**Financials (don’t) matter as stock determinants**

* **A panel analysis of the German industry**

**Abstract**

The question of what drives value is ever since the origin of the first stock exchange of significant importance for the academic and business community given that decision-relevant information is analyzed and discussed, which can be used for investment decisions, to guide and improve corporate performance, to upgrade accounting standards, and disclosure requirements. In the past, scholars and practitioners have already identified a number of financial determinants that are said to significantly impact a firm’s value. However, many results seem inconsistent with or even contradictory to each other. Moreover, determinants identified in the past are not guaranteed to be constant over time. In light of the ever faster-changing environment driven by disruptive technologies, such as artificial intelligence (AI), the distributed ledger technology, or the Internet of Things (IoT) and Services (IoS), it becomes even more important to further analyze and question the existing literature.

In summary, partly inconclusive results of the past, the faster-changing environment, and the explicit focus on the German industry motivate further research regarding the analysis of value determinants.

In this regard, the given thesis challenges and probes the relevance of financial ratios by providing empirical evidence to the question of whether and to which extent financial indicators are significantly related to a firm’s value change measured by the price to book (P/B) per share. Further evidence contradicting this assumption is subsequently discussed from the behavioral finance perspective, concerning the shortcomings of financial ratios and the need to account for qualitative information. The relationship is studied using the data of 99 German stock-listed companies between 2006-2019. The study contributes to the academic literature by looking at a dataset that has not been analyzed before, focusing on the German industry. Given the characteristics of the dataset, a panel regression is the most appropriate method.

**Keywords:**

Firm-Value; Value-Determinants; Behavioral Finance; Panel Regression; Germany

# Introduction

The capital market is the backbone of any country’s economy. Hence, the relevance of understanding stock return becomes most evident as stock investments are considered an important measure to ensure private pension to prevent old-age poverty. In this context, German politicians criticize the lacking retirement provisions of private households (Deutscher Bundestag, 2021). Meanwhile, financial literacy appears much less on the agendas of politicians, although stock investments would require basic knowledge to understand and adequately interpret the success of a company. In this light, the paper introduces how to understand the success of a company and its relevant value drivers.

In the past, scholars and practitioners have already identified several financial determinants that are said to significantly impact a firm’s value. However, many results seem inconsistent with or even contradictory to each other. Moreover, determinants identified in the past are not guaranteed to be constant over time.

The objective of this paper is to investigate whether and to which extent financial indicators are significantly related to a firm’s valuation. The proxy for a firm’s value is measured by the price to book (P/B) per share. The relationship of the relevant determinants is studied using the data of 99 DAX and MDAX companies gathered over a fourteen-year period. The study contributes to the academic literature by looking at a dataset that has not been analyzed before, focusing on the German industry.

This research may offer an answer to the question of whether value prediction based on financial indicators is a desperate ride through the rear-view mirror or whether there are meaningful insights to be found. The results, in turn, may indicate the relevance of behavioral finance over traditional financial indicators for investment choices. In this context, the given paper may also suggest a stronger emphasis on non-financial value reporting by standard-setting bodies, like the International Accounting Standard Board (ISAB) in Europe or the USA's Financial Accounting Standards Board (FASB).

To briefly sum up the above, the following research questions will be addressed:

1. Are financial indicators significantly related to stock returns, and if so, what is the extent of their relationship? (quantitative analysis)
2. What other factors may drive investment decisions? (literature study)

# Theoretical Backbone

## The Concept of Value

To better understand the role of traditional and behavioral finance in the framework of this paper, the concept of value is of utmost importance. The debates about the meaning of value stretch back more than a century. Today, numerous disciplines are concerned with the value understanding, such as anthropology, sociology, philosophy, business, and economics (Boztepe, 2007, p. 55).

In economics, two main categories of theories can be distinguished, the objective and subjective theories of value. In the traditional economic discipline, the most prominent representatives of value theories are likely these of Smith (1776), Ricardo (1817), and Marx (1847). The objective approach to value is generally concerned with the classical political economy and the labor theory of value. Thereby, classical economists tend to neglect the importance of demand and concentrate on hypothetical conditions in which objective features of goods, most notably the cost of production, determine the pricing (King, & McLure, 2014, p. 1).

On the other hand, the second point of view is generally referred to as subjective-value or marginal utility economics (Buchanan, 1978, p. 9). The theory became prominent after the 1870s under the influence of Jevons, Walras, and Menger and remains the accepted approach today by mainstream economists (King, & McLure, 2014, p. 1). Buchanan underlines: “utility is a subjective phenomenon, and it is not something that can be externally or objectively measured” (Buchanan, 1978, p. 9). Most economists agree that consumer goods are valued based on how much consumers believe the goods will satisfy their preferences (see Stringham, 2010; King & McLure, 2014).

