Prediction of Synergies in Mergers[1]

*Mária REŽŇÁKOVÁ – Jan PĚTA – Michal KARAS**

Abstract

In this paper we present a method of calculating the value of synergy resulting from mergers between private companies as well as a model for the prediction of potential synergy values in contemplated mergers (M&A deals). We first examined the process of determining the value of a synergy. Since we analysed mergers involving private mechanical engineering companies, we used the discounted capital cash flow method for the determination of the synergy value. We divided the selected mergers according to the achieved synergy value into two groups, i.e. into successful mergers and failed mergers. We then analysed the two groups in order to identify financial ratios with statistically significant differences (deviations). We then used those ratios to establish a rule for the differentiation between mergers that would increase in business value, i.e. with positive synergy, and those whose value would decrease. A decision rule was developed using the classification and regression trees method. In the research sample, the developed model distinguished successful merger from failed ones with 92% accuracy.

Keywords: *mergers in mechanical engineering, operating synergies, capital cash flow, value of synergies, classification and regression trees*

JEL Classification: G34, G32, L20

Introduction

Some earlier research has alleged that no synergy is achieved from mergers. In their overview of literature on mergers and acquisitions (M&A), Bernile and Bauguess (2011) state that the evidence based on long-term stock returns is least

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supportive of the idea that positive synergy values (further "synergy" for simplicity) exist. Indeed, they contended that the drop in stock prices outweighs the combined announcement gains. Similarly, Martynova and Renneboog (2008) report that 14 of 26 post-merger research studies identified a drop in operating income. Gugler et al. (2003) researched 1,250 M&A deals from 1981 to 1998 and found out that five years after mergers or acquisitions sales dropped by 14.5% on average compared to the pre-transaction value. Cartwright and Schoenberg (2006) found that only 35 – 45% of the transactions achieved revenue growth two to three years after the merger occurred. Ismail (2011), on the other hand, calculated that the value of merged companies three years after the merger was 11.3% higher than the sum of the two stand-alone companies a year before the merger. The author based his calculations on publicly listed US companies between 1985 and 2004. Rahman and Lambkin (2015) published results of a detailed study of 45 M&A deals that took place in the United States between 1990 and 2000. Their results show sales revenue growth and a reduction in sales, marketing and administrative costs (as a percentage of sales revenue). However, these benefits did not outweigh cost diseconomies in other parts of the business. They concluded that, despite extensive research in efficiency of M&A deals over the last three decades, the evidence suggests that post-merger performance tends to fall short of expectations, both in terms of real operating performance and in terms of stock market value.

The latest research in M&A performance produced different results. Using accounting measures of performance, Dargenidou, Gregory and Hua (2016) confirmed the presence of synergies developed during acquisitions. Alexandridis, Antypas and Travlos (2017) showed that during the post crisis period (2010 – 2015) public acquisitions and private mega-deals generated positive abnormal returns for acquiring shareholders. They noted that "*The acquiring firms create discernible shareholder value through public acquisitions post-2009 for the first time*".

A legitimate question is whether the efficiency of the contemplated merger can be predicted. The aim of our research was to find an answer to this question. In order to do this, we investigated the differences between mergers that resulted in improved performance of combined companies and those that had no such effect.

1. Literature Review: Measurement of M&A Efficiency

When announcing the merger intention, managers predict the expected positive effect, which is usually an increase in sales due to an improved market position, cost savings due to better utilisation of production capacities, lower investment, more efficient financing etc. These effects should be reflected in a higher

cash flow of the combined firm, and thus also in its value. Bernile and Bauguess (2011) found that the managers of acquiring companies expect synergies primarily in the area of operating costs in up to 90% of cases, with the remaining 10% being synergies due to increased market power and/or financial synergies. Similarly, Devos, Kadapakkam and Krishnamurthy (2009) consider operating synergies to be crucial in merger decisions. They state that less than 17% of total synergy is attributable to financial synergies achieved in the form of interest tax shields; the remainder are operating synergies.

To measure the effectiveness of a company, indicators such as financial ratios that make it possible to identify changes in the company's performance clearly and that signal a change in the company's value are used. In the case of M&A, the values of the indicators of stand-alone companies are compared with those of the newly created combined company. If there are financial ratios whose differences attained statistically significantly different values in successfully merged companies compared to those whose performance decreased, such ratios can be used to create a model for predicting the probability of merger success, i.e. whether synergies will be created or not. These indicators must be selected to allow measurement of operating synergies.

Healy, Palepu and Ruback (1992) found that combined companies improved their cash flow (*CF*) as a result of increased operating margin (EBIT/Sales), increased asset turnover (Sales/Assets), and reduced cost of labour as a result of staff reductions. Also, Sorensen (2000) analysed the effect of mergers based on standard financial analysis indicators. He found that only six indicators (Return on Sales, Return on Assets, Return on Equity, CF/Assets, interest coverage, and CF/interest) showed a statistically significant difference after the merger compared to pre-merger values. The most significant difference he found was in the return on assets ratio.

