Working papers
New trends in accounting and management

Universitat de Lleida
Department of Business Administration

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A STUDY ON THE IMPACTS OF FIRM-SPECIFIC AND INDUSTRY-SPECIFIC FACTORS ON THE SURVIVAL-BASED SUCCESS OF SPANISH NEW FIRMS

Abstract

With using decision tree approach, this paper explores the predictability and impacts of some firm-specific factors (mainly financial factors) and industry-specific factors on the survival-based success of Spanish new firms in manufacturing sector. In particular, decision trees are built not only for comparing the impacts between different factors but also for observing the change of factor's impact with firm´s ageing and after industry adjustment. The results from the generated trees are quite detailed and relatively complex, and the main results can be summarized as follows: (1) profitability is the most significant variable because of ranking at the first level in most trees; (2) the impact of firm size is also important due to frequently appearing at the second level; (3) the impact of liquidity tends to weaken with ageing; (4) industry adjustment degrades the impact of indebtedness; (5) as for industry-specific variables, concentration and entry rank before industry growth in the age 1 and age 2 predictions.

Key words

Firm-specific and industry-specific factors, survival-based success, decision tree

JEL codes

M13, L60

1. INTRODUCTION

There are two important issues regarding start-ups, as proposed by Van Praag (2003): promoting business starting up on the one hand; reducing business dissolutions of start-ups on the other hand. However, compared to the issue of start-up promotion, the problem of start-up dissolution seems to deserve more attention. Based on the finding that the variance of survival rates is much larger than that of entry rates in the subsectors of manufacturing industry, Audretsch (1995) believes that barriers of survival should be a more complex issue compared to barriers of entry. Geroski (1995) too points out some facts that to some extent underlie the research of new firm success: the easiness of entry but the hardness of survival, as well as the high of entrant failure rate and the long of time for survivors to be competitive with incumbents.

The history of using success or failure as the measure of performance has been lasting for several decades since at least 1960s (as pointed out by Dess and Robinson, 1984). However, arguments still exist on the definition and the measurement of success. Some scholars believe that the definition of success should be a quite wide concept. For example, Fisher et al. (2014) deem that defining the concept of success would include both subjective and objective elements, and to explain success is dependent on its indicators which may exist in a wide range of areas (for instance from business to psychology) for explaining, predicting and identifying success.

It is also advised to classify success into different levels and take multiple factors into account. Gordon and Davidsson (2013) point out the difficulty for measuring success in a single standard when, for example, considering industrial differences; furthermore they believe that the standard for measuring success should take the stage of development and the type of firms into account and, particularly, they propose that the firms surviving but with poor performance in profitability should be classified as being less successful than those surviving with gaining plenty of profits.

Based on previous research, Mcdougall et al. (1992) state two important features of new businesses: a period of time before gaining first profits and low survival rates. Further, Suárez and Utterback (1995) state that survival is the basis for firm success in (for example) market share or profitability. The difficulty for new firms to seek for profits is pointed out by Reynolds (2016): even after six years, only one third of new businesses can gain profits. So exploring survival-based success is the target of this paper, and firm profitability (treated as one of the independent variables) is also taken into consideration.

In the traditional survival analysis of new firms, age usually works as the time mark to observe the changes of survival rate and exit rate. Cefis and Marsili (2006) believe that the firms under

age 5 can be seen as young. In fact the research of Brixy et al. (2006) shows that, observing from the perspective of labor fluctuation and wage setting, the period for new firms to become incumbents is just a few years (three to five years). The characteristics of young firms are also widely explored by scholars: for example, Mata and Portugal (1994) find that only half of the new firms would survive for four years; the research of Konings et al. (1996) shows increasing trend of exit rate in the first three years and stable trend after. Thereby this paper observes the new firms from age 1 to age 5.

This paper studies the predictability and impacts of some firm-specific and industry-specific factors on the survival-based success of new firms at different ages in manufacturing sector (section C of NACE Rev. 2 from Eurostat of European Commission, 2008). The main contributions are two-fold: firstly, it enriches the study on the impacting factors to new firm success in recent depression period (because this paper samples the firms incorporated in 2008 and 2009); secondly, the change of factor's impact with ageing and the change after industry adjustment are analyzed for contributing to the study on impact's variation. Following the introduction part, the rest of the paper is organized in this order: Section 2 for literature review, Section 3 for sample, variables and methodology, Section 4 for results, and Section 5 for conclusions.

2. LITERATURE REVIEW

As summarized by Fackler et al. (2013), survival and exit are crucial research topics in different academic areas — for example, resource-based theory, organizational ecology, and industrial economics including the well-cited passive learning model (Jovanovic, 1982) saying that firms can learn their efficiency only after operation. There are also several theories of liability: liability of smallness (Aldrich and Auster 1986) stresses the high likelihood of exit on small firms; liability of newness (Stinchcombe, 1965) highlights the disadvantages of young firms; liability of adolescence (Brüderl and Schüssler 1990) draws the picture of exit as initially low (because of initial stock of resources) and then increasing but finally decreasing; liability of ageing (Barron et al., 1994) portrays increasing in exit risk along with the increase of firm´s age; liability of obsolescence (Barron et al., 1994) believes that inertia causes constraints for old firms to accommodate themselves to environmental changes; liability of senescence (Barron et al., 1994) attributes the higher exit risk of older firms to accumulated rules and routines.

Financial factors & size

Financial factors are the indicators of economic goals (Venkatraman and Ramanujam, 1986). Several decades have witnessed the development of using financial ratios to predict financial

distress and failure since the research pioneers in 1960s — Beaver (1966) and Altman (1968) — as pointed out by Gepp and Kumar (2015). In fact, early studies already establish the structure and system of financial ratios. Horrigan (1965) classifies financial ratios only into two categories: liquidity and profitability (where liquidity is further subdivided into short term liquidity and long term solvency, and profitability is too subdivided into turnover ratios, profit margin ratios and return ratios); similarly, Gupta (1969) identifies four types of financial ratios indicating profitability, turnover, leverage and liquidity. Because Altman (1968) states that profitability, liquidity, and solvency are important ratio factors for indicating bankruptcy and failure, this paper chooses these three factors to measure the impacts from financial perspective.

According to the traditional view of economics literature related to industrial organization, the excess of profitability drives firm entry (Audretsch, 1997); on the other hand, not earning sufficient money is a crucial reason for the discontinuance of business (Watson et al., 1998). Swinney et al. (2011) point out that one important difference of the targets between start-ups and established firms is to maximizing the probability of survival and maximizing expected profits. If wealth maximization and survival can coexist, chasing optimality would be the choice of firms; however, if it is hard to harmonize wealth maximization and survival, firms tend to prefer survival (Oprea, 2014). Empirical study may further muddy the waters: Golombek and Raknerud (2012) observe a seemingly unintelligible characteristic of Norwegian manufacturing firms — that is, the firms with consistently positive profits may also exit whereas frequently incurring negative profits may not necessarily drive firms out; furthermore, their research shows that profitability is negatively related to the probability of exit and that high probability of exit persists among the exiting firms (which does not support the impact of negative profitability shock prior to exit).