Finally, discussions about utility evolved in the equilibrium theory first described by Jevons and Walras (see Jevons, 1879; Walras, 1896). This theory attempts to determine prices in a whole economy within interacting markets by analyzing supply and demand behavior. This theory is of contemporary importance as it also represents the starting point for the capital asset pricing model (CAPM).

The CAPM is a market equilibrium model used to define the existing trade-off between risk and expected return in portfolio choices. The CAPM, independently introduced by Sharpe (1964), Lintner (1965), and Mossin (1966), and building on the work of Harry Markowitz (1952), was an early attempt to answer this question. Said authors have demonstrated that expected stock returns are positively and linearly related to the systematic market risk. Today, according to various academics, the CAPM has lost ground due to a lack of empirical evidence. The betas are said to not adequately explain differences in average returns (see Banz, 1981, p. 3; Malin, & Veeraraghavan, 2004, p. 156; Artmann et al., 2012, p. 758). These findings consequently motivated researchers to test additional variables to better understand the determinants of excess returns (alpha). Today, a few years and many publications later, academics and practitioners are still untiringly focused on improving the explanatory power of valuation/ return models from various scientific angles. There are, for instance, studies on *asset growth* (see Cooper et al., 2008), *leverage* (see Bhandari, 1988), or emphasizing the behavioral components such as sentiment, e.g., *Twitter mood* (see Bollen et al., 2011).

The never-ending research regarding the relevant value determinants underlines the difficulty of this discipline and highlights the importance of recognizing the subjectivity of utility that is somehow to be measured. This observation can be understood as exemplary for the experienced difficulty in explaining returns concerning the subjectivity of utility. Against this backdrop, several theories support a better understanding of the functioning of financial markets. Meanwhile, in the following, the emphasis lies exclusively on the behavioral finance discipline. In turn, the efficient market hypothesis (EMH) by Eugene Fama is still to be kept in mind.

## Behavioral Finance

From a behavioral finance perspective, the most-known counterpart of Fama’s theory is Professor Shiller of Yale University. His research is outlined in the next chapter.

Shiller supports the behavioral finance discipline and discusses the stock market from a psychological, sociological, and anthropological perspective (see Shiller, 1999). The behavioral principles that oppose the EMH are well-known, such as anchoring effect, home-bias, calendar effects, momentum strategies, small-firm effects, etc. Shiller argues that investors, being human, are swayed by psychology, and information may also be irrationally incorporated into decisions. Therefore markets are not efficient, and the validity of Fama’s EMH must be questioned.

Advocates of the behavioral finance theorem try to find evidence that market inefficiencies exist. In this context, Shiller explains that changes in the stock prices are partly driven by psychological elements and not only driven by fundamental value changes that occur with new information. To prove his perspective, Shiller examined whether changes in dividends, real interest rates, and the intertemporal marginal rate of substitution could explain the volatility in stock prices. He concludes that these indicators only fragmentarily explain the volatility in stock prices while a chunk of variance remains unexplained, which in turn supports his position against the EMH (Shiller, 1987, p. 33 et seqq.). Likewise, as one objective of this paper, evidence is gathered against the market efficiency understanding by analyzing to which extent historical information is already priced into the market.

## Literature Review on Value-Driver Determinants

Analogically to the methodology of this thesis, the paper by Anwaar analyzed the relationship of firm performance on stock returns in a panel study over the period 2005 to 2014. As opposed to this thesis, the value change was measured by stock returns over time. Said thesis instead focuses on the proxy price to book ratio per share. The study by Anwaar was conducted for firms listed on the Financial Times Stock Exchange Index (FTSE-100 Index). The researcher used earnings-per-share (EPS), return on assets (RoA), return on equity (RoE), net profit margin (NPM), and quick ratio as the independent variables. Results show insignificant results for quick ratio; meanwhile, both NPM and RoA have a significant positive impact, and EPS shows a significant negative impact on stock returns (Anwaar, 2016, p. 79 et seqq.).

Chen and Zhang's empirical results confirm significant effects on stock return variation driven by the dependent accounting variables: earnings yield, equity capital investment, changes in profitability, growth opportunities, and discount rates. According to their panel model, in sum, 20 percent of the variation of stock returns is explained by the choice of independent variables (Chen & Zhang, p. 219 et seqq.).

Aldin et al. investigated the return variation for the variables cash flows and liability computed as the change rate in comparison to the prior period. Results reveal an explanatory power accounting for 45.6% of the variation in stock returns.

