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The Influence of Stock Market Liquidity on Dividend Changes in Europe

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For my father Alfred Kuhlmann

TABLE OF CONTENTS

LIST OF ACRONYMS

D_1	=	estimated dividend per share in t_1
g	=	constant dividend growth rate in perpetuity
$ILLIQ_{iy}$	=	iliquidity ratio of Amihud (2002)
p_i	=	price of trade i
p_t	=	last traded price before time t
p_t^A	=	best asked price
p_t^B	=	best bid price
p_t^M	=	mid price
P_0	=	value of stock in t_0
q_i	=	shares of trade i
r_{EK}	=	companies' cost of equity capital
R_{iyd}	=	return on stock i on day d of year y
so	=	shares outstanding
$SrelM_t$	=	spread; relative calculated with mid price
$SrelT_t$	=	spread; relative calculated with last trade
TR_t	=	turnover to shares outstanding per time
$VOLD_{iyd}$	=	daily volume in dollars
X	=	independent variable
Y	=	dependent variable
Δ	=	Delta
α	=	y-intercept
$\sum$	=	sum

LIST OF ABBREVIATIONS

ADR	=	American Depositary Receipt
AMEX	=	American Stock Exchange
ANALYST	=	Analyst coverage
BBS	=	Buybacks of shares
CAPM	=	Capital asset pricing model
CASH	=	Cash and equivalents to total assets
CFTO	=	Cash flow to turnover
CG	=	Corporate Governance
CGS	=	Corporate Governance Score
CRS	=	Chordia, Roll and Subrahmanyam measure
DC	=	Dividend change
DCB	=	Dividend change binary
DCM	=	Dividend change multinomial
DEBT	=	Level of companies' indebtedness
Dec.	=	Decrease
DELTA	=	Relative change in comparison to the previous year
ETF	=	Exchange-traded fund
GBM	=	Gradient Boosting Model
GDP	=	Gross Domestic Product
H1	=	Hypothesis 1
H2	=	Hypothesis 2
H3	=	Hypothesis 3
Inc.	=	Increase
Infl.	=	Influence
IPO	=	Initial public offering
ISSUANCE	=	Issuance of equity capital
LACAPM	=	Liquidity adjusted capital asset pricing model
LDA	=	Linear discriminant analysis
LN	=	Natural logarithm
Log	=	Logarithm
Logit	=	Logistic regression
LR	=	Liquidity ratio

Main.	=	Maintain
M&A	=	Mergers and acquisitions
MA	=	Merger and Acquisition to turnover
NASDAQ	=	National Association of Securities Dealers Automated Quotations
NETINV	=	Net investments
NYSE	=	Ney York Stock Exchange
Obs.	=	Observations
OI	=	Net income to assets
OL	=	Occurrence of a loss
OLS	=	Ordinary least squares
PBR	=	Price to book ratio
PLC	=	Public Limited Company
PREVIOUS	=	Previous year's dividend change
R&D	=	Research and Development
REIT	=	Real-Estate-Investment-Trust
RF	=	Random Forest
SECURED	=	Secured debt capital
SIZE	=	Company size
SPREAD	=	Relative spread to mid price
Std. Error	=	Standard Error
TGR	=	Turnover growth rate
TQ	=	Tobin's Q
TR	=	Turnover ratio
USA	=	United States of America
WACC	=	Weighted average cost of capital
Y2007, …Y2014	=	Year 2007-2014
YIELD	=	Previous year's dividend yield

LIST OF FIGURES

LIST OF TABLES

FORMULA DIRECTORY

1 INTRODUCTION

1.1 PROBLEM DESCRIPTION

A growing body of literature documents the influence of firm-specific determinants on dividend changes.[1] In general, cash distributions are economically useful for managers and shareholders, if they lead share prices to rise.[2] This happens when investors prefer dividend-paying companies to nonpaying companies.[3] The assumed positive value effect is conclusive only if payouts are more advantageous than reinvestments and, for example, contribute to the assimilation of the information asymmetries between managers and investors to overcome free cash flow problems.[4] Although common explanatory variables for dividend changes are frequently derived from trade-off, pecking order and agency theories, pieces of the dividend puzzle are still missing, such as how stock market liquidity influences dividend changes.[5]

The 2008 financial market crisis has changed companies' business environment towards capital funding as well as significantly changing investors' affinity and shows in particular that liquidity in stock markets is not self-evident.[6] Because selling stocks becomes more expensive with a lack of tradability, it becomes disadvantageous to reverse investment decisions, and the insecurity of

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[1] Cf. Aggarwal, R. et al. (2012), p. 403 f.; Charitou, A. et al. (2011), p. 1521 f.; De Cesari, A., Huang-Meier, W. (2015), p. 1 f.; Goergen, M. et al. (2005), p. 375 f.; Li, W., Lie, E. (2006), p. 293 f.

[2] Cf. Aharony, J., Swary, I. (1980), p. 11.

[3] Cf. Baker, M., Wurgler, J. (2004), p. 1160.

[4] Cf. Gugler, K., Yurtoglu, B. B. (2003), p. 753; Jensen, M. C., Meckling, W. H. (1976), p. 342 f.

[5] Cf. Kraus, A., Litzenberger, R. H. (1973), p. 918; Myers, S. C. (1984), p. 575 f.; Myers, S. C., Majluf, N. S. (1984), p. 219 f.

[6] Cf. Bogle, J. C. (2016), p. 9 f.; Mancini, L. et al. (2013), p. 1821.

investing rises. The illiquidity experience might provide new insights to understand the nature of dividend changes.

The theoretical impact of illiquidity on dividend changes is ambiguous: it can be either substitutive or complementary.[7] The negative, exchangeable relationship is attributed to manager-shareholder conflict and the corporate goal of assimilating the corporate information level to reduce financing costs.[8] Because the decision to pay out a dividend contains information about the firms' perspectives, it can downsize investment risks by reducing agency costs.[9] Despite the numerous possibilities to demonstrate that they are not running the company opportunistically, managers favor cash distributions over stock buybacks to create trust.[10] In addition to information asymmetries, the risk of equity-holding increases if shareholders cannot reverse their investment decision quickly at low cost.[11] Therefore, the substitutive effect implies that both dividends and stock market liquidity can help to reduce investment risk.[12]

In contrast to the substitution theory, stock liquidity and dividends are also stated to be complementary.[13] Companies with more volatile earnings, unpredictable net cash flows and various investment opportunities pay lower dividends.[14] As larger firms tend to have more stable cash flows and lower debt, greater firm size significantly promotes dividend payments.[15] At the same time, access to capital markets improves with company size and larger companies

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[7] Cf. Aggarwal, R. et al. (2012), p. 428; Banerjee, S. et al. (2007), p. 394; Kale, J. R. et al. (2012), p. 27 f.

[8] Cf. Easterbrook, F. H. (1984), p. 650 f.; Healy, P. M., Palepu, K. G. (1988), p. 149 f.; Jensen, M. C. (1986), p. 323 f.; Lang, L. H. P., Litzenberger, R. H. (1989), p. 181 f.

[9] Cf. Kale, J. R. et al. (2012), p. 393.

[10] Cf. Benesh, G. A. et al. (1984), p. 140; Best, R. J., Best, R. W. (2001), p. 361 f.; Denis, D. J. et al. (1994), p. 586; Yoon, P. S., Starks, L. T. (1995), p. 1015 f.

[11] Cf. Bernstein, P. L. (1987), p. 55.

[12] Cf. Banerjee, S. et al. (2007), p. 371.

[13] Cf. Fama, E. F., French, K. (2002), p. 8; Jiang, F. et al. (2017), p. 312.

[14] These findings are in line with the trade-off model and the pecking order predictions.

[15] Cf. Steck, A. (2010), p. 4.

generally have more liquid traded stocks. Accordingly, a manager's decision to distribute dividends is positively connected to company size and simultaneously the tradability of shares improves. If this is the case, a positive relationship between stock liquidity and dividends can be assumed.

The contrary views in the literature, which are explained in more detail in section 3.3, show that further research is necessary to explore the effect of stock market liquidity on dividend changes. This dissertation aims to close that research gap and to answer the central question as to whether stock market liquidity determines dividend changes.

1.2 CONTRIBUTION TO THE CURRENT STATE OF RESEARCH

The study contributes to the growing body of dividend change research in several areas:

First, to the best of the researcher's knowledge the influence of stock market liquidity on dividend changes has not been analyzed yet. Therefore, the research is unique in controlling the influence of liquidity on dividend changes, while research is still currently engaged in seeking the key determinants of dividend changes. This investigation fits with that search by promoting the understanding of the modern capital allocation process. Besides the liquidity level, annual liquidity changes are used to explain managements' propensity to change dividends. Previous studies show that a decrease in transaction costs lead share prices to rise.[16] Furthermore, increasing stock liquidity influences the firm's growth opportunities positively and also corporate managers and shareholders base their investment decisions on the trading environment.[17] Despite these findings, the influence of liquidity changes on dividend changes is not adequately studied. The research question becomes particularly contemporary, since illiquidity shocks are more evident after the 2008 financial market crisis.

[16] Cf. Amihud, Y., Mendelson, H. (1986), p. 46.

[17] Cf. Becker-Blease, J. R., Paul, D. L. (2006), p. 50.

Second, dividend research commonly uses stochastic data modeling techniques such as linear regression or linear discriminate analysis.[18] Those techniques rely on historical information regarding the data structure and are therefore backward looking. To overcome that problem, machine learning approaches depend less on historical information, treat the nature of the variable as a black box and do not require a clear vision of the model.[19] Regarding their importance for the outcome variable, the algorithm organizes the input variables in descending order of importance.[20] As the statistical power of machine learning estimation is high and is not only backwards directed, it is a suitable tool to expand the stochastic investigation.[21] Compared to data models, algorithmic models can reach a better predictive accuracy and therefore provide superior information about the underlying mechanism.[22] To use a wide variety of tools in the present study, classical stochastic data modeling like panel logit estimation and linear discriminant analysis are used together with algorithmic data modeling techniques (data mining) like decision tree, random forest and gradient boosting, which are quite innovative in this research field.[23] Even if data mining does not per se outperform the classic models it can help to strengthen the understanding of dividend payout decisions.[24] Employing different classification techniques aims at delivering additional insights into the decision about whether to change dividends.

Third, the investigation of European companies is still underrepresented to date, as most investigations are conducted on American and British databases. Different corporate governance systems and degrees of shareholder protection

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[18] Cf. Chan, K. F. et al. (2016), p. 935 f.; De Cesari, A., Huang-Meier, W. (2015), p. 8 f.; Gugler, K., Yurtoglu, B. B. (2003), p. 731; La Porta, R. et al. (2000), p. 1 f., among others.

[19] Cf. Breiman, L. (2001), p. 199.

[20] Cf. Varian, H. R. (2014), p. 5.

[21] Cf. Breiman, L. (2001), p. 214.

[22] Cf. Huang, Z. et al. (2004), p. 543 f.

[23] Breiman, L. (2001), p. 214 recommends the use of multiple methods for data analysis.

[24] Cf. Luebke, K., Rojahn, J. (2016), p. 342 f.

can be examined in many countries, which makes a cross-border investigation necessary.[25] In this context, Europe is of high importance for the global economy, with a percentage on the world GDP of 23.70 in 2015; while Germany, Britain and France are in the top six of the worldwide nominal GDP.[26] The European area, furthermore, covers an interesting cross-border heterogeneous environment, especially due to the current sovereign debt crisis. Exemplary German companies are declared to have rather flexible distribution policies in an international comparison.[27] In fact, in more than three quarter of the present annual observations German companies' change their dividends. With reference to its great flexibility and versatility, Europe should be examined separately. For this reason the study might lead to results that differ from US and British studies and contributes to the current state of research.

Fourth, the time span of this study covers the eventful years from 2006 to 2014. It includes the outbreak of the financial market crisis in 2008 as well as the subsequent sovereign debt crisis. Contemporary liquidity issues, especially the financial market crisis in 2008, might provide new insights to explain how companies' payout behavior changes with illiquidity.[28] As companies aiming at keeping dividends on a constant level e.g. to avoid negative feedback from stock prices and to ensure steady financing costs, the turbulent conditions within the nine years covered by the research may force companies to reduce their payouts to ensure companies' solvency. Thus, the time span enlarges the possibility of investigating the nature of rarely appearing dividend decreases.[29] These special

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[25] Cf. Amihud, Y., Murgia, M. (1997), p. 397 f.; La Porta, R. et al. (2000), p. 1 f.; Short, H. et al. (2002), p. 105 f., among others.

[26] Cf. World Bank, 22 July 2016.

[27] Goergen, M. et al (2005) investigates the flexibility of dividend changes within different corporate governance systems.

[28] Cf. Caballero, R., Simsek, A. (2012), p. 2549 f.; Nagel, S. (2012), p. 2 f., among others.

[29] That dividend decreases are unpopular with corporate managers is documented among others in the early survey of Lintner, J. (1956) and in Javakhadze, D. et al. (2014) afterwards.

surroundings make Europe particularly interesting for investigation during the period presented.

1.3 METHODOLOGY

After sketching the importance of the investigation in an economic context, chapter two investigates the driving determinants of dividend changes. Since the influencing factors of the propensity to pay out a dividend and of dividend yields are more thoroughly studied than the determinants of dividend changes, the overview starts with a literature analysis of the well studied propensity to pay out dividends. Such an analysis permits examination of implications regarding the general firm-specific drivers of distribution policies and dividend changes. Managers commonly pursue the goal of keeping cash distributions at a constant level to ensure steady financing costs and a calculable equity base. Furthermore, dividends are sticky to avoid negative feedback from stock prices.[30] The special nature of dividend change and its influencing determinants is investigated in the course of further inquiry. As the dissertation examines the influence of liquidity on dividend changes it is indispensable to get an understanding of both the dividend-change decision and the liquidity phenomenon. Therefore, chapter three introduces the importance, the nature and the different stages of liquidity to enhance understanding of the complexity and particularity of this phenomenon. Because liquidity has different dimensions, it is difficult to quantify by a single measure. Accordingly, several liquidity measures are introduced. They are subsequently specifically assessed as to their quality and usefulness under different assessment criteria. After selecting suitable measures for the present study the potential liquidity proxies are compared to each other.

The chapter ends with an overview of the current state of research on liquidity and dividend changes and the definition of hypotheses that are derived from research findings.

The fourth chapter introduces the research strategy and different modeling techniques. Next, the variables selected for scientific research are introduced and the empirical analysis of stock liquidity and dividend changes is executed. To get

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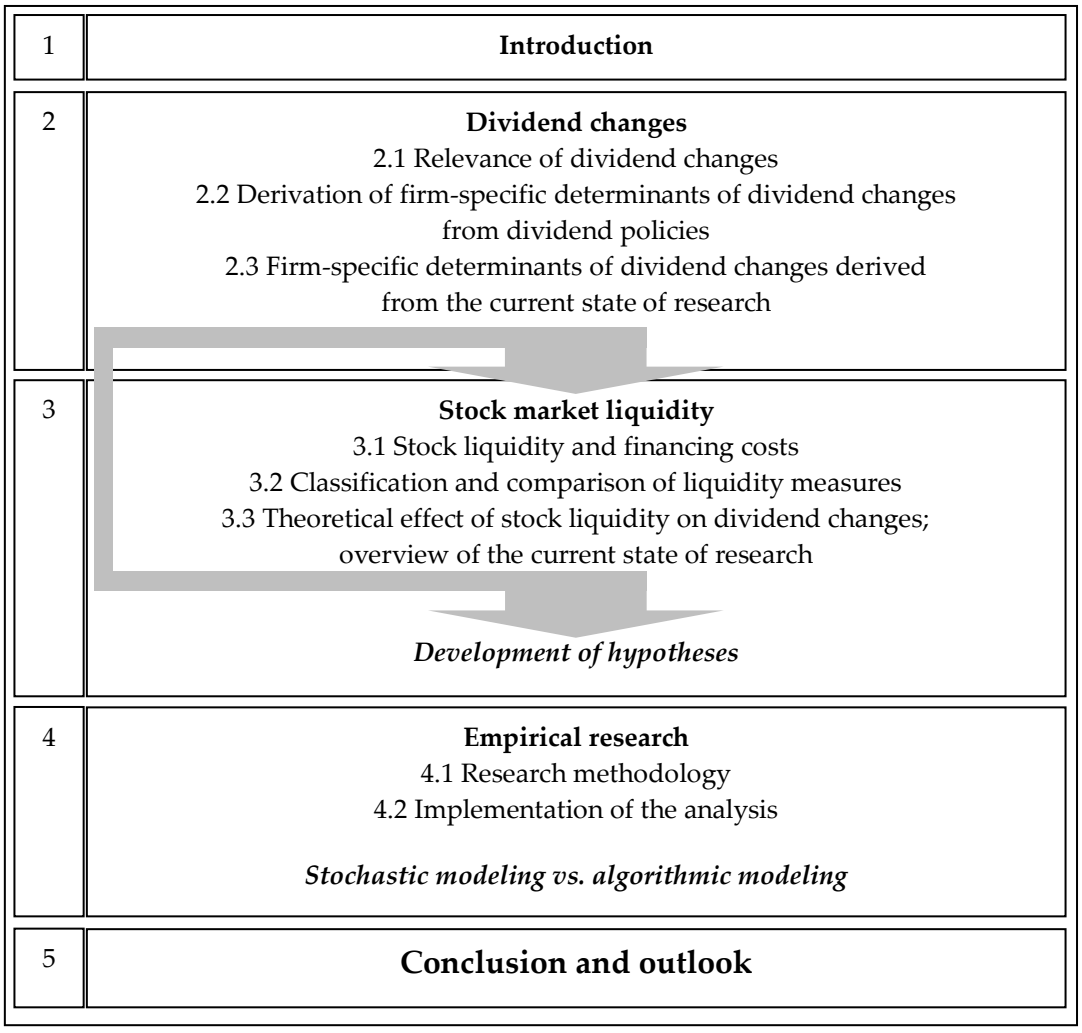
[30] Cf. Fang, V. et al. (2009), p. 150 f.; Subrahmanyam, A., Titman, S. (2001), p. 2389 f.

results for the cause-and-effect relationship between stock liquidity and dividend changes in Europe, stochastic models are used first and are expanded by three machine learning techniques, namely decision tree, random forest and gradient boosting. After those techniques are implemented and the analysis is performed, the dissertation continues with the interpretation of the statistical results and an outlook for further possible research fields that is given in chapter five. Summarized, by way of illustration, the structure of the work is given in Figure 1:

Figure 1: Structure of the work



2 DETERMINANTS OF DIVIDEND CHANGES

2.1 VALUE RELEVANCE OF DIVIDEND CHANGES

2.1.1 Market reactions to dividend changes

Although dividend payments appear to be easy to understand in the field of corporate management, they are difficult to appreciate from an economic point of view.[31] As a result, corporate finance literature is largely engaged in assessing the impact of dividend changes on the market value of listed securities.[32]

The dividend discount model illustrates the tension field between dividends and company growth. Basically it is assumed that the firm's value is the sum of its future cash flows (including dividend payments) and its constant growth rate discounted at an appropriate discount rate:[33]

(1) Dividend discount model

$$\boldsymbol{P_0 = \frac{D_1}{r_{EK} - g}}$$

P_0 = value of stock in t_0

D_1 = estimated dividend per share in t_1

r_{EK} = companies' cost of equity capital

g = constant dividend growth rate in perpetuity

Although the dividend payout ratio has a positive effect on the share price, the dividend growth rate sinks with higher dividend yields, because it is

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[31] Cf. Easterbrook, F. H. (1984), p. 650.

[32] Cf. Aggarwal, R. et al. (2012), p. 420 f.; Bulan, L. et al. (2007), p. 20; De Cesari, A., Huang-Meier, W. (2015), p. 8 f.; Deshmukh, S. (2003), p. 364 f.; Goergen, M. et al. (2005), p. 387 f.; Kale, J. R. et al. (2012), p. 365 f.; Li, W., Lie, E. (2006), p. 303 f.; Luebke, K., Rojahn, J. (2016), p. 335 f., among others.

[33] Cf. Gordon, M. J., Shapiro, E. (1956), p. 104.

calculated as the return on equity multiplied by the reinvestment rate (1 – dividend payout ratio). In other words, the growth of dividends is mainly influenced by the part of income that is ploughed back into the company and by the subsequent profitability of those reinvestments. This in turn can lower the theoretical value of the company.[34] Despite there being a trade-off between dividend payments and company growth following the specific model, several investigations indicate that dividend paying firms in particular grow fast.[35] Thus, there is a need to analyze the influence of dividend changes on share valuations in greater detail in the further course of research.

In a perfect capital market environment, financial decisions do not influence the share price.[36] Since in reality capital markets are far from being perfect, managers face, for example, agency costs, tax burdens and information asymmetries.[37] Due to those restrictions, dividend distributions are frequently stated to affect the company's market valuation in different ways:

First, the influence of dividend increases on corporate market valuations can be negative if capital gains are taxed at a lower rate than cash dividends.[38] If, for instance, institutional shareholders are taxed beneficially in comparison to retail investors, dividend-paying stocks attract more institutions than retail investors.[39] Institutional owners can be particularly valuable for the future firms' performance since they frequently hold larger stakes than private investors and have a monitoring function in the company.[40] That illustrates that capital markets respond to dividend changes depending on dividend clienteles that are discussed in more detail in the further course of the dissertation.

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[34] Cf. Benartzi, S. et al. (1997), p. 1031.

[35] Cf. Aivazian, V. et al. (2003), p. 386 f.

[36] Cf. Miller, M. H., Modigliani, F. (1961), p. 411 f.

[37] Cf. Easterbrook, F. H. (1984), p. 650 f.; Healy, P. M., Palepu, K. G. (1988), p 149 f.; Jensen, M. C. (1986), p. 323 f.; Lang, L. H. P., Litzenberger, R. H. (1989), p. 181 f.; Leary, M. T., Roberts, M. R. (2010), p. 332 f., among others.

[38] Cf. Jain, R. (2007), p. 406 f.

[39] Cf. Allen, F. et al. (2000), p. 2500.

[40] Cf. Barclay, M. J. et al. (2009), p. 2428 f.

Second, contrary to the "tax preference theory", the "bird in hand hypothesis" sees a positive effect in dividend changes and the shareholder value in view of the fact that future cash flows have a lower value than present cash flows.[41] This is due to two reasons: Inflation leads to a depreciation of money over time and entrepreneurial risk lowers the value of future cash flows and makes it favorable to obtain cash immediately.[42] Based on these assumptions, future cash flows are discounted by a reference interest rate.[43] If the company pays out dividends, that amount of money is no longer affected by the risk of suboptimal investment decisions by the responsible management.[44] However, dividend changes can influence shareholder value when investors prefer cash to repayments.[45] In other words, the theory assumes that equity claimants value dividends more than capital gains, because it is uncertain if reinvestments into the company lead to higher future returns.[46]

With regard to those agency costs, dividends have a positive influence on the share price.[47] If managers can abuse the firm's cash reserves for their own benefit (e.g. consumptions on the job) dividends can help to control managers by reducing available funds.[48] If private benefits are taken from cash, the future performance of the company will not change after the shift in dividends and the resulting signaling effect of dividend changes is misleading. Therefore, the disciplinary effect of dividends can create value.[49]

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[41] Cf. Bhattacharya, S. (1979), p. 260.

[42] Cf. Myers, S. C. (1984), p. 127.

[43] Cf. Bonduelle, Y. et al. (2003), p. 8.

[44] Cf. Nöll, B., Wiedemann, A. (2011), p. 57.

[45] Cf. Bajaj, M., Vijh, A. M. (1990), p. 217.

[46] Cf. Miller, M. H., Modigliani, F. (1961), p. 411 f.

[47] Cf. Aharony, J., Swary, I. (1980); Asquith, P., Mullins, D. W. (1983); Brickley, J. A. (1983); Charest, G (1978); Eades, K. M. (1982); Lipson, M. L. et al. (1998), among others.

