a sample of 61 firms from a unique activity sector, modeled the probability of exit through the three forms of firm exit. The author has concluded that the information about the characteristics of the firm alone was not enough to predict all forms of exit. Mehran et al. (1998) analyzed 30 voluntary liquidations and found that liquidation decisions are influenced by CEO incentive plans and increase shareholder value. Mata et al. (2010) studied the impact of financial variables in voluntary exit and in bankruptcy; the authors found that in voluntary exits, losses are supported by the equity holders and in bankruptcy, part are supported by debtholders. Balcaen et al. (2012) using a sample of Belgian firms, also considered three types of firm exit to analyze the firm level determinants of firm exit after economic distress. The exit by bankruptcy is the last exit strategy. Some existing studies do not establish a distinction between the two bankruptcy petitions.

While the most of the existing studies on firm exit focuses bankruptcy as a one way act, they do not consider that this procedure could be initiated by creditors or equity-holders. In another work, Vila and Schary (1995) addressed the bankruptcy decision, but this time on a real option perspective and they modeled the decision to liquidate as a put option, considering that the bankruptcy petition is the result of a strategic decision by management, in the case of voluntary bankruptcy, or by creditors, in the case of involuntary bankruptcy.

Evidence from a variety of studies shows that the book value of equity in recent years has been gaining importance on valuation. The role of book value of equity as a proxy for the abandonment options has been referred in several works from various authors.

Burgstahler and Dichev (1997), Berger et al. (1996), Barth et al. (1998) and Collins et al. (1999) defend that the value relevance of book value stems from its role as a proxy for adaption or abandonment value. Berger et al. (1996) investigate whether investors use balance sheet information about a firm's assets to value their option to abandon the ongoing business in exchange for the assets exit value and if the price of the option to abandon a firm at its exit value is supported on the abandonment option theory; they found strong support for the predictions of abandonment option theory. The authors think that the option has value and the information about the exit value of the firm's assets should affect its market value. This paper contributes to the scarce empirical studies about real options. Another important contribution is to the accounting research, because they established an important relationship between the balance sheet and the abandonment option. They focused on the association between balance sheet information and the abandonment option's value. The authors also hypothesize the probability of the abandonment option being exercised as a function of probability of financial distress.

Barth et al. (1998) studied the role of balance sheet. Using a sample of 396 bankrupt firms, founding that in the five years that preceded bankruptcy, the explanatory power of equity value increased and the explanatory power of net income decreased, and when testing a larger sample it was found that the explanatory power of equity book value is higher for firms categorized as being less financially healthy than other firms. The balance sheet increases in importance and the income statement decreases in importance as financial health decreases and for low-efficiency firms, book value is predicted to dominate earnings, while for steady-state firms, earnings are predicted to dominate book value (Zhang (2000)). The authors refer that the economic value of the assets of a firm facing financial difficulty more likely will equal liquidation value because the exercise of the abandonment option is more likely for these firms.

Burgstahler and Dichev (1997) found that when earnings/book value is low, the book value becomes a more important determinant of equity value. Collins et al. (1999) support the idea that book value serve as a proxy for abandonment option for firms with losses most likely to cease operations and liquidate. They argue that for firms with losses that go bankrupt, liquidate or that suffer multiple losses, the primary valuation role of book

value is as a proxy for liquidation or abandonment value. Schnusenberg and Skantz (1998) test the abandonment hypothesis using a sample of poorly performing companies. The authors found that book value increases and earnings decreases in valuation significance as the number of consecutive losses increases, and, as predicted by the abandonment hypothesis, a sufficiently weak earnings history increases the reliance on book value even though bankruptcy or liquidation is not eminent. Lim (2004) analyzed the prediction of the abandonment options, but the results show that the abandonment options hypothesis is only partially supported in UK.

The option to abandon a project in exchange for its salvage value was initially approached by Myers and Majd (1990) that pointed out that if the market conditions decline severely, management can abandon current operations permanently and realize the resale value of capital equipment and other assets in second-hand markets. Dixit and Pindyck (1994), on their real option framework, incorporate the irreversibility, uncertainty and timing on investment decision. The management has the flexibility to make decisions based on the market evolution, and, according to the available information, there is the option to abandoning or continuing the operations. If a project or an operation is poorly performing, management may have a valuable option to abandon the project permanently in exchange for its salvage value at any time.

The management has the right, but not the obligation, to sell the asset at a salvage price, the exercise price and this option can be valued as an American put option on current project value, with exercise price the salvage value (Trigeorgis (1995), Brach (2003)). Smit and Trigeorgis (2004) value this option as an American put option on current project value (V), with exercise price the salvage value (A) as the expanded present value of project that equals the present value of cash flows plus the intrinsic value of the option:

$$\textit{Expanded Present Value} = V + \textit{MAX}[\textit{abandon} (A - V), \textit{continue}] \quad (2.1)$$

The option to abandon the project in exchange for its salvage value, translates into the equity-holders option to choose the maximum of the projects value in its present use or its value in its best alternative use. The basic guideline is that the project is continued

when its value from continuing is larger than the salvage value, and otherwise abandoned. When the ratio of project value to salvage value is larger than 1, the project is continued, and otherwise is abandoned (Smit and Trigeorgis (2004)). The optimal abandonment decision must trade off salvage value and current losses against the potential for future profits (Kulatilaka and Trigeorgis (1994)).

Brennan and Schwartz (1985) and Moel and Tufano (2002) studied the decision of closing and reopening gold mines in North America. They valued the flexibility to open, to temporarily shut down or permanently abandon a mine based on the evolution of the commodity extracted from the mine. The authors found that the management decisions have been taken in accordance with real options model predictions. Baird and Morrison (2001) modeled the shutdown decision on a bankruptcy procedure as the exercise of a real option. The authors develop their study more related with a law perspective, in this case, analyzing the option on the judge side, who is the decision maker after the bankruptcy process has started. The judge has the possibility to decide between company reorganization and shutdown.

3. Empirical approach

In this chapter we present the empirical approach supported by literature to develop our work. We have analyzed the equity-holders abandonment option. Theory prices this real option as an American put with both a stochastic strike price (exit value) and a stochastic value of the underlying security (the present value of cash flows). One of the roles of the firm's net assets value is their importance to the value of a firm's abandonment option. Estimating the option value is a difficult process, even for firms with observables market values, therefore, since we are in the presence of privately held companies, to estimate the abandonment option for each one of the companies in our sample, we develop our study based on the relation established on literature between the exit value of firms net assets and the firm value as a going concern, which we will explain below.

3.1. Theory prediction

Berger et al. (1996) on their work to investigate whether investors price the option to abandon a firm at its exit value, developed their hypotheses backed up by the study provided by Myers and Majd (1990) on the relation between firm value and firm characteristics that determine the abandonment option's value as shown below:³

$$VALUE = PVCF + P(PVCF, EXIT, SDEV) \quad (3.1)$$

$$\left(\frac{VALUE}{PVCF} - 1\right) = P\left(1, \frac{EXIT}{PVCF}, SDEV\right) \quad (3.2)$$

Where:

VALUE = Firm's market value,

PVCF = Present value of expected future operating cash flows of a going concern,

P = Operator representing an American put option,

EXIT = Exit value of the firm's assets,

SDEV = Standard deviation of the ratio *EXIT* to *PVCF*.