The following table summarizes several studies:

Table 1: Research Overview of relevant Determinants

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source:** | **Dataset & Sample Selection:** | | **Analyzed Variables:** | | **Research Results:** |
| Biddle et al., 1997 | | US stock market, 1983-1994, 773 firm | EBEI, RI, o.CF EVA®, | Panel results indicate the highest explanatory power for EBEI of 9.0%, followed by RI 6.2%, EVA® 5.1%, and o.CF 2.8% for market-adjusted returns | |
| Chen & Dodd, 2001 | | US stock market, 1983-1992, 668 firms | OI, RI, EVA | Overall, 9.40% variation of stock returns is explained by the variation of the independent variables | |
| Copeland, 2002 | | S&P 500, 1992 to 1998, 2.390 observations | EPS, EVA | Panel results indicate explanatory power between 4.5-5.1% for EPS and between 0.3-3% for EVA | |
| Worthington & West, 2004 | | Australian stock market, 1992-1998, 110 firms | EBEI, RI, EVA, o.CF | Overall, 27% variation of stock returns are explained by the variation of the independent variables | |
| Feltham et al., 2004 | | US stock market, 1983–1994, 694 firms | EVA, RI, Earnings, o.CF | Panel results indicate the highest explanatory power for EVA of 6.3%, followed by RI 6.2%, Earnings 3.3%, and o.CF 2.9% (cf. vs. Biddle et al. 1997) | |
| Cheng & Zhang, 2006 | | 1983-2001, 27.897 observations | cf. text/ paper | Overall, about 20% variation of stock returns are explained by the variation of the independent variables | |
| Aldin et al., 2012 | | Iran, TSE, 2006-2010, 70 firms | cf. text/ paper | Overall, 45.6% variation of stock returns are explained by the variation of the independent variables | |
| Kebriaeezadeh et al., 2013 | | Iran, TSE, 2004-2010, 22 firms (Pharma) | cf. text/paper (9 variables) | Overall, 80% variation of stock returns are explained by the variation of the independent variables | |
| Hunjra et al., 2014 | | Pakistan, KSE, 2006-2011, 63 firms | DY, DPR, EPS, RoE, NOPAT | Overall, 85.88% variation of stock returns are explained by the variations of the independent variables | |
| Anwaar, 2016 | | London, FTSE-100 Index, 2015-2014, 30 firms | EPS, RoA, RoE, NPM, quick ratio, | Overall, 44.83% variation of stock returns are explained by the variations of the independent variables | |
| Wijesundera et al., 2016 | | Sri Lanka, CSE, 2014-2013, 60 firms | RoE, EPS, DY, P/B ratio, | Overall, 11.05% variation of stock returns are explained by the variation of the independent variables | |

Own illustration

Regarding the different findings, it is relevant to mention that the authors use different regression models, indicators, parameterizations, and scaling, including different depending variables. For this reason, the results are comparable to a limited extent only.

# Methodology

## Hypotheses

**Dependent Variable**

As explained in this thesis, the proxy for a firm's value change is measured by the price to book (P/B) per share. This ratio compares the stock market value to its book value. It thereby expresses how many times a firm’s stock is being traded compared to its book value. The ratio is calculated as follows:

|  |  |
| --- | --- |
|  | (1) |

In theory, when a firm is newly established, its market value would equal the investment made by its owner. However, with the growing maturity of the business, the market value evolves as the business may promise long-term returns. The market value can then be calculated as the present value of future dividends. Meanwhile, the book value is derived under the generally accepted accounting principles (GAAP) by its historical or accounting value (Agrawal et al. 1996, p. 334). Thus, the ratio can be interpreted as follows: The higher the market value of equity over its book value, the higher the investor’s expectations in future returns.

It is assumed that a change in the explanatory variables should correspond with a change in the P/B value. Otherwise, it must be assumed that investors may give less credit to financial ratios in their investment decisions which in turn supports the hypotheses of behavioral components that strongly influence the firm’s valuation. The null hypothesis (H0) generally assumes no relationships between the financial indicators (H1-n) and the change in value.

**Independent Variables (IVs):**

The following variables are considered key determinants when looking at the profitability of a company, its assets, and the capital structure. Consequently, the outcome of this study will reveal the significance of financial metrics in explaining the change in value.

Table 2: Predictors and Expected Effects on Firm’s value

|  |  |  |
| --- | --- | --- |
|  | **Predictor Variables** | **Expected Effect** |
|  | *Return on Assets (RoA)* | **(+)** |
|  | *Cash Reserves to Assets (CR/A)* | **(+)** |
|  | *Retained Earnings to Equity (RE/E)* | **(+)** |
|  | *Turnover Growth Rate (TGR)* | **(+)** |
|  | *Free Cash-Flow to Sales (FCF/S)* | **(+)** |
|  | *Free Flow (FF)* | **(+)** |
|  | *Leverage (LEV)* | **(-)** |
|  | *Relative Bid-Ask-Spead (rBAS)* | **(+)** |
|  | *Dividends to Assets (DIV/A)* | **(+)** |
|  | *Size* | **(-)** |

Own illustration

## Dataset

The original database consists of a set of figures from the financial statements of 152 constituents and 2.128 firm observations listed on the German stock exchange, DAX 30, and MDAX. The constituents thereby represent the largest German companies. The data was obtained from Thomson Reuters Eikon and checked for completeness in Microsoft Excel®. After required data adjustments, illustrated below, the sample still covers 99 firms and 870 observations. The overview of firms can be found in the appendix, Table 16.