[48] Cf. Gugler, K., Yurtoglu, B. B. (2003), among others.

[49] Cf. Faccio, M. et al. (2001), p. 71; Maury, C. B., Pajuste, A. (2002), p. 17; Jiang, Y., Peng, M. W. (2010), p. 685; Rozeff, M. S. (1982), p. 255 f.

Third, the impact of dividend changes on the share price can be positive, negative or irrelevant, depending on the signaling value.[50] In that sense the novelty of the dividend signal plays an important role, because some dividend distributions reflect the foretime (show the current and past earnings) whereas other dividends permit an outlook on what is coming.

To keep up the signaling hypothesis, two requirements have to be fulfilled: investors have to believe in the signaling value of dividends and dividend changes have to be reliable in respect of the future operating performance of the company. Whether these conditions are met is discussed in the further course.

2.1.2 Signaling value of dividends

If investors believe in the signaling value of dividend changes then they assume that dividend changes convey new information, which will lead to stock price reactions in an informational efficiency environment.[51] For instance, increased cash distributions show that the circumstances for investing in the company are solid and that the company can afford to distribute cash. In particular, dividends provide investors with valuable insights if information asymmetries are at a high level.[52] This is the case if managers have inside information that shareholders do not have. The opportunity for managers to use their superior information to enrich themselves at the shareholders' expense make equity claimants demand a higher risk premium for their investments.[53] Agency costs of unequal distribution are high, especially in the absence of high corporate governance principles like voluntary disclosure of inside information, financial reporting regulations, reliable auditing procedures and information

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[50] Cf. DeAngelo, H. et al. (2000), p. 310; Dhillon, U. S., Johnson, H. (1994), p. 281 f.; Bajaj, M., Vijh, A. M. (1990), p. 193 f., among others.

[51] Supported by Aharony, J., Swary, I. (1980); Asquith, P., Mullins, D. W. (1983); Brickley, J. A. (1983); Charest, G (1978); Eades, K. M. (1982); Lipson, M. L. et al. (1998).

[52] Cf. Allen, D. E. (1993), p. 101; D'Souza, J., Saxena, A. (1999), p. 36; Leary, M. T., Roberts, M. R. (2010), p. 332, Myers, S. C., Majluf, N., p. (1984), p. 189, among others.

[53] Cf. Brockman, P., Unlu, E. (2009), p. 291.

intermediaries.[54] On this basis, managers use the distribution policy to reduce information asymmetries between management and shareholders and help to lower the companies' costs of equity.[55] This implies that dividend changes lead to positive share price reactions when the dividend statement reduces the likelihood that managers are acting for their personal benefit.[56]

The literature finds considerable support for the view that, in particular, negative dividend events like omissions and decreases make shareholders adjust expectations, as those distributions are followed by significant declines in stock price.[57] Accordingly, it appears that investors care more about bad than about good news.

In this context, the surprise effect of dividend changes is a further important driver; when companies change their dividends unpredictably in one direction, investors will adjust their expectations in the same direction.[58] In particular, dividend decreases that are unexpectedly lower than the forecast make investors sell their shares.[59] Once dividends become expected, they do not tend to produce any reactions.[60]

How surprising dividend signals are depends largely on their deviation from the earning forecast and the shareholders' information level.[61] Generally, regular dividend increases do not lead to abnormal returns, but unexpected changes in dividends do.[62] That shows that investors rely more on the expected favorableness (good, bad or ambiguous) of the dividend signal than on the direction of the dividend shift.[63] Abnormal returns to dividend change

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[54] Cf. Be'dard, J. et al. (2004), p. 31 f.; Leuz, C. Verrecchia, R. E. (2000), p. 121.

[55] Cf. Easterbrook, F. H. (1984), p. 650 f.; Healy, P. M., Palepu, K. G. (1988), p 149 f.; Jensen, M. C. (1986), p. 323 f.; Lang, L. H. P., Litzenberger, R. H. (1989), p. 181 f., among others.

[56] Cf. Bhattacharya, S. (1979), p. 270.

[57] Cf. Ghosh, C., Woolridge, J. R. (1991), p. 328, among others.

[58] Cf. Manos, R. (2001), p. 55.

[59] Cf. Best, R. J., Best, R. W. (2001), p. 373; Woolridge, J. R. (1982), p. 245.

[60] Cf. Woolridge, J. R. (1982), p. 245.

[61] Cf. ibid.

[62] Cf. Chen, S-S., Fu, K.-C. (2011), p. 598.

[63] Cf. Elfakhani, S. (1998), p. 229.

announcements are larger when the firms outperform the earnings forecast that has been made before the dividend change.[64] In other words, the stock return resulting from dividend shifts is positively related to the level of the inaccuracy of the prior year's forecast.[65]

Based on the surprise effect, dividend changes can be separated into labeled and unlabeled dividend-events. Unlabeled dividend changes let volatility increase, whereas labeled dividend changes do not change the level of volatility.

The instability of the share price of unlabeled distribution changes can be explained by two opposite effects: dividends help to reduce information asymmetries and therefore are followed by decreasing volatility, but the uncertainty of future financing increases, due to the reduced equity base of cash payouts.[66] Consequently investors reconsider their portfolios' risk-return-profile after dividend announcements which, in turn leads to increasing volatility and market reactions.[67] Thus, dividends are stated to be either comforting signals as soon as the interpretation of the signal is obvious or noisy signals when the interpretation of the signal is less apparent.[68]

Accounting conservatism might be a relevant factor for the asymmetrical information effect of dividend increases and decreases. Lessening the dividend yield can be a long-term conservative precautionary intervention in order to insure the solvency of the company.[69] As dividends are costly, extended cash distributions imply that the company can afford the increase in dividends and signals that the current earning situation is on a constant level.[70] Actually, firms that increase their dividends are less likely to have earnings reductions in the following years than firms that do not change their dividend.[71] Besides the

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[64] Cf. Best, R. J., Best, R. W. (2001), p. 373.

[65] Cf. Woolridge, J. R. (1983), p. 1615.

[66] Cf. Jayaraman, N., Shastri, K. (1993), p. 684.

[67] Cf. ibid.

[68] Cf. Jayaraman, N., Shastri, K. (1993), p. 683.

[69] Cf. Nissim, D., Ziv, A. (2001), p. 2131.

[70] Cf. Benartzi, S. et al. (1997), p. 1032.

[71] Cf. ibid.

general dividend shift, the size of the change matters; the larger the dividend changes are, the larger are the resulting price changes.[72]

2.1.3 Reliability of dividend change signals

As a second prerequisite that makes dividends appropriate signals, dividend changes have to be reliable in respect of the future operating performance of the company.[73] For instance, it is expected that increasing dividends display current stable earnings and improved future profitability, while dividend decreases anticipate the opposite.[74] In the current state of the literature, it is shown that dividend increases actually lead to better operating results in the future after the dividend change, while dividend decreases do not influence the company's future earning level with statistical significance.[75]

Those findings are also valid for the low-information environment of ADR firms.[76] The small influence of lowered cash distributions on the future firm-performance might be due to the companies' operational adjustments as a consequence of the reduced payout that keep the companies' operating income on a stable level. Deliberate management strategies can lead to higher future earnings and can be superior to a resigned "no action strategy".[77] If dividend reductions lead to changes in companies' strategies that make the company more profitable in the future, the price decrease is less than the reaction to dividend reductions that are not followed by operational action.[78] That shows that reduced payouts may not be a signal for poor future performance under all circumstances.[79]

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[72] Cf. Benesh, G. A. et al. (1984), p. 140; Denis, D. J. et al. (1994), p. 585; Dhillon, U. S., Johnson, H. (1994), p. 288 f.

[73] Cf. Liu, C., Chen, A.-S. (2015), p. 205.

[74] Cf. Benartzi, S. et al. (1997), p. 1032.

[75] Cf. Chen, T.-Y., Kao, L.-J. (2014), p. 508; Iqbal, Z., Rahmann, M. H. (2002), p. 23; Nissim, D., Ziv, A. (2001), p. 2131.

[76] Cf. Aggarwal, R. et al. (2012), p. 428.

[77] Cf. Iqbal, Z., Rahmann, M. H. (2002), p. 24.

[78] Cf. Iqbal, Z., Rahmann, M. H. (2002), p. 23.

[79] Cf. Benito, A., Young, G. (2003), p. 552; Christie, W. G. (1994), p. 473.

It can be concluded that the influence of dividend changes on future profit finds wide support in the literature.[80] Despite numerous investigations finding support for the information content of dividend changes, different investigations conclude that the information content of dividend changes does not exist.[81] While the effect of dividend increases is more obvious, dividend decreases influence the future companies' profitability considerably less.

The results furthermore show that dividends are generally useful for transferring information. In order to evaluate the effect of illiquidity on dividend changes, the investor's willingness to buy or sell shares as a result of dividend changes appears to be the more important requirement. Investors determine the supply and demand of shares and thus influence the sales volume on the stock market. Even if traders know that these announcements do not contain any information, they expect them to affect share prices, and their beliefs are self-fulfilled.[82]

Since dividend omissions and initiations are special in nature, they are investigated separately in the following section. While the signaling value of dividend omissions is controversial, dividend initiations are described as the most informative dividend decision of all.[83]

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[80] Cf. Benesh, G. A. et al. (1984), p. 140; Denis, D. J. et al. (1994), p. 585; Dhillon, U. S., Johnson, H. (1994), p. 288 f.

[81] Cf. Grullon, G. et al. (2005), p. 1618.

[82] Cf. Carmerer, C. (1989), p. 11.

[83] Cf. Ross, S. A. et al. (2005), among others.

2.1.4 Special consideration of dividend initiations and omissions

2.1.4.1 Information content of dividend initiations

Assuming that managers aim to keep dividends at a constant level (strategy of dividend continuity), first-time dividend payments are an important milestone in the firm's life cycle, since it is not intended they will soon be omitted.[84] Initiation, furthermore, implies that the cash distribution will be followed by several further dividend payments in the following years. Consequently, paying out dividends demonstrates that companies' earnings are at a constant level and that the firms' prospects are good, because both factors are required to distribute cash regularly.[85] Generally, dividend policies differ between companies as a sum of the expected costs and benefits and can be divided into two categories, depending on the following stock price reaction.[86]

Dividend initiations increase the firm's value if equity investors desire them.[87] If investors aim for cash distributions they react positively to the announcement of such distributions.[88]

Given that in conditions of semi-strong market efficiency the collection of information is costly for shareholders, it is advantageous if information is widely publicly available. Data are especially readily available for firms that are highly monitored and/or actively traded on stock exchanges. If the companies' stock tradability is low and companies are not monitored, first-time dividend payments lessen the costs of gathering self-directed information.[89] When managers stick to their dividend policies, the first time dividend payment is particularly informative for investors and shows that managers anticipate that the future earning situation is good enough for successive cash distributions. Moreover, those dividends provide shareholders with liquid funds and a steady income

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[84] Cf. Kale, J. R. et al. (2012), p. 393.

[85] Cf. Goergen, M., et al. (2002), p. 375.

[86] Cf. Kale, J. R. et al. (2012), p. 393.

[87] Cf. Ferris, S. P. (2009), p. 1730 f.

[88] Cf. Baker, M., Wurgler, J. (2004), p. 1160; Li, W., Lie, E. (2006), p. 307.

[89] Cf. Mitra, D., Owers, J. E. (1995), p. 551.

component that is no longer exposed to operational risk.[90] This income becomes more meaningful in illiquid capital markets since creating home-made dividends by selling shares is costly. Distributing liquidity out of the company furthermore limits the investment possibilities of managers and serves as a monitoring mechanism. Likewise, dividend announcements lead to increasing volatility in equity returns for firms in a low-information environment.[91] That also shows that the investor's uncertainty is higher if information is not publicly available. Accordingly, the contribution of dividend initiations increases with the lack of information in a company's surroundings.[92]

Moreover, cross-firm valuation consequences of dividend initiations underline their high information value and show that investors not only expect the dividend-initiating company to perform better than it was forecasted to do, but also have the same expectation for the whole industry. The reaction to first-time dividend payments increases with the surprise effect of the dividend announcement.[93] In the literature, the positive reaction to dividend initiations far outweighs negative observations and supports the positive signaling value of such initiations.[94]

However, there are also findings that dividend initiations do not necessarily reflect positive developments.[95] It is stated that dividend initiations are not automatically a sign of high profitability but of shareholders' liquidity needs.[96] When companies with constant liquidity levels, increasing capital expenditures and improved profitability pay dividends, the distribution can also show that investment opportunities have declined.[97]

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[90] Cf. Brown, J. R. et al. (2007), p. 1935 f.

[91] Cf. Kalay, A., Loewenstein, U. (1985), p. 447.

[92] Cf. Lipson, M. L et al. (1998), p. 36.

[93] Cf. Firth, M. (1996), p. 210.

[94] Cf. Born, J. A. (1988), p. 44; McCaffrey, K., Hamill, P. (2000), p. 541.

[95] Cf. Jin, Z. (2000), p. 274.

[96] Cf. Kale, J. R. et al. (2012), p. 2.

[97] Cf. Wansley, J. W., Lane, W. R. (1987), p. 434.

2.1.4.2 Information content of dividend omissions

Normally, dividend omissions are stated to be unfavorable signals because they show a low historical income and a poor present and/or future earning situation.[98] Then again, they can also demonstrate increasing investments and growth opportunities.[99] When cash reserves are needed for firms' growth, the resulting allocation of capital leads to dividend suspensions, because the cash flows are being used alternatively. Hence, the information content of each individual payout omission is influenced by further variables like cash flows, leverage and investment opportunities.[100] As some of the influencing factors are positive and some are negative, the two opposing effects are compared in the following discussion.

That dividend omissions can be positive is especially true for companies with high investment opportunities.[101] If funds are required for promising projects, dividend omissions reflect great expectations rather than hard times.[102] All else being equal, stockholders will not sell their shares when the signaling message is credibly positive and based on investment opportunities.[103]

Besides the positive effect of dividend omissions, such events are often stated to be negative, since low profits and poor performance are the most common drivers for dividend omissions.[104] In this case, they are interpreted as management's signal that the short-term financial conditions are not expected to improve.[105] That is underlined by the market reaction to dividend omissions, which is larger when firms suffer a loss in the relevant year.[106] As the negative effect on share prices of omitted distributions is frequently smaller than

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[98] Cf. Healy, P. M., Palepu, K. G. (1988), p. 173; Liu et al. (2008), p. 1015.

[99] Cf. Christie, W. G. (1994), p. 473.

[100] Cf. Benito, A., Young, G. (2003), p. 552 f.

[101] Cf. Benito, A., Young, G. (2003), p. 552.

[102] Cf. Benartzi, S. et al. (1997), p. 1031 f.; Benito, A., Young, G. (2003), p. 552.

[103] Cf. Robin, A. J. (1998), p. 7.

[104] Cf. Benito, A., Young, G. (2003), p. 552.

[105] Cf. Ghosh, C., Woolridge, J. R. (1991), p. 328.

[106] Cf. Charitou, A. et al. (2011), p. 1540.

anticipated, the link between risk-adjusted excess returns and dividend omissions is more complex than expected:[107]

First, dividend omissions might be the turning point of the unsatisfactory situation and might promise a quick recovery.[108] Second, firms that leave out dividends entirely recover to the preannouncement level more quickly than do firms that only reduce their payouts.[109] Third, new equity investors who favor reinvestments over cash distributions can demand dividend omissions. In this case, investors will not review their fundamental valuation of the company and are uninfluenced by dividend omissions.[110]

Consequently, the market impact and the information content of dividend omissions vary individually. Firms that use cash flows for alternative growth opportunities are less likely to react negatively to dividend omissions than companies that omit payments as a result of missed earnings forecasts. That shows that the management's investment opportunities are important for the future development of the company. The opportunity to expand, change or shorten projects is a component of the total value of the firm that is referred to as a "real option" in the field of corporate evaluation.[111] Because an option is equal to the freedom of choice it is likely to influence future firm performance positively. From a rational perspective managers will not participate in projects when they expect them to lower shareholder value. Consequently, the right to choose is always a value driver that can potentially compensate the negative effect of dividend omissions.

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[107] Cf. Christie, W. G. (1994), p. 473.

[108] Cf. Gunasekarage, A., Power, D. M. (2002), p. 133.

[109] Cf. Christie, W. G. (1994), p. 473.

[110] Cf. Benito, A., Young, G. (2003), p. 532 f.

[111] Cf. McGrath, R. et al. (2004), p. 87.

2.2 FIRM SPECIFIC DETERMINANTS OF DIVIDEND CHANGES DERIVED FROM DIVIDEND THEORIES

2.2.1 Systematization

It is often claimed in the literature that corporate financing is one of the most important fields of value-driven corporate management.[112] Except for some limitations like legal requirements, debt covenants and the availability of cash, the companies' dividend assumptions are generally free.[113] Therefore, empirical research finds strong local, temporal and firm-specific variation in dividend policies.[114] Despite the large differences, one precondition is equal for all firms; the dividend decision competes with an alternative use of liquid funds such as reinvesting it into the company.[115] The capital allocation conflict—whether to retain or distribute free cash flows—enhances the field of tension between shareholders and managers.[116] With regard to the various assumptions that dividends could be advantageous, disadvantageous or irrelevant, the phenomenon described is well known as the "dividend puzzle", and illustrates the difficult nature of payout policies.[117] As the conflict described does not exist in complete capital markets, the systematization of dividend theories starts with the assumption that dividends are irrelevant under those circumstances.[118]

However, assuming complete capital markets, financing has no impact on the costs of capital and consequently stockholders do not have a preference between dividends being paid or not paid.[119] In the absence of restrictions, dividend payments are also insignificant for shareholder value. Investors who prefer cash payments to capital gains can generate liquidity for themselves by selling shares—so-called home-made dividends. When earnings are retained,

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[112] Cf. Graham, J. R. Harvey, C. R. (2001), p. 187 f., among others.

[113] Cf. Chava, S. et al. (2010), p. 1121 f.

[114] Cf. La Porta, R. et al. (2000), p. 27.

[115] Cf. Grullon, G., Michaely, R. (2002), p. 1676.

[116] Cf. La Porta, R. et al. (2000), p. 27.

[117] Cf. Black, F. (1976), p. 8; Lam, K.-C. (2014), p. 36.

[118] Cf. Mann, S. V. (1989), p. 3.

[119] Cf. Miller, M. H., Modigliani, F. (1961), p. 414.

investors can immediately convert shares into cash by selling the share at the increased price.[120] That means that, ceteris paribus, in contrast to distributions the accumulation of profits leads to higher share prices. Contrarily, the distribution of major parts of cash reserves without reinvesting money into the stability of the company can make future dividend payments more unlikely.[121]

Since frictionless trading is not possible in reality, the irrelevance theory does not seem to be appropriate to derive recommendations on dividend decisions in real life.[122] As investors aim to increase their own wealth at the lowest possible cost, shareholders are interested in discovering the value-driving determinants of the company.[123] That particularly includes cash distributions that are possible adjustment screws to reduce agency cost and to consequently increase the firm's value.[124]

The limitations of the irrelevance theory encourage further research in this thesis to expand the way in which shifting payouts are viewed. Hence, the firm-specific determinants of dividend changes in the presence of market imperfections are classified and discussed.

For the systematization of dividend theories, the overview categorizes those theories regarding their market imperfections. Not assuming complete capital markets can lead either to an optimum dividend strategy that maximizes the shareholder value or to a hierarchy that recommends an order in which dividends should be distributed. Additionally, some theories imply that managers choose their dividend policies depending on both an optimum and a pecking order.

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[120] Cf. Copeland, T. E. et al. (2010), p. 698; Miller, M. H., Modigliani, F. (1961), p. 414 f.

[121] Cf. Uddin, M. H., Osman, D. (2008), p. 99.

[122] This is underlined by an investigation of DeAngelo and DeAngelo (2005) that concludes that the irrelevance theory of Miller and Modigliani (1961) is irrelevant due to their inappropriate premises.

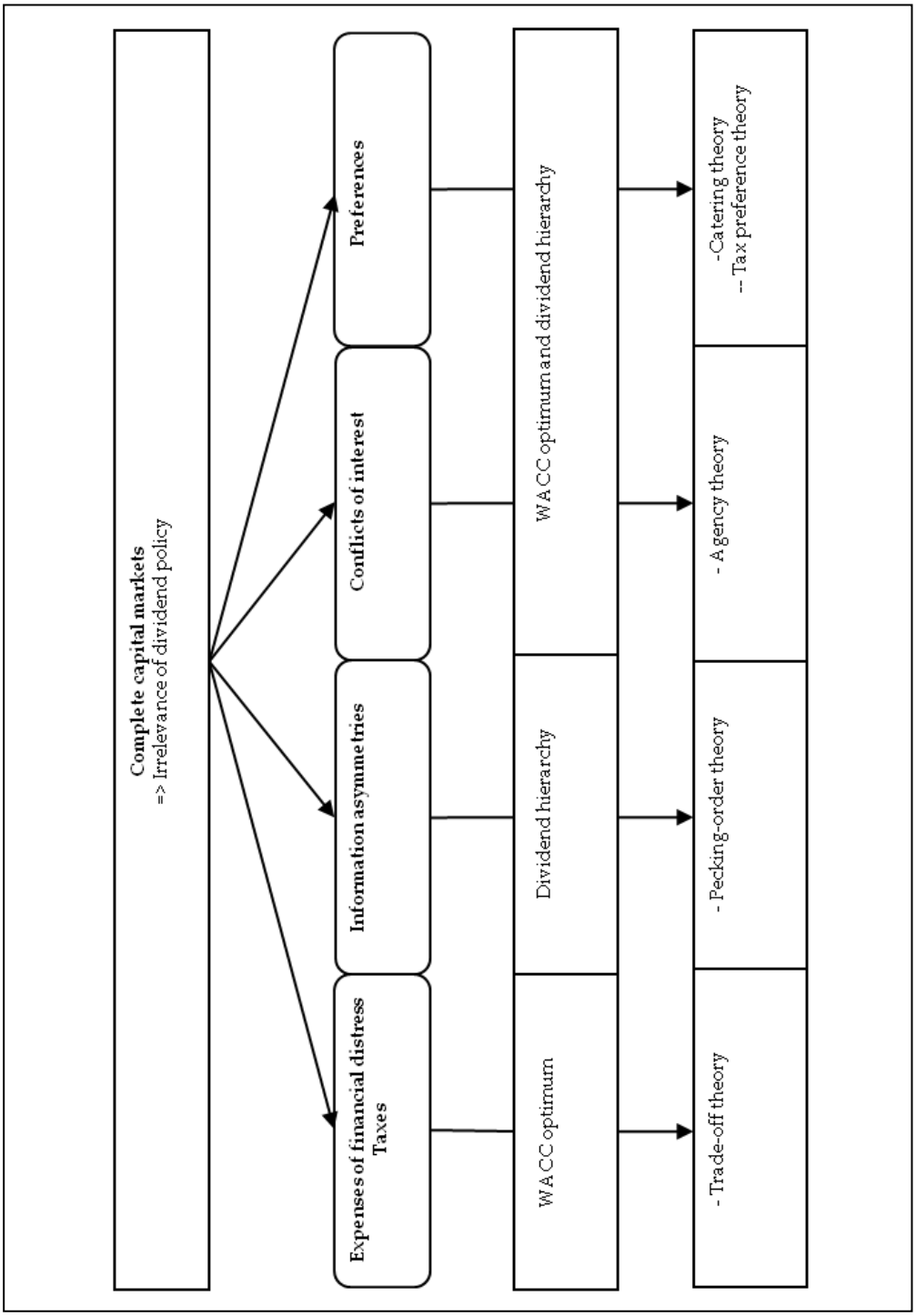
[123] Cf. Kelleners, A. (2004), p. 131; Wenzel, J. (2005), p. 67.

[124] Cf. Pott, O., Pott, A. (2012), p. 232; Rappaport, A. (1986), p. 1 f.; Rappaport, A. (1999), p. 68.