³ Equations and descriptions adopted from Berger, P. G., E. Ofek and I. Swary (1996), "Investor Valuation of the Abandonment Option", *Journal of Financial Economics*, Vol. 42, N° 2, pp. 257-287.

Through the Eq. (3.1), it is possible to show that the firm's market value equals the sum of the expected future operating cash flows of a going concern firm plus the value of the abandonment option, but the form of Eq. (3.1) is only appropriate when the abandonment option involves the choice of selling the entire firm. The authors divided each term of Eq. (3.1) and rearranged terms in Eq. (3.2) to develop their hypothesis and the result is an expression of the abandonment option value, in which the value of the option is a function of the ratio of Exit to PVCF, which they call excess exit value. Eq. (3.2) shows that excess exit value can be viewed as the stochastic strike price of a put option with a normalized value of one on its underlying stock.

$$Excess\ exit\ value^4 = \left(\frac{Estimated\ exit\ value\ of\ net\ assets}{PVCF} \right) - 1 \quad (3.3)$$

Considering the ratio of estimated exit value of net assets to PVCF used on Eq. (3.3), the option is at-the-money when the ratio of estimated exit value of net assets to PVCF is one, i.e., when the exit value equals the value of expected cash flows, the option is in-the-money for the amounts greater than one, and it is out-of-the-money when it is less than one. As the exit value increases, the option moves farther into the money. When the value of expected cash flow increases, the option moves farther out-of-the-money. Thus, excess exit value is positively related to abandonment option.

3.2. Estimating exit values

To estimate the abandonment option for the companies of our sample, we need the net assets exit value to the numerator of our ratio estimated on Eq. (3.3). The exit value of a firm's net asset is the liquidation value available in the event of default. However, the exit value of firms net assets is not observable, whereas the book value is and the book value of assets is also a common proxy used in literature according to some authors, like Burgstahler and Dichev (1997), who used book values as exit values of firms exit. One reason why net assets book value approximates liquidation value is that generally accepted accounting principles (GAAP) require asset write downs for some assets when

⁴ The expression "*Excess exit value*" was adopted from *ibid.*

market value is less than book value (Barth et al. (1998)). For the reasons listed above, we will consider two approaches for the exit values to estimate our ratio. One approach is using the value of firm's net assets collected directly from the balance sheet as the exit value to calculate the excess book value as Eq. (A.1) on appendix. The other approach is estimating the exit value of firm's net assets using information from Doing Business⁵ that collect information on the recovery rate of debt in insolvency by creditors. The average recovery rate for creditors was used as a proxy for the exit value of firm's assets.

The average recovery rate by creditors between 2006 and 2015 is 73%. The platform supported their methodology on the work of Djankov et al. (2008). The calculation takes into consideration the outcome: whether the business emerges from the process as an ongoing concern or the assets are sold piecemeal. Then, the costs of the bankruptcy process are deducted. Finally, the value lost as a result of the time the money remains tied up in bankruptcy process is taken into account, including the loss of value due to depreciation according to the international accounting practice, the annual depreciation rate of 20% used by the Doing Business platform. If an economy had zero cases a year over the past five years, involving a judicial reorganization, judicial liquidation or debt enforcement procedure (foreclosure or receivership), the economy receives a "no practice" mark for the time, cost and outcome indicators. As creditors recover on average only 73% of their claims, we measure the exit value of assets as detailed on Eq. (A.2) on appendix. The estimated exit value of net assets is defined as:

$$\begin{aligned} \textit{Estimated exit value of net assets} = \textit{Exit value of assets} - & \quad (3.4) \\ & \textit{payables} - \textit{total debt} \end{aligned}$$

3.3. Present value of cash flows

In order to obtain the relation between exit values of firm's net assets to PVCF, we need to estimate the PVCF as a going concern for each firm in our sample. As we do not have earnings or cash flows forecasts, we project cash flows from year one to perpetuity.

⁵ The Doing Business platform is a member of World Bank Group that collect information from small and medium-size companies across 189 economies.

Berger et al. (1996) on their work assumed the perpetuity after the year 11. The authors have at least 2 years of earnings forecasts, from the last forecast they project earnings through year 10 using analysts five-year earnings growth forecasts. They assumed earnings from year 2 will grow at the consensus growth rate through year 10. If the year 2 forecast earnings are negative, year 1's (or else years 3) are used if positive, or, if positive earnings are not forecast, the observation is removed from the sample. Berger et al. (1996) used earnings analysts' forecasts to calculate the PVCF proxy. Once they used going concern earnings, they had to include adjustments on capex and working capital in order to obtain the present value of going concern cash-flows. Since we are valuing private companies and the earnings are not a reliable information, as Ball and Shivakumar (2005) found it on a study in UK, that the earnings quality in private firms is lower than the one on listed companies, we use the Kaplan and Ruback (1995) method to calculate CCF:

$$\begin{aligned} \text{Capital Cash Flow} = & \text{Net Income} + \text{Depreciation} - \text{Capital Expenditures} \quad (3.5) \\ & \pm \Delta \text{Working Capital} + \text{Interest} \end{aligned}$$

The authors found that for a sample of 51 highly levered transactions, their estimates of discounted cash flows perform at least as well as valuation approaches using companies in similar industries and companies involved in similar transactions. To select the companies to our sample, we calculated the CCF for each company with at least four years of available accounting information in order to have at least three years of historical cash-flows. After the CCF calculation and the companies' selection with historical positive cash flows average, we calculated the PVCF using a perpetuity for the selected companies. As Copeland (2010) refers, an expert spends at least four hours to value a company and he needs to have a deep knowledge about the company and the market. The valuation of privately held companies is a difficult process, thus, once it is an ex-post analysis, and we are lagged on time, to determine the PVCF, we used a perpetuity. Copeland et al. (1996) shows that using a perpetuity model is a reliable method to value a company. We estimate a perpetuity based on the historical three years CCF average.

$$PVCF = \frac{CCF_{T+1}}{r^u - g} \quad (3.6)$$

As Kaplan and Ruback (1995) we discounted the capital cash flows using the expected return implied by the Capital Asset Pricing Model for the unlevered firm:

$$r^u = r_f + \beta^u \times [r_m - r_f] \quad (3.7)$$

The CAPM requires market values and since it is not available for private firms, we used proxies from Portuguese index PSI. Cooper and Priestley (2016) found that the cost of capital and firm valuations are similar across private and public firms. The authors defend that, using proxy firms from the public market and their stock returns to calculate the cost of capital, is a reliable benchmark. For the unlevered beta estimation, we used the levered beta and debt-to-equity ratios from Portuguese listed companies with the same NACE⁶ code used as a proxy firms and the corporate tax rate increased by the municipal surcharge *Derrama Municipal*⁷. Each one of this estimations was made for the correspondent year from the company in analysis. To find the proxy companies, we used the two-digit standard industrial classification (NACE) industry level data and selected, company by company, the ones that better fit the company sector of our sample. For the risk free rate proxy, we used a ten year treasury German bond adjusted for the year of the company in analysis. For market return, we used the index return from 1993 to 2015 on the PSI20. For the growth rate we used a 3% nominal growth rate which corresponds to a real growth rate of 1,5% based on the projections for Portuguese economy from Banco de Portugal (2016) (Bank of Portugal). Additionally, for each firm in study we also estimate the probability of default for the last four years of available accounting statements using the Z-Score model for private firms as proposed by Altman and Hotchkiss (2006), calculation details on appendix.