Houston, James and Ryngaert (2001) assessed merger-related synergies using the return on assets (*ROA*), return on equity (*ROE*) and changes in the operating cost. The most significant effect of mergers was the reduction of operating costs.

Huyghebaert and Luypaert (2010) compared the values of selected indicators between companies that completed M&A and stand-alone companies. They assumed that the decisive differences would be in the cash to total assets ratio (which may signal missed investment opportunities) and the bank loan to total assets ratio because they supposed that debt financing was often used in M&A transactions.

Bernile and Bauguess (2011) found that the value of the sales to asset ratio increased after merger. This could have been due to better asset utilisation or growth in sales. Based on the analysis of the EBITDA to total assets ratio development,

the authors demonstrated that the increase was due to growth in sales, specifically because the combined firms had an opportunity to increase the price of their products. In his research, Harford (2005) focused on the investigation and prediction of M&A waves, for which he wanted to use the appropriate financial ratios. The research was conducted on data from the years 1981 to 2000. He found that the following ratios in the period of merger waves were significantly greater than those outside the waves: CF to sales ratio, asset turnover, R&D expenditures, capital expenditures, ROA, growth in sales and increase in the number of employees.

Devos, Kadapakkam and Krishnamurthy (2009) found that merger synergies arise primarily from operating efficiencies. However, additional profit was not generated from sales growth or cost savings; merging firms were able to realise significant economies in their capital expenditures and investments in working capital. Shim (2011) conducted his research on US companies between 1989 and 2004 comparing companies engaged in mergers and those not engaged in them. He found that M&A had a negative impact on ROA and ROE: ROA declined by less than 3% on average compared to non-merged companies; ROE decreased by more than 7%. The author sees the reasons for these downturns in transaction costs incurred related to the merger, such as costs incurred as a result of the company's expanded organisational structure.

Recent research into merger efficiency focuses mainly on investigating the motives for and effectiveness of cross-border mergers (see e.g. Xu, 2017; Erel, Liao and Weisbach, 2012). Their effectiveness is being investigated using the same financial ratios mentioned above. Valouch, Sedláček and Králová (2015) examined merger deals closed in the Czech Republic between 2001 and 2008. The authors monitored chosen indicators for four years, specifically a year before the merger and three years after the merger. The research results confirmed the positive effect of mergers on the value of the total assets in the third post-merger year in small companies. A surprising finding was an increase of labour costs to sales, which was not identified in other research.

Merger-related effects are usually measured by comparing the performance of the combined company with the performances of the original stand-alone companies. The merger is considered a success if there is an increase, if not, the merger is considered a failure. The factors typically used in the measurement include: a change in sales, a change in profitability (this approach used by, for example, Griffin and Mahon, 1997; Brouthers, Van Hastenburg and Van Den Ven, 1998) or a change in asset value (see Valouch, Sedláček and Králová, 2015). In many cases, the results obtained could be confusing if performance improvement was identified only in some years of the period observed.

Another way of measuring the merger effect is to determine the value of the synergy derived from the combination (see Devos, Kadapakkam and Krishnamurthy 2009; Ismail, 2011). This approach allows the assessment of results over several years. The cited studies investigated the results of M&As of publicly listed companies and evaluated them according to the changes in stock prices or profits made by owners several years after the merger. In the latter case, the price at which the target company had been acquired was taken into consideration.

In our research we examined the results of mergers of private companies in the Czech Republic. Since we were unable to use market data, we determined the value of combined companies using the expected change in their cash flow. The calculation of company value is based on the forecast of its ability to generate future incomes (dividends, earnings or cash flow). The same approach may be used for synergy valuations because the synergy is accomplished when the value of the combined company is superior to the sum of the two stand-alone companies (Bradley, Desai and Kim, 1988). The value of synergy can be calculated as the difference between the value of the new company after merger (the combined company) and the sum of the values of the stand-alone companies before the merger.

Synergy value determination based on future earnings was used by Houston, James and Ryngaert (2001), who quantified the synergy effect based on earnings increments. The most common method of business valuation is based on discounted free cash flow (FCF). Bernile and Bauguess (2011) and Ismail (2011) used it to assess the synergy realised through mergers. Devos, Kadapakkam and Krishnamurthy (2009) used the discounted capital cash flow method to determine the synergy value of combined companies. The difference between the methods lies in their treatment of the interest tax shield. While in the free cash flow method, the tax shield is part of the calculation of the cost of capital (at a discount rate); in the cash flow method it is part of the cash flow calculation (see Kaplan and Ruback, 1995; Gilson, Hotchkiss and Ruback, 2000; Ruback, 2002).