Table 3: Sample

|  |  |
| --- | --- |
| **Observations (n)**  **Period 2006-2019** | |
| Prelinminary observations | *2.128* |
| Exclusion of Banks, Insurance, REITs | *-490* |
| Exclusion of new joiners before indexation | *-442* |
| Incomplete data | *-326* |
| **Final Sample** | ***870*** |

Own illustration

In alignment with other authors, banking, insurance companies, and Real Estate Investment Trusts (REITs) were excluded. This is justified given industry-specifics and regulations that may substantially influence predictors such as the dividend policy or the capital structure (Fama & French, 1992, p. 429; 2001, p. 6; Lee & Yoon, 2017 p. 733). After having excluded incomplete observations, the final data set contains 870 observations for 99 firms.

Concerning the characteristics of the panel, this is a short and unbalanced dataset, as the scope covers many firms but only a few years. In a balanced panel, all entities have measurements in all periods. Yet, due to missing observations, the panel of this thesis is unbalanced. Furthermore, it is a fixed panel as the same firms are observed for each period. In this context, it is also noteworthy that the sample accounts for the survivorship bias, which describes the tendency for failed companies to be excluded from performance studies because they no longer exist. Otherwise, this could cause skewed results given that only successful firms would survive until the end of the observations (see Davis, 1996). To avoid such biases, the constituents were collected after each period and compiled into one dataset. Thereby, the newness bias was also considered since all companies that joined the indices over time were included.

The plausibility check of the dataset in Excel® using minima and maxima revealed some major differences within the ranges of descriptive statistics. However, subsequent comparisons with the corresponding annual reports reveal that the discrepancies appear plausible. Thus, there is no reason to assume poor data quality.

# Research Results

## Descriptive Analysis

The following table summarizes the main characteristics of the dataset:

Table 4: Variables before transformation

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ***Variables*** | ***mean*** | ***median*** | ***sd*** | ***skewness*** | ***kurtosis*** | ***n*** |
| *P/B value* | 2.80 | 2.14 | 2.61 | 4.00 | 25.02 | 870 |
| *RoA* | 0.05 | 0.04 | 0.06 | 1.72 | 7.54 | 870 |
| *CR/A* | 0.12 | 0.10 | 0.10 | 2.36 | 9.19 | 870 |
| *RE/E* | 0.72 | 0.87 | 0.51 | -3.14 | 13.73 | 870 |
| *TGR* | 0.05 | 0.05 | 0.17 | 5.12 | 91.88 | 870 |
| *FCF/S* | 0.01 | 0.02 | 0.14 | -15.89 | 370.36 | 870 |
| *FF* | 0.69 | 0.73 | 0.27 | -0.38 | -1.14 | 870 |
| LEV | 0.64 | 0.65 | 0.15 | -0.57 | 0.22 | 870 |
| *rBAS* | 0.00 | 0.00 | 0.00 | 3.23 | 26.43 | 870 |
| DIV/A | 0.03 | 0.02 | 0.05 | 9.96 | 158.78 | 870 |
| S | 22.76 | 22.53 | 1.60 | 0.42 | -0.68 | 870 |

Own illustration

Some extreme values for skewness and kurtosis indicate a violation of the normality assumption (Rencher, 2003, p. 92 et seqq.; Barton et al., 2013, p. 612). To avoid non-normality and heteroscedasticity, which may occur when some variables are skewed, and others are not, the variables were transformed. While several transformation methods exist, the "bestNormalize" Package in R provides the most suitable transformation for each variable (Peterson & Peterson, 2017, p. 2). Among others, the Box-Cox transformation is used, which represents a family of power transformations that incorporates and extends the traditional options to find the optimal normalizing transformation for each variable (see Box & Cox, 1964); as such, Osborne argues that Box-Cox represents a best practice method (Osborne, 2010, p. 1 et seqq.). For a comprehensive review of the "bestNormalize" package and its advantages, see Peterson and Peterson (2007). The results of the transformation are illustrated below.

Table 5: Variables after Transformation

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ***Variables*** | ***mean*** | ***median*** | ***sd*** | ***skewness*** | ***kurtosis*** | ***n*** |
| *P/B value* | 0.00 | - 0.25 | 1.00 | 4.00 | 25.02 | 870 |
| *RoA* | 0.00 | - 0.00 | 1.00 | 0.00 | - 0.02 | 870 |
| *CR/A* | 0.00 | 0.01 | 1.00 | 0.01 | 0.17 | 870 |
| *RE/E* | 0.00 | - 0.00 | 1.00 | 0.00 | - 0.02 | 870 |
| *TGR* | 0.00 | - 0.00 | 1.00 | 0.00 | - 0.02 | 870 |
| *FCF/S* | 0.00 | 0.00 | 1.00 | - 0.00 | - 0.02 | 870 |
| *FF* | 0.00 | 0.02 | 1.00 | - 0.28 | - 0.45 | 870 |
| LEV | 0.00 | 0.00 | 1.00 | - 0.03 | - 0.17 | 870 |
| *rBAS* | 0.00 | - 0.00 | 1.00 | 0.00 | - 0.02 | 870 |
| DIV/A | 0.00 | - 0.00 | 1.00 | 0.06 | - 0.19 | 870 |
| Size | 0.00 | - 0.00 | 1.00 | 0.00 | - 0.02 | 870 |