⁶ The Statistical classification of economic activities in the European Community, abbreviated as NACE. The term NACE is derived from the French Nomenclature statistique des activités économiques dans Communauté européenne.

⁷ “Derrama Municipal” is a municipal surcharge to tax profits.

To elaborate this study, the following assumptions were taken: we have considered only two classes of stake-holders, the equity-holders and the debtholders. In order to simplify, we assumed all creditors as equal because we do not have any information about the credits type, thus, we assumed the same maturity for all debt. Alike other studies, we assumed that the assets are sold together, not separately as these are also valuable to investors, but for this hypothesis development, we have to consider the selling of the entire firm. We assumed the same level of assets specialization for all companies. Additionally, we have used exit values collected directly from the balance sheet, which assumes that the assets can be liquidated at their full going concern value, and we also used adjusted exit values. According to Schnusenberg and Skantz (1998), when a firm's exit value exceeds its value in use, its recognized net assets become the primary determinant of firm's value and when a value in use exceeds exit value, unrecognized net assets, such as goodwill and other intangibles, will be the primary determinant of a firm's value.

4. Sample selection and description

To build our sample, we had to collect data from multiple sources. The information about voluntary and involuntary bankruptcy petitions was provided by Informa D&B, which collects data on insolvencies since 2001. To the data request, we have imposed the following conditions: companies had to be privately held and had to have at least 5 years of activity and to possess a sales volume equal or superior to €5 million. In our work, we only studied privately held companies with the legal imposition of an independent auditor supervising the financial statements because, in theory, the accounting information is a more reliable source than other companies due to this the legal imposition. The choice of companies with at least 5 years of activity and sales equal or higher than €5 million have two concerns: firstly these are more likely to provide the required accounting historical data and exclude companies like start-ups or other companies in the beginning of their activity and traditionally have more mortality on the first years of activity.

Amongst the mandatory conditions resulted in a sample of 433 observations, in which 229 firms submitted a voluntary bankruptcy petition and 204 firms an involuntary bankruptcy petition. To access the overall data, the Informa D&B charged a fee, so, for this study they have agreed to provide half of the resulted sample, distributed proportionally, for free. The provided data comprises 216 companies from different sectors of activity, except financial sector, in which 115 presented a voluntary bankruptcy petition and 101 have an involuntary bankruptcy petition. The data contained information about VAT numbers, entities name, address, NACE codes, year of business beginning, year of last accounting and financial information report, sales, employees, type of bankruptcy petition (voluntary or involuntary) and the bankruptcy petition date.

The data granted by Informa D&B had to be complemented with financial and accounting information data obtained from SABI⁸ for at least four years of financial statements from each company. From SABI we obtained the balance sheet and income statement, for the available years, for each of the 216 companies in our sample. For market data information

⁸ The SABI is a platform from the group Bureau Van Dijk that provide companies information for individual countries around the world.

that was necessary to estimate the market return, risk free rate and information from the proxy firms, we used Datastream⁹. Amongst the 216 companies provided, we have removed those with more than four years without accounting statements and the firms with four years with information but with no consecutive years of information. In theory, by definition, the value of an option is always greater or equal to zero. An option with negative payoff will expire unexercised. The option should be exercised when its value is superior to zero, i.e., when the option is in-the-money. For these reasons, firms with negative equity value on the last year of available information were removed from the sample.

We assumed the last year of existing accounting statements as the year of the bankruptcy petition. Amongst the 137 resulting firms, we have calculated the Capital Cash Flow (CCF) for each one. After the calculation, we have removed the companies with negative CCF average on the last three years. The next step was the estimation of PVCF. We calculated the PVCF for 80 companies and the companies with negative valuation and companies in a very specific sector were removed from the sample due to the difficulty in obtaining a proxy.

Table 1 – Sample selection

Table 1 describes the sample selection. The data provided by Informa D&B includes 216 companies with a bankruptcy process in which 53% were processes voluntarily initiated by equity-holders and 47% were initiated by creditors. After the removed companies we finished with a sample of 63 companies, in which 54% were voluntary bankruptcy petitions and 46% were involuntary bankruptcy petitions.

	Voluntary Petition	(%)	Involuntary Petition	(%)	All
Observations	115	53%	101	47%	216
>4 years without information	5		15		20
<4 years of complete information	17		14		31
Last year negative equity value	17		11		28
3 Year CCF Average <0	33		24		57
Companies with no proxy	1		5		6
Companies with negative valuation (3%)	8		3		11
Total	34	54%	29	46%	63

*The companies with negative valuation were obtained considering a 3% perpetuity growth rate.

⁹ Datastream is the Thomson Reuters global financial and macroeconomic data platform.

After all the described conditions applied to the selected companies, we have reduced the initial data to the sample aim of our study with 63 observations as reported on table 1.

The bankruptcy petitions from the 63 companies were initiated between the year of 2006 and the year 2015 as presented on Table 2. The years of 2010, 2011 and 2012 were the years with most insolvencies, possibly as a consequence of the 2008-2009 global financial crisis.

Table 2 – Sample distribution

The companies in our sample filed for bankruptcy between 2006 and 2015. The years of 2009, 2010 and 2011 were the years with more companies initiating the bankruptcy process.

Year	Voluntary Petition	Involuntary Petition	All
2006	1	0	1
2007	1	0	1
2008	0	1	1
2009	6	1	7
2010	5	6	11
2011	7	6	13
2012	3	7	10
2013	6	2	8
2014	3	2	5
2015	2	4	6
2006-2015	34	29	63

A characteristic of the companies that filed for bankruptcy is that most of them do not have their financial statements available until the year bankruptcy was presented or required. Table 3 reports the information about the years without available accounting and financial information. Only two companies have reported the financial statements in the year of the bankruptcy petition. It is found that the range of years without any reported information to the date of the bankruptcy petition with more observations, is between one year and three years. Thirteen companies remained a year without reporting information. Thirty-two companies remained two years without reporting information and twelve companies remained three years without reporting accounting and financial information before the bankruptcy petition. Finally, we have four companies that remained four years without reporting any information. By looking at the table, we easily identify that the

companies that presented the voluntary bankruptcy petition, were those who tended to provide information closer to the bankruptcy petition.

Table 3 – Years without information report

The table reports the information about the years without available accounting and financial information. The range of years without any information to the date of the bankruptcy petition is between one year and three years with 90% of total observations. The period of two years without present financial and accounting reports it is the most typical on the companies on bankruptcy process.