The lack of consistency of M&A research conclusions prompted us to develop a model for predicting merger success. The aim of our research was to create a model for predicting the success of mergers, i.e. a model that will be able to distinguish potentially successful mergers from merger failures. Such a model may be used for selecting an appropriate target company by an investor or an acquiring company. It may lead to the rejection of the merger or its approval. It may also assist the management of a company seeking a potential partner by formulating recommendations in terms of what performance areas it needs to focus on. The model will also be suitable for the assessment of whether or not the considered merger will generate a synergy.

Developing such a model requires identification of appropriate financial indicators – potential predictors – of synergies. The appropriate indicators are those that attain statistically different values in the group of successfully merged companies (where the value of the combined company increased) compared to the group of companies in which the merger resulted in failure.

2. Methodology and Data

In our research we focused on private companies in mechanical engineering, since they are the prevailing form of business entity in the Czech Republic (their share on the total number of business entities in mechanical engineering is 99.996%). By merger we understand a combination of two (or more) companies into one successor company, with the remaining business entity (entities) ceasing to exist. We assume that the mergers are carried out by strategic investors interested in creating value added. When assessing merger effectiveness, it is first necessary to determine the achieved merger effect of stand-alone companies, i.e. whether the combination improved the performance of the successor company or not.

We measured the merger effect as the difference between the value of the newly formed company (the combined company) and the sum of the values of the stand-alone companies before the merger, i.e. *Value of Synergy = Value of the combined company – (Value of the acquiring company + Value of the target companies)*. This assumes that the change in value is the result of the merger which brought about changes due to better use of available capacities, joint research and development, product innovations, organisational changes etc., as well as improved efficiency of corporate governance. The effect of the combination is measured three years after the transaction, which is a period in which the above changes should already be reflected in the value of the combined company. We used the following procedure to create a model for predicting successful mergers:

- First, we created three datasets – two covering period three years prior to merger for both the acquiring and target companies and the third covering period three years after merger for the combined companies. We then calculated values of all of the companies at the year of the merger (T_M).
- In each merger case we assigned a value of the acquiring company and the target company at the beginning of T_M, i.e. when their values were not affected by the merger completion. The computation of the value of the acquiring (V_A) and target (V_T) companies was based on the assumption that the companies would operate in the same manner in the future as they operated in the past (*stand-alone principle*). The sum of the values of the merging companies represents *the theoretical value of the newly created company without synergy* ($V_A + V_T$).

- The value of the combined company (V_{AT}) was then determined by discounting the actual developments three years after the merger on the same date as the stand-alone companies were valued, i.e. T_M.
- The result was used to calculate the synergy value, which was defined as the difference between the value of the combined company and the sum of the values of the stand-alone companies entering the merger, i.e. $V_{AT} - (V_A + V_T)$. Positive difference was classified as a success (creating synergy), while negative difference was classified as a failed merger.
- We then quantified financial ratios for all three target groups of companies (target, acquiring and combined companies) and tested whether there were differences in mean values between companies with synergies after merger and those whose merger failed.
- After confirming this assumption, a model was created that would be able to predict, based on financial ratios from three pre-merger years, whether or not the merger under consideration would generate positive synergy or not, i.e. whether the value of the combined company would increase or decrease.

2.1. Data Used

We focused on examining the efficiency of mergers in one industry only in order to eliminate divergences in the development between various industries. This also partially eliminated the impact of business cycles on the results of mergers – assuming that business cycle developments affect both successful and failed mergers equally.

We applied the following criteria to determine the research sample:

- The merger was conducted by the companies based in the Czech Republic in period 2004 to 2011.
- There was only one merger in the period of 7 years between 2001 and 2014. This represents three years before the merger, the year of the merger, and three years after the merger.
- The financial statements of the target and acquiring company were publicly available (published on the portal www.justice.cz).

According to the Bisnode database, 614 mergers meet the criteria defined above. Almost one third of the mergers were carried out by companies in the manufacturing industry. In our research, we focused on sectors with the largest number of mergers in manufacturing industry. Specifically, two branches of the sector, namely the manufacture of metal structures (CZ-NACE 25) and the manufacture of machinery and equipment (CZ-NACE 28). Our criteria were met by 50 mergers involving 102 companies. One half of the mergers were horizontal integrations, i.e. combinations of entities operating in the same sector, and the other half were vertical integrations, i.e. combinations between suppliers and their customers.

2.2. Determination of Synergy Value

In order to divide the mergers we determined the synergy value by the discounted capital cash flow (CCF) presented by Richard S. Ruback in 2002. This method produces the same results as the better known discounted free cash flow method. The difference between the two methods lies in their assessment of tax shields: in the free cash flow method, the tax shield is included in the cost of capital (i.e. in a discount rate); in the capital cash flow method, the tax shield is included in the cash flow (see Kaplan and Ruback, 1995; Gilson, Hotchkiss and Ruback, 2000; Ruback, 2002). Devos, Kadapakkam and Krishnamurthy (2009) also used this approach in their research on the efficiency of mergers.