Because inability to pay due bills and technical insolvency (insufficiency to meet total liabilities) can be directly defined as failure (Bruno and Leidecker, 1988), liquidity and solvency deserve to be deeply studied. Bruinshoofd and Kool (2004) summarize three main reasons for holding liquidity: the first is transaction and opportunity costs (together with precautionary demand for money, including future investment opportunity, volatility of cash flow, and refinancing uncertainty); the second is about asymmetric information problems (for example, moral hazard in high leverage, the relationship with financial intermediaries, agency problems between managers and owners because of the preference of managers on liquidity but the preference of shareholders on profit, and asymmetries in information when investing in research and development, investing in high-tech sectors, and investing in economic recession period); the third is passive adjustment of capital structure according to the pecking order theory of Myers and Majluf (1984) and Myers (1984) and buffer stock liquidity for absorbing shocks. As for small firms, liquidity problems should be stressed because of relatively

lacking sources for financing, so it is necessary to prepare more assets in liquid form for daily transactions and in emergent situation (Bolek, 2013).

With regard to the research on debt and leverage, as pointed out by Flannery and Rangan (2006), financing theory has been greatly developed since the publication of irrelevance proposition by Modigliani and Miller (1958). The following theories developed are reviewed in the study of Frank and Goyal (2009): trade-off theory highlights the trade-off between the benefits and costs of debt, including tax benefits against bankruptcy costs; agency theory proposes agency costs and the existence of conflicts among manager, shareholder, and debt-holder (Jensen and Meckling, 1976; Jensen, 1986); pecking order theory points out that the financing order would be retained earnings, debt, and then equity because of adverse selection problem (Myers, 1984); market timing theory believes that capital structure is impacted much by the fluctuations of market valuations (Baker and Wurgler, 2002).

As for new firms, the change of leverage with ageing can be observed. Huynh et al. (2015) point out that, when tracking particular cohort (1985 and 1989 cohorts in their study), there is a decreasing trend of average leverage as firms age; and they also state the selection effects (initially lower average leverage for the survivors) and survival effects (leverage lowering down with ageing because of the increase in profits and then retained earnings and equity). Laitinen (1992) attributes the failure of newly founded firms to the factor of revenue financing to debt and describes the process as follows: in the initial stages, highly indebted firms require large revenues to fulfill financial obligations because of limitation in share capital; however, in some situations (for example, too poor profitability) where firms cannot reach the planned revenues, taking more debt is the way for keeping on survival, which would result in more planned revenues to reach for the increased financial obligation and finally cause failure due to insolvency. In addition, considering that the studying period of this paper (from 2008 to 2014) is generally in depression, leverage tends to be viewed as a negative indicator, since Theodossiou et al. (1996) point out that high leverage is more likely to cause firm´s failure in low income and downturn periods.

The impact of firm size on survival has been widely discussed especially by Industrial Organization scholars. Audretsch (1995) points out two characteristics of new entrants: the smallness in firm size and the low variance in start-up size. In fact, the smallness in size of entrants compared to incumbents would be kept for a period after entry, and even after one decade the sizes of those entrants are still smaller than the sizes of incumbents (Bellone et al., 2006). Mata et al. (1995) state that, as for new firms, it is hard for them to survive to the day that they are able to threat dominant firms, and their competitors are other small and new firms. Generally speaking, larger firms have advantages in scale economies, diversification, market power and then in earnings and stability (Mills and Schumann, 1985; Theodossiou et al., 1996), and one important reason for larger firms showing longer lifespan is that shrinking in

size (rather than exit) is the choice of larger firms in inefficient situations (Mata and Portugal, 1994). On the other hand, small firms could still be successful in competition with large ones by virtue of their more flexible production technologies to occupy a disproportionate share of industrywide output fluctuations (Mills and Schumann, 1985).

Group membership

New firms may be founded by other existing firms, and this situation entails the illustration of corporate entrepreneurship. As is distinguished from independent entrepreneurship, corporate entrepreneurship has two crucial forms (illustrated in the study of Sharma and Chrisman, 1999) — strategic renewal and corporate venturing, in which innovation may be included. Leten and Van Dyck (2012) state corporate venturing (that has been emerging since 1960s) as creating independent organization unit to invest new technological and business opportunities, which includes internal venturing and external venturing. This paper only takes external venturing (corporate venture capital units as independent start-ups for external opportunities — Birkinshaw and Hill, 2005) into study.

Sykes (1990) points out that: different to private venture capitalist with the only goal on financial return, most corporate venture capital programs view strategic goals (such as identifying new opportunities, developing business relationships, changing corporate culture, and finding potential acquisitions) for developing new business as the core and financial gains as minor. It must be highlighted that financial goals may not oppose strategic goals, and in fact strategic goals should generate financial benefits from the long run perspective; on the other hand, short-term financial goals may not correspond with strategic goals (Ernst et al., 2005). Nevertheless, scholars still have different viewpoints regarding this issue: Dushnitsky and Lenox (2006) believe that strategically (rather than financially) oriented corporate venture capital creates firm value, while the research of Birkinshaw and Hill (2005) shows that the survival rate of financially focused units is higher than that of strategically focused units.

It should be reasonable to expect corporate venturing as a positive factor, because of the experience of the established firms being helpful to subsidiaries (Audretsch and Mahmood, 1995). Musso and Schiavo (2008) also state that membership in a group (especially larger conglomerate) could be helpful to market access. Notwithstanding that, the positive effects of corporate venturing on new firm survival are still challenged. The research of Mata et al. (1995) shows that the survival rate of de novo single plant entrants generally is higher than that of the entrants with parent firm, which further causes the puzzle that the de novo single plant entrants with the characteristic of smallness in size (compared to other types of entrants) are quite strong in survival.

Industrial factors

With regard to industry-specific factors, Bellone et al. (2008) believe that industry characteristics impact more on young firms compared to old firms and that the impacts of industry dynamic features (turbulence) are more important than those of static features (market structure). As classified by Bellone et al. (2008), industry sales growth as well as entry signify industry turbulence; concentration is a factor representing market structure.