Years	Voluntary Petition	(%)	Involuntary Petition	(%)	All	(%)
0	2	3%	0	0%	2	3%
1	10	16%	3	5%	13	21%
2	17	27%	15	24%	32	51%
3	4	6%	8	13%	12	19%
4	1	2%	3	5%	4	6%
All	34	54%	29	46%	63	100%

Table 4 shows financial characteristics collected directly from each of the company's financial statements for the voluntary and the involuntary bankruptcy petitions groups. Once the analyzed variables did not show normality and homogeneity, we used the Mann-Whitney test, which is a non-parametric test to compare the medians between the two groups. The median it is also a more robust measure of central tendency in the presence of extreme values because it is less susceptible to changes when the data is skewed.

Table 4 groups the balance sheet main classes and income statement items for each bankruptcy petitions group. We computed and compared this firms characteristics for the last four years of companies' available information and we found differences between the median values of firm's characteristics statistically significant, which we will describe below.

The age variable refers to the companies' age at the time the bankruptcy petition is presented or required. In spite of being higher in voluntary bankruptcy petitions group, only the assets, equity, total debt and short-term debt variables are statistically different on the last year between the two groups, with the voluntary bankruptcy petitions group having always higher values in the four years analyzed. The voluntary bankruptcy

petitions group has a median age of 16 years, which is about half of the median age for the involuntary bankruptcy petitions group whose median age is 30 years. The book value of total assets is a common firm size proxy used on literature. When we compare the value of total assets between the two different groups, we found out that the voluntary bankruptcy petitions group almost has double the size of the involuntary bankruptcy petitions group, and this difference is statistically significant. Contributing to this, we find the fixed and current assets, except cash, which do not present very divergent values, and, on both groups, the current assets have a much higher weight than the fixed assets.

The value of equity on the voluntary bankruptcy petitions group is about the double of the value of the involuntary bankruptcy petitions group and both groups present a downward trend on equity value from year $t-3$ until the year $t=0$. Looking at the debt, we also have higher values on total debt for the voluntary bankruptcy petitions group and the difference is significant. This indicator shows a growing trend over the four years analyzed between both groups. However, this growing trend is explained by a decrease in a long term debt while current debt increases, indicating that companies fund themselves in the short term. Although variables of revenues and earnings before interest and taxes have much higher median values for the voluntary bankruptcy petitions group than the involuntary bankruptcy petitions group, it only has a significant difference on year's $t-3$ and $t-2$ and the net income do not present significant differences.

Table 4 – Firms characteristics

Financial Variables	t = 0				t = - 1				t = - 2				t = - 3			
	Mean	Median	Std. Dev.	p-value ^a	Mean	Median	Std. Dev.	p-value ^a	Mean	Median	Std. Dev.	p-value ^a	Mean	Median	Std. Dev.	p-value ^a
Total Assets																
Voluntary	22.793.667	14.137.931	24.659.596	0,003***	25.377.714	14.577.139	28.626.445	0,002***	26.404.458	15.341.763	29.341.714	0,001***	25.720.537	14.133.534	29.302.904	0,000***
Involuntary	9.745.729	7.305.210	7.303.647		9.826.257	7.428.379	7.750.971		9.574.531	7.123.918	8.253.524		8.933.979	5.821.574	7.723.235	
Fixed Assets																
Voluntary	8.755.832	3.662.893	14.834.076	0,021**	10.624.174	4.239.723	17.909.370	0,017**	11.243.428	4.973.399	18.408.296	0,005***	10.515.616	3.030.490	18.766.688	0,006***
Involuntary	2.912.920	1.469.770	3.829.563		2.970.803	1.401.679	3.772.592		2.948.906	1.298.307	4.222.183		2.322.415	924.012	2.896.853	
Current Assets																
Voluntary	14.926.858	9.485.239	16.300.037	0,001***	15.746.624	10.251.895	16.714.797	0,005***	16.140.308	9.869.520	17.110.946	0,001***	16.087.436	9.432.647	18.012.258	0,002***
Involuntary	6.832.809	5.306.888	4.445.149		6.855.454	5.381.061	4.439.605		6.625.625	4.819.792	4.660.161		6.611.564	5.050.304	5.859.595	
Cash																
Voluntary	305.587	110.719	504.676	0,440	321.990	108.048	593.418	0,847	379.503	123.570	511.886	0,649	366.989	171.832	568.155	0,901
Involuntary	156.983	82.372	196.690		270.828	133.883	328.863		287.879	141.335	425.681		320.038	147.197	583.086	
Equity																
Voluntary	4.445.201	2.079.380	6.797.830	0,018**	6.250.428	2.554.224	11.977.774	0,039**	6.226.677	2.495.906	11.575.837	0,020**	6.630.278	2.661.207	11.671.636	0,008***
Involuntary	1.506.670	1.042.761	1.470.581		2.310.532	1.022.905	2.830.087		2.347.810	1.017.560	2.852.569		2.341.678	1.343.260	2.725.403	
Total Debt																
Voluntary	18.348.466	12.116.756	19.606.114	0,005***	19.126.192	11.910.689	20.470.921	0,002***	20.238.945	11.319.492	21.360.280	0,001***	19.243.594	10.264.930	22.088.575	0,001***
Involuntary	8.239.059	5.985.598	6.065.398		7.565.064	6.139.831	5.147.595		7.278.473	5.435.065	5.701.019		6.643.106	5.057.358	5.345.661	
Long-term Debt																
Voluntary	8.040.704	1.844.871	16.957.916	0,102	8.216.072	2.485.059	16.855.033	0,023**	11.132.810	2.833.982	18.505.341	0,015**	10.994.823	2.416.192	19.316.240	0,026**
Involuntary	1.726.886	806.788	2.266.062		1.464.641	810.131	1.911.270		1.342.578	761.626	1.958.937		1.317.067	686.520	2.008.138	
Short-term Debt																
Voluntary	10.307.762	9.027.707	10.867.126	0,054*	10.911.214	7.375.736	10.644.148	0,035**	9.044.971	7.712.143	6.504.381	0,027**	8.095.437	7.007.266	6.083.905	0,057*
Involuntary	6.512.172	5.308.516	4.155.419		6.051.083	5.112.341	3.639.024		5.884.144	4.939.747	4.184.926		5.275.234	4.262.753	3.930.010	
Revenues																
Voluntary	13.234.877	10.806.608	11.632.001	0,129	15.726.460	11.744.724	15.452.232	0,168	16.820.441	11.092.728	14.279.758	0,098*	17.631.596	11.230.111	14.480.006	0,041**
Involuntary	10.071.980	8.729.112	6.259.142		11.927.338	9.356.907	8.641.843		11.965.423	9.706.410	8.395.356		11.111.533	8.804.310	8.416.297	
EBIT																
Voluntary	241.135	321.956	1.631.279	0,241	605.881	360.543	2.047.851	0,348	792.009	501.472	1.571.833	0,010***	848.789	438.359	1.540.322	0,047**
Involuntary	25.549	99.251	540.736		133.190	194.009	610.851		93.297	138.813	545.060		151.268	119.158	308.612	
Net Income																
Voluntary	37.351	40.917	1.281.498	0,710	109.247	45.820	1.067.461	0,553	419.774	57.871	974.312	0,160	56.087	37.106	1.101.404	0,465
Involuntary	-10.144	19.756	552.495		-131.093	37.874	633.116		52.547	38.471	136.825		149.026	44.934	312.215	
Age																
Voluntary	29	16	22	0,644												
Involuntary	32	30	27													

^a Elaborated with the non-parametric Mann-Whitney test. The results were automatically obtained by SPSS. ***, ** and * indicate significance at 1%, 5% and 10% respectively.

