A decision tree analysis of the financial impacting factors on the profit of new firms: Evidence from Spanish food industry in the upturn and the downturn periods

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Necessity for profit study

• Profit maximization is the core purpose of firm’s stockholders (Lieberman and Montgomery, 1988).

• Creating a profitable firm (as a stage of business creation) is a crucial topic of entrepreneurship (Reynolds, 2016).

• Firm-level profitability can be studied from: industry economics (with the structure–conduct–performance paradigm) and strategic management (focusing on internal resources) (Goddard et al., 2005).

• Crisis makes the role of financial management (burdening company’s liquidity, solvency, and finally owners’ capital) more important for the economic growth and the development of companies (Raykov, 2017).

• Being stable is a feature of food industry, which means that the impact of economic crisis is much smaller on food industry than on other industries (Castañer, 2009).
Food industry in Spain

• According to the data from Encuesta Industrial de Empresas in 2000, food, beverage and tobacco sectors in Spain occupied considerable shares in employment, business sales, and value added but showed relatively lower figures in value added per employee and value added per unit of sale, compared to other industrial sectors (Juste-Carrión and Gómez-García, 2005).

• According to the data of Spanish Ministry of Agriculture and the Industrial Companies Survey, as the first industrial sector food industry contributed for around one fifth of the net sales and employment as well as one seventh of the value added in 2012 (Duarte et al, 2015).

• Purpose: This paper tries to explore the impacts of financial factors (together with group membership) on gaining profits of new firms in Spanish food industry in the second and the third year after founding, and tries to catch the similarities and differences of the impacts between the upturn and the downturn periods.
<table>
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<tr>
<th>Literature review for the impacting factors on profitability</th>
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<tr>
<td><strong>Indebtedness</strong></td>
</tr>
<tr>
<td>• No influence of financial structure on firm value (Modigliani and Miller, 1958)</td>
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<tr>
<td>• Positive relationship: the increase in market’s perception of value along with the increase in leverage (Ross, 1977).</td>
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<tr>
<td>• Positive relationship: Debt financing can help to abate agency costs of free cash flows (Jensen, 1986)</td>
</tr>
<tr>
<td>• Negative relationship: Agency costs — conflicts between shareholders and debt-holders (Jensen and Meckling, 1976)</td>
</tr>
<tr>
<td>• Spanish empirical evidence: negative relationship of the firms in food industry in Spanish Navarre community (Zouaghi et al., 2017).</td>
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<tr>
<td><strong>Efficiency</strong></td>
</tr>
<tr>
<td>• Asset turnover represents asset productivity and then business efficiency (Pervan and Višić, 2012).</td>
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<tr>
<td>• DuPont system: ROE into profit margin, asset turnover and financial leverage (Soliman, 2008)</td>
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<tr>
<td>• Empirically, total asset turnover is positively related to profitability (Santosuosso, 2014).</td>
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</table>
Literature review for the impacting factors on profitability (continued)

| Liquidity          | • Keeping liquidity above the minimum required level, negative relationship exists; if below the minimum liquidity level, positive relationship exists (Bolek and Wiliński, 2012).
|                   | • Empirically, the ratio of current liabilities to current assets is negatively related to the profitability of food processing firms (Hirsch et al., 2014). |
| Firm size          | • Advantages of large size: economics of scale, bargaining power, brand name recognition, experience curve effects, and power to impact prices (Fiegenbaum and Karnani, 1991) 
|                   | • Advantage of small size: output flexibility (Fiegenbaum and Karnani, 1991) 
|                   | • Empirically positive relationship is supported by Roper (1999), Serrasqueiro (2009), and particularly Gschwandtner and Hirsch (2017) for US and EU food processing industry. |
### Literature review for the impacting factors on profitability (continued)

#### Growth
- **Positive relationship:** L-shaped cost curves and minimum efficient scale (Mansfield, 1979; Gupta, 1981)
- **Negative relationship:** growth beyond the efficient scale; expansion driving firms from the most profitable market segments to less profitable segments (Steffens et al., 2009)
- **Empirical studies:** being statistically insignificant (Baños-Caballero et al., 2012); positive relationship in food industry in Spanish Valencia community (Zouaghi et al., 2017).