Since basic dividend theories are more numerous than dividend change surveys, the determinants of dividend variations are derived from investigations that analyze dividend probabilities and dividend yields in a first step.[125] In summary, five theories are reviewed with the systematization process that is visualized in Figure 2. In a second step, the current state of the literature on dividend changes is analyzed to find the major drivers for dividend changes.

[125] Theories of dividend changes are analyzed in more detail in subchapter 2.2.3.

Figure 2: Systematization of dividend theories



2.2.2 Dividend policies

2.2.2.1 Trade-off theory

The static trade-off theory describes financing as an optimum of debt capitals' tax advantage and the cost of insolvency.[126] In this discussion, the capital structure choice becomes relevant as it can increase shareholder value.[127] The following determinants of dividend changes can be derived from the trade-off theory:

Table 1: Determinants of dividend increases based on trade-off theories

Determinants	Expected influence
• Effective tax rate	+
• Leverage	-
• Profitability	+
• Operational risk	-
• Investment alternatives	-
• Cash reserves	+/-
• Asset tangibility	+
• Company size	+
• Company age	+
• Target leverage	+/-

Everything else being equal, the tax deductibility of interest-expenses, combined with the profit from substituting cheaper debt capital for expensive equity capital, makes debt financing more attractive and minimizes the weighted

[126] Cf. Fama, E. F., French, K. R. (2002), p. 1 f.; Hackbarth, D. et al. (2007), p. 1390; Kraus, A., Litzenberger, R. H. (1973), p. 911 f.; Modigliani, F., Miller, M. H. (1958), p. 261 f.; Myers, S. C. (1984), p. 575 f.; Shyam-Sunder, L., Myers, S. C. (1999), p. 220.

[127] Cf. Kraus, A., Litzenberger, R. H. (1973), p. 918; Modigliani, F., Miller, M. H. (1958), p. 296; Myers, S. C., Majluf, N. S. (1984), p. 219 f.

average cost of capital.[128] In a few words, financing can be optimized by substituting cheaper debt capital for rather costly equity capital. However, decreasing the capital costs with higher leverage is only possible up to the point where the higher risk premium (that is due to the higher leverage) equals the substitution profit.[129] Because the dividend policy influences the ratio of equity and debt, it can influence the capital costs under these assumptions.[130] If dividends are distributed, the equity level decreases and the weighted average cost of capital sinks until the demanded risk premium of the investors exceeds the substitution profit.[131] Therefore it is expected the effective tax rates will have a positive influence on dividend increases.[132]

Generally, in line with the trade-off theory, to minimize their financing costs highly leveraged firms reduce their liabilities rather than distribute cash out of the company.[133] In greater detail, the profitability level—as also the size of the company—plays a major role for the effect of the leverage ratio on dividend changes. This is underlined by one of the pioneering investigations in dividend research; the early survey of Lintner (1956) shows that companies follow deliberate payout strategies based on the company's profit.[134] As more profitable firms have a more comfortable liquidity and equity base, a positive impact on

[128] Cf. Kraus, A., Litzenberger, R. H. (1973), p. 918; Modigliani, F., Miller, M. H. (1958), p. 261 f.; Myers, S. C., Majluf, N. S. (1984), p. 188; Shyam-Sunder, L., Myers, S. C. (1999), p. 220.

[129] Cf. Myers, S. C., Majluf, N. S. (1984), p. 219 f.

[130] Modigliani, F., Miller, M. H. (1958), p. 261 f.

[131] Cf. Myers, S. C., Majluf, N. S. (1984), p. 219 f.

[132] The positive influence of the tax rate is also analyzed in Allen, F. et al. (2000), p. 2499 f.; Barclay, M. J., et al. (2008), p. 2453; John, K., Williams, J. (1985), p. 1053 f.

[133] Cf. Al-Najjar, B. (2011), p. 209 f.; Charitou, A. et al. (2011), p. 1533; Grulllon, G. et al. (2002), p. 411.

[134] Cf. Lintner, J. (1956), p. 101.

dividends is assumed.[135] The profitability situation is one of the most investigated and well established drivers for distribution policy throughout other research.[136]

Hence, declining profitability increases the costs of insolvency; companies with highly fluctuating income tend to face higher costs.[137] Smaller companies have higher operational risk and more volatile earnings than do larger ones and therefore basically have higher costs of insolvency that make them keep their debt at a low level.[138] As larger firms usually have more stable incomes, their insolvency costs remain low despite their higher leverage ratio.[139]

In addition to external financing, the firm experiences expenses if the company prefers cash distributions to attractive investment opportunities.[140] The inhibition of promising investments is a further cost driver that might occur if investment opportunities exceed the firm's self-financing capabilities and the company refuses to raise external funds.[141] Thus, the opportunity cost of dividend payments is the value of the best alternative foregone and the missed opportunity to generate future profits.[142]

Although the influence of cash reserves on dividend policies is frequently documented in the literature[143], the direction of influence remains unclear: Even though high cash reserves might designate stable profits, they can also illustrate

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[135] Cf. Al-Najjar (2011), p. 213; Goergen, M. et al. (2005), p. 379; Grullon et al. (2002), p. 387; Jensen, G. R. et al. (1992), p. 257; Mizraei (2012), p. 327 f.; Lintner, J. (1953), p. 252.

[136] The influence of the profitability situation on dividends is also analyzed in Fama, E. F., French, K. R. (2002), p. 28; Goergen, M. et al. (2005), p. 379; Gugler, K. (2003), p. 1310; Jensen, G. R. et al. (1992), p. 257; Lintner, J. (1956), p. 101; Mizraei (2012), p. 327 f, among others.

[137] Cf. Fama, E. F., French, K. R. (2002), p. 14.

[138] Cf. Berk, J., DeMarzo, P. (2015), p. 367.

[139] Cf. Mueller, F. (2010), p. 49; Steck, A. (2010), p. 4.

[140] Cf. Miller, M. H., Rock, K. (1985), p. 1048.

[141] Cf. Miller, M. H., Rock, K. (1985), p. 1034 f.

[142] Cf. Gugler, K., Yurtoglu, B. B. (2003), p. 753.

[143] Cf. Bulan, L. et al. (2007), p. 33 f.; Chahayadi, C. S.; Salas, J. M. (2012), p. 461; Li, W., Lie, E. (2006), p. 303 f, among others.

that the firm expects access to fresh money to be challenging in the future.[144] Accordingly, poor access to capital markets makes companies keep cash in reserve.[145] If a solid liquidity base results from high income, the influence on dividends is positive and dividend increases become more likely.[146] The impact of cash reserves on dividends becomes negative if poor financing prospects are discovered. In this case, dividend increases become more unlikely and the probability of dividend decreases grows.

Asset tangibility can play a major role in protecting creditors' interests, as it can easily be converted into cash.[147] Consequently, firms with a large number of tangible assets might have easier access to external funds and higher debt ratios than might firms without such assets.[148] Firms rich in tangible assets are more likely to pay out cash if they can refund themselves without difficulty; a positive relationship with dividend increases is assumed.

Large company size can be accompanied with greater diversification of operational activities, which in turn reduces the risk of bankruptcy.[149] Additionally, larger firms tend to have less volatile earnings compared to smaller firms and therefore derive greater benefit from the leverage effect and the tax benefits of debt financing.[150] Since those companies are used to having higher debt ratios and large reinvestment opportunities via capital markets, the distribution of equity capital becomes more likely and the probability of dividend increases rises.[151]

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[144] Cf. DeAngelo, H. et al. (2006), p. 227 f.

[145] Cf. Chittenden, F. et al. (1996), p. 59 f.; Fama, E. F., French, K. R. (2002), p. 8.

[146] Cf. Fama, E. F., French, K. R. (2002), p. 28; Goergen, M. et al. (2005), p. 379; Gugler, K. (2003), p. 1310.

[147] Cf. Aivazian, V. A. et al. (2006), p. 442; Baker, M., Wurgler, J. (2006), p.1645 f.; Bates, T. W. et al. (2009), p. 1987.

[148] Cf. Michaelas, N. et al (1999), p. 115.

[149] Cf. Titman, S., Wessels, R. (1988), p. 17.

[150] Cf. Smith, C. W., Stulz, R. M. (1985), p. 403.

[151] Cf. Fama, E. French, K. (2002), p. 1 f.

Depending on the stage of their life-cycle, older firms have more ways of refinancing than younger firms have, based on a company's ability to generate cash over time.[152] It is evident that it is more challenging for companies that are still growing to generate constant cash flows than is the case for more stable firms.[153] A company undergoes a process in which it changes from being a fast-growing firm with many profitable investment projects to a more mature firm over the course of years.[154] Due to their high growth and investment opportunities, quickly expanding companies are confronted with completely different conditions than are established companies that grow more slowly.[155] In a later stage of the company life-cycle, the cash flows generated are more likely to exceed the ability to find profitable investment opportunities.[156] Therefore, dividends become more probable in a later stage, as they do not compete with other potential uses.[157] As soon as the growth rate and profitability are expected to decline, companies will start to initiate dividends.[158]

The static trade-off theory is commonly criticized because the costs of constant capital adjustments are high, since it takes only one certain point of time into account and does not observe the financing process over time. Furthermore, profit accumulations play an important role for funding in reality and are not taken into consideration within the static trade-off theory. To overcome that problem and increase the flexibility of the static assumption, the dynamic trade-off theory is a multiple-period hypothesis that states that firms will only change their capital structure if benefits exceed costs. In more detail, the transaction costs of adjusting the present capital structure have to be compared to the aspired

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[152] The life cycle theory goes back to Modigliani, F. (1966) and is reviewed by Fama, F. E., French, K. R. (2001), Grullon, G. et al. (2002), DeAngelo, H. et al. (2006).

[153] Cf. Dickinson, V. (2011), p. 1990.

[154] Cf. Grullon, G. et al. (2002), p. 422; Kadapakkam, P. R. et al. (1998), p. 293 f.

[155] Cf. Thanatawee, Y. (2011), p. 52.

[156] Cf. Baker, H. K., Powell, G. E. (2000), p. 29.

[157] Cf. Pan, Y. et al. (2016), p. 2983 f.

[158] Cf. Bulan, L. T., Subramanian, N. (2009), p. 3.

future financing configuration.[159] Consequently the dynamic model focuses on the future optimum capital structure and not exclusively on the current optimum leverage.[160] Depending on the difference between current and target leverage, companies can regulate their capital structure continuously, so that between such adjustments the ratio of debt and equity is not optimal and is frequently reached with delay.[161] The dynamic theory makes the evidence of the validity more complex but increases the flexibility.[162] It supplies an additional determinant of dividend changes, the target leverage, which has a negative influence on dividend changes.[163]

2.2.2.2 Pecking order theory

Differently from the previously described static trade-off hypothesis, the pecking order theory provides an investment hierarchy in the presence of information asymmetries.[164] Information is particularly lacking between managers and shareholders[165], where managers know more about the current and future situation of the firm than equity claimants do.[166] With regard to the information advantage, investors will always face the uncertainty that managers might act for their own benefit.

Despite the pecking order theory stating that there is no optimum in financing structure, the influence of profitability, investment alternatives, company age and cash reserves on dividend changes mainly agrees with the

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[159] Cf. Fischer, E. et al. (1989), p. 19 f.

[160] Cf. Lev, B., Pekelman, D. (1975), p. 75.

[161] Cf. Jalilvand, A., Harris, R. S. (1984), p. 127 f.; Marsh, P. (1982), p. 121 f.; Ozkan, A. (2001), p. 176.

[162] Cf. Leary, M., Roberts, M. (2005), p. 2575 f.

[163] Cf. ibid.

[164] Cf. Chirinko, R. S., Singha, A. R. (2000), p. 417 f.; Leary, M., Roberts, M. (2005), p. 2575 f.; Shyam-Sundera, L., Myersb, S. C. (1999), p. 219 f.

[165] Also see subchapter 2.2.2.3.1.

[166] Cf. Allen, D. E. (1993), p. 101; Leary, M. T., Roberts, M. R. (2010), p. 332, Myers, S. C., Majluf, N., p. (1984), p. 189.

assumptions of trade-off theory.[167] Additionally, if large company size is a proxy for high profitability it can influence dividend changes positively. On the other hand, if company size is associated with operational risk, it can also influence dividend changes negatively.[168]

Because companies prefer the source of financing that is accompanied with the lowest uncertainty and minimum resistance, managers act mainly for the benefit of the current equity claimants.[169] As a side effect of external financing, shareholders suffer dilution of control if equity capital is issued.[170] To prevent such an effect, shareholders have to participate in capital increases that include transaction costs that are disadvantageous for investors. Therefore, to avoid the danger of adverse selection, shareholders prefer internal funding to external funding and debt financing to equity financing.[171] That means that more profitable companies have more refinancing possibilities than do less profitable companies.[172] As current shareholders avoid the issuance of equity capital, companies with low earnings will not reduce their equity capital by paying it out to the shareholder. [173] If company size is associated with higher profitability and lower operational risk, company size also influences dividend changes positively.[174]

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[167] Cf. Chirinko, R. S., Singha, A. R. (2000), p. 417 f.; Leary, M., Roberts, M. (2005), p. 2575 f.; Shyam-Sundera, L., Myersb, S. C. (1999), p. 219 f.

[168] Cf. Hall, M.; Weiss, L. (1967), p. 319 f.; Uyar, A. (2009), p. 191.

[169] Cf. Myers, S. C. (1984), p. 99; Myers, S. C., Majluf, N. S. (1984), p. 219 f.

[170] Cf. Asquith, P., Mullins, D. W. (1986), p. 61 f.

[171] Cf. Allen, D. E. (1993), p. 101 f.; Baskin, J. (1989), p. 26 f.; Chirinko, R. S., Singha, A. R. (2000), p. 417 f.; Leary, M., Roberts, M. (2005), p. 2575 f.; Shyam-Sundera, L., Myersb, S. C. (1999), p. 219 f.

[172] Cf. Mukherjee, S., Mahakud, J. (2012), p. 42; Myers, S. C. (1984), p. 589.

[173] Cf. Fama, E. F., French, K. R. (2002), p. 4.

[174] Cf. Aggarwal, R. et al. (2012), p. 420 f.; Fama, E. F., Bulan, L. et al. (2007), p. 20; Deshmukh, S. (2003), p. 364 f. ; French, K. R. (2002), p. 4; Kale, J. R. et al. (2012), p. 365 f.

Dividend payouts become more unlikely when the company needs the cash for other purposes, such as investments.[175] In view of that, managers should pay dividends only if the distributed amount of money does not exceed the internal financing that is needed for other purposes. Accordingly, companies with a high dependency on external financing should pursue a more restrictive dividend policy.[176]

The pecking order theory shows that the agency constitution (e.g. shareholders, stakeholders) can influence distribution policy. Accordingly, agency oriented theories are analyzed in greater detail in the following subsections.

2.2.2.3 Agency theory

2.2.2.3.1 Manager-shareholder conflicts

An isolated examination of the previously discussed financing theories would fail to explain the complexity of dividend changes.[177]

Although the trade-off theory and the pecking order theory can help to increase understanding of financing decisions, the underlying assumptions are contradicted by investigations that show companies of similar size and structure have large diverging debt ratios.[178] Since the static trade-off theory is very much restricted to capital structure, the pecking order theory expands the view of the pecking order by taking information asymmetries into account.[179] In the following, agency conflicts between managers and shareholders, majority and minority shareholders, different shareholder groups and equity and debt investors are investigated.

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[175] Cf. Ince, U., Owers, J. E. (2009), p. 54.

[176] Cf. Rozeff, M. S. (1982), p. 257.

[177] Cf. Myers, S. C. (2001), p. 99.

[178] Cf. Fama, E. F., French, K. R. (2005), p. 26; Haugen, R. A., Senbet, L. W. (1986), p. 12.

[179] Cf. Jensen, M. C., Meckling, W. H. (1976), p. 308 f.

Summarized, the following determinants of dividend changes can be attributed to those agency conflicts:

Table 2: Additional determinants of dividend increases resulting from conflicts of interest

Determinants	Expected influence
• Ownership concentration	-
• Second-largest shareholder	+/-
• Institutional ownership	+
• Managerial ownership	-
• Foreign ownership	+
• Changes in ownership	+/-
• Shareholder activism	+/-
• Corporate governance level	-
• Bank equity investors	-
• Issued debt capital	-
• Debt covenants	-
• Bank loans	-
• Secured loans	+/-
• Access to capital markets	+
• Seasoned equity offering	+
• R&D investments	+
• M&A	+/-
• Number of business segments	+

Controlling for manager-shareholder conflict, Rozeff (1982) develops the equity distribution model. It states that an optimal dividend policy exists, if a minimum of two opposing cost-components can be reached.[180]

On the one hand, managers pay dividends if equity investors demand them.[181] Since rational equity investors want the company to decrease its financing costs, they will avoid additional financing costs for dividend payments.

[180] Cf. Rozeff, M. S. (1982), p. 249 f.

[181] Cf. Baker, M., Wurgler, J. (2004), p. 1160.

That means that capital gains are favored over cash distributions, since distributions make the need for future financing more likely.[182]

On the other hand, dividends can help to reduce the agency costs of capital that arise from the separation of ownership and control.[183] If a company is owned by a single owner-manager, agency costs equal zero.[184] Smaller firms are closest to the definition of a sole owner-manager firm and therefore agency costs can increase, among other things, with the size of the company, which makes external shareholding more likely.[185]

Contrary to the assumption that agency costs rise with the size of the company, larger companies are more likely to have legal reporting obligations, an investor relation division and better corporate governance, which helps to lower information asymmetries.[186] Furthermore, monitoring becomes more difficult and ineffective for multi-segment companies.[187] Together with the complexity of monitoring, analysts make more imprecise forecasts for diversified than for focused companies.[188] If large companies have more segments than small firms, the agency costs rise with the size of the company and dividend increases become more likely.[189]

Company age influences information asymmetries negatively, since the amount of accessible information rises over time.[190] Assuming that older companies are becoming larger over time, the previously discussed positive influence of company size on the information flow is also influenced by the age of the company.[191]

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[182] Cf. DeAngelo, H., Masulis, R. W. (1980), p. 453 f.

[183] Cf. Benartzi, S. et al. (1997), p. 1032.

[184] Cf. Jensen, M. C., Meckling, W. H. (1976), p. 305 f.

[185] Cf. Ang, J. S. et al. (2000), p. 83.

[186] Cf. Chari, V. V. et al. (1988), p. 110 f.; Wenzel, A. (2006), p. 182.

[187] Cf. Berger, P. G., Ofek, E. (1995), p. 40.

[188] Cf. Brennan, M. J., Hughes, P. J. (1991), p. 1665 f.; Merton, R. C. (1987), p. 483 f.

[189] Cf. Doukas, J. A. et al. (2000), p. 56.

[190] Cf. Wenzel, A. (2006), p. 180.

[191] Cf. Fama, F. E., French, K. R. (2001), p. 3 f.; DeAngelo, H. et al. (2006), p. 227 f. ; Grullon, G. et al. (2002), p 387 f.

While all business investments are accompanied by information asymmetries, the agency costs appear to be particularly high in the case of research and development (R&D).[192] The value of company-specific R&D investments is complex to measure. For instance, it is complicated to assess the monetary value of the development of computer programs, patents and medication. Since those investments are non-standardized they cannot be traded on markets and no market prices exist for those specific investments. Furthermore, the accounting rules are different for R&D investments than for other investments and do frequently not provide investors with value or productivity information.[193] The rising uncertainty makes investors claim higher dividends in order to reduce the amount of money that can potentially be invested into those projects. Accordingly, the expected influence of R&D on dividend changes is positive.

In particular, the availability of free cash flows can lead to diverging interests between managers and shareholders.[194] Managers have the incentive to enrich themselves at the expense of shareholders by extracting private benefit[195] from cash.[196] Furthermore, the management might decide to retain earnings rather than pay dividends due to private motives.[197] Reinvesting cash makes it more possible to build an empire by growing firm size, which leads to increasing salaries, status, power and the recognition of one's work.[198]

Mergers and acquisitions (M&A) can either be the way out or the proof of the conflicts of interest between managers and equity investors; the influence on dividend payments is therefore ambiguous. M&A illustrate agency problems, in

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[192] Cf. Abody, A., Lev. B. (2000), p. 2747.

[193] Cf. Abody, A., Lev. B. (2000), p. 2748.

[194] Cf. Gugler, K., Yurtoglu, B. B. (2003), p. 731 f.; Jensen, M. C., Meckling, W. H. (1976), p. 305 f.

[195] Private benefits are monetary gains that are arranged at the expense of other stakeholders.

[196] Cf. Benos, B., Weisbach, M. (2004), p. 217 f.; Brockman, P., Unlu, E. (2009), p. 291; Filatotchev, I., Mickiewicz, T. (2001), p. 1 f.

[197] Cf. He, W. et al. (2017), p. 281.

[198] Cf. Jensen, M. C. (1986), p. 323; He, W. et al. (2017), p. 281.

particular when managers invest their cash for low-benefit external growth rather than paying it out to shareholders.[199]

To overcome the free-cash-flow problem[200], dividend distributions are the most prominent solution. When cash is paid out to shareholders, the misallocation of funds becomes more unlikely and information asymmetries shrink.[201] Supporters of the signaling hypothesis state that dividend payments are a credible way to deliver information to markets and their participants.[202] Accordingly, dividends are initiated to show the high quality of the firm and its good prospects.[203] Even if dividend payments require the firm to seek financing in the future, that might be desirable, because investors expect conditions at that future time to be acceptable.

2.2.2.3.2 Conflicts between majority and minority shareholders

Besides the manager-shareholder conflicts described above, majority-minority shareholder conflicts can also contribute to explain why companies change their dividends.[204] In this context, ownership concentration commonly leads to dividend reductions. The negative impact of ownership concentration on dividend policies can be due either to the high information level of well-informed block holders or to rent extraction of minority investors by anchor equity investors.[205]

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[199] Cf. Jensen, M. C. (1986), p. 328.

[200] The free cash flow problem arises from the separation of ownership and control and is based upon the idea that managers can take private benefits of liquid funds to the detriment of shareholders.

[201] Cf. Easterbrook, F. H. (1984), p. 650 f.; Healy, P. M., Palepu, K. G. (1988), p. 149 f.; Jensen, M. C. (1986), p. 323 f.; Lang, L. H. P., Litzenberger, R. H. (1989), p. 181 f., among others.

[202] Cf. Kale, J. R. et al. (2012), p. 393.

[203] Cf. ibid.

[204] Cf. Faccio, M. et al. (2001), p. 54 f.; Rozeff, M. S. (1982), p. 249 f.; Young, M. N. et al. (2008), p. 196 f.

[205] Cf. Miller, M. H., Rock, K. (1985), p. 1031 f.

The incentives to monitor the issuer's management rise with ownership concentration.[206] That means that the disciplinary function of dividend payments is less needed in the presence of a controlling shareholder.[207] Since those large investors are frequently institutional investors, their information advantage and the professional nature of their management control generally creates value and makes cash payments redundant.[208]

Moral hazard becomes more probable if the anchor investor reaches an absolute majority and the residual ownership is highly granular. Major shareholders have an incentive to expropriate minority shareholders, especially in phases of economic downturns, when major shareholders suffer from significant losses in their stock holdings.[209] The risk of moral hazard by extracting private rents form cash increases with dividend omissions.[210]

Consequently, the second-largest equity investor might call for dividends as an internal control mechanism that potentially limits disposable cash flows.[211] When several anchor-investors form a coalition, they can either increase their controlling power by urging payment of higher dividends or reduce cash distributions in order to enhance their private benefits.[212] Regardless of what effect dominates, conflicts between large and small shareholders can influence dividend changes.

2.2.2.3.3 Examination of shareholder identity

An ideal dividend policy minimizes the sum of external financing on the one hand, and agency costs on the other hand, so that a firm-specific optimum

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[206] Cf. Gugler, K., Yurtoglu, B. B. (2003), p. 731 f.

[207] Cf. Al-Najjar, B. (2011), p. 213; Lee, W.-J. (2011), p. 313; Short, H. et al. (2002), p. 105.