5. Results

In this chapter we present the results for the estimation of PVCF, excess book value, excess exit value and the Z-Score calculated for each firm of our sample, as defined previously. The results are presented in two groups: the companies group which voluntarily initiated bankruptcy and the companies group which involuntarily initiated bankruptcy. Then, we have compared the results obtained between the two groups. The observations did not show normality, so we have emphasized median values for the results of each group and the Mann-Whitney test was used to compare if median values are statistically different between the two groups.

Table 5 shows the results on the estimation of PVCF, excess book value, excess exit value and the probability of financial distress for each of the companies from the voluntary and involuntary bankruptcy petitions groups. Under the same assumptions, in order to calculate the PVCF, using the historical cash flows and a perpetuity growth rate of 3% for all firms, it is noticed that the voluntary bankruptcy petitions group has a median value of PVCF almost three times higher when compared to the median PVCF of the involuntary bankruptcy petitions group, and this difference is statistically significant. This means that, under the same assumptions, the firms that voluntarily initiated the bankruptcy process worth more than the firms which involuntarily initiated the bankruptcy process and, according to the size proxy, these also are the largest companies. Once we have used the historical cash flows to determine the firm value, we assumed the same valuation in the four years analyzed for excess book value and excess exit value calculation.

However, when analyzing the excess book value for the two groups, the differences on the median values, considering this valuation, are smaller and are not statistically significant over the four years analyzed, which indicates a similar proportional relation among the firms net assets and PVCF values for both groups. We noticed that the difference between the values of two groups decreases over the four years. When we analyze the excess book value, which captures the percentage difference between the book value of firms net assets and the value of its PVCF, on the last year and on year t-3, the median voluntary group has lower values of excess book value, but on years t-1 and t-2,

the voluntary group has higher values and statistically a bit more significant. The last year had an excess book value of -77% and the involuntary median firm has a value of -78% , showing that the firm's net assets represents 23% and 22% of PVCF respectively, which practically does not show any difference.

Considering the excess exit value, which capture the percentage difference between the estimated exit value of firms net assets and the value of its PVCF, the involuntary bankruptcy petitions group has more negative values in all years analyzed and the difference is statistically more significant when compared to the results obtained for the excess book value. For the median voluntary bankruptcy petition firm, the excess exit value is -130% and for the median involuntary bankruptcy petition firm is -140% , showing that the estimated exit value of firms net assets represents -30% and -40% of PVCF respectively, which means that the equity-holders exercise the option when the estimated exit value of firms net assets it is not so negative as the value of estimated exit value of firms net assets on the involuntary group. This is explained because the companies from the voluntary bankruptcy petitions group have a lower ratio of debt to PVCF compared to the companies from the involuntary bankruptcy petitions group. Also here, we observed that the difference between the values of two groups decreases over the four years. The values inferior to -1 mean that when we consider the estimated exit value of firm's net assets, the resale value of the assets is insufficient to satisfy all creditors on both cases. Therefore, we have a negative net assets value. Although there are higher differences between the excess exit values for the two groups in comparison to the excess book value, the differences are still not statistically significant.

Apparently, based on the excess book value and excess exit value, there is no motivation to the equity-holders to initiate voluntarily the bankruptcy process because the exercise price on these cases was far from the underlying asset value, i.e., the exit value of firms net assets is inferior to the PVCF value. If we consider the value of net assets as the critical salvage value, this indicate that the PVCF for the voluntary and involuntary group is 77% and 78% , respectively, above of the strike price.

Along the four years analyzed, it is possible to follow the deterioration of z-score with the approximation to the danger zone measured by this indicator. The median voluntary

bankruptcy firm is already in the danger zone and the median involuntary bankruptcy firm is in the grey area. The z-score value for the companies from the voluntary bankruptcy petitions group, suggests that these companies are more likely to go bankrupt in comparison to the companies from the involuntary bankruptcy petitions group, but it is only a minimal difference and it is not statistically significant.

For the results reported on table 5, we had analyzed the last four years of companies accounting and financial information available, without establishing any distinction between the companies as reported on table 3. We have considered that the companies remained all in the same period without reporting accounting and financial information before the bankruptcy petition. Considering that the results of table 5 may be biased due to what we have analyzed the last four years of available accounting information together, we present on table 6 the same analysis done on table 5 with the companies grouped by the number of years they have remained without reporting accounting information. Table 6 reports the results divided into three main groups with the distinction between companies, for those who remained one, two and three years without report accounting information. These are the number of years that companies remained without reporting information with more observations. Panel A, B and C present the results for the companies that remained for one, two and three years, respectively, without any financial or accounting report. Even with this distinction, the results continue to be similar to the ones obtained on table 5, with no significant difference between the groups on panel A, B and C.

Table 5 - Results

This table reports the results on the estimate of PVCF, excess book value, excess exit value and the probability of financial distress for the companies from the voluntary and involuntary bankruptcy petitions groups. The PVCF was calculated by using the last three years average of historical capital cash-flows and a terminal growth rate of 3%. We have considered the same PVCF for all the years. Excess Book Value is the ratio of firm's net assets to PVCF, minus 1. Excess Exit Value is the ratio of estimated exit value of firm's net assets to PVCF, minus 1. Z-Score was obtained using the Altman methodology as described on appendix.

Financial Variables	t = 0				t = - 1				t = - 2				t = - 3			
	Mean	Median	Std. Dev.	p-value ^a	Mean	Median	Std. Dev.	p-value ^a	Mean	Median	Std. Dev.	p-value ^a	Mean	Median	Std. Dev.	p-value ^a
PVCF																
Voluntary	74.028.806	9.130.769	236.911.955	0,021**												
Involuntary	10.623.131	3.329.109	21.332.705													
Excess Book Value																
Voluntary	-0,33	-0,77	1,16	0,967	-0,20	-0,75	1,37	0,610	-0,20	-0,75	1,37	0,581	-0,18	-0,72	1,34	0,945
Involuntary	0,58	-0,78	5,21		0,92	-0,74	5,34		0,98	-0,70	5,81		0,82	-0,78	5,58	
Excess Exit Value																
Voluntary	-1,76	-1,30	1,20	0,241	-1,86	-1,32	1,54	0,314	-1,85	-1,18	1,38	0,535	-2,01	-1,24	1,73	0,148
Involuntary	-2,78	-1,40	4,15		-4,18	-1,41	9,91		-3,98	-1,42	10,61		-5,01	-1,44	11,84	
Z- Score																
Voluntary	1,28	1,16	1,15	0,321	1,63	1,29	1,48	0,225	1,63	1,29	1,32	0,107	1,84	1,51	1,88	0,372
Involuntary	2,38	1,28	6,26		2,56	1,50	5,45		2,05	1,63	2,10		2,50	1,58	3,67	

^a Elaborated with the non-parametric Mann-Whitney test.