We calculated the capital cash flow according to the following formula (Ruback, 2002; Devos, Kadapakkam and Krishnamurthy, 2009):

$$CCF = \left[S \cdot OM \cdot (1 - T) \right] - \Delta FA - \Delta NWC + I \cdot T \cdot D \tag{1}$$

where

S	– means sales,
OM	– the operating margin,
T	– the income tax rate,
ΔFA	– the net investment in fixed assets,
ΔNWC	– means investment in the NWC,
D	– debt,
I	– means interests on bank loans,
$S \cdot OM \ (1 - T)$	– after-tax operating profits,
$I \cdot T \cdot D$	– the interest tax shield.

The company value was calculated for each company in the sample as of 31 December of the year preceding the merger, on the basis of the following formula:

$$V_A \text{ or } V_T = \sum_{t=0}^{3} \frac{CCF_t}{(1+i)^t} + \frac{TV}{(1+i)^{t+4}} \tag{2}$$

$$TV = CCF_{t+3} \ . \ (1 + Inf_{cz}) \ . \ \frac{1}{(i - Inf_{cz})} \tag{3}$$

where

CCF_t	– capital cash flow forecast for each year,
TV	– terminal value of capital cash flows,
i	– discount rate (in this formula cost of equity),
Inf_{cz}	– inflation rate in the Czech Republic,
V_A	– value of an acquiring firm,
V_T	– value of a target firm.

In order to calculate stand-alone company values before merger we forecasted the relevant parameters for three years. In our calculations, we linearly interpolated the values of sales and operating profit margin (share of operating profits in sales). Investments in the fixed assets, investments in the net working capital and interest expenses were forecasted in accordance with Mařík (2011, p. 137) as a mean value in the three-year period before the merger. The income tax rate corresponded to the rate applicable in T_M. This approach adheres to the German valuation standard IDW S1 and was selected in line with the recommendation of Mařík (2011, p. 29).

The terminal value of capital cash flow (*TV*) was determined in line with Devos, Kadapakkam and Krishnamurthy (2009), with the stable rate of growth at the rate of expected inflation. In our research, we set the inflation rate based on the values of the International Monetary Fund for the Czech Republic. According to the authors cited above, the capital cash flow method is suitable for an uncertain cash flow estimation. In the CCF method, the discount rate is equal to the cost of equity; in our research we used the capital asset pricing model (CAPM) to calculate it. For investors unable to diversify their portfolio by investing in the capital markets, we used the total beta coefficient, i.e. total beta (Damodaran, 2012) in the formula. He considers this approach more suitable for determining the value of small private companies with higher business risk.

In this manner we obtained three sets of data for each merger: two sets of forecasts for the stand-alone companies and one set of real data for the post-merger combined companies. For each of these three sets of data, we calculated value of firm according to formulas (2) and (3). By summing the values of the stand-alone merging firms ($V_A + V_T$) we determined the value of the newly created company without synergy (the theoretical value).

We then calculated the value of the combined company based on the actual development three years after the merger (V_{AT}). The synergy value is the difference between the value of the combined company and the theoretical value ($V_{AT} - (V_A + V_T)$).

2.3. Financial Ratios

In order to create a model predicting merger success we had to determine variables that sufficiently differentiate between successful mergers (creating synergy) and failed mergers (creating no synergy or decreasing in value). In our case these were financial ratios that attained statistically different values in the group of successful mergers compared to failed mergers. Based on a literature search and our previous research, the following financial ratios were used (see Trautwein, 1990; Healy, Palepu and Ruback, 1992; Houston, James and Ryngaert,

2001; Sorensen, 2000; Pawaskar, 2001; Harford, 2005; Devos, Kadapakkam and Krishnamurthy, 2009; Huyghebaert and Luypaert, 2010; Mellen and Evens, 2010; Bernile and Bauguess, 2011; Shim, 2011; Asimakopoulos and Athanasoglou, 2013; Valouch, Sedláček and Králová, 2015; Režňáková and Pěta, 2018).

T a b l e 1

Financial Indicators Examined

Financial indicator	Abbreviation	Financial indicator	Abbreviation
Assets Turnover	A turn.	Inventory Turnover	In turn.
Bank Loans/ Assets	BL/A	Investment (=ΔFA)	Invest
Cash/ Assets	Cash/A	Labour Cost/ Sales	LC/S
Cash Flow/ Assets	CF/A	Leverage Ratio	LR
Cash Flow/ Interest	CF/I	Material Consumption/ Sales	MC/S
Cash Flow/ Sales	CF/S	Net Working Capital/ Assets	NWC/A
Production Consumption/ Sales	PC/S	Net working capital/ Sales	NWC/S
Depreciation/ Sales	D/S	Return of Assets	ROA
Fixed Assets/ Assets	FA/A	Return of Equity	ROE

Source: The authors' elaboration using the above mentioned research.