[208] Cf. Al-Najjar, B. (2009), p. 182 f.; Lee, W. J. (2011), p. 297 f.; Shleifer, A., Vishny, R. (1986), p. 461; Short, H. et al. (2002), p. 105 f.

[209] Cf. Young, M. et al. (2008), p. 214.

[210] Cf. Gugler, K., Yurtoglu, B. B. (2003), p. 753.

[211] Cf. Faccio, M. et al. (2001), p. 65 f.

[212] Cf. Faccio, M. et al. (2001), p. 71; Maury, C. B., Pajuste, A. (2002), p. 17; Jiang, Y., Peng, M. W. (2010), p. 685; Rozeff, M. S. (1982), p. 255 f.

dividend policy is reached.[213] When agency costs increase, a more stringent dividend policy is carried out and distributions become more cautious if the transaction costs of financing rise. The better investors are informed, the more easily they can waive dividends. External shareholders are more likely to face information asymmetries and therefore desire current income.[214]

The impact of institutional investors on dividend changes is particularly discussed in the scientific literature since different kinds of institutional investors exist who have different motivations for their investments.[215]

With the objective of realizing short-term profits, investors, especially institutional investors like hedge funds, regularly purchase considerable stakes in publicly-traded companies, while strategic investors aim to hold their investments over a longer period.[216]

Larger companies are more likely to have institutional investors that desire current income via dividends.[217] Then again, large institutional investors are generally well informed and can waive dividends if institutional ownership is accompanied by superior information.[218] The literature makes it clear that the influence of institutional shareholders on dividends changes, depending on their participation rate.[219] While dividend payouts and increases commonly become more likely if institutional investors hold considerable investments, their influence can be heterogeneous.[220] For that reason, it is necessary to separate them further into operating and financing as well as active and passive investors.

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[213] Cf. Rozeff, M. S. (1982), p. 258.

[214] Cf. Maury, C. B., Pajuste, A. (2002), p. 17.

[215] Cf. Gaspar, J. M. et al. (2013), p. 261 f.; Truong, T., Heaney, R. (2007), p. 683.

[216] Cf. Bennedsen, M., Nielsen, K. M. (2010), p. 2212.

[217] Cf. Reeding, L. (1997), p. 246.

[218] Cf. Bhattacharya, D. et al. (2015), p. 1 f.; Kaserer, C. et al. (2012), p. 85 f.; Reeneboog, L., Szilagyi, P. G. (2015), p. 18.

[219] Cf. Aggarwal, R. et al. (2012), p. 403 f.; Mirzaei, H. (2012), p. 327 f.; Thanatawee, Y. (2013), p. 121 f.

[220] Cf. Kuhlmann, S., Rojahn, J. (2017), p. 30.

To exercise control, operating investors[221] hold larger stakes than financial investors hold, aiming to minimize information asymmetries.[222] In order to increase the companies' value, they primarily focus on improving operational activities by achieving synergies and strategic guidance.[223] Thus, the presence of operational investors can lead to lower dividend payouts as a result of stronger future growth and expiring capital expenditures.

When institutional financial investors[224] hold considerable stakes in a publicly traded company, the influence on dividend changes is expected to be diametrical to the operational investors' influence.[225] The importance of dividend signaling rises in significance when institutional financial investors are outsiders.[226] Additionally, financial institutions commonly manage several different funds that have different investment strategies and differing track records.[227] To attract more investors, the funds will keep the capital allocation constant when track records are good.[228] High dividend payments can help financial institutions to reduce the danger of misallocation of funds and to present solid results.

To get deeper insights, a country-specific subdivision of institutional financial investors is promising, since it is shown for the German capital market that foreign financial institutions in particular influence dividend payouts.[229] Diverse conditions in corporate governance might influence this: Low shareholder protection increases agency costs and firms from countries with high

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[221] For instance companies that primary focus on synergies and strategic interactions with their target firms.

[222] Cf. Barclay, M. J. et al. (2009), p. 2423 f.

[223] Cf. Arping, S., Falconieri, S. (2010), p. 691.

[224] For instance hedge funds, insurance companies, pension funds and mutual funds that make investment decisions primarily based on the prospect for financial gain.

[225] Cf. Arping, S.,, Falconieri, S. (2010), p. 691 f.

[226] Cf. Truong, T., Heaney, R. (2007), p. 683.

[227] Cf. Bushee, B. J. et al. (2014), p. 123 f.

[228] The information content and survivorship bias of performance track records is explained in more detail in Fung, W., Hsieh, D. A. (1997).

[229] Cf. Kuhlmann, S., Rojahn, J. (2017), p. 30.

shareholder protection pay higher dividends.[230] Firms that are less protected due to their lower country-specific corporate governance distribute dividends more reservedly.[231] That shows that corporate governance can help shareholders to extract dividend payments to inhibit manager's cash flow abuse.[232]

From a different point of view, it can be assumed that in high-risk environments corporate governance alters the firm's dividend policy and complements it for low-risk firms.[233] Risk increases with increased levels of excess cash; and, to prevent overinvestment, good corporate governance encourages managers to reduce their cash reserves by dividend payouts.[234] Contrarily, if the idiosyncratic risk is low, underinvestment would be particularly costly for managers and corporate governance will not motivate managers to pay out cash. It more probably encourages firms to retain liquid funds for investment purposes.

Although it is stated that the probability of cash distributions has declined with the evolution of corporate governance technologies, the literature still disagrees as to how corporate governance affects corporate dividend policies.[235] In comparison to domestic institutions, foreign companies might have different investment goals because they face different country-specific conditions and, additionally, are exposed to higher information asymmetries than domestic institutional investors.[236]

Besides the local aspect, the separation of short-term and long-term institutional financial investors is necessary to control for the incentives to monitor the firm's management.[237] In expectation of positive market reactions,

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[230] Cf. La Porta, R. et al. (2000), p. 27.

[231] Cf. ibid.

[232] The influence of corporate governance on dividend policies is also analyzed in Amihud, Y., Murgia, M. (1997); Bhattacharya, D. et al. (2015); Gugler, K. (2003); Gugler, K., Yurtoglu, B. B. (2003).

[233] Cf. Bhattacharya, D. et al. (2015), p. 38.

[234] Cf. La Porta, R. et al. (2000), p. 27 f.

[235] Cf. Farre-Mensa, J. et al. (2014), p. 75 f.; Gugler, K. (2003), p. 1319.

[236] Cf. Aggarwal, R. et al. (2012), p. 406; Baik, B. et al. (2010), p. 89.

[237] Cf. Khan, T. (2006), p. 183.

short-term investors prefer stock repurchases to cash dividends, while long-term investors prefer payouts for monitoring purposes.[238]

The investment philosophy also varies between active and passive funds.[239] While operating investors use their controlling power to elevate the firms' performance by exercising control, passive investors only replicate indices and are focused on the least possible tracking error.[240] Since those passive investors focus on replicating an index's composition they might not be interested in influencing dividend policies at all. To the contrary, in order to protect their clients from moral hazard, their vote can become a relevant factor to control the management. Especially because they lack flexibility in the capital allocation process, the "exit threat"[241] is not an option for passive investors to monitor managers.[242] Consequently, the execution of voting rights becomes more important when shares cannot be traded on a free basis.

Apart from institutional investors, the Government can also influence dividend changes.[243] Their claim for dividends might be due to a desire to monitor managers to guarantee successful economic policy or to close a budget deficit.

Due to clientele effect, a change in ownership concentration can also lead to dividend increases or decreases, depending on the new shareholders' preference.[244]

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[238] Cf. Gaspar, J. M. et al. (2013), p. 261.

[239] Cf. Bogle, J. C. (2016), p. 9 f.

[240] Cf. Rompotis, G. G. (2011), p. 14 f.

[241] It describes the decision-making power of investors to sell their shares. Depending on the importance of the investor, the management accommodates their requests.

[242] Cf. Edmans, A. (2009), p. 2484.

[243] Cf. Gugler, K. (2003), p. 1297 f.

[244] Cf. Stinson, S. R., Ricketts, R. C. (2016), p. 122.

2.2.2.3.4 Conflicts between equity and debt claimants

Taking a closer look at the different kind of costs that can arise from payouts, cash distributions are particularly costly for the issuer and the investor if external financing is required at a later date.[245] Among other things, the costs of raising additional finance include exchange expenses, administration costs, license fees, and costs of compliance, own labor and time.[246] Those costs differ with the size of the company, where larger firms have better access to capital markets and benefit from fixed cost digressions if they issue high funding volume. Lower capital funding is more expensive, which generally penalizes smaller companies. Stock market liquidity can influence the costs of raising external capital. In this context it is found that seasoned equity offerings can determine the direct costs (investment banking fees) as well as the indirect costs (liquidity level) of raising capital. While investment banking fees decline, the tradability of the issuer's share improves when seasoned equity is offered and the effect becomes stronger with the size of the issued volume.[247] Consequently, better access to capital markets is associated with lower expenses, and the anticipated influence on dividend increases is positive.[248]

From an agency costs point of view, the diverging interests between managers, majority shareholders, minority shareholders and debt claimants make it more difficult for managers to raise capital. The resulting agency costs make a good access to capital markets more valuable. Firms that raise debt capital via capital markets rather than companies that source finance via bank loans pay dividends.[249] There are a variety of reasons for this.

First, companies that issue public debt normally have a higher credit quality than firms that waive public funding.[250] Second, bond market participants are most frequently institutional investors that can forego dividend signaling due to

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[245] Cf. Ofer, A. R., Thakor, A. V. (1987), p. 385.

[246] Cf. Asquith, P., Mullins, D. W. (1983), p. 94; Easterbrook, F. H. (1984), p. 650 f.

[247] Cf. Butler, A. W. et al. (2005), p. 980.

[248] Cf. Fama, E., Franch, K. (2002), p. 29.

[249] Cf. Aivazian, V. A. et al. (2006), p. 452.

[250] Cf. Arena, M. P. (2011), p. 143.

their good information basis.[251] Third, commercial banks have special capabilities to monitor the issuer of debt capital by their superior access to inside information.[252] Consequently, debt-financing can support dividend reductions and omissions due to the bonding character of secured loans and financial covenants.[253]

Put the other way around, firms financed entirely through equity have more problems controlling agency costs.[254] While debt investors make dividend reductions that are more likely to keep the company solvent, equity claimants frequently argue for payouts following the "bird in hand" argument.[255]

Regardless of insolvency costs and taxes, higher leverage can also influence dividend policies due to financial covenants.[256] In order to minimize their investment risk, debt claimants primarily aim to receive interest and repayments. To do so, they influence distribution decisions and make highly leveraged companies follow reserved dividend policies to insure the firms' solvency. Hence, financial covenants and dividends are expected to be substitutes.

2.2.2.4 Theories based on investor's preference

If the demand for dividends is a basic driver of distribution policy, dividend changes largely depend on investors' preference. Controlling for investors preference, four further determinants of dividend changes are complemented:

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[251] Cf. Aivazian, V. et al. (2006), p. 452.

[252] Cf. Goergen, M. et al. (2005), p. 396; Leland, H. E., Pyle, D. H. (1977), p. 372 f.

[253] Cf. Brockman, P., Unlu, E. (2009), p. 298; Stulz, R. M. (1990), p. 23.

[254] Cf. Florackis, C. et al. (2009), p. 783 f.

[255] Cf. Brockman, P., Unlu, E. (2009), p. 298; Jensen, M. C. (1986), p. 327.

[256] Cf. DeAngelo, H., DeAngelo, L. (1990), p. 1415 f.

Table 3: Additional variables of dividend increases based on investors' preference

Determinants	Expected influence
• Previous years dividend	+
• Individual tax rates	+/-
• Dividend premium	+
• Firm valuation	+/-

When managers cater to their investors with minimum distributions, the previous year's dividend policy has a positive influence on the current year's dividend changes.[257] Companies that increased their dividends in the previous year are more likely to continue to enhance their payouts. To do so, the long-term available operating cash flow is particularly essential.[258] Only if companies can rely on the stability of free cash flows[259] they can increase their payouts at a constant level.

In addition, individual tax rates influence the attitude of investors towards dividends and determine the willingness to buy or not to buy shares.[260] When investors are taxed at different rates, firms with high dividend-payout ratios are able to attract investors with low marginal tax rates.[261] If equity investors are taxed at a high rate, dividends produce a tax penalty.[262] Therefore, the model is also known as the "tax-preference-model".[263] In contrast to dividend payouts, the accumulation of the annual net profit does not lead to an immediate tax liability and supports higher share prices. It is still possible for the company to invest the money to gain a higher return on the capital invested. As there are no tax payments for accumulations, the compound interest effect can be a major

[257] Cf. Gugler, K. (2003), p. 1299; Pettit, R. R. (1972), p. 1006.

[258] Cf. Baker, H. K., Powell, G. E. (2000), p. 36.

[259] It describes the companies' generated liquid funds after spending the money required to maintain or expand the asset base. It is calculated as operating cash flow reduced by capital expenditures.

[260] Cf. Dhaliwal, D. et al. (2005), p. 675 f.; Litzenberger, R., Ramaswamy, K. (1979), p. 163 f.; Nguyen, K. H. (2014), p. 584.

[261] Cf. Allen, F. et al. (2000), p. 2499 f.

[262] Cf. Li, O. Z. (2007), p. 21.

[263] Cf. Graham, J. R., Kumar, A. (2006), 1305 f.

argument against dividends.[264] Thus, the influence of dividend payouts on share valuations is negative due to the disadvantageous tax effect.[265]

The current literature also includes opposite findings: For instance, the previous assumptions could not be supported for the country of Saudi Arabia.[266] Regardless of whether individual tax rates influence dividend policies, the tax penalty does not seem to be a major influencing factor for dividend policies. Cash distributions are commonly demanded by shareholders despite their being disadvantageously taxed in comparison to tax on retained earnings.[267] That shareholders demand dividends regardless of the uneconomical character of such a policy is sensible only if payouts lead to other positive market reactions that are larger than the negative tax effects.

In order to explain the positive market reaction that firms cater to, this demand suggests that clienteles substantially influence dividend policies.[268] Basically, it is assumed that firms' management supplies the investors with dividends on demand.[269] That means that dividends are distributed when investors pay higher prices for dividend-paying companies than for non-dividend-paying companies.[270]

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[264] Cf. Seida, J. A. (2001), p. 19.

[265] Cf. Dhaliwal, D. et al. (2005), p. 675 f.; Litzenberger, R., Ramaswamy, K. (1979), p. 163 f.

[266] Saudi Arabia is predestined for tax influence surveys, as investors do not have to pay income taxes in this country.

[267] Cf. Fama, E. F., French, K. R. (2001), p. 3 f.

[268] The catering theory of dividends was developed at the beginning of the 21st century and is based on the simple idea that the demand determines the price of the share.

[269] Cf. Hoberg, G., Prabhala, N. (2009), p. 112 f.

[270] Cf. Baker, M., Wurgler, J. (2004), p. 1160.

To approximate catering incentives the comparison of the market-to-book ratio of dividend payers and non-dividend payers (dividend premium) leads to a significant positive influence of the dividend premium on dividend increases.[271] The empirical investigation shows that managers might use dividend changes to affect the own firm-valuation. For the same reason, managers tend to retain earnings rather than to distribute them if shareholders prefer a regressive dividend policy.[272] Therefore, the companies' valuation level is an important determinant of dividend changes under catering assumptions. This illustrates the investor's expectations of the company's future situation.[273] A high valuation level shows that investors expect management to create more value from the current situation.[274]

On the one hand, a high valuation can be interpreted to be a positive signal; market participants are willing to invest in the company. On the other hand, a high ratio of market capitalization to book value of equity might imply an overvaluation that motivates investors to sell shares. Due to the contrary assumptions, the valuation-levels' direction of influence on dividends remains unclear.

[271] Cf. Li, W., Lie, E. (2006), p. 307.

[272] Cf. Baker, M., Wurgler, J. (2004), p. 1160.

[273] Cf. Huang, R. D., Shiu, C-Y. (2009), p. 567 f.

[274] Cf. Yoon, P. S., Starks, L. T. (1995), p. 1016.

2.2.3 Summary of firm-specific determinants of dividend changes

The main drivers of dividend increases that are derived from the theories are summarized in the following table:

Table 4**:** Determinants of dividend increases based on dividend theories

Theory	**Determinant**	**Expected Influence**
Trade-off theory	• Effective tax rate	+
	• Leverage	-
	• Profitability	+
	• Operational risk	-
	• Investment alternatives	-
	• Cash reserves	+/-
	• Asset tangibility	+
	• Company size	+
	• Company age	+
	• Target leverage	+/-
Agency theory	• Ownership concentration	-
	• Second-largest shareholder	+/-
	• Institutional ownership	+
	• Managerial ownership	-
	• Foreign ownership	+
	• Changes in ownership	+/-
	• Shareholder activism	+/-
	• Corporate governance level	-
	• Bank equity investors	-
	• Issued debt capital	-
	• Debt covenants	-
	• Bank loans	-
	• Secured loans	+/-
	• Access to capital markets	+
	• Seasoned equity offering	+
	• R&D investments	+
	• M&A	+/-
	• Number of segments	+
Catering theory Tax preference theory	• Previous years dividend	+
	• Individual tax rates	+/-
	• Dividend premium	+
	• Valuation level	+/-

It is conventional wisdom that managers are unwilling to change (especially reduce or omit) dividends and aim to keep distributions on a constant level.[275] If managers act differently, dividend changes tend to be informative concerning the firms' situation and generally produce share price reactions.[276] Because dividend changes are special events with special information content, they are examined separately.

2.3 DETERMINANTS OF DIVIDEND CHANGES DERIVED FROM RESEARCH FINDINGS

The selection of firm-specific determinants of dividend changes is expanded by the current state of dividend-change research. Since investigations of dividend-change drivers are not very numerous, the firm-specific determinants of dividend initiations are also included. Table 5 classifies the investigations regarding their arrangement of the endogenous dividend variable. Starting with dividend initiations, also multinomial measured dividend changes and binary coded dividend increases and decreases are observed. All determinants that impact the specific dividend variable with an error rate below 0.10 are listed; if variables do not reach the 90 % confidence interval, they are excluded from the overview. In addition to the statistical significance, the summary controls for the direction of influence.

[275] Cf. Fang, V. et al. (2009), p. 150 f.; Lintner, J. (1956), p. 104; Subrahmanyam, A., Titman, S. (2001), p. 2389 f.

[276] Cf. Best, R. J., Best, R. W. (2001), p. 361 f.; Denis, D. J. et al. (1994), p. 567; Yoon, P. S., Starks, L. T. (1995), p. 1016.

Table 5: Summary of the current state of determinants of dividend change research

	Deshmukh (2003)	**Bulan et al. (2007)**	**Kale et al. (2012)**	**Goergen et al. (2005)**	**Aggarwal et al. (2012)**	**Li and Lie (2006)**	**De Cesari and Huang-Meier (2015)**	**Luebke and Rojahn (2016)**
Samples	Global	USA	USA	Germany	ADRs	Global	USA	Germany
Research technique	Exponential regression	Logistic and hazard regression	Heckman two-step approach	Ordered probit regression	Logistic and OLS regression	Logistic regression	Logistic regression	Logistic regression, LDA, classification tree, random forest, support vector machines
Dividend dummy variable	Initiation: 1 = initiation 0 = no initiation	Initiation: 1 = initiation 0 = no initiation	Initiation: 1 = initiation 0 = no initiation	Change: 2 = increase 1 = maintain 0 = decrease	Increase: 1 =increase 0 = no increase	Increase/ decrease: 1 = inc./dec. 0 = no inc./dec.	a) Increase/ b) decrease: 1 =inc./dec. 0 = no inc./dec.	Change: 2 = increase 1 = maintain 0 = decrease
Variables with significant positive influence ($\alpha < 0.1$)	Profitability Company size	Profitability* ** Company size Dividend premium Cash reserves* Risk* Growth opportunities* Δ Growth*** opportunities	Profitability Company size Retained earnings Dividend premium Seasoned equity Institutional ownership Stock exchange listing	Profitability Δ Profitability Cash flow Δ Cash flow	Profitability Company size	Profitability Company size Dividend premium* Cash reserves	Profitability Company size Abnormal return	Δ Profitability Δ Growth opportunities Δ Turnover
Variables with significant negative influence ($\alpha < 0.1$)	Growth opportunities	Growth opportunities* ** Firm's risk level** NASDAQ member 1970s IPO 1990s IPO	Growth opportunities Debt Firm's risk level Stock liquidity	Loss	Growth opportunities Institutional ownership Analyst coverage Stock liquidity	Growth opportunities Dividend yield Debt	Dividend yield	Year 2007 Year 2009 Year 2010 Debt Loss
Notation		* future values ** historical values *** relative change from historical to future values				* Δ weighted market-to-book ratio of dividend payers and non-dividend payers		* apply innovative techniques in this field of research using data mining

The literature review selects many determinants of dividend changes that have already been discussed in the previous section:

As a key driver, firms change their dividends based on their profitability level.[277] With higher income increases become more likely[278] and the probability of dividend decreases lowers.[279] It is also found that companies initiate dividends if they have solid incomes and their retained earnings are high.[280]

Together with the earnings situation, firm size also influences dividend changes positively.[281]

In line with the catering theory, the "dividend premium" has a positive effect on dividend increases and a negative influence on dividend decreases.[282] Since initiations are also positively affected,[283] managers change their dividends at the shareholders' demand.

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[277] Cf. Aggarwal, R. et al. (2012), p. 420 f.; Bulan, L. et al. (2007), p. 20; De Cesari, A., Huang-Meier, W. (2015), p. 8 f.; Deshmukh, S. (2003), p. 364 f.; Goergen, M. et al. (2005), p. 387 f.; Kale, J. R. et al. (2012), p. 365 f.; Li, W., Lie, E. (2006), p. 303 f.; Luebke, K., Rojahn, J. (2016), p. 335 f.

[278] Cf. Aggarwal, R. et al. (2012), p. 420 f.; De Cesari, A., Huang-Meier, W. (2015), p. 8 f.; Goergen, M. et al. (2005), p. 387 f.; Li, W., Lie, E. (2006), p. 303 f.; Luebke, K., Rojahn, J. (2016), p. 335 f.

[279] Cf. De Cesari, A., Huang-Meier, W. (2015), p. 16 f.; Goergen, M. et al. (2005), p. 387 f.; Li, W., Lie, E. (2006), p. 303 f.

[280] Cf. Bulan, L. et al. (2007), p. 20 f.; Deshmukh, S. (2003), p. 364 f.; Kale, J. R. et al. (2012), p. 381 f.

[281] Cf. Aggarwal, R. et al. (2012), p. 420 f.; Bulan, L. et al. (2007), p. 33 f.; De Cesari, A., Huang-Meier, W. (2015), p. 8 f.; Deshmukh, S. (2003), p. 364 f.; Kale, J. R. et al. (2012), p. 381 f.; Li, W., Lie, E., (2006), p. 303 f.

[282] Cf. Li, W., Lie, E. (2006), p. 307.

[283] Cf. Bulan, L. et al. (2007), p. 33 f.; Kale, J. R. et al. (2012), p. 381 f.

Since the evaluated literature shows that dividend increases become more unlikely with the greater debt level[284] and the firm's growth opportunities[285], the effect of cash reserves on dividend changes remains unclear[286].

Additionally, it becomes more likely that distributions change if they have changed in the previous year.[287] The impact of the firm's risk level could be outlined thus: While the direction of influence is sometimes stated to be unclear[288], different findings report that dividend initiations become more unlikely with the firm's increased risk-level.[289]

Also the positive effect of institutional ownership on dividend increases is shown with statistical significance[290] while a deficit in institutional ownership[291] leads to dividend initiations.[292] Since stock exchange listing is frequently seen as giving good access to additional funds, listings on the NYSE make initiations more likely.[293]

Expanding previous findings, five further firm-specific determinants of dividend changes could be derived from the dividend-change literature overview:

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[284] Cf. Li, W., Lie, E. (2006), p. 303 f.; Luebke, K., Rojahn, J. (2016), p. 335 f.