Theoretically speaking, industry entry and growth should respectively exert negative and positive impacts on firm survival, because — as stated by Mata and Portugal (1994) — high industry entry would bring competition and challenges to both the new firms per se and incumbents (including the new firms in different generations) and in fast-growing industries it is less possible to cause the loss of market share and then retaliations from rivals. Except for less retaliations from incumbents, Strotmann (2007) points out that another important beneficial factor is the increase of price-cost-margins driven by the increase of demand in growing industries. As for industry concentration, traditional viewpoint is that industry concentration means market imperfection, so firms with lower market power (especially young firms) would have higher probability to exit (Bellone et al., 2008). Notwithstanding that, López-García and Puente (2006) state two different views about highly concentrated industries (the existence of survival space for suboptimal scale new firms; and the collusion of incumbents for against new entrants).

On the other hand, in spite of the portrayal of theory, empirical study may draw a different picture. Mata and Portugal (1994) find that concentration is insignificant in manufacturing industry, and this kind of result is explained by Mata (1991) and Mata and Portugal (1994) as the weakness of the impacts of fear of aggression on entry. Similarly, the research of Holmes et al. (2010) on manufacturing industry shows positive impacts of sectoral growth on the survival of both micro-enterprises and small and medium establishments (SMEs) as well as insignificant impacts of concentration. In the contrary, McCloughan and Stone (1998) find that industry growth is insignificant to survival whereas industry concentration (albeit with ambiguous effect) is significant.

To sum up, on the ground of the above studies, this paper uses profitability, liquidity, indebtedness, firm size, and group membership to represent the impacts of firm-specific factors as well as industry entry, concentration, and industry growth to observe the influence from industry. Here, different to some previous studies, hypotheses about the relationships between factors and success are not built after considering the possible complicate results generated by decision trees.

3. SAMPLE, VARIABLES AND METHODOLOGY

The sample selection method in this paper is similar to that of Helmers and Rogers (2010) who choose the firms incorporated in 2001 and follow them for a five-year period after incorporation; here the firms incorporated in both 2008 and 2009 in SABI database (Iberian Balance sheet Analysis System developed by INFORMA D&B and Bureau Van Dijk) are candidates for sample and each firm is also tracked for five years after the incorporation year. It must be noticed that incorporation year is not a variable here because of combining the two cohorts (2008 and 2009) as a whole with the purpose of enlarging sample size.

Given the problem pointed out by Wagner (1994) that the life span at the beginning may be less than a year (for example just several months) when using year as the unit to measure the life span of firm, this paper sets a requirement that all the sample firms should report operating revenues at age 1 (the year after the incorporation year). Finally, there are 4544 firms selected in manufacturing sector (shown in Table 1).

Table 1. Distribution of sample size according to ages as well as failure and success percentages in two-digit code industry division (according to NACE Rev. 2 from Eurostat; European Commission, 2008)

Manufacturing sector	**Sample size at age 1**	**Sample size at age 2**	**Sample size at age 3**
10. Manufacture of food products	442	395	353
11. Manufacture of beverages	115	99	89
13. Manufacture of textiles	146	125	110
14. Manufacture of wearing apparel	130	110	89
15. Manufacture of leather and related products	181	157	129
16. Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	232	210	189
17. Manufacture of paper and paper products	41	38	31
18. Printing and reproduction of recorded media	367	321	273
19. Manufacture of coke and refined petroleum products	4	2	2
20. Manufacture of chemicals and chemical products	117	102	83
21. Manufacture of basic pharmaceutical products and pharmaceutical preparations	16	15	15

22. Manufacture of rubber and plastic products	132	119	100
23. Manufacture of other non-metallic mineral products	195	177	156
24. Manufacture of basic metals	83	72	57
25. Manufacture of fabricated metal products, except machinery and equipment	940	808	677
26. Manufacture of computer, electronic and optical products	88	78	68
27. Manufacture of electrical equipment	88	76	64
28. Manufacture of machinery and equipment n.e.c.	257	239	207
29. Manufacture of motor vehicles, trailers and semi-trailers	44	39	33
30. Manufacture of other transport equipment	42	36	31
31. Manufacture of furniture	256	211	172
32. Other manufacturing	155	135	124
33. Repair and installation of machinery and equipment	473	421	370
Failure	488	506	462
Success	4056	3479	2960
Success percentage	89%	87%	86%
Total	4544	3985	3422

When considering financial factors together with industrial factors, the issue of industry adjustment should be discussed. Ooghe et al. (2003) point out the difference of model´s predictability in different industries, so they propose to develop industry-specific models and variables. Platt and Platt (1991) also suggest to use industry-relative ratios (dividing company ratios by industry average ratios) in bankruptcy prediction models, which can eliminate industry-specific bias; and their research results show that industry-adjusted ratios perform better than unadjusted ratios do in accuracy and stability. Hence, with using the adjusting method of dividing the original financial ratios to the industry medians (Izan, 1984), this paper compares the predictability of some original financial variables to that of their paired industry-adjusted variables. Specifically speaking (shown in Table 2), liquidity ratio, indebtedness, and total assets (as the proxy of firm size) are divided by the industry medians; the adjustment of total assets could to some extent reflect the impacts of minimum efficient scale, because industry minimum efficient scale is measured as median logarithm of total assets in an industry in the research of Huyghebaert and Van de Gucht (2007). Here, considering that the sign of ROA (return on total assets) could be positive or negative, the adjusting method on ROA is to calculate the difference between firm´s ROA and the industry median ROA (firm´s ROA minus that of industry median).

Classification tree is used in this paper for analyzing the predictability and impacts of firm-specific (together with their industry-adjusted formats) and industry-specific factors on the survival-based success at different ages (age 1, 2 and 3). According to the statement of Gepp and Kumar (2015), the history of using decision tree to explore the prediction of business failure could be traced back to the research of Frydman et al. (1985). Delen et al. (2013) list some advantages of decision trees: showing the results and relationships visually and clearly, being easy to understand and interpret, needing little data preparation, being able to process numerical and categorical data, and working fast. In this paper, Chi-squared Automatic Interaction Detector (CHAID) is chosen as the algorithm. As stated by Delen et al. (2013), on the basis of adjusted significance testing CHAID generates more than two categories at a level (rather than binary), and its output is characterized of high visualization and easiness to interpret. Firms are categorized into two groups separately representing success and failure for building dependent variable (shown in Table 2). Because there are much more firms in success groups than in failure groups, weighting is used to address the issue of imbalance.