We assumed that the investors, in search of appropriate target companies, look for similar traits (industry, performance, corporate governance, etc.). Therefore we determined two sets of indicators (potential predictors) – one for the acquiring ($indicator_A$), the other for the target company ($indicator_T$). Both were analysed and tested separately for each group. Each merger was thus described by 18 indicators over six years each (except for the investment indicator, where only four values were determined in each transaction). In total, 106 financial indicators were analysed.

For the purposes of identifying outliers, we used the Grubbs' test (see Grubbs, 1969):

$$G = \frac{\underset{i=1,2,..,N}{max} \left| Y_i - \overline{Y} \right|}{s} \tag{4}$$

where

Y_i – the observed value of the examined indicator,

$\overline{Y}$ – the mean of the examined indicator,

s – the standard deviation.

2.4. Methods Used to Create the Prediction Model: Classification and Regression Trees

For the purposes of creating a prediction model, we opted for the non-parametrical classification and regression trees (CART) method developed by Breiman et al. (1983). The advantage of this method lies in the capacity to capture a comprehensive relationship between the variables (Brezingar-Masten,

Masten, 2012). This method is used both for classification and regression purposes. It is suitable for the selection of predictors, i.e. the variables of the model (see, for example, Brezingar-Masten, Masten, 2012), as well as for formulating the decision-making (classification) rule (see, for example, Gepp and Kumar, 2015; Liang et al., 2016). It is indisputably robust to the existence of outliers (Di Marco and Nieddu, 2014), and is therefore suitable for the analysis of our data. In addition, the resulting classification rule is easily interpretable.

The stability of the created model (the decision tree) is a frequently discussed topic when applying the CART method, i.e. the dependence of its structure on the learning sample. It is common for the accuracy of out-of-sample testing to be significantly lower despite high accuracy of the application to the learning sample. In order to reduce the dependence of the model coefficient values on the specific structure of the learning sample (thus supporting the robustness of the model), we used the k-fold cross validation method at $k = 10$, similarly to Liang et al. (2016). Using this procedure, the examined sample is divided into ten subsamples of the same size, of which 9 serve as the learning sample and 1 as the validation sample. The procedure is repeated 10 times, and each subsample serves as the validation sample only once. The resulting classification rule is the mean of the 10 rules created. Measuring the node impurity utilised the Gini coefficient – for details see Hastie, Tibshirani and Friedman (2009, p. 306).

3. Results and Discussion

3.1. Synergy Value

To create a merger success prediction model, it was necessary to determine the synergy value of each merger. As already mentioned, the synergy value was calculated as the difference between the value of the combined company and their theoretical value (sum of the values of the original stand-alone companies), i.e. the value of synergy = $V_{AT} - (V_A + V_T)$. The statistical characteristics of calculated synergy values in all mergers are shown in Table 2.

T a b l e 2

Change in the Value of Combined Companies – Descriptive Statistics

Value increase (%)	Mean	Median	Minimum	Maximum	Std. Dev.	Skewness	Kurtosis
All mergers	–0.08133	–0.30981	–0.93119	1.58923	0.71348	0.68602	–0.65273
Vertical mergers	–0.02005	–0.12770	–0.93119	1.58923	0.66324	0.76569	0.07754
Horizontal mergers	–0.14260	–0.42744	–0.90680	1.30440	0.74187	0.72876	–1.02053

Source: Our results.

The average value gain is –8.1%, i.e. no positive synergy was achieved. This phenomenon occurred in the majority of the companies examined: 62% of the mergers failed to generate a positive synergistic effect for three post-merger years, as evidenced by the positive skewness value. Merger effect could have been affected to some extent by the type of merger. Horizontal mergers take place among combining companies from the same industry while vertical mergers among companies from different industries (i.e. combinations between companies from the customer-supplier chain). In the case of vertical mergers, the decrease was –2%; in the case of horizontal mergers, the value decreased by –14.26%. This seems to suggest that mergers involving companies from outside the industry under investigation were more successful. Given the research sample limitations, no further attention was paid to this factor.

In terms of development over time, mergers carried out in the second half of the period observed, especially in 2008, were more successful. The reason for the lower success rate of the mergers at the beginning of the observed period could have been overly optimistic forecasts of future developments in stand-alone companies involved in merger deals. The value of these entities was determined on the basis of the "stand alone" assumption, i.e. that their future development would follow the trend of their past performance. If the company grew in the pre-merger period, it was expected that it would continue to grow in the future as well. In this case, the prospects may have been exaggerated and the value set too high.

The actual development in the combined company could then have been adversely affected by external conditions, and its value was lower than the theoretical value. The synergy value in this case was negative. The opposite situation may have occurred as well if the expected revenue growth was underestimated and the overall value of the company in question was set too low. If extreme values were identified during valuation (e.g. unsustainably high investments or revenue growth), the parameters used to determine the value were adjusted (usually replaced by an average value of a group of target or acquiring companies).