Own illustration

## Power of Panel Regression

Different panel models may or may not be suitable to interpret the regression. The model selection depends on the observed heterogeneity, which analyzes whether individual effects, time effects, or both effects are present. If individual effects are present, heterogeneity, e.g., industry specifics, are not captured in regressors and may influence the quality of the model.

The decision or test process can be summarized as follows:

Table 6: Methodology in choosing the Adequate Panel Model

|  |  |  |  |
| --- | --- | --- | --- |
| **Fixed effect**  **(F test)** | **Random effect**  **(LM test)** | | **Selection** |
| H0 is not rejected  (No fixed effect) | H0 is not rejected  (No random effect) | Pooled OLS | |
| H0 is rejected  (fixed effect) | H0 is not rejected  (No random effect) | Fixed Effect model | |
| H0 is not rejected  (No fixed effect) | H0 is rejected  (random effect) | Random Effect model | |
| H0 is rejected  (fixed effect) | H0 is rejected  (random effect) | (1) Fixed and Random Effect model  (2) Choice depending on the result of Hausman test | |

Own illustration based on Park, 2011, p. 50

For this purpose, first, all panel models were computed to understand and explore the explanatory power of each. After that, the appropriate tests were conducted to identify the adequate panel model.

First, the F- and LM-Tests were conducted. Fixed effects were tested using the F-Test, while the LM-Test examined random effects. Concerning the Breusch-Pagan LM test, the null hypothesis is that individual-specific or time-specific error variance components are zero. With a large chi-square value of 263.32, the null hypothesis was rejected in favor of the RE model (p <.0000). As shown in the table below, some parameter estimates of the regressors are different from those in the pooled OLS.

Regarding the F-Test, the FE model fits the data better than the pooled OLS. The model below shows an F-Test result of 21.21; hence the null hypothesis is rejected in favor of the FE model (p <.0000). Again, some parameter estimates of individual regressors are different from those in the pooled OLS. For instance, the variable retained earnings to equity shows reversed coefficients 0.005 to -0.086 with a gain in significance at the 0.000 significance level. Also, the predictor free-cash-flow to sales reports a reversed coefficient of 0.105 to 0.086, however no change in the significance level.

Given that both fixed and random effects were found, the Hausman specification test was conducted. As outlined, this test examines whether individual effects are uncorrelated with other regressors in the model, which would violate a Gauss-Markov assumption and consequently suggest using the FE model. The results reveal that the null hypothesis must be rejected, with a chi-squared of 7.840 (p > 0.000); hence the FE model is favored over its random counterpart.

Furthermore, given the characteristics of this short panel, the within estimation was used to estimate the FE model. Unlike LSDV, the within estimation does not need dummy variables but uses deviations from groups or time periods and thus has larger degrees of freedom, smaller mean squared errors (MSE), and smaller standard errors of parameters (Park, 2011, p. 29). Additionally, a two-way effect model was performed. Two-way effect models have two sets of dummy variables for individual and time variables. As it can be seen in the table below, the panel model fits the data better than the one-way model.

As shown below, in the two-way FE model, the F statistic increased from 19.152 (p<.000) to 31.856 (p<.000), SSE (sum of squares due to error or residual) decreased from 258.5 to 188.88, and R2 increased from .0.08 to .0.18. Parameter estimates of individual regressors are slightly different from those in the one-way model. For instance, the coefficient of free-cash-flow to sales increased from -0.054 to -0.086, indicating statistical significance (p<.0000).