Table 2. Definitions of variables

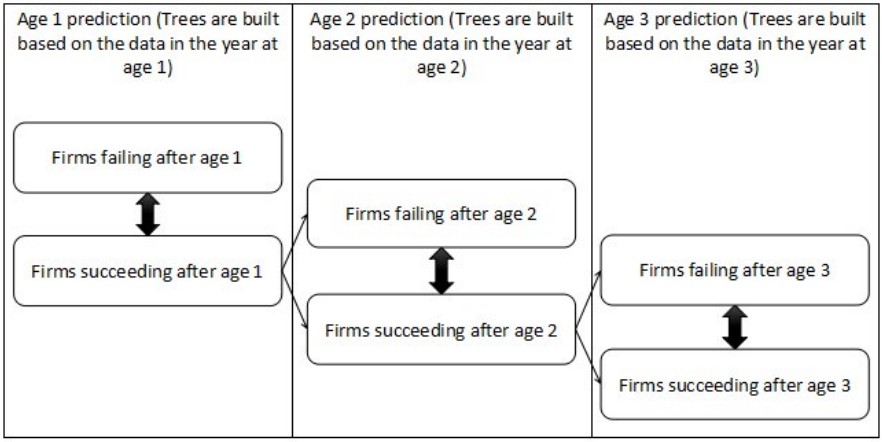
Factors	Variables	Definitions
Dependent variable		
Success or failure	Two consecutive years without reporting operating revenues as the signal of failure	It equals 1 representing success if not showing the signal of failure; equals 0 if showing the signal of failure.
Independent variables		
Financial factor	Profitability	Return on total assets (ROA): Profits before tax / Total assets
		Adjusted format: Firm´s ROA — Industry median ROA
	Solvency	Indebtedness: (Total shareholders funds and liabilities — Shareholders equity) / Total shareholders funds and liabilities
		Adjusted format: Firm's indebtedness / Industry median indebtedness
	Liquidity	Current ratio: Current assets/Current liabilities
		Adjusted format: Firm's current ratio / Industry median current ratio
Firm size	Total assets	Total assets in thousands of Euros
		Adjusted format: Firm's total assets / Industry median total assets

Group membership	Whether being in a group	Membership in a group, equals 1 if the number of companies in corporate group is more than zero; equals 0 if the number of companies in corporate group is zero.
Industrial factors (identified in two-digit code industry division)	Entry rate	The number of incorporated firms within a year in a selected industry / The number of the firms reporting total assets in that industry in the same year
	Concentration rate	The total amount of operating revenues of the top 10 percent firms in a selected industry in a year / The total amount of operating revenues in that industry in the same year
	Industry growth rate	(Operating revenues in a selected industry in a year — the operating revenues in that industry one year before) / The operating revenues in that industry one year before

Here the adopted cutting point between firm's success and failure is whether without reporting operating revenues to SABI database in two consecutive years. This type of identifying method is also employed in past research: Mata and Portugal (1994) propose the judgment of two consecutive years without appearing in the database to identify exit in order to reduce the misclassifying risk, after considering that it is possible for firms to be absent in the database due to the reasons like operation suspending or failing to report the data (rather than ceasing operation permanently). In fact, the importance of production in identifying the survival span of firms is also underlined by Harhoff et al. (1998) who believe that the production period of a firm after the declaration of bankruptcy should still be recorded in its survival span. Table 2 describes the details of both dependent and independent variables. Note that the firms that do not report operating revenues in two consecutive years are not necessarily those exiting from the market, so this paper uses "survival-based success and failure" rather than the term "survival and exit".

Referring to the research method of Persson (2004), this paper sets three time nodes after the founding of firms — age 1, age 2 and age 3 (respectively representing one, two and three years after the founding year); decision trees are built for each age. The reason for just studying the impacts at the first three ages is that the last two years in the observed five-year period are used for identifying success or failure (due to two consecutive years without reporting operating revenues as the judging standard for failure). Particularly, as shown in Picture 1, the total samples are subdivided into success and failure groups according to survival year after year: firstly dividing the total into two groups — the firms keeping on survival after age 1 and the firms not; secondly, dividing the firms keeping on survival

after age 1 into two groups — those keeping on survival after age 2 and those not; finally, again dividing the firms keeping on survival after age 2 into two groups — those keeping on survival after age 3 and those not. Decision trees are operated twice (separately with the original financial and size variables and their adjusted formats) for each age division on the paired success group and failure group. Noteworthy here is that as age grows firms would have more years of financial records: for example, the firms surviving after age 3 have financial records at age 1, 2 and 3. In this paper, only the data in the latest age years are processed in that the research design here is to analyze the impacts of factors on survival immediately after the recorded year.



Picture 1

4. RESULTS

The detailed results generated by decision trees are shown in Appendix from Table A1 to A6. For the age 1 prediction (unadjusted), indebtedness is the variable at the first level, and the likelihood of success decreases with the increase in indebtedness except for the case of low indebtedness; the second level is occupied by liquidity ratio, total assets, industry concentration, and industry entry; except for total assets and group membership, all the variables appear at the third level, and in most cases ROA tends to be positively related to success where the relationship between success and industry growth tends to be negative. For

the adjusted age 1 prediction, at the first level adjusted ROA shows positive relationship with the likelihood of success. At the second level, the other three adjusted variables (liquidity, indebtedness and total assets) together with industry concentration appear; again, the relationship between adjusted indebtedness and success is negative except for the case of low adjusted indebtedness. Except for adjusted ROA and group membership, all the variables appear at the third level; adjusted liquidity as well as industry growth tend to be negatively related to success. Obviously, here the adjustment protrudes the impact of ROA.

For the age 2 prediction, the results of the unadjusted and adjusted models are to some extent similar: the first level is occupied by ROA or adjusted ROA, and both are generally positively related to success (with a slightly negative relationship in high ROA); at the second level, group membership (being positively related to success), industry concentration, total assets (or adjusted total assets) appear in both models, whereas industry entry and adjusted indebtedness separately appear in the unadjusted model and adjusted model; at the third level, indebtedness or its adjusted format (being negatively related to success), industry concentration, liquidity or adjusted liquidity, and industry entry (mostly being positively related to success) appear in the unadjusted and adjusted models, together with group membership (being negatively related to success) in the unadjusted model as well as adjusted ROA and industry growth in the adjusted model.

For the age 3 prediction, the first level is occupied by ROA or adjusted ROA, and both are generally positively related to success except in high ROA. At the second level, industry growth, total assets, and indebtedness appear in the unadjusted model; on the other hand, industry growth, adjusted total assets (being positively related to success), industry entry rate, and industry concentration are shown in the adjusted model. At the third level, the unadjusted tree includes indebtedness, liquidity, industry concentration, and industry growth. The third level of the adjusted tree is composed of adjusted ROA, industry entry, adjusted indebtedness, and industry growth, where positive relationship to success is shown in industry growth and negative relationship to success is observed in industry entry and adjusted indebtedness. Generally speaking, decision tree approach generates quite detailed and relatively complex results; next section will glean some palpable and important ones.