3.2. Financial Rations with Statistically Significant Differences

A closer analysis of the individual mergers showed that better-managed companies were buying those with identified potential for increasing performance and generating synergies. This conclusion follows from the analysis of financial ratios carried out separately for acquiring and target companies. Due to the fact that it was difficult to include all 106 indicators in this paper, we provide values only for one year – see Table 3.

T a b l e 3

Descriptive Statistics of the Financial Ratios of the Research Sample

One year before merger – acquiring companies (A)							
	Min	Lower quartile	Median	Upper quartile	Max	St. dev.	P-value[1)]
PC/S	0.0000	0.3553	0.5651	0.7331	1.1136	0.3009	1.0000
MC/S	0.0000	0.0581	0.2286	0.5806	0.9157	0.2663	0.9704
A turn.	0.0000	0.7218	1.0860	1.6667	4.9449	1.0764	**0.0141**
In turn.	0.0000	1.8355	6.7155	12.8309	32.7091	8.4118	**0.0000**
LC/S	0.0000	0.0360	0.1194	0.2159	0.5172	0.1317	0.2032
D/S	0.0000	0.0052	0.0179	0.0455	0.1812	0.0448	**0.0330**
ROA	–1.4805	–0.0035	0.0556	0.1163	4.2059	0.6566	**0.0000**
ROE	–4.5411	–0.0008	0.1433	0.2898	1.0169	0.7946	**0.0000**
Cash/A	0.0000	0.0292	0.0999	0.2766	1.0000	0.2553	**0.0417**
LR	0.0000	0.2146	0.4576	0.7434	1.2873	0.3543	1.0000
BL/A	0.0000	0.0000	0.0000	0.2180	0.5003	0.1396	0.1498
CF/A	–1.4805	0.0251	0.0781	0.1633	4.2059	0.6506	**0.0000**
CF/I	–23.7518	0.0000	0.1370	11.8469	112.1111	18.4928	**0.0000**
CF/S	–0.2376	0.0138	0.0660	0.1239	4.9310	0.6978	**0.0000**
Invest	–1.3526	–0.0153	0.0365	0.3986	5.1705	1.0434	**0.0000**
NWC/S	–0.2360	0.0000	0.2120	0.3515	1.6894	0.3742	**0.0020**
NWC/A	–0.6513	0.1191	0.3207	0.4804	1.0000	0.2975	**0.0471**
FA/A	0.0000	0.0817	0.2653	0.4079	0.7338	0.2129	1.0000
One year before merger – target companies (T)							
	Min	Lower quartile	Median	Upper quartile	Max	St. dev.	P-value[1)]
PC/S	0.0000	0.3332	0.5847	0.7250	1.1419	0.2846	1.0000
MC/S	0.0000	0.0281	0.2357	0.4870	0.7706	0.2393	1.0000
A turn.	0.0000	0.7965	1.3990	2.5765	8.9484	2.0820	**0.0199**
In turn.	0.0000	0.0000	5.4598	9.8447	40.3480	9.4279	0.0761
LC/S	0.0000	0.0536	0.1265	0.2028	0.8539	0.1856	**0.0044**
D/S	0.0000	0.0045	0.0289	0.0597	0.8301	0.1240	**0.0000**
ROA	–3.2678	0.0057	0.0473	0.1765	0.9339	0.5585	**0.0000**
ROE	–2.5661	0.0327	0.1255	0.3685	7.9244	1.3167	**0.0000**
Cash/A	0.0000	0.0190	0.0732	0.2153	0.8056	0.1997	**0.0292**
LR	0.0000	0.3182	0.5012	0.7927	1.3608	0.3381	0.8224
BL/A	0.0000	0.0000	0.0000	0.1270	0.9624	0.2159	**0.0008**
CF/A	–3.2678	0.0256	0.0838	0.1814	1.1078	0.5677	**0.0000**
CF/I	–17.2486	0.0000	0.0000	3.9530	185.9429	27.8304	**0.0000**
CF/S	–1.3266	0.0230	0.0490	0.1353	0.5836	0.2558	**0.0000**
Invest	–1.5139	–0.0996	0.0254	0.2726	1.1688	0.4980	0.0761
NWC/S	–0.6451	0.0422	0.1373	0.3705	2.8601	0.5661	**0.0000**
NWC/A	–0.5651	0.0973	0.3211	0.4814	0.9842	0.3271	0.3452
FA/A	0.0000	0.0168	0.2514	0.4503	0.9905	0.2835	0.4950

Note: [1)] Grubbs test; the values in bold confirm the existence of outliers for the indicator at the 5% significance level.

Source: The authors' results.

