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ESTIMATING EBITDA FOR SMES

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PREFACE

This research investigates whether it is possible estimate the profitability of a small- or medium sized company based on public data. This is done by searching for correlations between EBITDA and other metrics, and testing these using several modeling techniques. EBITDA is a commonly used financial metric for example in the multiple valuation method. To test to what extent it is possible to estimate this value, a series of literature based variables is tested on its correlation towards target variable EBITDA. These insights are used to test the ability of several modeling techniques to estimate EBITDA.

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1. INTRODUCTION

Within this research is investigated whether it is possible estimate the profitability of a small- or medium sized company based on public data. This is done by searching for correlations between EBITDA and other metrics, and testing these using several modeling techniques. EBITDA is a commonly used financial metric for example in the multiple valuation method.

From an academic perspective, the predictability of EBITDA and its correlation with other variables is an area in which little research has been conducted. While much research has been done regarding valuation multiples and their links to other variables, these studies often do not touch upon the value of multiplying. That part is the void we are trying to fill in this research.

Big datasets are required to set up a valid model. The need for more data is likely one of the core reasons why so little research has been conducted within this specific area. Exploring the relationship between EBITDA and a broad selection of other variables brings new knowledge. The findings throughout this process have the potential to offer additional foundational knowledge for future research towards financial metrics and their determinants.

Additionally, identifying and testing new correlations within this research will broaden the academic argument towards financial evaluations. This is mainly because only a few research studies regarding EBITDA have been conducted. This implies that this research will likely find something new and identify interesting follow-up research or other insights that can be used in future optimisation projects. Furthermore, this research will test different models against each other; the findings of these tests will be helpful since they tell future researchers what techniques are worth investigating and which ones one should not try.

2. RESEARCH DESIGN

The goal of this research is to establish correlations which allow one to accurately estimate a companies profitability, expressed in EBITDA. The main research question we are trying to answer here is:

"How can the EBITDA of SMEs accurately be estimated based on publicly available data?"

To tackle this problem we need to go through several research phases. These are give below.

1. **Phase 1: introduction and approach**

In the first research phase the research design is set up and the main research question is determined

2. **Phase 2: Literature review**

The second phase of this research touches upon the first building block towards answering our main research question. Here is an extensive literature review, considering literature discussing indicators of any kind for the profitability of an enterprise. Here, we look at literature focusing on the SME sector. Due to the limited availability of research regarding influences on EBITDA, we look into research towards factors influencing profitability.

3. **Phase 3: Data gathering and model selection**

The third phase of this research forms the basis for the experiments conducted in phase 4. Within this phase, the insights gained from the literature review in phase 2 are taken as a basis to create a dataset which we use to test to what extent EBITDA can be estimated. Next a selection of models is chosen to test the data.

4. **Phase 4: Conducting Experiments**

Here the chosen models are tested using specified test metrics and validation techniques. The test metrics are chosen to allow us to compare the accuracy of each models capabilities to estimate out target variable EBITDA.

5. **Phase 5: Conclusions**

In the last research phase, we look back at the results of our experiments and draw conclusions to answer the main research question. Furthermore we discuss any flaws that could make the execution of this research debatable.

3. LITERATURE REVIEW

Within the literature review, we need a systematic approach. To do so we first identify the main knowledge question we want to answer in our literature review, which is:

"What are the indicators that correlate with profitability in small and medium-sized enterprises (SMEs)?"

To search for literature, we set up a criteria and a search terms, which form the basis of our search. Important to note is that in practice, we went off these search strategies sometimes since we found that valuable literature for our research could also be found, e.g. in the references of articles that popped up using our search string. Further, we need to mention that although the primary approach of our research is EBITDA, we chose to look for literature discussing factors contributing to profitability due to limited available research regarding correlations with EBITDA. Given that data on the easiest metrics to estimate EBITDA, such as net revenue, gross margin and cost of goods sold, is usually not available for smaller firms we focus on, these obvious variables will be excluded from the theoretical framework.

For the theoretical framework, several aspects have to be addressed to ensure the framework is relevant and applicable to our research. First, we need to address and map correlations and interrelationships between established variables. This element is key since the variables will be used in a model. If variables correlate, this may have consequences for the ability to create a solid model. Besides, it is important to review and address the article's research population to ensure their relevance. For example, research based on small farms in Ethiopia is not likely to be representative of Western European SMEs. To ensure the relevance of the theoretical framework, the conditions of all sources used are taken into consideration. From a total of 27 sources, seven times; this is non-applicable due to the source being a book or literature review. In 17 cases, the research is regarding SMEs, with only three outside of Europe. The other four sources are three based on research taking into account SMEs and large firms and one on only larger firms.