The results were automatically obtained by SPSS.

** indicate significance at 5% level for a two-tailed test.

Table 6 – Results by year

This table reports the results on the estimate of PVCF, excess book value, excess exit value and the probability of financial distress grouping companies by the number of years it remained without reporting accounting and financial information for the voluntary and involuntary bankruptcy petitions.

Panel A: 1yr				t = 0				t = - 1				t = - 2				t = - 3			
Financial Variables	Mean	Median	Std. Dev.	p-value ^a	Mean	Median	Std. Dev.	p-value ^a	Mean	Median	Std. Dev.	p-value ^a	Mean	Median	Std. Dev.	p-value ^a			
Excess Book Value																			
Voluntary	-0,31	-0,75	1,44	0,937	-0,19	-0,77	1,64	1,000	-0,10	-0,76	1,75	1,000	-0,07	-0,71	1,72	0,811			
Involuntary	0,32	-0,88	2,18		1,63	-0,75	4,31		1,62	-0,76	4,30		0,22	-0,86	1,94				
Excess Exit Value																			
Voluntary	-1,74	-1,27	1,08	0,937	-1,67	-1,26	0,89	0,469	-2,02	-1,26	1,39	0,573	-2,37	-1,25	2,40	0,692			
Involuntary	-2,52	-1,25	2,37		-2,92	-1,42	2,91		-3,31	-1,66	3,37		-3,43	-1,64	3,59				
Z- Score																			
Voluntary	0,98	0,72	0,61	0,811	1,38	1,24	0,75	0,937	0,47	1,29	0,76	0,469	1,47	1,67	0,59	0,921			
Involuntary	0,75	0,83	0,52		1,34	1,11	0,59		2,18	1,22	1,68		2,14	1,55	1,17				

Panel B: 2yr				t = 0				t = - 1				t = - 2				t = - 3			
Financial Variables	Mean	Median	Std. Dev.	p-value ^a	Mean	Median	Std. Dev.	p-value ^a	Mean	Median	Std. Dev.	p-value ^a	Mean	Median	Std. Dev.	p-value ^a			
Excess Book Value																			
Voluntary	-0,14	-0,74	1,21	0,737	0,04	-0,68	1,47	0,737	-0,03	-0,68	1,40	0,682	0,00	-0,78	1,36	1,000			
Involuntary	1,31	-0,78	7,15		1,56	-0,63	7,13		1,84	-0,64	7,88		1,78	-0,64	7,68				
Excess Exit Value																			
Voluntary	-2,00	-1,33	1,46	0,737	-2,26	-1,42	2,00	0,602	-2,02	-1,23	1,60	0,766	-2,10	-1,24	1,59	0,823			
Involuntary	-3,26	-1,38	5,48		-5,33	-1,25	13,36		-4,66	-1,24	14,33		-6,37	-1,29	15,95				
Z- Score																			
Voluntary	1,71	1,28	1,39	0,682	2,07	1,41	1,91	0,737	1,99	1,42	1,70	0,526	2,30	1,64	2,56	0,880			
Involuntary	3,61	1,31	8,64		3,57	1,58	7,52		2,45	1,63	2,66		2,90	1,62	4,79				

Panel C: 3yr				t = 0				t = - 1				t = - 2				t = - 3			
Financial Variables	Mean	Median	Std. Dev.	p-value ^a	Mean	Median	Std. Dev.	p-value ^a	Mean	Median	Std. Dev.	p-value ^a	Mean	Median	Std. Dev.	p-value ^a			
Excess Book Value																			
Voluntary	-0,81	-0,79	0,13	0,808	-0,81	-0,79	0,13	0,461	-0,80	-0,75	0,13	0,283	-0,76	-0,71	0,16	0,570			
Involuntary	-0,20	-0,75	1,49		0,07	-0,70	1,98		-0,22	-0,56	1,00		-0,15	-0,57	1,06				
Excess Exit Value																			
Voluntary	-1,26	-1,27	0,18	0,368	-1,23	-1,25	0,18	0,461	-1,25	-1,26	0,32	0,214	-1,35	-1,30	0,47	0,368			
Involuntary	-2,36	-1,49	2,42		-3,32	-1,52	5,16		-3,63	-1,54	5,77		-3,89	-1,44	6,28				
Z- Score																			
Voluntary	0,82	0,93	0,47	0,683	0,79	0,58	0,75	0,283	1,03	1,01	0,43	0,109	1,56	1,25	1,19	0,527			
Involuntary	1,07	0,99	0,76		1,50	1,30	1,01		1,67	1,72	0,84		2,03	1,51	1,77				

^a Elaborated with the non-parametric Mann-Whitney test. The results were automatically obtained by SPSS.

The results previously presented were based on the PVCF calculation assuming a 3% terminal growth rate. The perpetuity model is very sensitive to the assumptions made on growth rate, which is the reason why we have recalculated the PVCF to each firm in our sample with different growth rates.

Table 7 provides information about the sensitivity tests to the terminal growth rate on the perpetuity calculation. We present the results for the PVCF, excess book value and for the excess exit value to the voluntary and involuntary bankruptcy petitions groups. The results are very sensitive to the assumptions made on the growth rate, and this is noticeable through the variation on the number of observations. We have calculated the PVCF without growth and using a terminal growth rate of 6% and have compared the results with the previous calculation assuming a terminal growth rate of 3%. The variation on the number of observations is due to the limitation of the perpetuity model, because the model only can be applied if the cost of equity is greater than the perpetuity growth rate, reason why we have a rank of observations between 52 and 73 companies.

When we analyze the results with no growth rate or with a 6% terminal growth rate, we attest that the excess book value has always a more negative value on the voluntary bankruptcy petitions group and the excess exit value has always a less negative value for the voluntary bankruptcy petitions group than for the involuntary bankruptcy petitions group. The estimate of the PVCF with no growth increases the difference between the two groups. The excess book value presents larger differences, but is in the excess exit value that the differences are statistically more significant, with the voluntary bankruptcy petitions group having less negative excess exit value than the involuntary bankruptcy petitions group. Assuming a 6% terminal growth rate, the results remain in the same trend, with the PVCF being statistically different between the two groups and the excess exit value having less negative values for the voluntary bankruptcy petitions group.

The sensitivity analysis reinforces the results obtained previously. In all case scenarios, the equity-holders abandonment option from the voluntary bankruptcy petitions group, is more out-of-the-money than the equity-holders abandonment option from the involuntary bankruptcy petitions group, but only has statistical significance in some cases.

Table 7 – Sensitivity tests

This table reports the results on the sensitivity tests on the estimate of PVCF, excess book value and excess exit value using a 0%, 3% and 6% growth rate.