The values of all cost and profitability ratios listed above support the idea that the acquiring companies achieved higher efficiency than the target companies did. In addition, there were also significant differences in their assets structure. The ratio of fixed assets to assets (*FA/A*) in acquiring companies was 1.39 percentage points (pp) higher than in target companies (which represents 5.5% difference) and the depreciation to sales ratio (*D/S*) was 1.1 pp lower (38%

difference). This supports the idea that acquiring companies could utilise their fixed assets better.

However, the value of the assets turnover ratio (*A turn*) did not imply this, which is surprising. The acquiring companies had a significantly higher cash (the cash to assets ratio was 2.67 pp, the difference is 36.5%) and the net working capital (*NWC/S*) was 7.47 pp higher in (54.4%) the group of acquiring companies than in the group of target companies, and the data showed less variability. In addition, acquiring companies invested more in long-term assets (the annual growth of fixed assets was 1.11 pp. (43.7%) higher in acquiring companies; moreover they achieved this at a lower rate of indebtedness.

The values of the above mentioned indicators confirm the assumption that there were differences between target and acquiring companies. We adopted the same approach to identify the financial ratios with statistically significantly different values in companies that create synergy and the companies that do not (for details see Režňáková and Pěta, 2018). This conclusion favours our assumption that there are significant differences in the indicators, which may be used to develop a prediction model.

Due to the existence of outliers in our sample (confirmed by the Grubbs' test; see Table 3, p-value), we had to develop a model robust to outliers.

3.3. Prediction Model

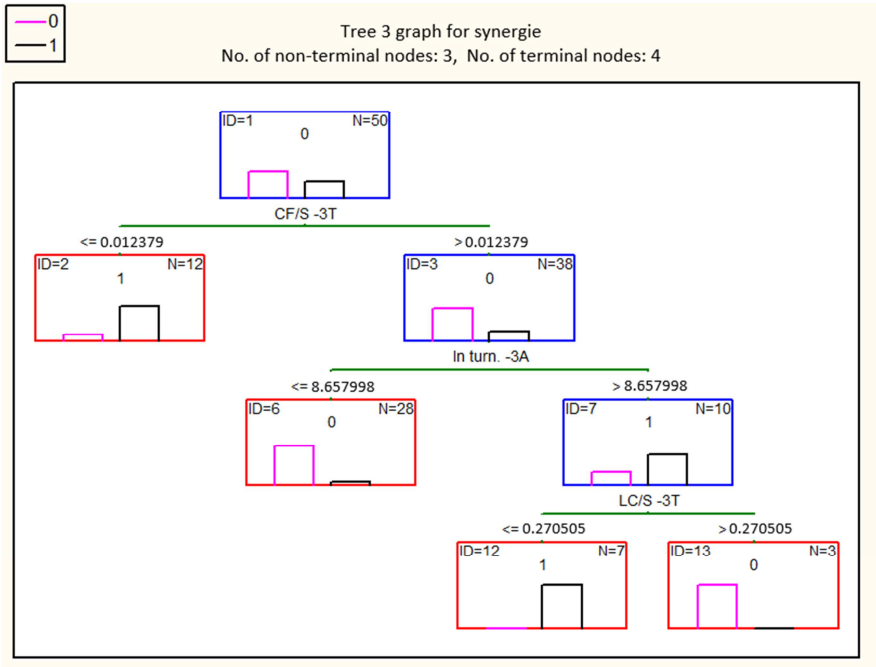
For the purpose of creating a prediction model, we looked for indicators (see Table 1) capable to differentiate between companies with the potential to generate a positive synergy (assigned value "1") effect from those lacking that potential (assigned value "0"). Based on the characteristics of the indicators used, we chose the appropriate method for creating a prediction model (decision rule). The method that met our requirements is the CART method, which enabled both the identification of suitable predictors and the creation of a decision rule. The decision rule was incorporated in individual nodes that represent the boundary value of the indicator used.

Since mergers are not a very frequent phenomenon in the economy, our learning sample included data from all 50 mergers we had analysed. To test the accuracy of the model, our validation sample (out-of sample) included mergers completed in 2012. We could not use mergers from the following years because data on the combined company development over the three-year post-merger period were needed to calculate its value. In 2012, four mergers that met the defined criteria were concluded (see 2.1. Data used).

The created model uses three variables to differentiate between successful mergers (creating positive synergy) and merger failures – see Figure 1.

F i g u r e 1

CART Model of Synergy Effect Identification



Source: The authors' results.

The model contains a total of four terminal nodes and three non-terminal nodes. It unambiguously follows from Figure 1 that the most important indicators for decisions about whether positive synergies will be achieved are the cash flow to sales ratio in the target company three years before the merger (CF/S_{-3T}), the inventory turnover indicator in the acquiring company three years before the merger ($In\ turn._{-3A}$) and the labour cost to sales ratio in the target company three years before the merger (LC/S_{-3T}) – all of them three years prior to merger. These three criteria make it possible to identify the positive value of synergy effects. Our model indicates that merger will generate positive synergy if one of the following two conditions is satisfied:

- if $CF/S_{-3T} \leq 0.012379$ (see node ID=2); or
- if $CF/S_{-3T} > 0.012379$, the following two conditions must be satisfied:
  a. $In\ turn._{-3A} > 8.657998$ (see node ID=7),
  b. $LC/S_{-3T} \leq 0.270505$ (see node ID=12).