#### Previous profitability
- **Good past-year profitability** can bring more resources in (Yazdanfar, 2013).
- **Positive relationship** is supported by Serrasqueiro (2009) and Salman and Yazdanfar (2012).
- **Lower profit persistence** of food processing firms (Gschwandtner and Hirsch, 2017).

#### Group membership
- **Benefits:** internalizing market transactions, creating internal networks, and transferring financial resources internally to decrease risk (Estrin et al., 2009)
- **Drawback:** the values of affiliates are extracted by business groups for promoting group stability (Estrin et al., 2009).
- **The importance of the environment created by corporate parent** on the profitability of firms in food economy is stressed by Chaddad and Mondelli (2013).

2000 and 2001 cohorts are combined as the upturn period group, while 2008 and 2009 cohorts are combined as the downturn (crisis) period group.

Each firm is tracked for three years after the incorporation year.

Only analyzing the data in the second year and the third year (the data in the first year for proffering the previous economic profitability and calculating the growth of sales).

The upturn group has 722 firms in the second year and 620 firms in the third year; the downturn group has 359 firms in the second year and 321 firms in the third year.
### Variables

<table>
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<tr>
<th>Variables</th>
<th>Definitions</th>
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<tbody>
<tr>
<td><strong>Dependent variable</strong></td>
<td></td>
</tr>
<tr>
<td>Gaining profits or not</td>
<td>If economic profitability (profits before tax/total assets) is positive, it equals 1; if economic profitability is zero or negative, it equals 0.</td>
</tr>
<tr>
<td><strong>Independent variables</strong></td>
<td></td>
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<tr>
<td>Leverage</td>
<td>Indebtedness: (Total shareholders funds and liabilities—Shareholders equity)/Total shareholders funds and liabilities</td>
</tr>
<tr>
<td>General liquidity</td>
<td>Current ratio: Current assets/Current liabilities</td>
</tr>
<tr>
<td>Efficiency</td>
<td>Asset rotation: Sales/Total assets</td>
</tr>
</tbody>
</table>
### Independent variables

<table>
<thead>
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<th>Definitions</th>
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<tr>
<td><strong>Firm size</strong></td>
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<tr>
<td><strong>Growth</strong></td>
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<tr>
<td><strong>Previous profitability</strong></td>
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<tr>
<td><strong>Group membership</strong></td>
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Methodology

Bastos and Ramalho (2016, p.349) said:

“Decision trees are one of the simplest techniques of pattern recognition, deriving their predictive power by recursively partitioning the original data set, in accordance with some criteria, into smaller mutually exclusive subsets, until all observations are allocated to a terminal node.”

The CHAID (Chi-squared Automatic Interaction Detection) algorithm enables implementation of the following processes (Milanović and Stamenković, 2016, p.572):

• The selection of the relevant independent variables from the set of input variables in such way that, in the resulting hierarchically arranged structure, as the first independent variable for the partition of input data is selected the variable with the lowest p-value, and is, therefore, most strongly associated with the dependent variable.

• In the procedure of hypothesis testing, if the p-value is equal to or lower than the predefined level of significance $\alpha$, then the alternative hypothesis, which suggests a dependency between variables is accepted, which, in the context of tree development, denotes node splitting using a given independent variable. Otherwise, the node is considered to be the terminal node.