5. CONCLUSIONS

Among the findings obtained, the foremost one is that nearly all the trees highlight the importance of profitability and firm size, for the reason that five out of six models rank ROA (or its adjusted format) at the first level while total assets (as well as its adjusted format) frequently appear at the second level in all the predictions.

Because the first levels of the generated trees are occupied by profitability (and indebtedness in one model), the changes happening at the second level can illustrate the changes of the impacts of variables. Liquidity (or its adjusted format) plays a more important role in the age 1 prediction by virtue of appearing in the second level; this may represent a decreasing trend of the impact of liquidity with ageing, which may be caused by the bettering performance in profitability and then cash inflow with ageing. The impact of group membership (as a dichotomous variable) is relatively weak not only because of just appearing in the age 2 prediction but also due to instability of its relationship to success.

The research results here fail to conclude the effect of industry adjustment on the whole model, because the correct percent of prediction (a little decreasing in the age 1 and 3 predictions while a little increasing in the age 2 prediction after adjustment) does not change much. Notwithstanding that, industry adjustment does influence some variables. For instance, industry adjustment upgrades the impact of profitability in the age 1 prediction (replacing indebtedness at the first level), whereas adjustment does not waver the status of profitability ranking at the first level in the age 2 and age 3 predictions. And degrading the impact of indebtedness not only happens in the age 1 prediction, but it also emerges in the age 3 prediction (which pushes indebtedness from the second level in the unadjusted model to the third level in the adjusted model). So industry adjustment tends to increase the impact of profitability and decrease the impact of indebtedness.

As for industry-specific factors, industry entry and industry concentration tend to be more important than industry growth does because of more frequently appearing at the second level; another interesting result is that, in the age 1 and age 2 predictions, industry adjustment drives industry entry from the second level in the unadjusted model to the third level in the adjusted model. Industry growth comes into the second level in the age 3 prediction. Therefore, industry growth ranks behind industry entry and industry concentration at early ages (here age 1 and age 2).

With regard to the relationships of variables to firm success, fluctuating relationship prevalently exists not only for the continuous variables but also for the dichotomous variable (group membership changing its relationship to success at different levels in the age 2 prediction). This matches with the complexity of the results generated; thank to the complexity, decision tree approach can draw a more detailed picture of the results, which is an important advantage. On the other hand, here after observing both the unadjusted and adjusted models, two tendencies can be caught: indebtedness generally being negatively related to success and profitability generally being positively related to success. In fact, these two relationships are not quite surprising, since the results here correspond with the common sense about the positive impact of profitability as well as the instability caused by insolvency and bankruptcy risk when bearing high leverage.

All in all, the research results of this paper add new evidence to the complexity of the empirical study on the impacting factors to new firm success (which can be seen from the tables of decision trees showing relatively complicated results) and, at the same time, display the necessity to further explore the change of factor's impact with time and after adjustment. As a prototype, the study of Bellone et al. (2008) shows the differences of factor´s impact in young, middle-aged, and old firms, so future research could do more contributions in this direction.

APPENDIX

Note that the decision trees are generated in table format from left to right, and the "N" and "S" in the parentheses separately represent the number of firms and the likelihood of success; because of weighting, the total number of firms in each model is larger than the sample size; and the minimum number of cases in the child nods is set to 100.

Table A1. Success prediction at age 1 with original variables (Correct percent: 66.8%; N: 7960)

Indebtedness <=0.435 (N: 796; S: 0.52%)	Liquidity <= 2.622 (N:294; S: 73%)	ROA <= 0.003 (N:133; S: 58%)
		ROA > 0.003 (N:161; S: 85%)
	Liquidity > 2.622 (N:502; S: 39%)	Industry entry <= 0.028 (N:121; S: 21%)
		Industry entry (0.028, 0.030] (N:110; S: 42%)
		Industry entry (0.030, 0.039] (N:151; S: 58%)
		Industry entry > 0.039 (N:120; S: 33%)
Indebtedness (0.435, 0.673] (N: 798; S: 72%)	Total assets <= 61.541 (N:223; S: 53%)	Industry growth <= -0.037 (N:102; S: 69%)
		Industry growth > -0.037 (N:121; S: 40%)
	Total assets (61.541, 122.243] (N:173; S: 68%)	
	Total assets (122.243, 236.134] (N:129; S: 100%)	
	Total assets (236.134, 777.067] (N:160; S: 80%)	
	Total assets > 777.067 (N:113; S: 72%)	
Indebtedness (0.673, 0.797] (N: 794; S: 62%)	Total assets <= 87.529 (N:330; S: 44%)	ROA <= 0.003 (N:140; S: 26%)
		ROA > 0.003 (N:190; S: 58%)
	Total assets (87.529, 236.134] (N:229; S: 69%)	
	Total assets (236.134, 777.067] (N:131; S: 94%)	
	Total assets > 777.067 (N:104; S: 62%)	

Indebtedness (0.797, 0.967] (N: 2392; S: 57%)	Liquidity <= 0.571 (N:265; S: 43%)	Indebtedness <= 0.927 (N:146; S: 51%)
		Indebtedness > 0.927 (N:119; S: 33%)
	Liquidity (0.571, 1.111] (N:1217; S: 62%)	ROA <= -0.108 (N:114; S: 37%)
		ROA (-0.108, 0.072] (N:929; S: 61%)
		ROA > 0.072 (N:174; S: 82%)
	Liquidity (1.111, 1.271] (N:496; S: 44%)	Indebtedness <= 0.871 (N:337; S: 38%)
		Indebtedness > 0.871(N:159; S: 55%)
	Liquidity (1.271, 1.625] (N:164; S: 76%)	
	Liquidity > 1.625 (N:250; S: 58%)	
Indebtedness (0.967, 1.153] (N: 1588; S: 47%)	Industry concentration <= 0.662 (N:486; S: 47%)	Liquidity <= 0.762 (N:126; S: 43%)
		Liquidity (0.762, 1.017](N:196; S: 59%)
		Liquidity > 1.017 (N:164; S: 37%)
	Industry concentration (0.662, 0.723] (N:551; S: 35%)	Industry growth <= -0.065 (N:256; S: 44%)
		Industry growth > -0.065 (N:295; S: 27%)
	Industry concentration (0.723, 0.843] (N:392; S: 65%)	ROA <= -0.023 (N:143; S: 78%)
		ROA (-0.023, 0.003] (N:114; S: 51%)
		ROA > 0.003(N:135; S: 64%)
	Industry concentration > 0.843 (N:159; S: 40%)	
Indebtedness (1.153, 1.590] (N: 797; S: 38%)	Industry entry <=0.034 (N:524; S: 42%)	Industry concentration <= 0.723 (N:354; S: 37%)
		Industry concentration > 0.723 (N:170; S: 53%)
	Industry entry > 0.034 (N:273; S: 30%)	
Indebtedness > 1,590 (N: 795; S: 24%)		