3.1 IDENTIFYING CORRELATIONS

The profitability of small and medium-sized enterprises (SMEs) relies on a correlating network of variables, all contributing to the success of the firm. These variables vary from financial, strategic or even external ones. The difficult intercorrelations between all these aspects form the determinants and understanding of what makes a firm profitable.

The size of a firm, usually easy to capture by the number of employees, indicates its growth dynamics. Larger SMEs frequently have a more stable business, secured by both operational capabilities and market reach (Coad et al., 2013; Gupta & Banga, 2010). The age of an SME has a similar ability to capture a firms maturity, which usually culminates in raised profitability. There is a positive correlation between firm age and size, older usually means bigger (Coad et al., 2013; Nunes et al., 2012).

Debt management plays a crucial role in the financial success of an SME. Particularly important is how an enterprise handles its debtors. This is directly related to the liquidity and financial health of a firm in general (Gitman, 2003; Peel et al., 2000). Furthermore, the collection period of debtors has a negative relation with a firms profitability (Iqbal et al., 2014).

Most researchers have come to the conclusion that working capital is the lifeblood of any firm (Padachi, 2006). The management of working capital involves balancing short-term assets and liabilities. This is a key area of attention and directly has implications for profitability (Iqbal et al., 2014; Lazaridis & Tryfonidis, 2006). Well-structured working capital management has a positive relationship towards a firms profitability (Deloof, 2003; Edi & Saad, 2010). Empirical research identified a concave relationship between working capital and profitability. This implies that an optimal level of working capital has to be maintained. Deviations from this optimum result in reduced profitability (Afrifa & Padachi, 2016; Korent & Orsag, 2018). Debt management and working capital management are practises that influence each other. Ensuring a continuous capital flow via solid debt management is crucial for a firms operational fluency (Gitman, 2003; Jack, 2010). On the other hand, solvency ratios, influenced by debt management and asset utilization, offer a clear view of a firms financial well-being (Mun & Jang, 2015).

The sector in which an enterprise is active plays a pivotal role. Challenges and opportunities emerging when doing business are highly reliant on a firms sector, and therefore, the sector influences profitability significantly (Beaver, 2002). Furthermore, factors such as technological advancements, market saturation and competition are highly sector-dependent (Makadok, 2010). Earlier research establishing a framework to estimate financial metrics, in this case, ROA, also shows different correlations per sector between model variables and ROA (Brush et al., 1999). Brush et al. directly connects to another predictive metric of a firms profitability, namely financial ratios, which can be predictors of a firms financial health and profitability. Financial ratios, especially solvency, are key in deriving an SMEs financial stableness and measuring its profitability prospects (Brigham & Ehrhardt, 2013). Previous research by Popa & Ciobanu considered both return on equity (ROE) and return on invested capital (ROIC) and set up valid regression models with a determination coefficient of over 65%. Financial ratios, such as solvability and coverage of interest ratios, had a significant contribution to these models (Popa & Ciobanu, 2014).

Engaging in Corporate Social responsibility (CSR) could give a SMEs reputation a boost, resulting in better profitability (Lins et al., 2016). Online presence, grounded by a significant digital footprint and e-commerce capabilities, could extend a firms market reach and thus enhance sales and profitability (Luca, 2011). Licensing and patents provide exclusive rights, usually leading to a competitive advantage and improved profitability (Arundel & Kabla, 1998). Earlier research establishes reason to believe that research and development (R&D) increases this competitive advantage and enhances profitability

further. Nunes et al. claim a positive relationship between R&D and profitability (Nunes et al., 2012). Although econometric models could not establish a significant influence of R&D on profitability due to small samples, the results of Purcarea & Stancu show a trendline suggesting a positive correlation. (Purcarea & Stancu, 2008).

Networking plays a crucial role for SMEs. It facilitates access to resources, knowledge sharing and access to collaborations and opportunities directly impacting profitability (Jack, 2010). Within SME the networking dynamics of a firm will at least be partially reliant on the owners competency, which is a variable proven to have a positive effect on an SMEs performance and, thus, profitability in general (Ucbasaran et al., 2008). Furthermore, the networking dynamics could influence multiple facets, including technological adoption and market expansion. When SMEs form partnerships, their strategic capabilities are enhanced, directly influencing profitability (Jack, 2010). At the same time, technological integration and online presence serve as important pillars to meet customer preferences and ensure sustained profitability in evolving markets (Raymond & St-Pierre, 2005; Zahra, 1991). Last, a firms access to financial resources correlates with almost all factors influencing profitability. A firms resources play a key role in its ability to fund projects, handle emergencies and sustain competitive advantages (Barney, 1991).