[285] Bulan, L. et al. (2007); Deshmukh, S. (2003), Kale, J. R. et al. (2012) show the negative influence of growth opportunities on dividend initiations. Li, W., Lie, E. (2006) and Luebke, K., Rojahn, J. (2016) show the negative influence on dividend increases and decreases. Aggarwal, R. et al. (2012) show the negative influence on increases.

[286] Cf. Li, W., Lie, E. (2006), p. 303 f.

[287] Cf. Simons, K. (1994), p. 586.

[288] Cf. Bulan, L. et al. (2007), p. 33 f.

[289] Cf. Kale, J. R. et al. (2012), p. 381 f.

[290] Cf. Aggarwal, R. et al. (2012), p. 417 f.

[291] The difference between the predicted institutional ownership and the actual institutional ownership; institutional ownership is measured as the fraction of the firm's equity owned by all institutions.

[292] Cf. Kale, J. R. et al. (2012), p. 377.

[293] Cf. Kale, J. R. et al. (2012), p. 381.

First, financial analysts evaluate and analyze different companies, stocks and their derivatives, as well as economies and industries.[294] Their work serves as a basis for the investment decisions of national and international, private and institutional investors, financial advisors and portfolio managers.[295] Analysts can be subdivided into buy-side- and sell-side analysts, who are either information providers or information intermediaries.[296] Sell-side analysts examine businesses that are listed on different stock exchanges and provide primary external clients with the accumulated data by selling their research reports.[297]

Different from that, buy-side analysts are employees of institutional investors like banks, investment funds or insurance companies.[298] Therefore buy-side analysts are strongly linked with institutional investors, as they work in the business.[299] When analysts provide new information (information provider) they contribute more to reduce agency costs than do information intermediaries, who only follow already existing information.[300] Their results are for internal use only and consequently unsuitable for empirical investigations.

In general, there are two possible ways financial sell side analysts can influence dividend changes: They can monitor the management in order to reduce agency costs and provide additional information.[301] While investors observe several stocks to diversify their portfolio, financial analysts specialize on a few stocks they know particularly well.[302] After the purchase and analysis of

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[294] Cf. Bassen, A. (2002), p. 16 f., Cooper, R. A. et al. (2001), p. 383 f.; Eberts, M. (1986), p. 46 f.; Groysberg, B. et al. (2008), p. 25; Healy, P. M., Palepu, K. G. (2001), p. 406, among others.

[295] Cf. Cooper, R. A. et al. (2001), p. 384; Eberts, M. (1986), p. 46; Groysberg, B. et al. (2008), p. 25.

[296] Cf. Healy, P. M., Palepu, K. G. (2001), p. 406.

[297] Cf. Fieseler, C. (2008), p. 52 f.; Mueller, C. (2005), p. 18.

[298] Cf. Groysberg, B. et al. (2008), p. 25.

[299] Cf. Bassen, A. (2002), p. 16; Reimann, M. (2005), p. 21; Weber, J. et al. (2004), p. 302 f.

[300] Cf. Wilke, H. (2016), p. 170.

[301] Cf. Easterbrook, F. H. (1984), p. 654 f.; Jensen, M. C. (1986), p. 323; Wilke, H. (2016), p. 21.

[302] Cf. Hax, (1998), p. 494 f.

data, sell-side and buy-side analysts can provide information to many different investors (cross-sectional-reusability). The benefits of specialization and the reusability of the data enables analysts to have lower stock-monitoring costs than private investors have and that can help to reduce the chance that managers run the business for their own benefit.[303] Since, in the presence of financial analysts, dividends are less required as a means of keeping investors informed, free cash is less likely to be distributed. When analysts base their recommendations on information gathered from outside sources, it is easier for them to evaluate companies in an improved information environment.[304] To avoid heavy workloads, analysts cover stocks with easily accessible information. As a result, analyst coverage can also be used to approximate the information environment level, while superior analyst coverage indicates better access to information. Therefore a substitutive effect of analyst-coverage and dividend distributions is assumed.[305]

Contrarily, it is also assumed that buy-side analysts influence the propensity of dividend changes to occur due to their influence on institutional investors.[306] When analysts provide institutional investors with information, their superior level of information enables such investors to waive dividends for signaling purposes.[307] From a different perspective, the institutional investor's desire for current income can also outweigh the information advantage argument and dividend payments are more likely to increase the greater the number of analysts that cover the stock.[308] If this is the case, analyst coverage is more likely to have a positive impact on dividend increases.

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[303] Cf. Henze (2004), p. 13.

[304] Cf. Baker, H. K. et al. (2002), p. 498; Huddart, S. J., Ke, B. (2007), p. 204 f.

[305] Cf. Aggarwal, R. et al. (2012), p. 411.

[306] Cf. Mikhail, M. B et al. (2004), p. 68; Stanzel, M. (2007), p. 14 f.; Steiger, M. (2000), p. 195.

[307] Cf. Mizraei, H. (2012), p. 331.

[308] Cf. Reeding, L. (1997), p. 246.

Second, in addition to financial analysts, abnormal returns are also a determinant of dividend changes that is derived from the literature review. Assuming that some traders can be better informed concerning a firm's situation than anybody else, they can influence the firm's valuation. The resulting abnormal returns can even provide novel information to managers, such that it makes them revisit their dividend decisions.[309] In other words, anomalous stock returns can be considered by managers in view of their dividend change decision, hence unexpected share price movements can be informative about cash flows and/or discount rates.[310] When cash flows are larger than expected or discount rates are surprisingly low, positive market reactions will follow that make managers increase their dividends. Accordingly, the influence of the previous year's abnormal returns on dividend changes tends to be positive.[311]

Third, the previous year's dividend yield can also influence dividend changes. If the last year's payout rate in comparison to the reference value was high, dividends are less likely to increase still further.[312] It is plausible that companies that have already distributed large parts of their profits are limited to distributing less in the following year. Starting from a high dividend level, the probability of dividend decreases rises with high dividend yields.[313]

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[309] Cf. Bond, P. et al. (2012), p. 342 f.

[310] Cf. Chen, L. Zhao, X. (2009), p. 5213 f.; De Cesari, A., Huang-Meier, W. (2015), p. 16.

[311] Cf. Chemmanur, T. J. et al. (2010), p. 430.

[312] Cf. De Cesari, A., Huang-Meier, W. (2015), p. 11; Li, W., Lie, E. (2006), p. 304.

[313] Cf. De Cesari, A., Huang-Meier, W. (2015), p. 9 f.

Fourth, index membership is an additional determinant of the propensity to initiate dividends.[314] It can be associated with permanent future returns that cannot be traced back in terms of different firm-specific reasons but result from an increased demand after the firm was included in the index.[315] In order to avoid tracking errors, index tracking funds replicate the compilation of an index as precisely as possible and hold their positions until the composition of the index changes. The rise of index tracking Exchange-traded funds could therefore be a possible explanation for a long-lasting positive effect.

In contrast to the assumption that the positive consequence of index membership is longstanding, different surveys see only a temporary peak in demand, because potential sellers have a delayed reaction to the stock price increase.[316] The influence of index membership remains ambiguous and the estimated direction of influence on dividend changes can vary between different indices.

Index membership indicates a fifth influencing factor of dividend changes; companies' industry. The composition of indices is not randomly selected and combines businesses that meet specific requirements. The criteria selected to be included in the relevant index might be the relevant factor for the influence of the composition of the index on dividends. For example NASDAQ index members are high-tech companies; it can therefore be assumed that dividend payouts of those enterprises vary with technological progress that enables substantial and fast growth opportunities.[317] As long as the investment opportunities are good, managers prefer to keep liquid funds for investments rather than paying it out.

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[314] Cf. Bulan, L. et al. (2007), p. 14.

[315] The effect is investigated by Shleifer, A. (1986); Shleifer, A. (2000) for the S&P 500 index.

[316] Investigated by Harris, L., Gurel, E. (1986) for the S&P 500 index.

[317] Cf. Bulan, L. et al. (2007), p. 13.

The additional determinants of dividend changes and initiations that are obtained from research findings are highlighted in the subsequent Table 6:

Table 6: Determinants of dividend increases derived from research findings

Investigation	Determinant	Expected influence
Dividend increases	• Analyst coverage • Abnormal return • Historical dividend yield	**+/-** **+** **-**
Dividend initiations	• Index membership • Companies' industry	**+/-** **+/-**

Besides analyst coverage, abnormal returns, historical dividend policies, index membership and industry affiliation, dividend change literature also expands previous findings by controlling for the influence of stock liquidity on dividend initiations.[318] The propensity to initiate dividends is negatively affected by the stock market liquidity level, which is attributed mainly to the information value of stock market liquidity that can replace dividend signaling.[319] When investors aim at disinvesting, they can either claim cash dividends or sell their shares. Stock liquidity can therefore serve as a surrogate for dividend distributions.

The listed investigations approximate stock liquidity with trading volume, which does not respect the multidimensional complexity of stock market liquidity.[320] Implementing additional liquidity proxies is necessary to make more valid statements.

Moreover, the listed analyses estimate only dividend initiations that are special in nature and cannot be compared to dividend changes.

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[318] The influence of stock market liquidity on dividend initiations is investigated by Aggarwal, R. et al. (2012); Kale, J. R. et al. (2012).

[319] Cf. Aggarwal, R. et al. (2012), p. 428; Kale, J. R. et al. (2012), p. 382.

[320] That liquidity is a complex multidimensional phenomenon is investigated in Chai, D. et al. (2010); Grullon, G. et al. (2004); Makower, H., Marschak, J. (1986), among others.

Consequently, the measurement problems of stock market liquidity and, furthermore, the arrangement of the endogenous dividend variable makes further research necessary to understand how stock liquidity influences dividend changes.

3 STOCK LIQUIDITY VALUE AND ESTIMATION

3.1 STOCK LIQUIDITY AND FINANCING COSTS

3.1.1 Value of stock market liquidity

Above and beyond the influence of dividend changes on financing costs, a company's stock liquidity also plays a significant role within the refinancing process.[321] Due to the internationalization of capital markets and the growing importance of institutional investors, the necessity of value-based management increases in the competition for capital.[322] To date it is common knowledge that high-value firms have better and easier access to new capital sources than do companies with low firm values, since high stock liquidity enhances the valuation of the company.[323]

Rappaport's (1986) shareholder value approach illustrates how stock liquidity influences the valuation of stocks.[324] The widely used foundation for value-oriented management places equity investors in the focus of corporate activities.[325] That means that management has the primary incentive to increase shareholders' wealth (the market value of equity) as a long-term goal.[326] To

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[321] Cf. Fernández-Amador, O. et al. (2013), p. 55; Gopalan, R. et al. (2012), p. 333 f.; Hoshi, T. et al. (1991), p. 57.

[322] Cf. Fischer, T. M. (2006), p. 1; Günther, T., Gonschorek, T. (2008), p. 132.

[323] Cf. Cooper, S. K., Groth, J. C. (1985), p. 19 f.; Fang, V. et al. (2009), p. 150 f.; Schmeisser, W. et al. (2009), p. 6.

[324] For further information regarding the shareholder value approach also see Blyth, M. L. et al. (1986), p. 48 f.; Heilbron, J. et al. (2014), p. 1 f.; Rappaport, A. (1983), p. 28 f.; Rappaport, A. (1986), p. 1 f.; Rappaport, A. (1987), p. 58 f.; Rappaport, A. (2006), p. 66 f.

[325] Cf. Hahn, D., Hintze, M. (2006), p. 84; Jung, H. (2014), p. 521; Keay, A., Adamopoulou, R. (2012), p. 5 f.; Körnert, J., Wolf, C. (2007), p. 133.

[326] Cf. Sundaram, A. K., Inkpen, A. C. (2004), p. 359.

concentrate on shareholders in particular tends to be conclusive, given that shareholders have only a residual claim after all of the firms' liabilities have been deducted.[327] That is different for all other stakeholders within the company that can rely on contractual guaranteed claims.

Despite shareholders being especially worth protecting, the value-oriented management approach is also criticized in the literature.[328] It is alleged that the exclusive concentration on shareholders neglects the interests of stakeholders such as employees, customers, debt investors, suppliers etc.[329] To create shareholder value, the long-term success of the company has to be ensured and therefore stakeholders also have to be content.[330] Despite the critics, the shareholder value approach is very highly respected within firms to date and has been adopted by many corporate managers.[331]

Generally, liquidity influences the shareholder value in two ways:

First, liquidity can reduce a firm's weighted average cost of capital and facilitates access to additional funds.[332] Listing on stock exchanges enables the issuer to reach a broader base of investors to meet that issuer's financing needs.[333] This is also underlined by the liquidity-adjusted capital asset pricing model (LACAPM) of Acharya and Pedersen (2004), which emphasizes the influence of

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[327] Cf. Easterbrook, F. H. (1984), p. 656; Easterbrook, F. H., Fischel, D. R. (1983), p. 395 f.; Fama, E. F., Jensen, M. C. (1983), p. 302.

[328] Cf. Banzhaf, J. (2006), p. 121 f.; Krol, F. (2009), p. 61; Metten, M. (2010), p. 165 f.

[329] Cf. Keay, A., Adamopoulou, R. (2012), p. 7 f.; Rappaport, A. (1987), p. 59; Stier, C. (2017), p. 54.

[330] Cf. Donaldson, T., Preston, L. E. (1995); p. 65 f.; Freeman, R. E. (2010), p. 1 f.; Poeschl, H. (2013), pp. 127 f.; Skrzipek, M. (2005), p. 47 f.

[331] Cf. Kraus, K., Strömsten, T. (2012), p. 188.

[332] Cf. Husman, C. (2003), p. 81.

[333] Cf. Amihud, Y., Mendelson, H. (1988), p. 13.

illiquidity risk on security performance that is discussed in the subsequent section.[334]

Second, managerial decisions can vary with a firm's liquidity level through feedback from stock prices.[335] Liquidity effects equity and debt financing and gives companies with liquid traded shares lower issuance costs.[336] These decreasing financing costs allow corporate managers use additional funds for investment purposes and increase the company's investment in liquid assets, which can lead to increased future profitability.[337] For that reason, liquidity generates positive feedback prices, while illiquidity can lead to negative results.[338]

However, managers seek to ensure that the firm's shares can be traded with low friction.[339] To do so, managers have two general opportunities to increase liquidity; they can enlarge the alienability of their shares or reduce information asymmetries.[340] To increase the alienability of shares companies can go public, standardize their claims, issue new public equity, denominate their stocks or list on different exchanges. Furthermore, in order to reduce information asymmetries, companies can limit their liability, increase their corporate borrowing or disclose inside information.[341] Despite the shareholder value oriented view on capital markets showing that liquidity is an essential condition for the financial markets

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[334] Cf. Acharya, V. V., Pedersen, L. H. (2004), p. 392. The liquidity effect on asst pricing is also analyzed by Jacoby, G. et al. (2000), p. 69 f.; Liu, W. (2006), p. 631 f.; Papavassiliou, V. G. (2013), p. 184 f.

[335] Cf. Fang, V. et al. (2009), p. 150 f.; Subrahmanyam, A., Titman, S. (2001), p. 2389 f.

[336] Cf. Lipson, M. L., Mortal, S. (2009), p. 611 f.

[337] Cf. Hasbrouck, J., Seppi, D. J. (2001), p. 383.

[338] Cf. Fang, V. et al. (2009), p. 150 f.; Subrahmanyam, A., Titman, S. (2001), p. 2389 f.

[339] Cf. Holmström, B., Tirole, J. (2000), p. 317, Loukil, N. (2015), p. 415.

[340] Cf. Amihud, Y., Mendelson, H. (1988), p. 8 f.

[341] For further information regarding the management possibilities of stock liquidity see Amihud, Y., Mendelson, H. (1988).

to function effectively, the financial market crisis exposes that stock market liquidity cannot be taken for granted.[342]

3.1.2 Liquidity adjusted CAPM

Extending the imagined frictionless economy of the traditional CAPM by liquidity costs, the liquidity adjusted CAPM shows that illiquidity influences market returns negatively and investors should not only be concerned about their investments in economic downturns but also when disinvesting becomes more difficult;[343] especially when crisis-driven times make investing more insecure, or inversely, the increased risk is displayed by higher illiquidity.[344] Under this premise, illiquid capital markets lead to a premium that the buyer has to pay and a discount that reduces the sellers' revenue when placing a market order.[345] This model reviews the one-beta CAPM by supplying three liquidity risk components:

To start with, the demanded return on investment increases with the commonality-in-liquidity effect.[346] That means that shareholders demand higher stock returns in the covariance between the security liquidity and the market liquidity. When the stock market in general becomes illiquid, the tradability of a specific share also decreases, which in turn makes investors demand higher risk-compensating returns.[347]

Beyond that, a linear relationship between securities' expected return and market liquidity is assumed, where illiquid stocks produce higher risk-adjusted

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[342] Cf. Boehmer, E. et al. (2009), p. 1398; Váradi, K. (2012), p. 2.

[343] Cf. Acharya, V. V., Pedersen, L. H. (2004), p. 392.

[344] Cf. Campello, M. et al. (2010), p. 470 f.; Jacoby, G. et al. (2000), p. 69 f.; Liu, W. (2006), p. 631 f.

[345] Cf. Easterbrook, F. H. (1984), p. 657 f.; Jensen, M. J. (1986), p. 328; Papavassiliou, V. G. (2013), p. 184 f.

[346] The commonality-in-liquidity effect is also analyzed in Brockman, P. et al. (2009), p. 851 f.; Chordia, T. et al. (2001), p. 501 f.; Fernando, C. S. (2003), p. 233 f.; Karolyi, G. A. et al. (2012), p. 82 f.; Koch, A. et al. (2016), p. 1943 f.

[347] Cf. Chordia, T. et al. (2001), p. 501 f.; Hasbrouck, J., Seppi, D. J. (2001), p. 408.

market returns than frequently traded stocks do.[348] This makes corporations demand liquidity to lower their costs of capital and increase shareholder value.[349]

Finally, the demanded risk premium should sink in the covariance between securities' liquidity and market returns.[350] In times of financial distress and market downturns investors aim to replace high asset returns for the tradability of the securities held in their portfolios.[351] Stock liquidity becomes more valuable in a downward market because disinvesting can preserve investors from suffering considerable losses. In other words, disinvesting would generate substantial expenses in illiquid capital markets.[352]

Under these circumstances, stock liquidity reduces agency costs and determines the shareholders' risk-adjusted return expectations on their invested capital.[353] Depending on those agency costs, equity investors demand a risk-adjusted return on their invested capital.[354]

As there are several well studied possibilities to overcome the information deficit problem, such as dividend payments, controlling shareholders and debt financing, the possibility of reversing an investment decision quickly and with low consequential losses is also expedient.[355] The more frictionless trading becomes, the lower is the risk-premium that is required by the firm's equity investors.[356] Inversely, illiquidity causes financing costs to rise because shareholders are obliged to keep their shares over a long period of time, which

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[348] Cf. Pástor, L. Stambaugh, R. F. (2003), p. 683.

[349] Cf. Holmström, B., Tirole, J. (2000), p. 295 f.

[350] Cf. Chordia, T. et al. (2001), p. 501 f.

[351] Cf. Young, M. et al. (2008), p. 214.

[352] Cf. Acharya, V. V., Pedersen, L. H. (2004), p. 382.

[353] Cf. Diamond, D., Verrecchia R. (1982), p. 275 f.

[354] Cf. Heger, W. (2005), p. 42.

[355] Cf. Benartzi, S. et al. (1997), p. 1032.

[356] Cf. Amihud, Y. Et al. (2015), p. 367.

makes investing more insecure.[357] In general, the standardization of equity financing makes trading of property rights via capital markets possible.[358]

3.1.3 Liquidity definition and dimensions

Lippmann and McCall (1986) see the time that is required until an asset is exchanged for money to be the most relevant factor in defining liquidity. Garbade and Silber (1979) state that together with the trading time, the distance to the contemporaneous equilibrium value of the share is the most important factor.

Campbell et al. (1997) state that "Financial market liquidity (is) the ability to buy or sell significant quantities of a security quickly, anonymously, and with relative little price impact.[359]", while Wyss (2004) defines stock market liquidity by subdividing it into different stages: The first and most rudimentary stage of stock market liquidity is defined as the ability to trade at all.[360] In contrast to illiquidity, at least one bid and one ask offer exists. The next rudimentary step is trading with a large impact on the quoted price. With higher liquidity, the price impact decreases.[361] If trading is possible with only small price effects[362], the third level of liquidity is reached. If no price impacts are given and assets can be traded at the same price at the same point of time, a point of maximum liquidity is approached. This situation can be improved only by immediate trading, which is stated to be the highest form of liquidity. In this case stock trading causes no charges, price impacts or delays in time.[363]

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[357] Cf. Amihud, Y. et al. (2015), p. 350 f.; Brennan, M., Huh, S. W. (2013), p. 133 f.; Chan, H. W., Faff, R. W. (2005), p. 429 f.; Easterbrook, F. H. (1984), p. 657 f.; Jensen, M. J. (1986), p. 328.

[358] Cf. Amihud, Y., Mendelson, H. (1988), p. 9.

[359] Campbell, J. Y. et al (1997), p. 99 f.

[360] Cf. Wyss, R. (2004), p. 8 f.

[361] Cf. Phan, H. et al. (2007), p. 52.

[362] The price impact is based on transitory price movements that are described in more detail in subchapter 3.1.4.

[363] Cf. Wyss, R. (2004), p. 8.

Figure 3: Liquidity levels

Source: own figure based on Wyss, R. (2004), p. 8.

The different definitions imply that liquidity is a multidimensional phenomenon (a package of properties) that is complex in nature.[364] To consider the multidimensional character of liquidity, the depth of the market, the breadth of the market and the resilience of the market have to be observed.[365] Moreover, several investigations determine an additional fourth dimension; time (immediacy).[366] This makes the major problem concerning liquidity-measurement visible; liquidity cannot be measured in one dimension. The four liquidity dimensions are highlighted below:[367]

1. Tightness (breadth)

The tightness dimension primarily takes the cost aspect into account and reflects the costs that arise from buying and immediately selling shares. The less dense the market is, the higher are the costs that result from a different bid-ask quotation.[368] If the cumulative volume neither exceeds the highest bid nor the

[364] Cf. Chai, D. et al. (2010), p. 181 f.; Grullon, G. et al. (2004), p. 457; Makower, H., Marschak, J. (1986), p. 284.

[365] Cf. Schmidt, H., Iversen, P. (1991), p. 210.

[366] Cf. Kindermann, S. (2005), p. 15 f.; Ranaldo, A. (2001), p. 312.

[367] Cf. Brunner, A. (1996), p. 3; Ranaldo, A. (2001), p. 312.

[368] Cf. Hasbrouck, J. (2003), p. 2375 f.

lowest asked price, tightness remains unaffected.[369] Most commonly, the different spread measures are used to evaluate the breadth of the market.

2. Depth

Depth explores the quantity of a limited order book.[370] The market becomes deeper with the quantity of shares that can be traded to a given bid-asked-quotation.[371] More precisely, the depth dimension explores the number of shares that can be traded at the given bid-asked-indication without influencing it. It is commonly measured by the order ratio, the trading volume, the flow ratio or the depth itself.

3. Resilience

A large unlimited order that far exceeds the given supply and demand can lead to an order imbalance that makes the new share-price differ from the fair market value.[372] Due to a strongly diverging market evaluation of the companies' value, informed investors will bring the price into balance, due to their following orders. For that reason, resilience is also described as the speed and the costs that are needed to return the share price to the fair market value.[373] It covers the influence of the traded volume on the quoted price and can be measured by intraday returns, the variance ratio or the different liquidity ratios.

4. Time (immediacy)

The literature implies a fourth dimension; time (immediacy). It is defined as the duration required to find an appropriate counterparty to trade a given volume to given costs. It is also termed the quantity of transactions that is necessary to sell or buy a given amount of shares to a given price.

The dimensions of a limited order book that have been described above are visualized in Figure 4.