Table 7: Review Panel Models

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **\*\*\* see remarks** | **Pooled OLS** | **RE** | **FE (one-side)** | **FE (two-side)** |
| Constant | 2.961e-17 [2.687e-02] | 3,668e-4  [0.059] |  |  |
| **RoA** | 0.242\*\*\*  [0.005] | 0.222\*\*\*  [0.049] | 0.239\*\*\* [0.050) | 0.028\*\*\*  [0.043] |
| **CR/A** | 0.010\*\*\*  [0.003] | 0.0603\*  [0.033] | 0.095\*\* [0.037] | 0.061\*  [0.032] |
| **RE/E** | 0.005  [0.003] | -0.035  [0.038] | -0.067 [0.046] | -0.086\*\*\*  [0.040] |
| **TGR** | -0.130\*\*\*  [0.003] | -0.105\*\*\*  [0.024] | -0.092\*\*\* [0.024] | -0.007\*\*\*  [0.0232] |
| **FCF/S** | 0.105\*\*\*  [0.003] | 0.011  [0.036] | -0.054 [0.038] | -0.086\*\*\*  [0.034] |
| **FF** | -0.007\*\*\*  [0.003] | -0.140\*\*\*  [0.037] | -0.173\*\*\* [0.043] | -0.169\*\*\*  [0.037] |
| **LEV** | 0.310  [0.004] | 0.412\*\*\*  [0.047] | 0.524\*\*\* [0.057] | 0.600\*\*\*  [0.050] |
| **rBAS** | -0.163\*\*\*  [0.004] | -0.154\*\*\*  [0.039] | -0.136\*\*\* [0.039] | -0.076\*\*\*  [0.038] |
| **DIV/A** | 0.0331\*\*\*  [0.004] | 0.205\*\*\*  [0.047] | 0.168\*\*\* [0.051] | 0.199\*\*\*  [0.045] |
| **Size** | -0.036\*\*\*  [0.005] | -0.476\*\*\*  [0.064] | -0.605\*\*\* [0.103] | -0.769\*\*\*  [0.103] |
| F-test | 52.413 (p<.000) |  | 19.152 (p<.000) | 31.856 (p<.000) |
| DF | 859 |  | 761 | 748 |
| RSS | 539.69 | 316.66 | 258.5 | 188.88 |
| R-Squared | 0.379 | 0.216 | 0.201 | 0.299 |
| Adj. R Sq. | 0.371 | 0.207 | 0.088 | 0.185 |
| No Obs. | 870 | 870 | 870 | 870 |
|  | 1 Standard errors are reported in parenthesis.  Statistical significance at \* <95%, \*\*<99%, \*\*\*<100% level | | | | |

Own illustration

As outlined by Park, the two-way FE models entail some issues in estimation and interpretation (Park, 2011, p. 9). Also, further limitations must be considered concerning the OLS diagnostics and, in particular, concerning the linearity assumption (see Table 17). However, given the focus of this thesis which is not to find the best determinants but to understand the overall performance of regression models to explain the firm value, the interpretation of coefficients can be neglected. Still, the results imply that a big chunk of variance remains unexplained by the chosen financial predictors, which perhaps is contributed to non-financial determinants and irrational market behavior. The results are consistent with the multiple regression results in Chapter 4.2.

# Discussion - The Death of Traditional Ratios

## Major Contributions

Concerning the panel regression results, specifically regarding the two-way FE model, it is observed that the regression coefficients for all variables are not equal to zero and significant at the 0.05 significance level. Hence, the null hypothesis that assumed no relationship between the financial indicators (H1-n) and firm value must be rejected in all cases. However, the hypothesized effect directions have not been confirmed consistently, as shown below.

Despite the statistical significance, the practical significance relativizes the magnitude of the presented results. These results thereby also support prior research findings of Worthington and West (2004), receiving a rather low explanatory power for the investigated variables of financial nature in the Australian stock market. This goes along with Wijesundera et al.'s findings (2006), which show only moderate prediction power for the Sri Lanka firms, likewise observed by Chen and Dodd (2001) in their study of the US stock market.

The regression results provide sufficient evidence to highlight the relevance of predictors of non-financial nature and give room to argue in favor of the existence of irrational investment choices in the context of the behavioral finance discipline.

Lastly, the results of the FE panel model are to be acknowledged. With the price to book ratio as the dependent variable, the numerator represents the market price, while the denominator represents the book value. The larger the difference between these variables, the larger the discrepancy between the future value expectations versus the current book value. This gap varies across industries, given the different prospects of an industry or a firm. This claim was confirmed by the panel regression results as evidenced by the need to chose a FE model that indicates heterogeneity across the dataset.

## Acknowledgment of the Behavioral Finance

Recalling the specific purpose of this thesis to not only explain to which extent financial indicators are significantly related to the valuation of a firm but to also discuss, based on the recent research findings, what else may drive investment decisions, the following acknowledgment will shortly summarize the results from the behavioral finance perspective.

In finance, the cornerstone of any investment decision involves information that investors analyze to be able to make a decision. As outlined, the behavioral discipline considers market participants' behavior and attempts to explain capital market anomalies based on the observed so-called behavioral anomalies (see Röckemann, 1995; Kaserer & Hanauer, 2017). The persistent, underlying assumption describes that individuals experience emotional influences and have limited capacities in terms of perception resulting in biased decision-making (see Table 1). Due to such observations, well-founded concerns have arisen about the rational processing of information by investors (see Nguyen & Schüßler, 2012; Malin, & Veeraraghavan, 2004; Artmann et al., 2012). The current research results thereby join a series of earlier findings where researchers prioritized financial information and confirmed a low or moderate correlation between stock price performance and fundamental data. These findings suggest that non-numerical data, next to behavioral anomalies, should be considered in the context of investigating value determinants.