3.2 CONCLUSION LITERATURE REVIEW

Using the insights from the literature review in Section 3.2. We can identify fourteen different aspects that are likely indicators of a firms profitability. These fourteen aspects can be seen in the interference matrix in Figure 1. This matrix shows what different aspects interfere according to the literature. Using this, we categorized the fourteen into eight different categories. For each of these categories, quantifiable variables will be identified in Chapter 4. In Figure 1, the category is given behind the aspect using Roman numerals. Underneath Figure 1, each category is explained. Overall, we can conclude that in our literature research, we found eight categories containing one or more indicators that form the answer to the question, "What are the indicators that correlate with profitability in small and medium-sized enterprises (SMEs)?".

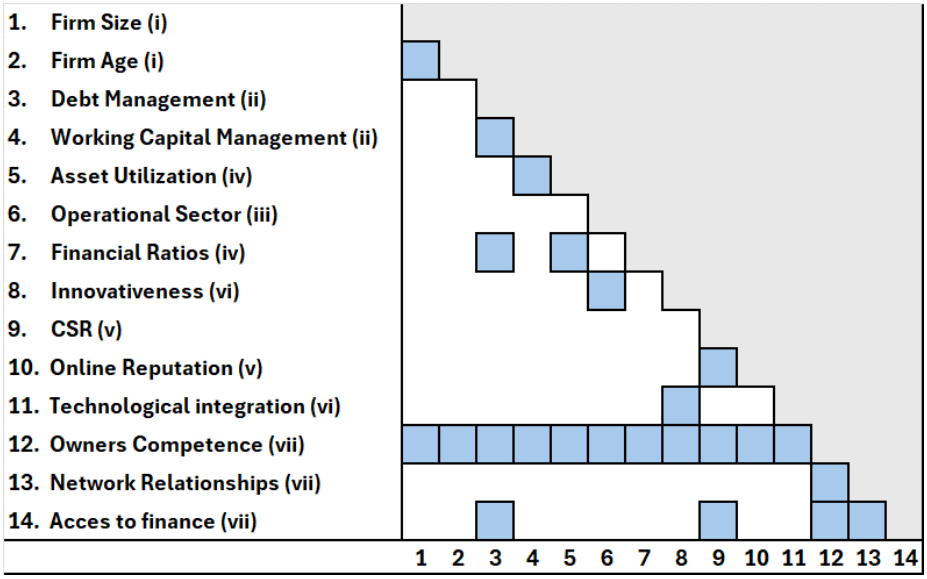

Figure 1. Interference matrix areas of interest

i. *Firm age and size:* Older and larger SMEs usually have a higher level of profitability and stability. These two intercorrelate, as firms generally get more profitable as they age and grow due to expanding their market reach while developing more robust operational capabilities.

ii. *Financial management:* Within the financial management of a firm, the performance depends heavily on efficient working capital and debt management. The liquidity and overall financial health of a firm highly relies on its ability to manage debtors and maintain an optimal level of working capital. The concave relation between working capital and profitability implies that any deviations from the ideal working capital can impact profitability.

iii. *Sector:* An SMEs profitability is highly impacted by the industry in which it is active. Several aspects such as competition, market saturation play a pivotal role and impact the profitability of an enterprise.

iv. *Financial ratios:* Financial ratios are useful metrics are useful estimator for a firms financial health and profitability. Especially metrics regarding solvency are key to measure a firms financial stability. Furthermore, financial ratios such as ROA are great to measure a firms asset utilisation.

v. *Corporate Social Responsibility and digital presence:* For SMEs – and any company in general – it is becoming increasingly important to engage in CSR and have a strong digital presence. Both these elements expand an enterprise its market reach and improve their general reputation. Generally this results in increased sales and profitability.

vi. *Innovation and technological integration:* Investing in R&D to gain a competitive advantage correlates positively with profitability. An SMEs capacity to incorporate new technology in its operation is important to adapt to modern market trends and demands. Overall innovation contributes to ensuring profitability on the longer term.

vii. *Networking and owners competence:* An SMEs networking dynamics, and the competency of its owner are crucial factors that both effect profitability. Networks provide knowledge and resource sharing, where competent leadership navigates companies in the direction of profitability.

viii. *Access to financial resources:* Profitability of a firm is highly reliant on its access to financial resources. Financial resources allow a firm to finance new opportunities, manage crises and protect their competitive edge.