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[369] Cf. Kindermann, S. (2005), p. 15.

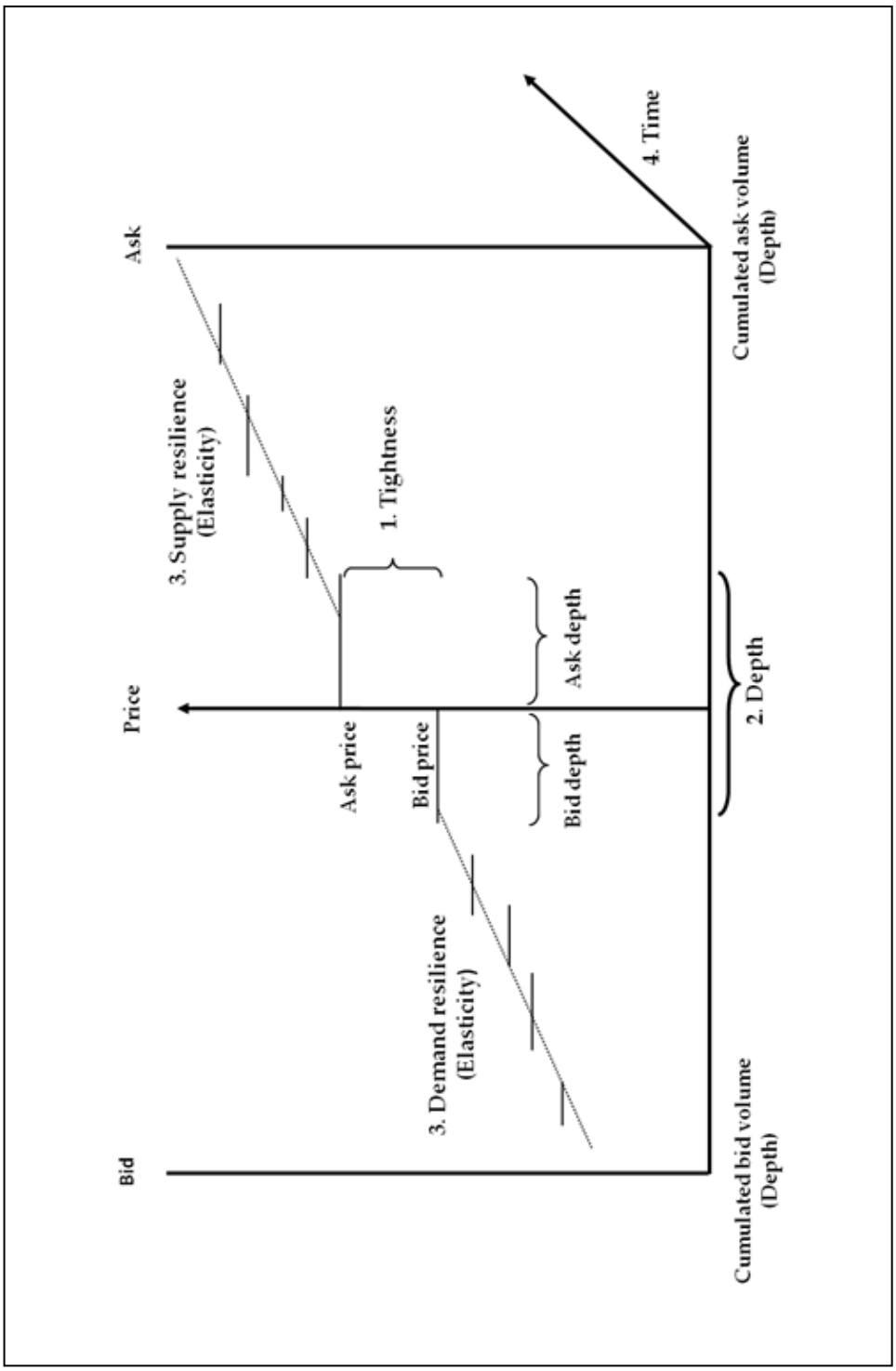
[370] Cf. Bar-Yosef, S., Prencipe, A. (2013), p. 300 f.; Wyss, R. (2004), p. 5.

[371] Cf. Garbade, K. D. (1982), p. 420 f.

[372] Cf. Fung, J. K. W. (2007), p. 701.

[373] Cf. Kindermann, S. (2005), p. 16.

Figure 4: Liquidity aspects



Source: own figure based on Ranaldo, A. (2001), p. 312.

In order to find measures that evaluate the nature of liquidity appropriately and make different stocks' liquidity comparable to each other, the investigation takes the four liquidity dimensions into consideration.[374] The interdependency between the different dimensions makes the selection of appropriate liquidity proxies more difficult.[375]

Because a growing order volume also increases the bid-ask span[376], the breadth and the depth dimension are linked to each other and are frequently measured together.[377] The execution of a given volume can be accomplished by aggregating orders over several periods (aggregate exchange behavior) within a limited order book.[378] Therefore, the breadth and the time for a given volume and the depth and the time for a given span are correlated to each other.[379]

Furthermore immediacy is connected to resilience. If a price can quickly return to the fair market price (high resilience) only a few orders are necessary to adjust the imbalance. Low resilience indicates that many orders are required to return to the fair market value.

Finally, the tightness and the depth dimensions depend on the resilience. If there are unlimited orders that lead to an execution of many limited buying orders, the spreads will increase (tightness) and analogously the depth will decrease.[380]

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[374] The multidimensional investigation of liquidity measures is based on Wyss, R. (2004), p. 8.

[375] Cf. Kindermann, S. (2005), p. 16.

[376] The difference between the prices quoted for an immediate sale (offer) and an immediate purchase (bid).

[377] Cf. Lee, C. M. S. et al. (1993), p. 349 f.

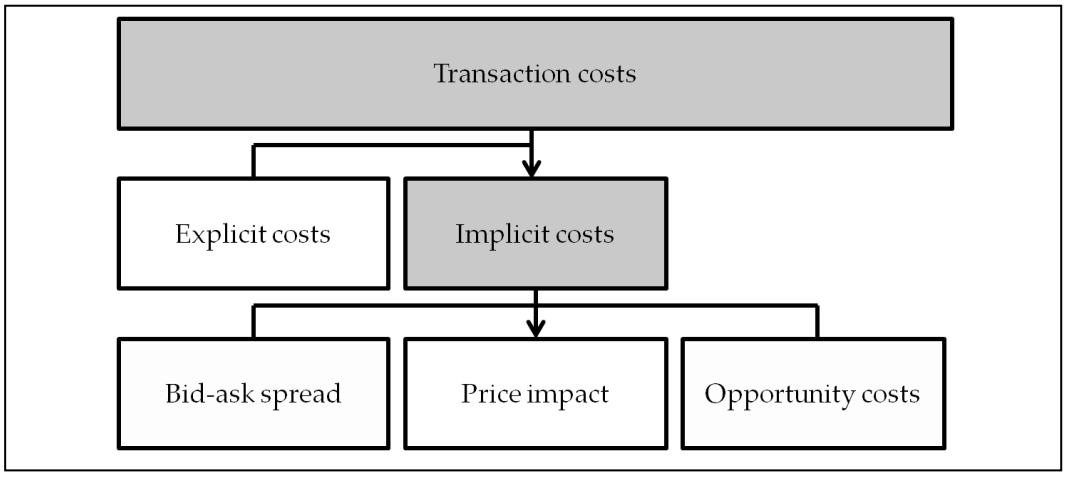
[378] Cf. Campbell, J. Y., Cochrane, J. H. (1999), p. 205 f.; Evans, M. D. D., Lyons, R. K. (2002), p. 170 f.

[379] Cf. Kindermann, S. (2005), p. 18.

[380] Cf. ibid.

Since liquidity cannot be measured directly, it is commonly approximated by transaction costs.[381] The lower the costs of trading are, the higher is the liquidity level.[382] An overview of the different transaction costs, separated into explicit and implicit cost components, is given in the following discussion.[383]

Figure 5: Single components of transaction costs



Source: own figure based on Gomber, P., Schweickert, U. (2002), p. 487.

The rather obvious explicit trading costs (also termed direct transaction costs) arise from processing.[384] Among other things, broker's commissions, handling fees and taxes are the most common examples of explicit trading costs and reduce the expected return on the invested capital.[385]

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[381] Cf. Amihud, Y., Mendelson, H. (1991), p. 1411 f.; Domowitz, I. (2002), p. 142 f.; Jang, B.-G. et al. (2007), p. 2329 f.; Kindermann, S. (2005), p. 9 f.; Lesmond, D. A. et al. (1999), p. 1132;

[382] Cf. Aitken, M., Comerton-Forde, C. (2003), p. 46.

[383] Cf. Keim, D. B., Madhavan, A. (1998), p. 50.

[384] Cf. Domowitz, I. et al. (2001), p. 224; Keim, D. B., Madhavan, A. (1998), p. 50; Korajczyk, R. A., Sadka, R. (2004), p. 1040.

[385] Cf. Demetz, H. (1968), p. 33 f.; Jegadeesh, N., Titman, S. (1993), p. 77; Stoll, H. R. (2001), p. 16 f.

In contrast to explicit trading costs, implicit costs of trading are a product of imperfect capital markets and are applicable to every trader.[386] Because implicit trading costs are negatively linked with liquidity, financing becomes cheaper with increasing liquidity.[387] For purposes of subdivision, the implicit costs of trading can be classified into three groups: The bid-ask spread, price impact and opportunity costs.[388] Bid-ask spreads are most frequently used to measure trading ability; thus they are explained in the following remarks. [389]

In the first step of the trading process, various orders are collected in an open order book.[390] On the bid side, the lowest price is most likely to be executed and, correspondingly, the highest price on the ask side.[391] If there is a difference between the bid and the ask price, it is not possible to trade shares free of charges.[392] In other words, the bid-ask spread makes selling shares and immediately repurchasing them impossible at the same price.[393]

The size of the spread is, furthermore, attributed to the market makers'[394] order processing, inventory holding and adverse information costs.[395] These are explained in more detail in the following paragraphs.

Order processing costs are the fixed costs that are required to fulfill the customer's order. For instance, they include connection costs to the dealing system and costs for the demand of electronic information.[396] The market maker

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[386] Cf. Healy, P. M., Palepu, K. G. (2001), p. 422.

[387] Cf. Datar, V. T. et al. (1998), p. 203 f.; Gomber, P., Schweickert, U. (2002), p. 487.

[388] Cf. Gomber, P., Schweickert, U. (2002), p. 487.

[389] The bid-ask spread is also used in Banerjee, S. et al. (2007); Griffin, C. H. (2010); Huang, G.-C. et al. (2012); Jayaraman, S., Milbourn, T. T. (2012), among others.

[390] Cf. Ranaldo, A. (2001), p. 312.

[391] Cf. Kindermann, S. (2005), p. 7.

[392] Cf. Wyss, R. (2004), p. 13.

[393] Cf. Collins, B. M., Fabozzi, F. J. (1991), p. 28.

[394] Market makers display buy and sell quotations for a given number of shares and assume the risk of holding shares to facilitate trading in that security.

[395] Cf. Madhavan, A. (2000), p. 208 f.

[396] Cf. Krinsky, I., Lee, J. (1996), p. 1523.

enhances the bid-ask spread to account for the reduced profit margins that go along with these kinds of costs.[397]

Inventory holding costs occur when the market maker holds a less diversified portfolio to supply the market with liquidity.[398] Therefore, inventory-holding models assume that the market maker actively manages the spread to achieve the desired inventory.[399] While an expanding inventory increases the price-change risk, a rather low inventory increases the danger of uncovered sales and market illiquidity.[400] However, the deviation of the optimal inventory holding can leave the market maker with substantial costs.[401] Because the inventory-holding costs component is driven by the price risk as well as the opportunity costs of holding securities, the influence on dividend initiations is positive.[402] In general, dividends reduce the price change risk because the cash distribution lowers the money that is left in equity risk. Accordingly, inventory-holding costs should increase the probability of dividend increases. However, the opportunity costs of holding an inventory also support dividend increases. Funds that are distributed in the form of cash dividends can be used for different purposes so that the opportunity costs decline.

Besides inventory holding, information costs can also be a driving determinant of the bid-ask spread.[403] As long as information is unequally distributed in reality, the uninformed market maker changes the bid-ask spread to compensate for the risk that is associated with dealing with a better-informed counterparty.[404] An informed investor demands shares if the valuation level is too low, and sells shares if the firm's market valuation exceeds fair value. That simply means that informed traders increase their own profit at the market maker's

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[397] Cf. Huang, R. D. (2002), p. 1285 f.

[398] Cf. Bollen, N. P. B. et al. (2002), p. 97.

[399] Cf. Amihud, Y., Mendelson, H. (1980), p. 31 f.; Garman, M. B. (1976), p. 257 f.; Ho, T., Stall, H. R. (1981), p. 47 f.

[400] Cf. Damodaran, A. (2005), p. 4 f.

[401] Cf. Garman, M. B. (1976), p. 257 f.

[402] Cf. Howe, J. S., Lin, J.-C. (1992), p. 1.

[403] Cf. Stoll, H. R. (2000), p. 1482.

[404] Cf. Glosten, L. R., Milgrom, P. R. (1985), p. 71 f.; Grossman, S. J., Miller, M. H. (1988), p. 617.

expense and market makers respond by raising spreads for protection.[405] It is expected that the information costs component of the spread influences dividend increases positively, because the information content of dividend increases can help to reduce information asymmetries.[406]

The three cost components suggest that the market maker's risk increases with volatility and information asymmetries.[407] Further, it is found that institutional trading activity can increase insecurity and with it the bid-ask spread, due to the institutional investors' presumed information advantage.[408]

Conversely, several determinants—among others the price level, the trading volume and the number of market makers—influence the bid-ask spread negatively.[409] The determinants lead to higher trading frequency. In the presence of various market makers or high trading volume, liquidity rises and the span between the bid and ask quotation decreases.[410] Because the span between the two offers is larger for illiquid assets than for liquid assets, illiquidity makes trading more costly for the investor.[411] Thus, the quoted bid-ask difference indicates a liquidation discount that reflects the price of immediacy, the timing costs.[412]

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[405] Amihud, Y., Mendelson, H. (1980), p. 31 f.

[406] Cf. Aharony, J., Swary, I. (1980); Asquith, P., Mullins, D. W. (1983); Brickley, J. A. (1983); Charest, G (1978); Eades, K. M. (1982); Lipson, M. L. et al. (1998).

[407] Cf. Amihud, Y., Mendelson, H. (1980), p. 31 f.; Guéant, O. et al. (2013), p. 477 f.

[408] Cf. Kothare, M., Laux, P. A. (1995), p. 52.

[409] Cf. Jagadeesh, N., Subrahmanyam A. (1993), p. 171; Stoll, H. R. (1978), p. 1133 f.

[410] Cf. Lee et al. (1993), p. 345 f.

[411] Cf. Amihud, Y., Mendelson, H. (1991), p. 57.

[412] Cf. Amihud, Y., Mendelson, H. (1988), p. 5.

In terms of liquidity measurement, the relevant literature distinguishes between quoted and realized bid-ask spreads.[413] Whereas the quoted spread is calculated as the gap between the quoted ask and the dealers' quoted bid price at a certain point of time, the realized spread has a different time component.[414] It shows the difference between the market makers' purchasing prices and the market makers' selling price.[415] Since the quoted spread reflects the conditions that investors face in reality more appropriately, it appears to be more suitable than the realized spread for liquidity investigations.

In addition to different spreads the price impact is a trading cost component for an asset that is driven by the trading-volume. If the volume of the best bid or ask quotation has been exceeded, the order goes to the second-best quotation. Consequently, trading becomes more expensive if immediate execution is desired.[416] It can be predicted that the order quantity of the limited order book promotes stock liquidity and leads to more frictionless trading. Hence, the order-volume of liquid capital markets is higher than the order-volume of illiquid capital markets and the market-impact costs increase with increasing illiquidity.[417]

As many market participants intend to avoid price-impact costs to make investments more profitable, they delay the execution and watch for more attractive trading partners that offer them better conditions. Nevertheless, the delayed transaction in order to avoid timing-costs and market-impact costs is also costly for the investor. Waiting causes them to lose the value of the best alternative use of the liquid funds—so-called opportunity costs.[418]

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[413] Cf. Elyasiani, E. et al. (2000), p. 2.

[414] Cf. Wyss, R. (2004), p. 13 f.

[415] Cf. Stoll, H. R. (1989), p. 115.

[416] Cf. Collins, B. M., Fabozzi, F. J. (1991), p. 28.

[417] Cf. Amihud, Y., Mendelson, H. (1991), p. 57.

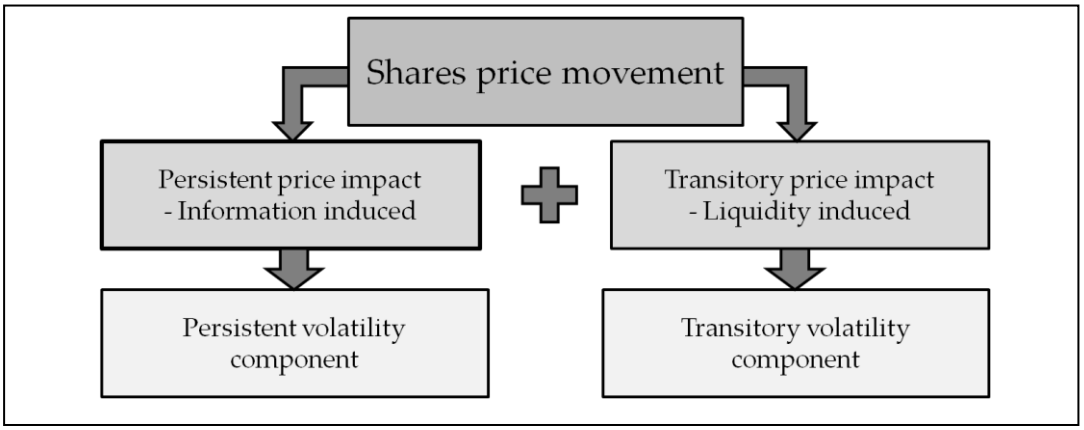
[418] Cf. Amihud, Y., Mendelson, H. (1991), p. 57; Griffiths, M. D. et al. (2000), p. 66; Lesmond, D. A. et al. (1999), p. 1132.

The described costs of trading are repetitive, which means that they have to be paid whenever an asset is traded.[419]

3.1.4 Volatility components of price movements

Given that the volatility of the share determines the execution likelihood of a limited order, it influences the tradability of the share.[420] If all information were freely available for everyone, trading would be done at the company's fair market value.[421] Since information is lacking in reality, new fundamental information makes investors review the evaluation of the company and lets the share's price move. To evaluate how new fundamental information influences the bidding behavior of investors, price movements can be divided into persistent and transitory components. A persistent price impact is based on fundamental information. It allows the share price move to its fair market value. A transitory price impact leads share prices in the opposite direction, away from fair value.[422]

Figure 6: Reasons for share price movements



Source: own figure based on Kindermann, S. (2005), p. 31 f.

[419] Cf. Amihud, Y., Mendelson, H. (1988), p. 6.

[420] Cf. Kinderman, S. (2005), p. 31.

[421] Cf. Boyer, R. (2007), p. 780.

[422] Cf. Hasbrouck, J. (1991), p. 179.

While "transitory price movement" signals illiquidity, "persistent price movement" results from information flow.[423] The price impact varies with the novelty of the information for the different kinds of traders, which is based on their individual information level.[424] Given that liquidity is an equilibrium between liquidity demand and liquidity supply, different kinds of investors are distinguished, depending on whether they supply or demand liquidity.[425]

First, informed traders need liquidity to benefit from their information advantage (liquidity demand).[426] They evaluate the fair value of a business and sell shares if the share price exceeds the fair value and buy shares if the company is under-valued.[427] This is possible only if the execution can be done with the lowest possible friction.

Second, uninformed traders supply the market with liquidity.[428] As these market participants are unaware of the fair market value and unable to assess the share properly, they primarily aim to trade at the lowest possible costs. To obtain a completion advantage they place limited orders that supply the market with liquidity.

Third, noise traders do not base their investment decision on fundamental information but on "noise" that is due to overreactions, inaccurate ideas and incorrect data.[429] Generally, noise traders add liquidity to a market while not distorting valuations.[430]

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[423] Cf. Elyasiani, E. et al. (2000), p. 5.

[424] Cf. Glosten, L. R., Milgrom, P. R. (1985), p. 76; Hasbrouck, J. (1990), p. 234 f.; Wyss, R. (2004), p. 20.

[425] Cf. Ranaldo, A. (2001), p. 312.

[426] Cf. Kinderman, S. (2005), p. 31 f.

[427] Cf. Kim, M. J. et al. (1991), p. 12.

[428] Cf. Kinderman, S. (2005), p. 33.

[429] Cf. Black, F. (1986), p. 531.

[430] Cf. Brown, G. W. (1999), p. 82 f.

Fourth, arbitrageurs influence liquidity depending on the underlying reason for the arbitrage. When arbitrageurs increase the market-making capacity as a result of non-fundamental demand shocks, market liquidity improves.[431] While demand shocks appear rather seldom in reality, a different connection seems to explain the relationship more appropriately.

If the arbitrage arises from fundamental trading, arbitrageurs can exploit less informed investors due to their information advantage and therefore demand liquidity.[432]

Fifth, market makers supply liquidity to enable market participants to trade immediately. They decrease market volatility and support the volume of transactions.

Despite the great significance of liquidity on share prices for modern stock markets and the existence of numerous studies, various inconsistent definitions of liquidity have made liquidity measurement challenging for a long time.[433]

3.2 CLASSIFICATION AND COMPARISON OF LIQUIDITY MEASURES

3.2.1 Liquidity measure classification

Given that liquidity is not directly measurable, one possible way to measure it is to concentrate on its quantifiable properties.[434] Thus, liquidity measures could be categorized by their dimensional and multidimensional character.[435] Due to interdependency between the different liquidity dimensions, it is commonly not possible to point out which dimension is influenced the most. Hence, one further

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[431] Cf. Gromb, D., Vayanos, D. (2010), p. 251 f.; Holden, C. W. (1995), p. 423 f.

[432] Cf. Domowitz, I. et al. (1998), p. 2001 f.; Kumar, P. Seppi, D. J. (1994), p 293 f.

[433] Cf. Boulding (1955), p. 310; Váradi, K. (2012), p. 35; Wyss, R. (2004), p. 5 f.

[434] Cf. Makower, H., Marschak, J. (1986), p. 284; Mancini, L. et al. (2011), p. 1806; Wyss, R. (2004), p. 5 f.

[435] Cf. Wyss, R. (2004), p. 9.

way to divide liquidity measures into categories is used; the separation into "pre-trade" and "post-trade" categories.[436]

Both pre-trade and post-trade estimation can provide valuable information about the level of stock market liquidity.[437] Information that is prior to the transaction is based on the depth and the tightness of the open order book that contains information about the ability to trade the share.[438] That means that in an open order book the relevant information is also available for all market participants before trading takes place.[439] Pre-trade measures display the trading costs that can be observed before trading takes place.[440] They can be defined as the "…availability of information about pending trading interest in the market.[441]" Pre-trade measures mainly include limited bid orders that are visible and publicly available in the order-book. Pre-trade measures, like the bid as spread, show how costly buying and immediate selling would be.[442] In other words, these measures capture the tradability of shares in a current market situation.

A few drawbacks accompany pre-trade measurement. The trading decision can be influenced by the available information and investors can manipulate the price-building process ("gaming").[443] Furthermore, time-related characteristics like the resilience of the market are unobservable before the trade.[444]

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[436] Cf. Collins, B. M., Fabozzi, F. J. (1991), p. 27 f.

[437] Cf. Atkins, A. B., Dyl, E. A. (1997), p. 309 f.; Boehmer, E. et al. (2005), p. 784; Kindermann, S. (2005), p. 47.

[438] Cf. Kindermann, S. (2005), p. 46.