• Tree building ends when p-values of all the observed independent variables are higher than a certain split threshold.
Methodology (continued)

The CHAID (Chi-squared Automatic Interaction Detection) algorithm enables implementation of the following processes (Milanović and Stamenković, 2016, p.572):

- Merging the categories (values) of each independent variable so that a certain number of nodes, with statistically significant difference between them, appear on the tree.
- In fact, the algorithm identifies pairs of values of independent variables which are least different from the dependent variable, so that the number of categories of predictor variables depends on the Chi-square test results and p-value.
- If the obtained p-value is higher than a certain merge threshold, the algorithm merges particular categories with no statistically significant differences.
- After that, the search for a new merging pair continues until the pairs, for which the p-value is smaller than the defined level of significance $\alpha$, are not identified.
Results & conclusions

• Previous profitability and indebtedness are most important, due to high rankings.
• The most important contribution is: profit-impacting factors in food industry tend to be different in different macro-economic environments, especially in the second year.
• From the upturn to the downturn period, indebtedness replaces previous profitability as the first level variable in the second year tree, while liquidity becomes significant at the second level in the third year tree.
• Being similar to Notta and Vlachvei (2014), where liquidity and leverage work as statistically significant variables during crisis in Greek dairy manufacturing sector.
• Thus, for the firms in crisis, keeping liquidity and controlling leverage are good options.
• As a general trend, positive relationship to gaining profits is observed for previous profitability, growth, asset rotation, total assets, and general liquidity; indebtedness tends to be negatively related to gaining profits.
The tree of food industry in the upturn period (the second year)
The tree of food industry in the downturn period (the second year)
Positive profit

Indebtedness
Adj. P-value=0.000, Chi-square=123.098, df=2

<= 0.0242

Node 1
Category | % | n
---|---|---
0.000 | 35.0 | 86
1.000 | 65.0 | 160
Total | 49.9 | 246

(0.0242, 1.0165)

Node 2
Category | % | n
---|---|---
0.000 | 48.0 | 48
1.000 | 52.0 | 52
Total | 50.2 | 100

> 1.0165

Node 3
Category | % | n
---|---|---
0.000 | 91.9 | 138
1.000 | 8.1 | 12
Total | 90.0 | 150

Previous profitability
Adj. P-value=0.000, Chi-square=58, 440, df=2

<= -0.0138

Node 4
Category | % | n
---|---|---
0.000 | 68.8 | 48
1.000 | 31.2 | 21
Total | 40.0 | 69

[-0.0138, 0.0458]

Node 5
Category | % | n
---|---|---
0.000 | 33.3 | 24
1.000 | 66.7 | 42
Total | 46.4 | 71

> 0.0458

Node 6
Category | % | n
---|---|---
0.000 | 13.2 | 14
1.000 | 86.8 | 92
Total | 46.4 | 106

Total assets
Adj. P-value=0.000, Chi-square=9, 388, df=1

<= 318,7150

Node 7
Category | % | n
---|---|---
0.000 | 20.9 | 14
1.000 | 79.1 | 53
Total | 44.6 | 67

> 318,7150

Node 8
Category | % | n
---|---|---
0.000 | 0.0 | 0
1.000 | 100.0 | 59
Total | 7.9 | 39
The tree of food industry in the upturn period (the third year)
The tree of food industry in the downturn period (the third year)
## Food industry in the upturn period (the second year; N: 976, correct percent: 77.4%)