4. DATA AND MODEL SELECTION

To test several estimation models a broad set of data is extracted from public sources. This dataset contains variables that connect to the eight categories identified in the literature review.

Next, we need to carefully select modelling techniques to get a clear overview of the possibilities and potential of estimating EBITDA. For this research, we choose to pursue four different models. These are selected to capture a broad range of modeling techniques while keeping the amount limited to stay within the time restrictions of this research. The following modelling techniques are tested and evaluated:

1. First of all, we test the classic linear regression. Linear regression is a fundamental tool for understanding linear relationships. Linear regression is the most widely accepted regression method and, therefore, must be included in our tests (James et al., 2013).
2. Next, a must-include in our model testing is the random forest. Breiman states that random forests are unique in handling non-linear data. The random forest uses a group of decision trees to get more accurate predictions than a single decision tree (Breiman, 2001).
3. Third, we use the LightGBM. This model is a valuable addition because it first uses gradient boosting instead of the independent trees of the random forest. Moreover, one of the key elements of LightGBM is its ability to handle large datasets, which is the case for this research. Last, this method generally performs better with unbalanced data (Ke et al., 2017).
4. Fourth and last, we want to test the possibility of using a k-nearest model. This is chosen based on expert insights. According to several experts, finding companies that closely resemble a company we want to predict could be an effective way to create predictions. Therefore, we choose to include this model to test whether the experts idea is correct.

Within the testing we will perform analysis on our data using the linear regression, the random forest, the lightGBM and a K-nearest model. To compare the models we will use the following tests:

1. Mean Absolute Error (MAE): our goal is to be as close to EBITDA as possible. Since we want to measure the estimation accuracy, we choose for the absolute error, to give us a good reflection of how close we generally are from the actual value.

2. SMAPE (symmetric mean absolute percentage error): When estimating 200k off a 300k EBITDA, this is a problem, but when the EBITDA is 1.5M being 200k off is a good estimation. Therefore we include the absolute percentage error, since this reflects our accuracy over the whole range.

3. R-Squared: using R-Squared, we measure the proportion of the variance that can be explained by our models.

4. Bias: using the Bias we can get an insight of how the values our model predicts are compared to the real values. The lower the bias, the closer our predictions are, on average, to the actual values.

5. Scatter plot of actual vs estimated EBITDA: to visualise the accuracy of the models.

6. Feature importance plot: to identify the importance of the feature and do a rerun with only the most crucial features to test what this does to the performance of the model. For the case of the linear model we skip this metric since it is not possible.

To get an accurate idea of how the different models perform, we will test our models using k-fold cross validation. In this way we test the consistency of our model when we pick different portions of the set as the test set. In Figure 2, this is visualised. The final value for each of the MAE, R-squared and Bias is calculated by taking the average of the five observed values.

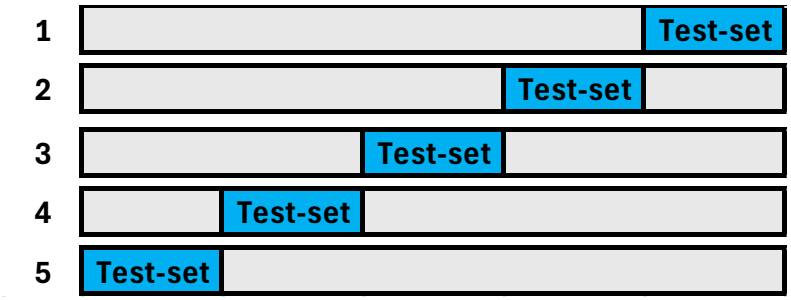

Figure 2. K-Fold cross validation visualised

5. CONCLUSION AND DISCUSSION

Based on this research we can conclude that tree based estimation models are best to capture a companies profitability. However, error margins are still on the high side, implying that an accurate estimate using public data is hard.

Furthermore, the findings of this research are based on only profitable companies only, implying that it is unknown whether similar results will be obtained on data containing companies that are not profitable. Next, the data is mostly from 2022, a period where lots of companies were still dealing with the aftermath of COVID. This may have its consequences for this research too.

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