Panel A: g=0% N=73		t = 0				t = - 1				t = - 2				t = - 3			
Financial Variables	Mean	Median	Std. Dev.	p-value ^a	Mean	Median	Std. Dev.	p-value ^a	Mean	Median	Std. Dev.	p-value ^a	Mean	Median	Std. Dev.	p-value ^a	
PVCF																	
Voluntary	142.791.719	10.378.149	697.125.391	0,003***													
Involuntary	9.852.832	1.970.226	18.381.055														
Excess Book Value																	
Voluntary	-0,17	-0,73	1,59	0,392	0,00	-0,76	1,88	0,133	0,00	-0,69	1,88	0,122	0,03	-0,71	1,85	0,165	
Involuntary	0,79	-0,63	5,55		1,27	-0,54	5,82		1,35	-0,45	6,33		1,11	-0,52	5,96		
Excess Exit Value																	
Voluntary	-1,92	-1,29	1,63	0,035**	-2,05	-1,33	2,06	0,077*	-2,00	-1,22	1,76	0,266	-2,21	-1,31	2,27	0,043**	
Involuntary	-3,20	-1,68	4,48		-4,62	-1,58	10,52		-4,28	-1,61	11,52		-5,56	-1,81	12,63		

Panel B: g=3% N=63		t = 0				t = - 1				t = - 2				t = - 3			
Financial Variables	Mean	Median	Std. Dev.	p-value ^a	Mean	Median	Std. Dev.	p-value ^a	Mean	Median	Std. Dev.	p-value ^a	Mean	Median	Std. Dev.	p-value ^a	
PVCF																	
Voluntary	74.028.806	9.130.769	236.911.955	0,021**													
Involuntary	10.623.131	3.329.109	21.332.705														
Excess Book Value																	
Voluntary	-0,33	-0,77	1,16	0,967	-0,20	-0,75	1,37	0,610	-0,20	-0,75	1,37	0,581	-0,18	-0,72	1,34	0,945	
Involuntary	0,58	-0,78	5,21		0,92	-0,74	5,34		0,98	-0,70	5,81		0,82	-0,78	5,58		
Excess Exit Value																	
Voluntary	-1,76	-1,30	1,20	0,241	-1,86	-1,32	1,54	0,314	-1,85	-1,18	1,38	0,535	-2,01	-1,24	1,73	0,148	
Involuntary	-2,78	-1,40	4,15		-4,18	-1,41	9,91		-3,98	-1,42	10,61		-5,01	-1,44	11,84		

Panel C: g=6% N=52		t = 0				t = - 1				t = - 2				t = - 3			
Financial Variables	Mean	Median	Std. Dev.	p-value ^a	Mean	Median	Std. Dev.	p-value ^a	Mean	Median	Std. Dev.	p-value ^a	Mean	Median	Std. Dev.	p-value ^a	
PVCF																	
Voluntary	231.583.924	22.989.775	791.803.824	0,011**													
Involuntary	57.780.100	4.840.356	223.017.973														
Excess Book Value																	
Voluntary	-0,61	-0,90	0,70	0,222	-0,54	-0,91	0,83	0,159	-0,54	-0,88	0,82	0,208	-0,53	-0,89	0,80	0,236	
Involuntary	0,68	-0,83	5,39		0,93	-0,68	5,42		0,98	-0,68	5,91		0,89	-0,69	5,75		
Excess Exit Value																	
Voluntary	-1,45	-1,15	0,71	0,103	-1,52	-1,13	0,93	0,154	-1,55	-1,09	0,95	0,428	-1,63	-1,12	1,11	0,039**	
Involuntary	-2,73	-1,43	4,24		-4,41	-1,46	10,28		-4,40	-1,30	10,80		-5,25	-1,34	12,24		

^a Elaborated with the non-parametric Mann-Whitney test.

The results were automatically obtained by SPSS.

***, ** and * indicate significance at 1%, 5% and 10% levels, respectively, for a two-tailed test.

We also were interested in examine the behavior of the exit value of firms net assets with other balance sheet classes and income statement items throughout the four years analyzed to understand if exists different relations between the variables along these four years on the two groups. After testing the normality of the distributions and, since these did not show normality, to this analysis, we used the Spearman's rank correlation coefficient.

Table 8 reports the results of the relationship between the exit value of firm's net assets and the selected variables over the four years analyzed for the voluntary and involuntary bankruptcy petitions groups. The exit value of firm's net assets presents a strong positive correlation with the probability of bankruptcy for the voluntary and involuntary bankruptcy petitions groups, which means that, as the likelihood of the firm's bankruptcy increases, it produces less exit value. The variables of assets present a weak to moderate negative correlation for the voluntary bankruptcy group or no correlation for the involuntary bankruptcy group, but it is interesting to analyze that, despite the exit value decrease over the four years, the value of total assets had an increase between t-3 and t=0.

The total debt, for the voluntary bankruptcy petitions group, has a strong negative correlation with the exit value of firms net assets, which indicates that the debt increase is responsible for the decrease on exit value, but this negative correlation is caused by current debt, although the long term debt decrease over the four years, the increase on current debt is higher than the reduction on long term debt, which causes an opposite variation between total debt and exit value. The current debt has a very strong negative correlation with the exit value of firm's net assets and it is statistically significant. However, for the involuntary bankruptcy petitions group it is not visible the same predisposition for total and long term debt that has no correlation, only with current debt having a moderate negative correlation. The earnings before interest and taxes have a moderate positive correlation and a strong positive correlation for the voluntary and involuntary bankruptcy petitions groups, respectively, which shows that the decrease of this indicator accompanies the decrease on exit value. The sales presents a strong positive correlation for the voluntary bankruptcy petitions group and a very strong positive correlation for the involuntary group, that is statistically significant, which indicates a perfect correspondence between the sales reduction and the exit value decrease.

Table 8 – Correlation between variables

This table reports the results of the correlation coefficient between the exit value of firm's net assets, balance sheet classes and income statement items over the four years analyzed for the voluntary and involuntary bankruptcy petitions groups. *P*-values are (in parentheses) and Spearman's *r* values are without parentheses.

	Exit Value	
	Voluntary	Involuntary
Z-Score	0,800 (0,200)	0,800 (0,200)
Total Assets	-0,400 (0,600)	0,000 (1,000)
Fixed Assets	-0,400 (0,600)	-0,400 (0,600)
Current Assets	-0,200 (0,800)	-0,400 (0,600)
Total Debt	-0,800 (0,200)	0,000 (1,000)
Long Term Debt	0,200 (0,800)	0,000 (1,000)
Current Debt	-1,000 (0,000)***	-0,400 (0,600)
EBIT	0,400 (0,600)	0,800 (0,200)
Sales	0,800 (0,200)	1,000 (0,000)***

Elaborated with the Spearman's rank correlation coefficient test.

The results were automatically obtained by SPSS.