Table A2. Success prediction at age 1 with adjusted variables (Correct percent: 64.3%; N: 7960)

Adjusted ROA <= -0.658 (N: 796; S: 25%)	Adjusted liquidity <= 0.253 (N: 424; S: 19%)	Adjusted Total assets <= 0.095 (N: 225; S: 25%)
		Adjusted Total assets > 0.095 (N: 199; S: 12%)
	Adjusted liquidity > 0.253 (N: 372; S: 31%)	Industry growth <= -0.013 (N: 213; S: 40%)
		Industry growth > -0.013 (N: 159; S: 19%)
Adjusted ROA (-0.658, -0.280] (N: 798; S: 38%)	Adjusted Total assets <= 0.047 (N: 126; S: 24%)	
	Adjusted Total assets (0.047, 0.211] (N: 345; S: 35%)	Adjusted liquidity <= 0.579 (N: 192; S: 42%)
		Adjusted liquidity > 0.579 (N: 153; S: 27%)
	Adjusted Total assets > 0.211 (N: 327; S: 46%)	
Adjusted ROA (-0.280, -0.113] (N: 794; S: 44%)	Adjusted liquidity ratio <= 0.579 (N: 303; S: 45%)	
	Adjusted liquidity ratio (0.579, 0.852] (N: 289; S: 34%)	
	Adjusted liquidity ratio > 0.852 (N: 202; S: 56%)	

Adjusted ROA (-0.113, 0.009] (N: 2387; S: 52%)	Adjusted Indebtedness <= 0.611 (N: 240; S: 50%)	Adjusted liquidity <= 1.990 (N: 105; S: 62%)
		Adjusted liquidity > 1.990 (N: 135; S: 41%)
	Adjusted Indebtedness (0.611, 0.952] (N: 164; S: 76%)	
	Adjusted Indebtedness (0.952, 1.216] (N: 365; S: 67%)	Industry entry <= 0.034 (N: 229; S: 79%)
		Industry entry > 0.034 (N: 136; S: 47%)
	Adjusted Indebtedness > 1.216 (N: 1618; S: 47%)	Industry concentration <= 0.714 (N: 699; S: 48%)
		Industry concentration (0.714, 0.723] (N: 185; S: 35%)
		Industry concentration (0.723, 0.809] (N: 286; S: 64%)
		Industry concentration (0.809, 0.843] (N: 213; S: 47%)
		Industry concentration > 0.843 (N: 235; S: 32%)
Adjusted ROA (0.009, 0.066] (N: 1593; S: 58%)	Industry concentration <= 0.602 (N: 116; S: 79%)	
	Industry concentration (0.602, 0.662] (N: 414; S: 46%)	Industry growth <= -0.138 (N: 216; S: 59%)
		Industry growth > -0.138 (N: 198; S: 31%)
	Industry concentration (0.662, 0.683] (N: 100; S: 84%)	
	Industry concentration > 0.683 (N: 963; S: 58%)	Adjusted Total assets <= 0.095 (N: 121; S: 67%)
		Adjusted Total assets (0.095, 0.147] (N: 116; S: 45%)
		Adjusted Total assets (0.147, 0.400] (N: 299; S: 60%)
		Adjusted Total assets (0.400, 0.575] (N: 147; S: 46%)
		Adjusted Total assets > 0.575 (N: 280; S: 66%)

Adjusted ROA > 0.066 (N: 1592; S:0.65)	Adjusted Total assets <= 0.047 (N: 178; S: 42%)	
	Adjusted Total assets (0.047, 0.095] (N: 184; S: 52%)	
	Adjusted Total assets (0.095, 0.147] (N: 137; S: 71%)	
	Adjusted Total assets (0.147, 0.211] (N: 197; S: 51%)	
	Adjusted Total assets (0.211, 0.300] (N: 133; S: 76%)	
	Adjusted Total assets (0.300, 0.400] (N: 170; S: 58%)	
	Adjusted Total assets (0.400, 0.575] (N: 164; S: 71%)	
	Adjusted Total assets (0.575, 0.896] (N: 157; S: 90%)	
	Adjusted Total assets > 0.896 (N: 272; S: 76%)	Adjusted Indebtedness <= 1.111 (N: 148; S: 84%)
		Adjusted Indebtedness > 1.111 (N: 124; S: 68%)

Table A3. Success prediction at age 2 with original variables (Correct percent: 64.2%; N: 7021)

ROA <= -0.486 (N: 702; S: 28%)	Group membership 0 (N: 545; S: 24%)	Indebtedness <= 1.597 (N: 170; S: 34%)
		Indebtedness > 1.597 (N: 375; S: 20%)
	Group membership 1 (N: 157; S: 42%)	
ROA (-0.486, -0.189] (N: 699; S: 39%)	Industry concentration <= 0.650 (N: 145; S: 23%)	
	Industry concentration (0.650, 0.713] (N: 131; S: 47%)	
	Industry concentration (0.713, 0.724] (N: 148; S: 29%)	
	Industry concentration > 0.724 (N: 275; S: 49%)	
ROA (-0.189, -0.009] (N: 1407; S: 44%)	Total assets <= 29.348 (N: 133; S: 16%)	
	Total assets (29.348, 49.171] (N: 104; S: 46%)	
	Total assets (49.171, 75.816] (N: 157; S: 33%)	
	Total assets (75.816, 151.819] (N: 266; S: 45%)	
	Total assets (151.819, 210.098] (N: 109; S: 61%)	
	Total assets > 210.098 (N: 638; S: 50%)	Industry concentration <= 0.713 (N: 126; S: 67%)
		Industry concentration (0.713, 0.724] (N: 151; S: 26%)
		Industry concentration > 0.724 (N: 361; S: 53%)
ROA (-0.009, 0.004] (N: 703; S: 39%)	Industry entry <= 0.030 (N: 265; S: 47%)	Indebtedness <= 0.913 (N: 108; S: 61%)
		Indebtedness > 0.913 (N: 157; S: 38%)
	Industry entry (0.030, 0.031] (N: 173; S: 27%)	
	Industry entry (0.031, 0.049] (N: 159; S: 52%)	
	Industry entry > 0.049 (N: 106; S: 21%)	