In conclusion, the neoclassical school of thought is continuously more challenged with new evidence from the behavioral finance discipline. The behavioral theory thereby complements neoclassical assumptions with behavioral economics. Among other factors, emotions and behavioral anomalies of individuals must be included in new decision-making models, which brings us back to the panel study by Pellens et al. (2018), which provides evidence on the information preferences by investors. It is shown that private investors do not only differ from institutional investors in their decision-making but also that preferences on information sources change over time. This also leads us to a quote by Ken Arrow: “One of the things that microeconomics teaches you is that individuals are not alike. […].” In consideration of the above, the difficulty of ex-ante forecasts of returns continues to be a major challenge. Hence, a key concern of the behavioral finance discipline is linked to the question of how to measure, explain and predict the decision processes based on (changing) behavioral patterns.

In summary, this thesis acknowledges that returns are most likely linked to financial determinants; at the same time, they are also associated with non-financial data and linked to behavioral anomalies. As a final remark, contrasting Fama’s efficent market theorem, it is argued that the technical chart analysis already deals with this behavioral component while simultaneously looking at trends that analyze the investor’s behavior as they respond to external factors. This, in turn, brings us to the limitation of this thesis, subsequently outlined in detail.

## Limitations

A conceptual limitation is linked to the fact that only quantitative financial information from financial statements was analyzed, whereby the macroeconomic environment and other qualitative and behavioral determinants were neglected. Given the lacking explanatory power and referencing the study by Pellens et al. (2018), it can be assumed that the neglected factor’s contribution is of high importance for the overall quality of a research model which aims to explain or predict a firm’s value.

Finally, it can be assumed that there potentially is an issue regarding the time lag between capturing the firm’s value and disclosing the financial results. In this regard, it is difficult to attribute the financials to a specific announcement period. Therefore, for future analysis it is suggested to use the weighted average principle for capturing the change in value over time.

## Recommendations

The communication of non-financial and financial information provides a convenient approach to reduce the overall complexity in understanding a business for market participants and helps managers and investors in their decision-making processes. From a firm perspective, new insights may offer new directions to Chief Financial Officers and Investor-Relation departments to understand value drivers and ratios that attract analysts' and investors' interest. From an investor's point of view, promising companies can be identified to invest with more confidence financial resources. Based on the presented results, recommendations from different angles can be drawn to benefit from the findings:

**Firm’s Perspectives**

From a firm's point of view, further analysis and concern with the information sources, which investors preferentially use to support their investment decisions, is recommended. Additionally, another suggestion to the firms' management is to propagate value-oriented indicators. Pushing information regarding the value concept of a company may consequently become a self-fulfilling prophecy. If investors base their decisions on financial indicators, this will increase the rationality of such decisions and lead to a closer relationship of a firm’s financials and its valuation. Some well-known examples are summarized in the appendix (see Table 17).

**Perspectives of Investors/ Shareholders**

Concerning the investors' perspectives, private investors are strongly commended to look at a firm’s financials when making investment decisions. For a good reason, institutional investors currently use this information extensively (see Pellens et al., 2018). For private investors, it is equally important to understand the annual reports to close information gaps which may enable the investors to understand whether a company is trustworthy and honest with its financial story or not.

Likewise, private shareholders must push the management to report the true economic value in their financials and give better financial forecasts in mid- and long-term views to close information gaps and prevent dysfunctional behavior of the management. Thereby they can ensure that the management interests are aligned with their objectives as information asymmetries are revealed within the disclosure of financial statements.

# Conclusion

In summary, partly inconclusive results of the past, the fast-changing environment, and the explicit focus on the German industry motivated further research regarding the subject of value determinants. As outlined, this research is of major importance for the academic and business community since decision-relevant information is analyzed and discussed. The findings can be used for investment decisions, guidance and improvement of corporate performance, as well as to improve accounting standards and disclosure requirements.

Consequently, the given paper provides empirical evidence to the question of whether financial indicators are significantly related to the change in value, measured by the P/B ratio, of German stock-listed companies. Meanwhile, it can be concluded that several financial indicators are helpful as predictors of a firm’s value. Nevertheless, a big chunk of the value change over time cannot be explained by the financial predictors chosen. Therefore, the results can be interpreted in favor of the importance of non-financial information and they support the existence of behavioral anomalies that drive investment decisions. Finally, as outlined in the recommendations section, in terms of management control, the advantage of value-oriented indicators should be acknowledged as this may contribute to less budgetary slack and better incentive systems.

Future research may follow up on the research results for instance by:

* Using event studies to measure and compare investor’s short term reactions to specific events versus long-term panel results;
* Comparing the goodness of fit and significance across industries to potentially also identify industry-specific KPIs;
* Capturing additional non-financial variables such as board changes, investor relations quality, CSR, etc.