[439] Cf. Kindermann, S. (2005), p. 47.

[440] Cf. Boehmer, E. et al. (2005), p. 784; Kindermann, S. (2005), p. 47.

[441] Boehmer, E. et al. (2005), p. 784.

[442] Cf. Amihud, Y., Mendelson, H. (1989), p. 479 f.; Atkins, A. B., Dyl, E. A. (1997), p. 309 f.; Bacidore, J. M. (1997), p. 92 f.; Chordia, T. et al. (2011), p. 709 f.; Chordia, T. et al. (2001), p. 501 f.; Hasbrouck, J. (2004), p. 305 f.; Huang, G.-C. et al. (2012), p. 43 f.; Ranaldo, A. (2000), p. 26 f.

[443] Cf. Hasbrouck, J. Schwartz, R. A. (1988), p. 11.

[444] Cf. Kindermann, S. (2005), p. 47.

In particular, potential traders who monitor the order-book cannot be detected, nor can special kinds of orders[445], which are not shown in the order book.[446] If traders who monitor the order book react to moving share prices by placing an order, they influence the market.[447] Therefore, the observers' willingness to trade can only be measured post-trade as it is visible only after the execution of the order.

As a result, post-trade measures supply additional information to pre-trade proxies that are generated with the transaction.[448] Market participants who are willing to trade but who do not place market orders, as well as special order forms, are visible after trading. Likewise, post-trade measures are free from "gaming" and few post-trade measures can discriminate between persistent and temporary price movements.[449]

However, post-trade measures are stated not to quantify the transactions' costs adequately, since the shareholders' ability to trade immediately depends on the information that is available prior to the trade. That means that a post-trade measure overrates the trading opportunities systematically.[450]

There are three general ways to obtain liquidity information after trading. They are based on the transaction time, the transaction quantity and/or the transaction price. The overview in Figure 7 subdivides the potential proxies based on these criteria.

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[445] E.g. iceberg orders that show only a small part of the order volume.

[446] Cf. Kindermann, S. (2005), p. 48.

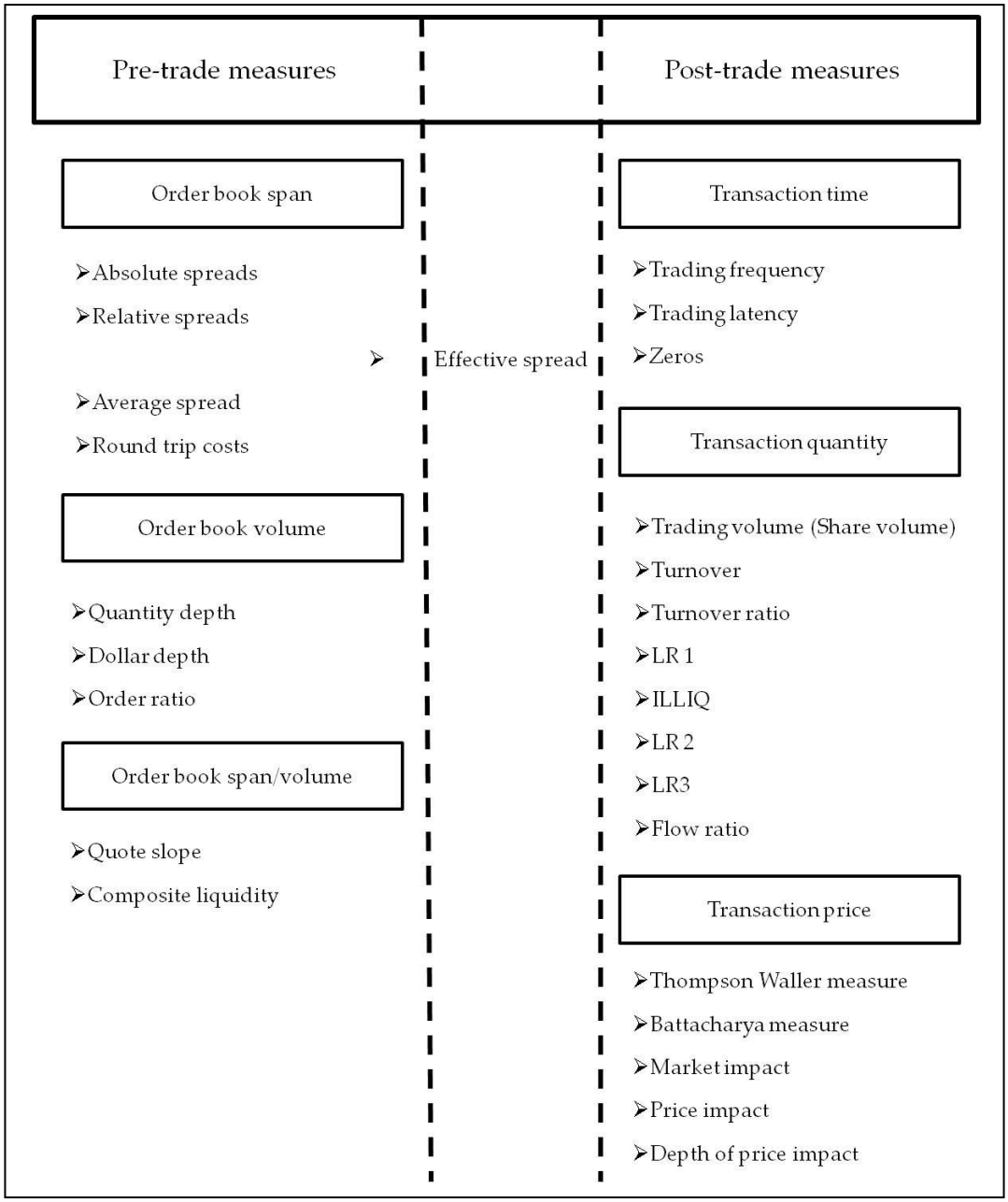
[447] Cf. Kindermann, S. (2005), p. 25 f.

[448] Cf. Collins, B. M., Fabozzi, F. J. (1991), p. 27 f.

[449] Cf. Hasbrouck, J. Schwartz, R. A. (1988), p. 11.

[450] Cf. Collins, B. M., Fabozzi, F. J. (1991), p. 32.

Figure 7: Categorization of liquidity measures



Source: own figure based on Kindermann, S. (2005), p. 109; Wyss, R. (2004), p. 9.

On the one hand, the overview shows that there are various potential liquidity measures, because scientific investigations and the multidimensional character of liquidity permit the application of multiple measures.[451] On the other hand, the high number of liquidity measures complicates the selection process.[452] On that account the suitability and data availability of the liquidity measures is evaluated with the following three criteria to reduce the selection possible.[453]

Firstly, the variables should lead every market participant to the same evaluation within the price-building process. That means that the variables should lead to identical prices from the seller's and the buyer's perspective. Therefore, appropriate liquidity measures need symmetrical properties to lead to the same results independent from buying or selling shares.[454] The prerequisite can be tested by the accumulation of all rates of return. If the sum is different from zero, the condition is not fulfilled, because every appropriate liquidity measure demonstrates that trading is a "zero-sum game".[455] For the reason that discrete variables like the bid-ask spread do not fulfill the condition, the logarithm can convert discrete variables into continuous ones.[456] Hereafter, variables that can be converted into continuous variables by conversion with the natural logarithm are labeled "if log".[457]

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[451] Multiple measures are also used in Kindermann, S. (2005) and Wyss, R. (2004).

[452] Cf. Kindermann, S. (2005), p. 45.

[453] Kindermann, S. (2005), p. 112 defines three further criteria that are required to approximate stock market efficiency instead of volatility. Since that makes the separation of transitory and permanent price movements necessary, and almost all long-term available liquidity measures fail to do so, the additional criteria are not considered further.

[454] Cf. Cuny, C. J. (1993), p. 73.

[455] Cf. Berkowitz, S. A. et al. (1988), p. 97 f.

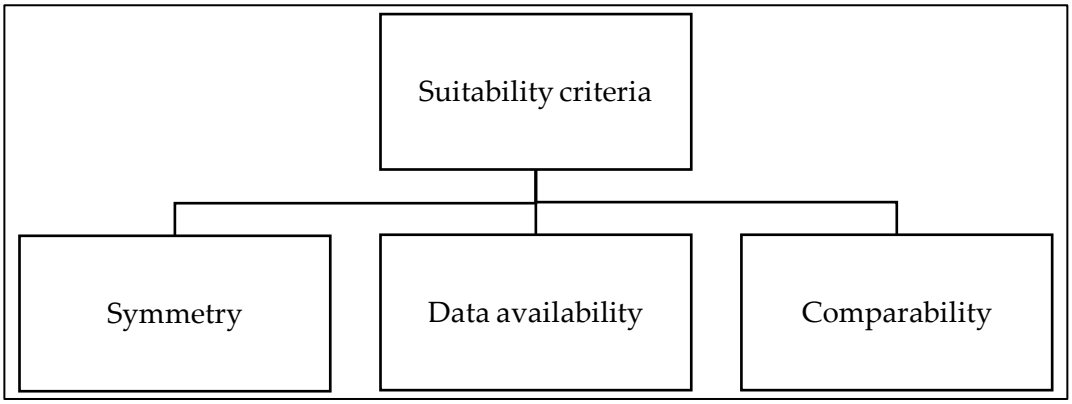
[456] Cf. Berkowitz, S. A. et al. (1988), p. 100.

[457] Cf. Kindermann, S. (2005), p. 112.

Secondly, the investigation of dividend changes requires a long-term dataset. Thus, a further criterion is the availability of data, especially because the importance of stock market liquidity estimation has increased quite recently, and the necessary liquidity information cannot be traced back far into the past. Therefore, the lack of availability of data for a long-term investigation is a large restriction.

Thirdly, comparability between different companies is stated to be the last relevant factor for measures to be appropriate.[458] In summary the described conditions for an appropriate liquidity measure are given in Figure 8:

Figure 8: Criteria for the evaluation of liquidity measures



Source: own figure based on Kindermann, S. (2005), p. 39 f.

In assessing the suitability of the different measures the three liquidity criteria are summarized in Table 7. The column furthest to the right in the table shows the number of criteria that are met by the specific liquidity measure.

[458] Cf. Wyss, R. (2004), p. 13.

Table 7: Overview of the suitability of all introduced measures

Liquidity Proxies	Symmetry	Availability	Comparability	∑ Suitability
Pre-trade measures				
Order book span				
Absolute spreads	if log	fulfilled	not fulfilled	2 of 3
Relative spreads	if log	fulfilled	fulfilled	*3 of 3*
Effective spread	if log	not fulfilled	fulfilled	2 of 3
Average spread	if log	fulfilled	not fulfilled	2 of 3
Round trip costs	not fulfilled	not fulfilled	not fulfilled	0 of 3
Order book volume				
Quantity depth	not fulfilled	not fulfilled	not fulfilled	0 of 3
Dollar depth	not fulfilled	not fulfilled	fulfilled	1 of 3
Order ratio	not fulfilled	not fulfilled	not fulfilled	0 of 3
Order book span/volume				
Quote slope	not fulfilled	not fulfilled	not fulfilled	0 of 3
Composite liquidity	not fulfilled	not fulfilled	not fulfilled	0 of 3
Post-trade measures				
Transaction time				
Trading frequency	fulfilled	not fulfilled	not fulfilled	1 of 3
Trading latency	fulfilled	not fulfilled	not fulfilled	1 of 3
Zeros	fulfilled	fulfilled	not fulfilled	2 of 3
Transaction quantity				
Trading volume	fulfilled	fulfilled	not fulfilled	2 of 3
Turnover	fulfilled	fulfilled	not fulfilled	2 of 3
Turnover ratio	fulfilled	fulfilled	fulfilled	*3 of 3*
LR 1	if log	fulfilled	not fulfilled	2 of 3
ILLIQ	if log	fulfilled	fulfilled	*3 of 3*
LR 2	if log	fulfilled	fulfilled	*3 of 3*
LR3	if log	fulfilled	not fulfilled	2 of 3
Flow ratio	if log	fulfilled	not fulfilled	2 of 3
Transaction price				
Thompson Waller measure	if log	not fulfilled	not fulfilled	1 of 3
Bhattacharya measure	if log	not fulfilled	not fulfilled	1 of 3
Market impact	not fulfilled	not fulfilled	not fulfilled	0 of 3
Price impact	fulfilled	not fulfilled	fulfilled	2 of 3
Depth of price impact	fulfilled	not fulfilled	fulfilled	2 of 3
** The liquidity measure meets all three criteria.*				

Source: own table based on Kindermann, S. (2005), p. 112.

Since the literature creates many similar measures that are not suitable for calculating liquidity, the dissertation focuses on four liquidity proxies that meet the defined suitability criteria, namely, relative spread, turnover ratio, ILLIQ and LR 2.

3.2.2 Pre-trade liquidity measures

The relative spread is the only pre-trade measure that meets the defined criterion. It shows a ratio of the absolute spread and a reference value:[459]

(2) Relative spread

$$\textbf{relative spread} = \frac{\textbf{spread}}{\textbf{reference value}}$$

The relative spread, measured as the span between the lowest bid price and the highest ask price can be compared to the mid-price or the last trade.[460] The lower the spread is, the more liquidly the asset can be traded.[461] The spread in relation to the calculated mid price is one of the most frequently used measures in the literature.[462]

(3) Relative spread (calculated with mid price)

$$\mathbf{SrelM_t} = \frac{\mathbf{p_t^A - p_t^B}}{\mathbf{p_t^M}} = \frac{\mathbf{2 * (p_t^A - p_t^B)}}{\mathbf{p_t^A + p_t^B}}$$

$SrelM_t$ = spread; relative calculated with mid price
p_t^A = best asked price
p_t^B = best bid price
p_t^M= mid price calculated $\frac{p_t^A + p_t^B}{2}$

[459] Cf. Wyss, R. (2004), p. 14.

[460] Cf. Stoll, H. R., Whaley, R. E. (1990), p. 70.

[461] Cf. Wyss, R. (2004), p. 13.

[462] Used in Acker, D. et al. (2002); Bertin, W. et al. (2005); Chordia, T. et al. (2001); Corwin, S. A. (1999); Elyasiani, E. et al. (2000); Greene, J., Smart, S. (1999); Kavajecz, K. A. (1999); Rojahn, J., Elschen, R. (2009); Kluger, B. D., Stephan, J. (1997); Levin, E. J., Wright, R. E. (1999); Lin, J.-C. et al. (1995); Menyah, K., Paudyal, K. (2000); Van Ness, B. F et al. (2000).

An alternate relative spread measure is calculated with the last trade in the denominator.[463] The ratio of the spread and the last trade considers that the market is moving in different directions: upward moving, where p_t = ask price and downward moving, where p_t = bid price.[464]

(4) Relative spread (calculated with last trade)

$$\mathbf{SrelT_t} = \frac{\mathbf{p_t^A - p_t^B}}{\mathbf{p_t}}$$

$SrelT_t$ = spread; relative calculated with last trade
p_t^A = best asked price
p_t^B = best bid price
p_t = last traded price before time t

If the spread is scaled by a reference value it makes different companies' liquidity comparable.[465] Further, it is possible that the spread leads to the same price from the buyers' and sellers' perspective if logarithmic values are used.[466]

3.2.3 Post-trade liquidity measures

Because they are easily measured, many investigations use volume related liquidity variables like trading volume, turnover and turnover ratios for estimation.[467] Like all post-trade measures, volume-related proxies over-evaluate the liquidity level systematically. Despite their common use, volume related liquidity variables are unsuitable for measuring liquidity, as they do not take the

[463] Used in Fleming, M. J., Remolona, E. M. (1999) and Amihud, Y., Mendelson, H. (1991).

[464] Cf. Wyss, R. (2004), p. 15.

[465] Cf. Wyss, R. (2004), p. 14.

[466] Cf. Kindermann, S. (2005), p. 112.

[467] Cf. Banerjee, S. et al. (2007); Chordia, T. et al. (2011); Greene, J., Smart, S. (1999); Jayaraman, S., Milbourn, T. T. (2012); Joshipura, M. (2009); Mancini, L. et al. (2013).

share price into account.[468] A given traded amount of money (turnover), leads to a different trading volume depending on the price level.

Because trading volume and turnover are absolute figures, they fail to make different observations comparable.

A modified turnover measure, the turnover ratio, which divides the calculated turnover by a company's outstanding shares, is used to overcome the problem described above.[469] Turnover, which shows trading activity, is negatively correlated to the bid-ask spread, which means that it is positively correlated to liquidity.[470]

(5) Turnover ratio

$$\mathbf{TR_t} = \sum_{\mathbf{i=1}}^{\mathbf{Nt}} \frac{\mathbf{p_i} * \mathbf{q_i}}{\mathbf{so}}$$

TR_t = turnover to shares outstanding per time
p_i = price of trade i
q_i = shares of trade i
so = shares outstanding

Despite outstanding shares being exogenous market factors that are not taken into account by market participants regarding their trading decision,[471] the turnover ratio is advantageous in respect of the turnover measure. It relates to the shares that can potentially be traded by taking outstanding shares into account. Furthermore, scaling the turnover by the reference value makes companies' liquidity comparable.

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[468] Cf. Kindermann, S. (2005), p. 69.

[469] Used in Banerjee, S. et al. (2007); Griffin, C. H. (2010); Huang, G.-C. et al. (2012); Jayaraman, S., Milbourn, T. T. (2012).

[470] Cf. Huang, G.-C. et al. (2012), p. 45.

[471] Cf. Kindermann, S. (2005), p. 69.

In addition to the turnover ratio, the previous liquidity measure overview shows that Amihuds' liquidity measure "ILLILQ" also meets the defined suitability criteria.

ILLIQ is the daily ratio of absolute stock return compared to its trading volume, averaged over a period of time; and quantifies the effect of one traded monetary unit on the daily price response. In other words, Amihud's liquidity measure estimates the stock's ability to absorb trading volumes with no major share price variations.

The ILLIQ proxy makes it possible to construct long time series of liquidity that are necessary to test the effects of illiquidity on ex ante and contemporaneous stock excess returns over time. This is much more complicated with finer illiquidity measures like the bid-ask spread.[472]

(6) Amihud illiquid measure (ILLIQ)

$$\mathbf{ILLIQ_{iy} = 1/D_{iy} \sum_{t=1}^{Diy} |R_{iyd}| VOLD_{iyd}}$$

ILLIQ_{iy} = illiquidity ratio of Amihud (2002)
R_{iyd} = return on stock i on day d of year y
$VOLD_{iyd}$ = respective daily volume in dollars
iy = number of days with available data for stock i in year y

The fourth and last measure that meets the symmetry, data availability and comparability criteria is liquidity ratio 2:

[472] Cf. Amihud, Y. (2002), p. 32.

For calculation, the volume of traded shares is reduced by the free float.[473] The reduction is based on the minor changes in the daily free float.

(7) Liquidity ratio 2

$$\mathbf{LR2_t} = \frac{\mathbf{LR1_t}}{\mathbf{N_e - N_0}} = \frac{\sum_{i=1}^{N} \mathbf{p_i * q_i}}{(\mathbf{N_e - N_0}) * |\mathbf{r_t}|}$$

$LR2_t$ = liquidity ratio 2
$(N_e - N_0)$ = free float = total number of shares minus shares owned by the firm
p_i = price of trade i
q_i = shares of trade i

3.2.4 Selection of liquidity measures

The preceding review of liquidity measures shows that only four measures meet the defined necessary criteria of symmetry, data availability and comparability. In order to choose between the selected measures, they are analyzed regarding their difficulty of their interpretation, their liquidity valuation and a consideration of potential traders and invisible orders, shown in Table 8. In order to select the most suitable proxies, each category values one scoring point. The sum of scoring points determines the most convenient liquidity measures for the present investigation.

Table 8: Liquidity measure selection process

Criterion (scoring systematology)	**Relative spread**	**Turnover ratio**	**ILLIQ**	**Liquidity ratio 2**
Interpretation (easy 1, difficult 0)	easy	easy	difficult	difficult
Liquidity valuation (appropriate 1, overvalue 0)	appropriate	overvalue	overvalue	overvalue
Potential traders/ invisible orders (considered 1, missed 0)	missed	considered	considered	considered
∑ Score	2/3	2/3	1/3	1/3

[473] Used in Ranaldo, A. (2000).

The comparison provided by this overview shows that the relative spread and the turnover ratio meet more of the defined criteria than do ILLIQ and liquidity ratio 2.[474] Accordingly, ILLIQ and liquidity ratio 2 are not considered in the final investigation.

While liquidity ratios consider potential traders and invisible orders, negative characteristics are predominant: interpretation is difficult and they overvalue liquidity systematically.[475]

Contrarily, it is found that two liquidity proxies are particularly suitable for the investigation: the relative spread and the turnover ratio.

One of the several advantages of the spread measurement for liquidity approximation is the accuracy of the spread in comparison to many other coarser measures and its acceptance in the literature.[476] It is a fine measure for liquidity as small spread changes can lead to large variations in the price-building process and interpretation is easy.[477] Furthermore, the relative spread does not over value liquidity, since it is measured before the trade takes place.[478] The most noteworthy disadvantage of the relative spread is that pre-measurement misses out potential traders and invisible orders.[479]

For estimation purposes the spread can be set into relation to the mid price or the last trade.[480] Since the ratio of the spread and the last trade depends more on share price movements that are smoothed by using the mid price, the relative spread calculated with the mid price is taken to make observations less fluctuating.

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[474] The liquidity measure selection process is given in Table 8.

[475] Cf. Collins, B. M., Fabozzi, F. J. (1991), p. 32.

[476] Also see sub chapter 3.2.2.

[477] Cf. Amihud, Y. (2002), p. 32.

[478] Cf. Collins, B. M., Fabozzi, F. J. (1991), p. 32.

[479] Cf. Kindermann, S. (2005), p. 47.

[480] Cf. Wyss, R. (2004), p. 14 f.

Also, liquidity estimation with the turnover ratio is easy to interpret.[481] Differently from the relative spread, the liquidity valuation with the turnover ratio considers potential traders and invisible orders. Because the turnover ratio is a post-trade liquidity measure, it accounts for that interesting information.

As with every post-trade measure, it is a negative in the sense that the overvaluation of liquidity is a systematic problem of the turnover ratio.[482]

In conclusion, the selection of appropriate liquidity measures is challenging. On the one hand, the availability and lack of comparability of data limits the range of suitable liquidity measures. On the other hand, many of the potential liquidity measures presented do not correspond to the previous definition of liquidity.

3.3 CURRENT STATE OF RESEARCH AND HYPOTHESES DERIVED FROM RESEARCH FINDINGS

In a frictionless world, from a transaction costs point of view investors with a cash preference are indifferent between cash distributions and selling shares.[483] To generate liquid funds, shareholders can either sell shares (homemade dividends) or be supplied with cash distributions. Since tradability is a necessary requirement to convert assets into cash, liquidity and dividends can be considered to be substitutes from that point of view.

Since capital markets are not frictionless and trading as well as dividend payment are accompanied by transaction costs, the influence of stock liquidity on dividend changes is more complex. The influence of stock liquidity on dividend changes is unclear in the current state of the literature.

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[481] Cf. Banerjee, S. et al. (2007); Chordia, T. et al. (2011); Greene, J., Smart, S. (1999); Jayaraman, S., Milbourn, T. T. (2012); Joshipura, M. (2009); Mancini, L. et al. (2013).

[482] Cf. Collins, B. M., Fabozzi, F. J. (1991), p. 32.

[483] Cf. Miller, M. H., Modigliani, F. (1961), p. 411 f.