ROA (0.004, 0.015] (N: 699; S: 56%)	Total assets <= 109.028 (N: 165; S: 45%)	
	Total assets > 109.028 (N: 534; S: 59%)	Liquidity <= 1.382 (N: 403; S: 55%)
		Liquidity > 1.382 (N: 131; S: 73%)
ROA (0.015, 0.168] (N: 2106; S: 63%)	Total assets <= 29.348 (N: 170; S: 38%)	
	Total assets (29.348, 109.028] (N: 609; S: 56%)	Group membership 0 (N: 389; S: 60%)
		Group membership 1 (N: 220; S: 49%)
	Total assets (109.028, 300.433] (N: 697; S: 63%)	Liquidity <= 1.039 (N: 213; S: 67%)
		Liquidity (1.039, 1.382] (N: 276; S: 52%)
		Liquidity > 1.382 (N: 208; S: 73%)
	Total assets (300.433, 496.183] (N: 239; S: 77%)	Industry entry <= 0.030 (N: 136; S: 69%)
		Industry entry > 0.030 (N: 103; S: 86%)
	Total assets (496.183, 1115.402] (N: 190; S: 85%)	
	Total assets > 1115.402 (N: 201; S: 69%)	
ROA > 0.168 (N: 705; S: 55%)	Total assets <= 75.816 (N: 280; S: 38%)	Industry concentration <= 0.733 (N: 140; S: 50%)
		Industry concentration > 0.733 (N: 140; S: 25%)
	Total assets (75.816, 151.819] (N: 115; S: 76%)	
	Total assets > 151.819 (N: 310; S: 64%)	Industry entry <= 0.037 (N: 201; S: 58%)
		Industry entry > 0.037 (N: 109; S: 74%)

Table A4. Success prediction at age 2 with adjusted variables (Correct percent: 65.4%; N: 7021)

Adjusted ROA <= -0.479 (N: 699; S: 29%)	Group membership 0 (N: 542; S: 25%)	Adjusted Indebtedness <= 2.227 (N: 154; S: 36%)
		Adjusted Indebtedness > 2.227 (N: 388; S: 21%)
	Group membership 1 (N: 157; S: 42%)	
Adjusted ROA (-0.479, -0.193] (N: 705; S: 38%)	Industry concentration <= 0.650 (N: 158; S: 20%)	
	Industry concentration (0.650, 0.713] (N: 139; S: 45%)	
	Industry concentration (0.713, 0.724] (N: 147; S: 29%)	
	Industry concentration > 0.724 (N: 261; S: 52%)	
Adjusted ROA (-0.193, -0.0002] (N: 2106; S: 43%)	Adjusted Total assets <= 0.114 (N: 356; S: 25%)	
	Adjusted Total assets (0.114, 0.183] (N: 146; S: 62%)	
	Adjusted Total assets (0.183, 0.362] (N: 395; S: 36%)	Industry entry <= 0.030 (N: 124; S: 49%)
		Industry entry > 0.030 (N: 271; S: 30%)
	Adjusted Total assets (0.362, 1.098] (N: 672; S: 48%)	Industry concentration <= 0.713 (N: 231; S: 61%)
		Industry concentration > 0.713 (N: 441; S: 41%)
	Adjusted Total assets (1,098, 2.485] (N: 230; S: 57%)	Adjusted liquidity <= 0.787 (N: 102; S: 73%)
		Adjusted liquidity > 0.787 (N: 128; S: 45%)
	Adjusted Total assets > 2.485 (N: 307; S: 43%)	Industry entry <= 0.031 (N: 205; S: 32%)
		Industry entry > 0.031 (N: 102; S: 66%)

Adjusted ROA (-0.0002, 0.011] (N: 703; S: 53%)	Adjusted Total assets <= 0.183 (N: 118; S: 41%)	
	Adjusted Total assets (0.183, 2.485] (N: 476; S: 59%)	
	Adjusted Total assets > 2.485 (N: 109; S: 42%)	
Adjusted ROA (0.011, 0.165] (N: 2106; S: 63%)	Adjusted Total assets <= 0.114 (N: 318; S: 49%)	Adjusted liquidity <= 0.787 (N: 116; S: 64%)
		Adjusted liquidity > 0.787 (N: 202; S: 41%)
	Adjusted Total assets (0.114, 0.183] (N: 211; S: 64%)	
	Adjusted Total assets (0.183, 0.259] (N: 255; S: 53%)	Adjusted ROA <= 0.064 (N: 147; S: 62%)
		Adjusted ROA> 0.064 (N: 108; S: 42%)
	Adjusted Total assets (0.259, 0.718] (N: 628; S: 68%)	Industry growth <= -0.027 (N: 195; S: 68%)
		Industry growth (-0.027, -0.005] (N: 224; S: 56%)
		Industry growth > -0.005 (N: 209; S: 80%)
	Adjusted Total assets (0.718, 1.098] (N: 264; S: 58%)	Adjusted ROA <= 0.029 (N: 114; S: 45%)
		Adjusted ROA > 0.029 (N: 150; S: 67%)
	Adjusted Total assets (1.098, 2.485] (N: 235; S: 82%)	Industry growth <= -0.010 (N: 134; S: 74%)
		Industry growth > -0.010 (N: 101; S: 93%)
	Adjusted Total assets > 2.485 (N: 195; S: 71%)	
Adjusted ROA > 0.165 (N: 702; S: 55%)	Adjusted Indebtedness <= 0.609 (N: 226; S: 54%)	Industry entry <= 0.030 (N: 123; S: 37%)
		Industry entry > 0.030 (N: 103; S: 73%)
	Adjusted Indebtedness (0.609, 1.196] (N: 326; S: 68%)	Industry concentration <= 0.681 (N: 148; S: 57%)
		Industry concentration > 0.681 (N: 178; S: 76%)
	Adjusted Indebtedness > 1.196 (N: 150; S: 30%)	

Table A5. Success prediction at age 3 with original variables (Correct percent: 66.7%; N: 5732)

ROA <= -0.482 (N: 572; S: 26%)	Industry growth <= -0.089 (N: 107; S: 38%)	
	Industry growth (-0.089, -0.086] (N: 104; S: 8%)	
	Industry growth (-0.086, -0.020] (N: 187; S: 23%)	
	Industry growth > -0.020 (N: 174; S: 31%)	
ROA (-0.482, -0.226] (N: 574; S: 32%)		
ROA (-0.226, 0.002] (N: 1720; S: 47%)	Total assets <= 81.411 (N: 428; S: 36%)	
	Total assets (81.411, 165.851] (N: 333; S: 44%)	Indebtedness <= 0.997 (N: 197; S: 51%)
		Indebtedness > 0.997 (N: 136; S: 34%)
	Total assets (165.851, 232.801] (N: 164; S: 63%)	
	Total assets (232.801, 328.543] (N: 216; S: 39%)	
	Total assets (328.543, 1144.558] (N: 365; S: 52%)	Liquidity <= 1.213 (N: 244; S: 43%)
		Liquidity > 1.213 (N: 121; S: 70%)
	Total assets > 1144.558 (N: 214; S: 64%)	