# Appendix

Table 8: Dataset

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| adidas | Daimler | Gerresheimer | MEDION | SGL Carbon |
| Airbus NL | Degussa (Evonik Operation) | Gerry Weber Intern AG | Merck KGaA | Siemens |
| Altana | Deutsche  Lufthansa | Hamburger Hafen & Logistik | Metro | Siemens Health |
| ARQUES Industries | Deutsche Post | Heidelberg Druck | MTU  Aero Engines | Siltronic |
| Aurubis | Deutsche  Telekom | HeidelbergCement | Nemetschek | Software AG |
| Axel Springer SE | Deutz | Hella | Norma Group | Stada Arzneimittel AG |
| BASF SE | DMG MORI AG | Henkel | Osram Licht | Südzucker AG |
| Bauer | DOUGLAS HOLDING | Hochtief | ProSiebenSat.1 Media | Symrise |
| Bayer | Duerr | Hugo Boss | Puma DE | Telefonica DE |
| BayWa | E.ON | Infineon | Rational | Thiel Logistik |
| Bechtle | ElringKlinger | Innogy SE | Rheinmetall | ThyssenKrupp |
| Beiersdorf | Eventim | Jungheinrich AG | Rhoen-Klinikum AG | Tognum |
| Bertrandt | Evonik Industrie | K+S | RTL Group | TUI AG |
| BERU | Fielmann | Kion Grp | RWE | Uniper |
| Bilfinger SE | Fraport Airport | Klöckner & Co | Salzgitter | United  Internet |
| BMW | freenet | Krones AG | SAP | Volkswagen |
| Carl Zeiss Meditec | Fresenius  Medical Care | KUKA | Sartorius | Vossloh |
| Ceconomy AG  (e.g. Mediamarkt, Saturn) | Fresenius Pref | Lanxess | Schaeffler AG | Wacker Chemie AG |
| Continental | Fuchs Petrolub | Leoni AG | Schwarz Pharma | 1&1 Drillisch |
| Covestro AG | GEA Group | Linde | Scout24 AG |  |

Table 9: Panel OLS Assumptions by Variable

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assumptions** | ***i.*** | ***ii.*** *(a)* | ***ii.*** *(b)* | ***iii.*** | ***iv.*** | ***v.*** | ***(vi.)*** |
| **H**0 **Hypotheses** | ***Linearity*** | ***Mean 0*** | ***No Corr.***  ***Residuals*** | ***Homoscedasticity*** | ***No autocorrelation*** | ***No Multicollinearity*** | ***Normality*** |
| **Objective (H**0**)** | ***Keep*** | ***Keep*** | ***Keep*** | ***Keep*** | ***Keep*** | ***Keep*** | ***Keep*** |
| **Sig. level** | **0.05** | ***-*** | **Corr./ VIF>5** | **0.05** | **0.05** | **Corr./VIF >5** | **0.05** |
| **RoA** | Reject H0 | Keep H0 | Reject H0 | Reject H0 | Keep H0 | Keep H0 | Reject H0 |
| **CR/A** | Reject H0 | Keep H0 | Reject H0 | Reject H0 | Keep H0 | Keep H0 | Keep H0 |
| **RE/E** | Reject H0 | Keep H0 | Reject H0 | Reject H0 | Keep H0 | Keep H0 | Keep H0 |
| **TGR** | Reject H0 | Keep H0 | Keep H | Reject H0 | Reject H0 | Keep H0 | Keep H0 |
| **FCF/S** | Reject H0 | Keep H0 | Keep H | Keep H0 | Keep H0 | Keep H0 | Keep H0 |
| **FF** | Reject H0 | Keep H0 | Reject H0 | Reject H0 | Keep H0 | Keep H0 | Keep H0 |
| **LEV** | Reject H0 | Keep H0 | Keep H | Keep H0 | Keep H0 | Keep H0 | Keep H0 |
| **rBAS** | Keep H0 | Keep H0 | Keep H | Reject H0 | Keep H0 | Keep H0 | Keep H0 |
| **DIV/A** | Reject H0 | Keep H0 | Keep H | Reject H0 | Keep H0 | Keep H0 | Keep H0 |
| **Size** | Reject H0 | Keep H0 | Keep H | Reject H0 | Keep H0 | Keep H0 | Keep H0 |

Own illustration

Table 10: Value-Oriented Concepts of Corporate Control

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Concepts | Creator/Promoter: | Publication | | | Author: |
| Economic Value Added (EVA) | Stern Stewart & Co. | | 1990 | Stern & Stewart | |
| Added Value (AV) | London Business School | | 1990 | Davis & Kay | |
| Economic Profit | McKinsey & Company | | 1994 | Copeland et al. | |
| Cash Flow Return on Investment (CFROI) | Boston Consulting Group | | 1995 | Lewis | |
| Earnings less risk-free  Interest Charge (ERIC) | KPMG | | 2004 | Velthuis | |

Own illustration

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