<table>
<thead>
<tr>
<th>Previous profitability</th>
<th>Growth &lt;= 0.0360; N: 83, P: 6%</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;= -0.0546; N: 293, P: 20%</td>
<td>Asset rotation &lt;= 1.5150; N:125,P:17%</td>
</tr>
<tr>
<td></td>
<td>Growth &gt; 0.0360; N: 210, P: 26%</td>
</tr>
<tr>
<td>Asset rotation &lt;= 0.8360; N: 87,P: 15%</td>
<td>Asset rotation &gt; 1.5150; N: 85, P: 39%</td>
</tr>
<tr>
<td>Previous profitability (-0.0546, 0.0005]; N: 195, P: 29%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Indebtedness &lt;= 0.9643; N: 53,P: 59%</td>
</tr>
<tr>
<td>Asset rotation &gt; 0.8360; N: 108,P: 41%</td>
<td>Indebtedness &gt; 0.9643; N: 55, P: 24%</td>
</tr>
<tr>
<td>Previous profitability (0.0005, 0.0111]; N: 98, P: 63%</td>
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</tr>
<tr>
<td>Previous profitability &gt; 0.0111; N: 390, P: 74%</td>
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<tr>
<td>Indebtedness &lt;= 0.9934; N: 350,P:80%</td>
<td></td>
</tr>
<tr>
<td>Indebtedness &gt; 0.9934; N: 40, P: 25%</td>
<td></td>
</tr>
<tr>
<td>Category</td>
<td>Lower Bound</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Indebtedness &lt;= 0.9242</td>
<td></td>
</tr>
<tr>
<td>Previous profitability &lt;= -0.0138</td>
<td></td>
</tr>
<tr>
<td>Previous profitability (-0.0138, 0.0438]</td>
<td></td>
</tr>
<tr>
<td>Previous profitability &gt; 0.0438</td>
<td></td>
</tr>
<tr>
<td>Total assets &lt;= 318.7150</td>
<td></td>
</tr>
<tr>
<td>Total assets &gt; 318.7150</td>
<td></td>
</tr>
<tr>
<td>Indebtedness (0.9242, 1.0195]</td>
<td></td>
</tr>
<tr>
<td>Indebtedness &gt; 1.0195</td>
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</tbody>
</table>
Food industry in the upturn period (the third year; N: 815, correct percent: 77.1%)

<table>
<thead>
<tr>
<th>Previous profitability &lt;= -0.0011; N: 325, P: 25%</th>
<th>Asset rotation &lt;= 1.1260; N: 185, P: 15%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asset rotation &gt; 1.8180; N: 101, P: 31%</td>
<td>Growth &lt;= -0.0770; N: 53, P: 2%</td>
</tr>
<tr>
<td>Asset rotation (1.1260, 1.8180]; N: 39, P: 59%</td>
<td>Growth &gt; -0.0770; N: 132, P: 20%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Previous profitability (-0.0011, 0.0176]; N: 164, P: 50%</th>
<th>Indebtedness &lt;= 0.7546; N: 38, P: 42%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indebtedness &gt; 0.9796; N: 53, P: 32%</td>
<td>Indebtedness &gt;= 0.7546; N: 78, P: 90%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Previous profitability (0.0176, 0.1321]; N: 245, P: 77%</th>
<th>Indebtedness &lt;= 0.7546; N: 37, P: 62%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indebtedness &gt; 0.9796; N: 94, P: 87%</td>
<td>Indebtedness &gt; 0.9796; N: 36, P: 39%</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>Previous profitability &gt; 0.1321; N: 81, P: 90%</th>
<th>Indebtedness &lt;= 0.7546; N: 78, P: 90%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indebtedness &gt; 0.9796; N: 36, P: 39%</td>
<td>Indebtedness &gt; 0.9796; N: 36, P: 39%</td>
</tr>
<tr>
<td>Previous profitability &lt;= -0.0143; N: 177, P: 16%</td>
<td>Previous profitability (-0.0143, 0.0033]; N: 44, P: 46%</td>
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<td>-------------------------------------------------</td>
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<tr>
<td>General liquidity &lt;= 0.3610; N: 65, P: 2%</td>
<td>General liquidity &gt; 0.3610; N: 112, P: 25%</td>
</tr>
<tr>
<td>Asset rotation &lt;= 1.7650; N: 77, P: 12%</td>
<td>Asset rotation &gt; 1.7650; N: 35, P: 54%</td>
</tr>
<tr>
<td>Indebtedness &lt;= 0.7369; N: 88, P: 75%</td>
<td>Indebtedness (0.7369, 0.8970]; N: 54, P: 89%</td>
</tr>
<tr>
<td>Indebtedness &gt; 0.8970; N: 79, P: 47%</td>
<td>Indebtedness &gt; 0.8970; N: 79, P: 47%</td>
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</tbody>
</table>
References


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