ROA (0.002, 0.151] (N: 2293; S: 65%)	Indebtedness <= 0.390 (N: 213; S: 58%)	Industry concentration <= 0.733 (N: 100; S: 40%)
		Industry concentration > 0.733 (N: 113; S: 73%)
	Indebtedness (0.390, 0.726] (N: 548; S: 72%)	Industry concentration <= 0.733 (N: 210; S: 74%)
		Industry concentration (0.733, 0.814] (N: 236; S: 59%)
		Industry concentration > 0.814 (N: 102; S: 94%)
	Indebtedness (0.726, 0.814] (N: 352; S: 59%)	Industry growth <= -0.064 (N: 148; S: 43%)
		Industry growth > -0.064 (N: 204; S: 71%)
	Indebtedness (0.814, 0.896] (N: 332; S: 75%)	Industry concentration <= 0.686 (N: 125; S: 62%)
		Industry concentration > 0.686 (N: 207; S: 83%)
	Indebtedness (0.896, 1.181] (N: 711; S: 65%)	Industry growth <= -0.089 (N: 158; S: 47%)
		Industry growth (-0.089, -0.064] (N: 140; S: 66%)
		Industry growth (-0.064, -0.020] (N: 118; S: 80%)
		Industry growth (-0.020, 0.043] (N: 152; S: 61%)
		Industry growth > 0.043 (N: 143; S: 79%)
	Indebtedness > 1.181 (N: 137; S: 39%)	
ROA > 0.151 (N: 573; S: 57%)	Total assets <= 119.443 (N: 299; S: 42%)	
	Total assets > 119.443 (N: 274; S: 74%)	Industry growth <= -0.020 (N: 158; S: 62%)
		Industry growth > -0.020 (N: 116; S: 90%)

Table A6. Success prediction at age 3 with adjusted variables (Correct percent: 64.9%; N: 5732)

Adjusted ROA <= -0.487 (N: 571; S: 25%)	Industry growth <= -0.089 (N: 107; S: 38%)	
	Industry growth (-0.089, -0.086] (N: 104; S: 8%)	
	Industry growth (-0.086, -0.020] (N: 187; S: 23%)	
	Industry growth > -0.020 (N: 173; S: 31%)	
Adjusted ROA (-0.487, -0.218] (N: 578; S: 33%)		
Adjusted ROA (-0.218, -0.030] (N: 1144; S: 47%)	Adjusted Total assets <= 0.126 (N: 186; S: 29%)	
	Adjusted Total assets (0.126, 0.415] (N: 361; S: 45%)	Adjusted ROA <= -0.096 (N: 172; S: 51%)
		Adjusted ROA > -0.096 (N: 189; S: 40%)
	Adjusted Total assets > 0.415 (N: 597; S: 53%)	Industry entry <= 0.030 (N: 155; S: 65%)
		Industry entry (0.030, 0.044] (N: 303; S: 52%)
		Industry entry > 0.044 (N: 139; S: 40%)
Adjusted ROA (-0.030, 0.010] (N: 1148; S: 55%)	Adjusted Total assets <= 0.198 (N: 244; S: 39%)	
	Adjusted Total assets > 0.198 (N: 904; S: 60%)	Adjusted Indebtedness <= 0.862 (N: 121; S: 85%)
		Adjusted Indebtedness (0.862, 1.272] (N: 287; S: 62%)
		Adjusted Indebtedness > 1.272 (N: 496; S: 52%)
Adjusted ROA (0.010, 0.029] (N: 572; S: 72%)	Industry entry <= 0.028 (N: 130; S: 72%)	
	Industry entry (0.028, 0.031] (N: 136; S: 87%)	
	Industry entry > 0.031 (N: 306; S: 65%)	

Adjusted ROA (0.029, 0.058] (N: 573; S: 58%)	Industry concentration <= 0.769 (N: 436; S: 53%)	
	Industry concentration > 0.769 (N: 137; S: 74%)	
Adjusted ROA (0.058, 0.147] (N: 571; S: 68%)	Adjusted Total assets <= 0.126 (N: 109; S: 45%)	
	Adjusted Total assets (0.126, 0.585] (N: 242; S: 68%)	Industry growth <= -0.034 (N: 136; S: 60%)
		Industry growth > -0.034 (N: 106; S: 77%)
	Adjusted Total assets > 0.585 (N: 220; S: 81%)	Industry entry <= 0.033 (N: 116; S: 95%)
		Industry entry > 0.033 (N: 104; S: 65%)
Adjusted ROA > 0.147 (N: 575; S: 57%)	Adjusted Total assets <= 0.126 (N: 175; S: 31%)	
	Adjusted Total assets > 0.126 (N: 400; S: 69%)	Industry growth <= -0.020 (N: 236; S: 62%)
		Industry growth > -0.020 (N: 164; S: 78%)

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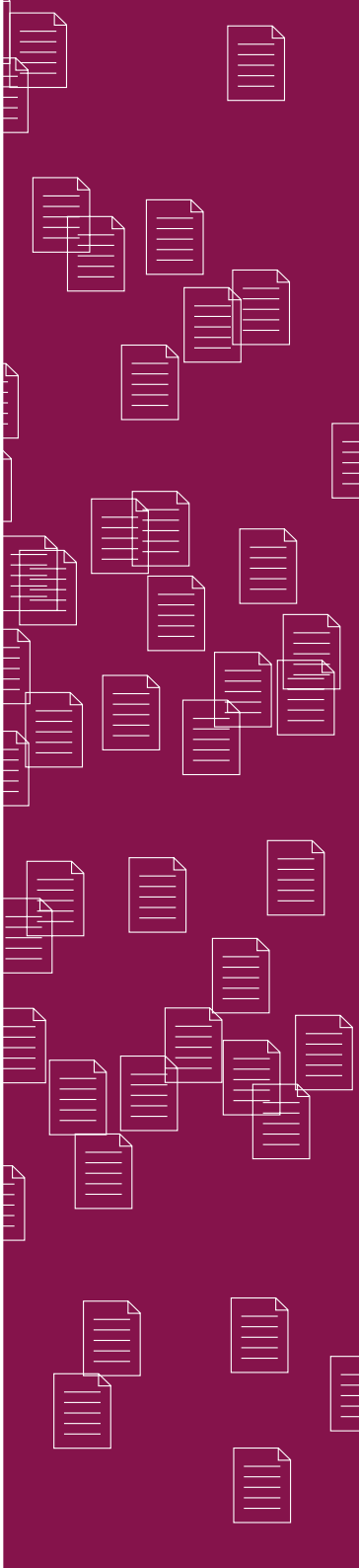

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