The CF/S_{-3T} criterion was sufficient to assess 12 mergers as successful, i.e. generating positive synergy. Otherwise, when a combination of all three criteria was used, only 7 mergers were classified as successful. The prediction model accuracy is given in Table 4.

T a b l e 4

Accuracy of Predicting Synergy Creation

		Predicted		Sum
		0 (negative synergy)	1 (positive synergy)	
Observed	0 (negative synergy)	29	2	31
	1 (positive synergy)	2	17	19
Sum		31	19	50

Source: The authors' results.

Our model correctly identified 89% mergers with positive synergies and 94% mergers with negative synergies. A total of 4 transactions (i.e. 8%) were categorised incorrectly.

One of the decision rule criteria, specifically the cash flow to sales ratio in the target company three years before the merger, may seem illogical. Why should a company capable of generating more cash than the threshold (1.24%) end up creating negative synergy? The reason may be found in the developments in the other two monitored years (i.e. one and two years before merger): The ability to generate relatively higher cash flows may accentuate managers' propensity to increase expenditures (investments, high inventory levels, growing operating costs), which will translate into a decline in company performance in the coming years. The assumption was not confirmed.

The other two decision rules criteria signal the potential to create synergy: if an acquiring company has an effective inventory management system in place (in our case their inventory turnover rate is higher than 8.66), the company has the potential to generate positive synergy. Similarly, in the case of the labour cost to sales ratio: companies have the potential to create synergy if the labour cost of the target company does not exceed 27% of sales.

3.4. Model Verification

The validity of the selected criteria was tested in four mergers completed in the mechanical engineering sector in 2012. One of them was a horizontal merger and the remaining three were vertical mergers. Based on synergy value calculations, two mergers were classified as successful, and two as failed. The results of success prediction (generation of positive synergy) in the four merger deals are shown in lines 1 – 4 of Table 5.

Success predictions according to the proposed model were based on the values marked in bold. In two mergers, the prediction was based on the cash flow to sales ratio of the target company (CF/S_{-3T}) and the labour cost to sales ratio of the target company three years before the merger (LC/S_{-3T}). Prediction in the third merger was made on the basis of the CF/S_{-3T} indicator, and in the fourth

merger on the basis of a combination of the inventory to sales (*In turn.*$_{-3A}$) and *CF/S*$_{-3T}$ indicators.

T a b l e 5

Verification of the Synergy Prediction Model

Mergers	Indicators			Predicted synergy	Actual synergy	Predicted correctly
	CF/S$_{-3T}$	In turn.$_{-3A}$	LC/S$_{-3T}$			
1	0.0562	98.5183	**0.1509**	Positive	Positive	Yes
2	0.1145	91.8839	**0.2124**	Positive	Negative	No
3	**–0.0435**	8.0058	0.1270	Positive	Positive	Yes
4	0.0727	**4.1323**	0.0684	Negative	Negative	Yes

Source: Our results.

Using our model (selected criteria), we classified three of the tested mergers as successful, and one as failed. Three of the transactions were identified correctly, i.e. the model accuracy was 75% out-of-sample.

Conclusion

In our research, we aimed to create a model for the prediction of the success of merger deals between companies operating in the mechanical engineering industry in the Czech Republic. We first divided the set of investigated mergers into successful ones and failed. We determined the synergy value using the discounted capital cash flow method. In this respect, we were inspired by previous research by Devos, Kadapakkam and Krishnamurthy (2009). It was first necessary to determine the value of the companies before and after the merger. The company values before the merger were determined on the basis of a forecast of capital cash flow while respecting the stand-alone principle. The combined company value was determined on the basis of real capital cash flow after the merger. The synergy value was then calculated as the difference between the combined company value and the sum of acquiring and target stand-alone companies' values.

Using the CART method, we then created a decision rule for distinguishing between successful and failed mergers, which can also be used to predict the success of contemplated mergers. Our model was very successful on the research sample where it correctly predicted the outcome of 92% of mergers. We also tested the distinction capability of the model (i.e. the validity of the decision rules) on a sample of four mergers that were not included in the research, i.e. out-of-sample. In this test, the model accuracy was 75%.

The model we created cannot be considered a universal model for all potential mergers because it is based on industry specific data under specific conditions. Since the experience from previous research clearly shows that sector specific characteristics need to be taken into account in company performance assessments, the application of our model will apparently also be sector-limited. Unlike previous research into the efficiency of mergers and acquisitions, we examined private companies in our research and present a method for determining the value of synergies as well as predicting the success or otherwise of the contemplated mergers.

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