*** indicate significance at 1% level.

After the variables behavior analysis over the four years, we also were curious to understand if any one of the variables had explanatory power on the excess book value variation. For this, we have performed a simple linear regression model of the relation between the excess book value and the principal balance sheet classes and income statement items for the companies' observations on the last year. These regressions test if the excess book value is related to other variables. The excess book value is our dependent variable and we test one independent variable at a time because we intend to analyze the differences on the variables variations between the two groups. We also take logs for all variables to reduce the influence of outliers. To the voluntary bankruptcy petitions firms, the variable Z-Score has an adjusted *R*-squared of 21,4%, which explain a part of the variation on excess book value with statistical significance, whereas for the involuntary

bankruptcy petitions firms this is not the case. The total debt also explain 7,5% of the variation on excess book value, but is the current debt value that contributes more to the variation with 8,2% of the variation on excess book value for the voluntary bankruptcy petitions firms, in contrast to the companies from the involuntary bankruptcy petitions group. The PVCF, which is a part of the excess book value, has more explanatory power to the variation in this ratio for the voluntary bankruptcy petitions firms than the involuntary bankruptcy petitions firms, being responsible for 62,4% and for 42,4% of the variation on excess book value, respectively. The equity value has more explanatory power on the involuntary bankruptcy petitions group with 19% of the variation on excess book value explained.

Table 9 – Regression estimates

Regressions estimate of the relation between the excess book value and the main balance sheet classes and income statement items for the companies' observations on the last year. *P*-values are (in parentheses) and adjusted R^2 values are without parentheses.

Dependent Variable	Excess Book Value	
	Voluntary	Involuntary
Z-Score	0,214 (0,003)***	0,000 (0,790)
Total Assets	0,024 (0,190)	0,007 (0,283)
Fixed Assets	0,022 (0,197)	0,000 (0,610)
Current Assets	0,033 (0,154)	0,000 (0,508)
Total Debt	0,075 (0,063)*	0,000 (0,392)
Long Term Debt	0,044 (0,121)	0,033 (0,172)
Current Debt	0,082 (0,055)*	-0,023 0,510
Sales	0,000 (0,603)	0,000 (0,603)
PVCF	0,624 (0,000)***	0,424 (0,000)***
Equity	0,011 (0,246)	0,190 (0,010)***

Elaborated with OLS regression.

The results were automatically obtained by SPSS.

*** and * indicate significance at 1% and 10% levels respectively.

6. Conclusions

This study assesses the equity-holders abandonment option of firms that initiated the bankruptcy process by using a sample of Portuguese privately held companies that, voluntarily or involuntarily, filed for bankruptcy, and compares the results obtained between the two groups. For our reference, a similar study does not exist, mainly for non-listed companies.

We found that the companies from the voluntary bankruptcy petitions group are almost twice the size of the companies of involuntary bankruptcy petitions group and that the firm's net assets value has the same proportional difference between the groups. After the estimate of the PVCF of a going concern, based on historical cash-flows, assuming a 3% growth rate, we found that the median valuation of companies in the voluntary bankruptcy petitions group is almost three times higher than the value of companies in the involuntary bankruptcy petitions group. The voluntary bankruptcy petitions group is characterized by larger firms, higher exit values and most valuable companies. The companies of the voluntary bankruptcy petitions group remain less years without reporting financial statements to the date of the bankruptcy petition than the group of involuntary bankruptcy petitions and are younger than the involuntary bankruptcy petitions companies. In spite of not being statistically different, the group of voluntary bankruptcy petitions group has lower values of z-score for almost all the years, which suggests more probability of default. The voluntary bankruptcy petitions group has a higher relation between the decrease on exit value of equity and the increase on current-debt as a decrease on long-term debt over the four years analyzed, when compared to the involuntary bankruptcy petitions group. The involuntary bankruptcy petitions group has a higher relation between the decrease on the exit value of equity and the decrease on revenues.

Although the results were not statistically significant for all scenarios, the results obtained suggest that when the equity-holders initiate the bankruptcy process, they do it earlier than the debtholders. The voluntary bankruptcy petitions group has more negative abandonment option value in almost all scenarios, but this difference is only statistically different in some case scenarios. The results analyzed, considering the excess book value, shows that they exercise the option when the companies worth more in relation to the

firms net assets value. When the analysis is made from the perspective of estimated exit value, the voluntary bankruptcy petitions group also exercise the option when the exit value of firms net assets it is not as negative as the value on the involuntary bankruptcy petitions group. However, the results are not conclusive.

The results, contrary to what some authors refer, suggest that the equity-holders exercise the option of voluntary bankruptcy petition, even without the threat of debtholders. This may be indicative of information asymmetry, where equity and debtholders may have different incentives to put the firm on bankruptcy, as Vila and Schary (1995) refers. In the case of a voluntary bankruptcy petition, it can be a strategic decision by management in order to preserve more value or to put the assets on a better alternative use. In our sample, we confirm that a situation of negative net worth or equity position equal to zero is not a sufficient condition to force a firm in bankruptcy.

Appendix

Appendix 1 – Excess book value

$$\text{Excess book value}^{10} = \left(\frac{\text{Book value of net assets}}{\text{PVCF}} \right) - 1 \quad (\text{A.1})$$

Appendix 2 – Excess exit value

$$\text{Exit value of assets} = \text{creditors recovery rate} * \quad (\text{A.2}) \\ (\text{payables} + \text{total debt})$$

Appendix 3 – Equity-holders Abandonment option

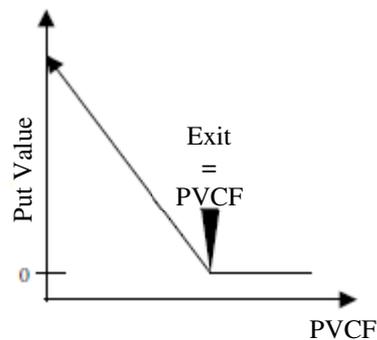


Figure 1 – Equity-holder Abandonment Option

Appendix 4 – Capital Cash Flows

Unlevered beta

$$\beta_U = \frac{\beta_L}{[1 + (1 - t)(D/E)]} \quad (\text{A.4})$$

¹⁰ The expression “*Excess exit value*” was adopted from Berger, P. G., E. Ofek and I. Swary (1996), “Investor Valuation of the Abandonment Option”, *Journal of Financial Economics*, Vol. 42, N° 2, pp. 257-287.

Where,

β_L = Levered beta

t = Tax rate

D/E = Debt to equity ratio

Capital Expenditures

$$\text{Capital expenditures} = \text{Fixed assets}_t - \text{Fixed assets}_{t-1} + \text{Amortization}_t \quad (\text{A.4.1})$$

Change in net working capital

$$\Delta \text{Net working capital} = (\text{Current assets}_t - \text{Current liabilities}_t) - (\text{Current assets}_{t-1} - \text{Current liabilities}_{t-1}) \quad (\text{A.4.2})$$

Appendix 5 - Z-Score Altman (1993)

$$Z = 0.717 X_1 + 0.847 X_2 + 3.107 X_3 + 0.420 X_4 + 0.998 X_5 \quad (\text{A.5})$$

$$X_1 = \frac{\text{Current Assets} - \text{Current Liabilities}}{\text{Total Assets}} \quad (\text{A.5.1})$$

$$X_2 = \frac{\text{Retained Earnings}}{\text{Total Assets}}$$

$$X_3 = \frac{\text{Earnings before Interest and Taxes}}{\text{Total Assets}}$$

$$X_4 = \frac{\text{Book Value of Equity}}{\text{Total Equity}}$$

$$X_5 = \frac{\text{Sales}}{\text{Total Assets}}$$

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