On the one hand, a substitutive relationship is investigated by Aggarwal et al. (2012), Banerjee et al. (2007) and Kale et al. (2012). Banerjee et al. (2007) argue that transaction costs are responsible for the negative influence of stock liquidity on dividends, because shareholders' liquidity requirements can be met by creating home-made dividends in highly liquid capital markets. Kale et al. (2012), as well as Aggarwal et al. (2012), see the information value of liquidity and dividends to be more significant for the substitutive effect of liquidity and dividends. Both dividends and liquidity can be used to reduce investment risk to overcome agency problems.[484] Since agency costs become larger with illiquidity, firms with illiquid shares are more likely to initiate dividends to reduce the risks of investment than are firms with satisfactory liquidity.[485]

On the other hand, Fama and French's (2002) and Jiang et al.'s (2017) findings support a complementary influence of liquidity on dividends. Fama and French (2002) argue that size matters for dividend payments, because larger firms have better access to capital markets that provides them with more liquid shares.[486] Large companies are also more likely to distribute dividends due to their constant cash flows and low leverage.[487] Company size is stated to be the main driver for the influence of stock liquidity on dividend changes. Both are enhanced with greater firm size; the liquidity level and the probability of dividend issuance increase.

Also, Jiang et al. (2017) argue that liquidity positively influences the propensity to pay a dividend, and that dividend yields are increasing with rising liquidity. Since share prices are less affected by informed traders in liquid markets, they provide convenient surroundings for informed investors to hide private information.[488] Further, gathering information becomes more important

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[484] Cf. Easterbrook, F. H. (1984), p. 650 f.; Healy, P. M., Palepu, K. G. (1988), p 149 f.; Jensen, M. C. (1986), p. 323 f.; Lang, L. H. P., Litzenberger, R. H. (1989), p. 181 f., among others.

[485] Cf. Amihud, Y., Mendelson, H. (1991), p. 57.

[486] The positive influence of company size on dividends is also investigated in Aggarwal, R. et al. (2012); De Cesari, A., Huang-Meier, W. (2015); Kale, J. R. et al. (2012), Li, W., Lie, E. (2006), among others.

[487] Cf. Fama, E. French, K. (2002), p. 1 f.

[488] Cf. Jiang, F. et al. (2017), p. 295.

for less informed shareholders in order to increase their information level and make investing more secure. If uninformed investors increase their information level with increasing liquidity, they are more likely to detect managers who opportunistically abuse the companies' cash flows for private benefits. When managers are concerned about being exposed, they distribute liquid funds in the form of cash dividends rather than taking private benefits.

The controversies presented here as to whether stock liquidity has a negative[489] or positive[490] effect on the probability of paying a dividend make further investigations necessary. Furthermore, additional insights by investigating dividend changes are needed to put further pieces of the dividend puzzle in place.

Following the argument of the substitution theory, information asymmetries must be downsized to eliminate or reduce shareholders' risks and as a result to keep the cost of financing as low as possible. One option to keep shareholders and other market participants informed is to pay out dividends. The distributed amount of money limits potential cash flow abuse and opportunistic behavior by management (moral hazard).[491] While dividend payments reduce the risk of unpredictability, illiquidity causes higher information asymmetries and, as a consequence, financing costs rise.[492] If management use their distribution policies in this way, dividend changes may depend on the degree of liquidity. Based on the studies of Aggarwal et al. (2012), Fama and French (2002), Banerjee et al. (2007), Kale et al. (2012) and Jiang et al. (2017) that liquidity influences dividends, the following hypothesis will be examined:

H1: *Stock market liquidity significantly affects the probability of dividend changes.*

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[489] Cf. Banerjee, S. et al. (2007), p. 369 f.; Kale, J. R. et al. (2012), p. 365 f.

[490] Cf. Fama, E. French, K. (2002), p. 1 f.; Jiang, F. et al. (2017), p. 295 f.

[491] Cf. Achleitner, A.-K., Pietzsch, L. (2005), p. 379 f.; He, W. et al. (2017), p. 281.

[492] Cf. Easterbrook, F. H. (1984), p. 657 f.; Jensen, M. J. (1986), p. 328.

To test the importance of and general link between stock market liquidity for shifting dividends, stochastic models as well as data mining techniques seem particularly suitable.[493]

Besides the general link between stock liquidity and shifting dividends, the direction of influence is investigated to increase understanding of how stock liquidity and dividend changes are connected. Therefore, further hypotheses are derived from research findings. Following Fama and French (2002) and Jiang et al. (2017), it is considered that dividend changes and stock market liquidity are complementary. This can be a size effect or a result of the enhanced information level of uninformed investors in the presence of stock liquidity. Since large companies have more liquid shares and better conditions for dividend payments such as constant cash flows, in comparison to smaller firms, company size supports the complementary effect of stock liquidity and dividend changes.[494] Moreover, liquid capital markets enable managers to hide private information in share prices, which makes it necessary for uninformed investors to gather more information to reduce agency costs. Due to the increased information level, dividends become less required for monitoring managers[495], which also supports the assumption that stock liquidity and dividend changes are positively linked. Consequently, the second and third hypotheses are:

H2: *Stock market liquidity has a negative effect on the probability of dividend decreases.*[496]

H3: *Stock market liquidity has a positive effect on the probability of dividend increases.*[497]

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[493] Also Luebke, K., Rojahn, J. (2016) use stochastic models as well as data mining to test the importance different firm-specific variables have for dividend changes.

[494] Cf. Fama, E., Franch, K. (2002), p. 29.

[495] Dividends can serve as monitoring devices because less liquid funds are left under managements' control.

[496] Derived from Fama, E. French, K. (2002) and Jiang, F. et al. (2017).

[497] Derived from Fama, E. French, K. (2002) and Jiang, F. et al. (2017).

In line with Fama and French (2002), the thesis subsequently tests whether the positive influence of firm size on dividend changes is to be attributed to large companies having easier access to capital markets. The research design to test the three hypotheses is described and results are analyzed and interpreted in chapter four.

4 EMPRIRICAL ANALYSIS

4.1 RESEARCH METHODOLOGY

4.1.1 Dividend change classification techniques

The current state of research employs multiple approaches to dividend change measurement. Classification methods are the most prominent solutions.[498] Most simply, dividend changes can be measured binarily. That means that the nominal scaled dividend change variable can take two different values. As an illustrative definition a binary change variable takes the value one if the dividend increases, zero otherwise.[499] Because dividend change events consist of numerical scores that exist on an ordinal scale, a dividend change event is an ordinal variable. Therefore, an ordered probit or ordered logit model seems appropriate for the investigation of a multiclass dividend change variable. The advantage of these methods over a simple OLS regression is that the gap between dividend increases/decreases and maintenance is not assessed in the same way as an OLS would do.[500] In addition to binary estimation, multinomial classification divides the dividend change events into three or more classes, such as decreases, maintenance and increases. This considerably improves the accuracy of the whole measuring process, while multiple classes are narrower.

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[498] Dividend changes are also investigated with classification methods in Aggarwal, R. et al. (2012), p. 420 f.; Bulan, L. et al. (2007), p. 20; De Cesari, A., Huang-Meier, W. (2015), p. 8 f.; Deshmukh, S. (2003), p. 364 f.; Goergen, M. et al. (2005), p. 387 f.; Kale, J. R. et al. (2012), p. 365 f.; Li, W., Lie, E. (2006), p. 303 f.; Luebke, K., Rojahn, J. (2016), p. 335 f., among others.

[499] Cf. Simons, K. (1994), p. 579.

[500] Cf. Goergen, M. et al. (2005), p. 379.

One of the most common models in the literature is:[501]

$$Y = 0 \text{ if } y* \leq 0 \text{ (decrease)}$$
$$Y = 1 \text{ if } 0 < y* \leq \mu \text{ (maintain)}$$
$$Y = 2 \text{ if } 0\ \mu \leq y* \text{ (increase)}$$

To distinguish between small and large dividend events, the change can be split into four or more groups.[502] For example, Alangar et al. (1999) include only numerous dividend changes that are larger than 50 percent as well as dividend initiations and dividend omissions in the following pattern:

1. Dividend initiations (first time or first after three years)
2. Omissions (after at least three years of payment for at least one year)
3. Large increases (>50%)
4. Large decreases (<50%)

The commonly used classification techniques are auspicious for dividend change research and can simply be expanded or modified; but some circumstances have to be considered.

First, the number of classes is of special importance for an appropriate classification. It has to sustain the distinctive characteristics of dividend changes.

Second, too many classes waters down the quality of information; but the original character of the variable is lost if too few classes are built and no scaling up is possible afterwards.[503]

Third, it is difficult to find useful classes that handle the nature of the variable with little friction.[504]

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[501] Cf. Goergen, M. et al. (2005), p. 379.

[502] Cf. Alangar, S. et al. (1999), p. 429 f.

[503] Cf. Abdessemed, L., Escofier, B. (1994), p. 604.

[504] Cf. Tsoumakas, G., Katakis, I. (2007), p. 2 f.

Despite it being complicated to find suitable classes, in general the benefits of classification outweigh the disadvantages by far. For the present investigation it is particularly valuable that investigation of dividend changes makes it easy to find appropriate categories such as dividend omissions, decreases, maintenance, increases and first time initiations. It is also helpful that dividend research provides a non-linear relationship and harmonizes the nature of the data if it is heterogeneous.[505] Due to these advantages, the present investigation uses classification techniques to measure dividend changes. A multinomial investigation appears to correspond particularly well to the character of dividend changes.[506] If the dividend change observations are unequally distributed across the different groups, they can be adjusted by putting classes together. The adjustment helps to equalize the observations of each category and possibly increases information value and predictive power.[507]

4.1.2 Comparison of stochastic and algorithmic modeling

In general, data modeling is like a black box, where the input variable x enters the box on one side and the response variable y comes out on the other side.[508]

Figure 9: Nature of data

Source: own figure based on Breiman, L. (2001), p. 199.

[505] For further information see Keune, H. et al. (1991), p. 249 f.

[506] Cf. Goergen, M. et al. (2005), p. 379.

[507] Cf. Domingos, P. (2012), p. 79 f.

[508] Cf. Breiman, L. (2001), p. 199.

Models are derived from scientific literature to figure out how the "real world" works. Although all models fail to reflect reality entirely, some of them are useful to make complex reality more comprehensible.[509]

Today there are two general modeling-cultures: stochastic and machine learning.[510] While classical stochastic statistics allows more detailed inference by deriving the process by which data was generated, machine learning focuses on the prediction of future data.[511]

Classical statistics, like logit regression models and linear discriminant analysis, primarily aims to test hypotheses of causes and effects and the interpretability of models.[512] Those models are generally chosen by the parameter significance and the goodness-of-fit, while the outcomes are easy to interpret. Breiman (2001) argues that classical models are interested only in minimizing loss, using anything that works.[513] Forecasting is not their primary objective, because stochastic models are primarily based on well-known historical assumptions.[514] This is a major disadvantage, because "It is quite true what philosophy says: that Life must be understood backwards. But that makes one forget the other saying: that it must be lived forwards.[515]" The request for forward-oriented approaches underlines the importance of machine learning models because they consider the nature of variables as unknown and do not bank upon historical patterns.[516]

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[509] Cf. Hand, D. J. (2014), p. 99.

[510] Cf. Breiman, L. (2001), p. 199 f.

[511] Cf. Rodriquez, B. et al. (2008), p. 266.

[512] Cf. Foo, J., Merkel, M. (2010), p. 49.

[513] This is also stated by Hand, D. J. (2014), p. 3.

[514] Cf. Breiman, L. (2001), p. 202.

[515] Quotation from Søren Kierkegaard 1988 (Danish philosopher and theologian).

[516] Cf. Hastie, T. et al. (2017), p. 1 f.

Accordingly, the analysis in this study extends the classical stochastic modeling techniques by further methods, aiming to illustrate reality even more suitably. To do so, machine learning techniques are used additionally, to get new insights and increase the reliability of the statistical outcomes.[517] The primary focus of those models is on predictive accuracy, because the underlying data mechanism is more reliable when the predictive accuracy is high.[518] Algorithmic modeling tends to achieve better performance accuracy than do traditional statistical methods, but is more complicated to interpret.[519] Models are not chosen by their parameter significance or goodness-of-fit but on their cross-validated predictive accuracy, using training and test samples.[520] One can say that the machine learning algorithms rely on making progress; machine learning is advantageous in handling large and sophisticated data sets in comparison to data modeling.

"If our goal as a field is to use data to solve problems, then we need to move away from exclusive dependence on data models and adopt a more diverse set of tools."[521] For this reason the dissertation aims to answer the research question using these two different modeling techniques.

Each technique can be divided into two sub-categories, depending on the arrangement of the endogenous dividend change variable, namely multinomial and binary classification. Multinomial measurement explains the nature of dividends by putting them into more than two classes, while binary measurement can help to equalize the dividend change categories to improve model accuracy.

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[517] Cf. Huang, Z. et al. (2004), p. 543 f.

[518] Cf. Hastie, T. et al.(2017), p. 24 f.

[519] Cf. Huang, Z. et al. (2004), p. 543 f.

[520] Cf. Saravanan, P., Kalpana, P. (2017), p. 97.

[521] Breiman, L. (2001), p. 199.

The stochastic techniques used are panel logit models and linear discriminant analysis, while the machine learning analysis focuses on Breiman's (2001) preferred method, random forests.[522] As a preliminary step a single decision tree is grown to simplify the interpretability of the tree model. Additionally, a more complicated technique is used that can advance the accuracy of a relatively weak learning algorithm by using re-sampling on training data in a process known as gradient boosting.[523]

Starting with the stochastic estimation, the different statistical models are explained in more detail in the following section.

4.1.3 Stochastic modeling approaches

4.1.3.1 Panel logit analysis

The Hausman Test of Specification is used to differentiate between fixed and random effects in panel data.[524] As random effect is preferred a random effects logit panel with a multinomial endogenous variable is calculated, using panel data controls for unobserved heterogeneity within the estimation of the coefficients. Accordingly, a logistic function is used to estimate the probabilities between the dependent categorical variable and the independent variables.[525] Using multinomial classification, the endogenous variable can take more than only binary characteristics.[526] It can be said that the logit classification is generalized to multidimensional problems and it is assumed that a logistic relationship between the predictors and the log odds of group membership exists.[527]

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[522] Cf. Breiman, L.(2001), p. 207.

[523] Cf. Friedman, J. et al. (2000), p. 337.

[524] Cf. Hausman, J. A. (1978), p. 1251 f.

[525] Cf. Hilbe, J. M. (2009), p. 15 f.

[526] For the multinomial panel logistic estimation the dividend change variable can take the value 0 for decreased, 1 for maintained and 2 for increased dividends.

[527] Cf. Finch, H., Schneider, M. K. (2007), p. 48; Gujarati, D. N. (2009), p. 597.

For panel data, every individual company *i* chooses its dividend policy with *j* choices at time *t*. The company's choice depends on observed characteristics that change between single firms and over time (X_{it}). Also, time-constant unobserved individual effects are taken into account by α_i :

(8) Panel logit estimation with individual effects

$$\pi_{it,j}\ (\alpha_i) = \frac{\exp(X'_{it,}\beta_j + \alpha_{ij})}{\sum_{k=1}^{c}\exp(X'_{it,}\beta_k + \alpha_{ik})}$$

As α_i effects choice probabilities, it has to be integrated over the distribution of unobserved heterogeneity. The random effects multinomial logit sample likelihood is as follows:

(9) Random effects multinomial logit likelihood

$$L(y_i) = \int L(\,y_i|a)dG_a(a) = \int \prod_{t=1}^{T_i} (\frac{\exp\,(\sum_{j=1}^{c} y_{it,j}(a_{ij} + X'_{it,j}\beta))}{\sum_{k=1}^{c}\exp(a_{ik} + X'_{it,k}\beta)})dG_a(a)$$

where $y_{it,j} = 1$ if the company *i* chooses the alternative *j* at time *t*, and zero otherwise.[528]

In addition to the multiclass estimation, a further calculation with a binary endogenous variable is executed to check the robustness of the model. The binary response variable is estimated with one or more predictor variables at more than two points in time (panel structure of data).[529] The panel structure has the advantage of controlling the unobserved heterogeneity within the estimation of the coefficients.

(10) Random effect panel logit estimation

$$P\big(Y_{it} = 1\big|\alpha_{i(RE)}\big) = \frac{1}{1 + \exp\,(-\big(\alpha_{i(RE)} + X_{it}{}'\beta\big))}$$

[528] Cf. Frees, E. W. (2004), p. 398.

[529] Cf. O'Connell, A. A. (2006), p. 29 f.

This model is different from the standard model of logistic regression in that the number of different values for $\alpha_{\mathrm{i(RE)}}$ equal the number of companies within the investigation.[530] It is preferable to a fixed effects model in that it takes time-constant characteristics into account and it is a result of the previously implemented Hausman model specification test.[531] Due to the binary variable, the conditional distribution is a Bernoulli and not a Gaussian distribution and the predicted values are limited to take the value null or one.[532]

4.1.3.2 Linear discriminant analysis

The second step linear discriminant analysis (hereafter LDA) is very similar to the logit model that has already been presented; both contain linear decision boundaries and explain one endogenous variable as a linear combination of further independent variables.[533] This creates an equation that minimizes the possibility of misclassification of cases into their respective groups.[534] The difference is that LDA uses the assumption of a multivariate normal distribution of X with a common covariance matrix $\sum$ within the classes.[535] With μ_j= E(X|K=j) and prior probabilities π_j allocation via

(11) Estimation of linear discriminant

$$\underset{\mathrm{j}}{\arg\max}\ (\chi^T \sum^{-1} \mu_j - \frac{1}{2}\mu_j^T \sum^{-1} \mu_j + log\ \mu_j).$$

The differences in the mean vector of each class weighted by the inverted covariance matrix provide information concerning the differences in the classes.[536]

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[530] Cf. O'Connell, A. A. (2006), p. 29 f.

[531] Cf. Gisselmann, M., Winzio, M. (2012), p. 150.

[532] Cf. Austin, P. (2008), p. 1228 f.

[533] Cf. McLachlan, G. J. (2004), p. 7.

[534] Cf. Bhatnagar, V., Srinivasa, S. (2013), p. 185.

[535] Cf. Hastie, T. et al. (2017), p. 108.

[536] Cf. Luebke, K., Rojahn, J. (2016), p. 335 f.

4.1.4 Algorithmic modeling techniques (machine learning)

4.1.4.1 Decision tree modeling

Decision trees are quite simple in nature; they describe a chain of choices that conclude with an outcome.[537] They can be used for regression and classification purposes by recursive binary splitting.[538] Based on a root, branches are built on the basis of a splitting criterion x (independent variables) to get a terminal node (leaf).[539] The inner branching points are named internal nodes. The terminal node is the estimation of y. Because all observations can potentially lead to terminal nodes within a decision tree (overfitting), the tree is pruned by complexity parameters that are generated by cross-validation.[540] Given data on the predictor variables and the categorical response variable "dividend change", the decision tree algorithm builds a model for understanding the relationship between the variables.[541] Therefore, the trees are grown with several nodes, where bottom nodes are terminal nodes.[542] Using fixed splitting criteria at each node the data is split into two sub-nodes.[543] The process of building a decision tree can be separated into four steps, given in Table 9.

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[537] Cf. Inzalkar, S. M., Sharman, J. (2015), p. 488 f.; Varian, H. R. (2014), p. 8; Wilkinson, L. (1998), p. 43.

[538] Cf. Hastie, T. et al. (2017), p. 305.

[539] Cf. Finch, H., Schneider, M. K. (2007), p. 48.

[540] Cf. Therneau, T. M., Atkinson, E. J. (2015), p. 13.

[541] Cf. Hastie, T. et al. (2017), p. 305 f.

[542] Cf. Varian, H. R. (2014), p. 12.

[543] Cf. Barros, R. et al. (2015), p. 10.

Table 9: Decision tree algorithm

1. Step	Recursive binary splitting on training data to grow a large tree. Stopping when terminal node has fewer than the minimum of observations.
2. Step	Apply cost complexity pruning to the large tree => sequence of best subtrees of α.
3. Step	Use K-fold-cross-validation to choose α. That is, divide the training observation into K folds. For each k = 1,..., K: a) Repeat step 1 and 2 on all but the k^{th} fold of the training data b) Evaluate the mean squared prediction error on the data in the left-out k^{th} fold, as a function of α. Average the results for each value of α, and pick α to minimize the average error.
4. Step	Return the subtree from Step 2 that corresponds to the chosen value of α.

Source: own figure based on James, G. et al. (2016), p. 309.

The splitting principle for classification trees is the Gini criterion:

(12) Gini splitting criterion

$$\mathbf{Gini} = \boldsymbol{N_L} \sum_{\boldsymbol{k=1,\ldots,k}} \boldsymbol{P_{kL}}) + \boldsymbol{N_R} \sum_{\boldsymbol{k=1,\ldots,K}} \boldsymbol{P_{kR}}(\mathbf{1}\text{-}\boldsymbol{P_{kR}})$$

p_{kL} = proportion of class k in left node

p_{kR} = proportion of class k in right node

As α can be defined as a tuning factor, it controls a trade-off between the complexity and the fit to the training data. That means that the subtree is equal to T_0 if α is zero. An increase of the tuning factor may be disadvantageous, because it can lead to too many terminal nodes. Decision tree modeling can be very effective, because it handles the categorical predictors naturally and is simple to fit, even for large data sets.[544] If the tree is small the results are easy to interpret,

[544] Cf. Srivastava, A. et al. (1999), p. 238.

but the complexity rises with the size of the tree.[545] Furthermore, it can handle highly non-linear interactions and handles missing values by replacement through surrogate variables.[546] Trees can furthermore give valuable insight by determining the importance of the different variables and terminal nodes cluster data naturally into homogeneous groups.[547]

The advantages mentioned are countered by one certain disadvantage of binary or multinomial regression trees; small data changes can have major effects.[548] Therefore, more accurate models are required to get more stable results. As a solution, the more constant random forest approach is used.[549] The fundamental idea is that changing data may change individual trees but not the combination of many trees (forest).

4.1.4.2 Random forest algorithm

The bagging algorithm is used to grow a forest of multiple decision trees.[550] Bagging pursues the goal of creating several random decision trees by drawing random samples with replacement to give notable improvements in accuracy (reduced variance).[551] The algorithm grows trees out of the bootstrap-samples, using one randomly selected splitting criterion x afterwards.[552] The random forest analysis has two major differences from decision trees; missing values are not handled by surrogates but by proximities and the interpretation is vastly more complex. Within the randomly selected bootstrap sample some observations end up in the sample several times (overlapping), while other observations are "out of bag", which means that they do not end up in the sample at all.[553] Random forest models do not produce a picture of a single tree, but of many trees that may

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[545] Cf. Han, J., Kamber, M. (2011), p. 321.

[546] Cf. Rokach, L., Maimon, O. (2005), p. 481.

[547] Cf. Freitas, A. A. (2002), p. 50.

[548] Cf. Rokach, L., Maimon, O. (2015), p. 82 f.

[549] Cf. Breiman, L.(2001), p. 207.

[550] Cf. Bauer, E., Kohavi, R. (1999), p. 106.

[551] Cf. Hastie, T. et al. (2017), p. 587; James, G. et al. (2016), p. 317.

[552] Cf. Breiman, L. (2001), p. 207.

[553] Cf. Maindonald, J., Braun, W. J. (2010), p. 369.

overlap each other.[554] Hence, the possibilities of interpretation sink and indistinctness rises on the one hand, but the model's accuracy increases on the other hand. The five steps for calculating the random forest by bootstrap sampling are described in Table 10.

Table 10: Random forest algorithm

1. Step	Choosing the random sample from the data N1 = Learning sample (n1= 7/10) N2 = Out-of-bag data (n-n1)
2. Step	Learning sample is used to create a tree; only one random independent variable is used for splitting purposes
3. Step	Repeat step 1-2 for all B bootstrap samples
4. Step	Bagging (summarizing results)
5. Step	Calculation of the out-of-bag error rate

Source: own figure based on Hastie, T. et al. (2013), p. 588; Varian, H. R. (2014), p. 17.

For the investigation, each of the trees is grown on an independent bootstrap sample. After that, an observation of each node is necessary to randomly select *m* variables out of *M* possible variables and find the best split on the selected determinants.[555] For bagging purposes, multiple predictors are generated to create one aggregated predictor.[556] Therefore, bootstrap replicates of the learning set are created and used as new learning sets. As already stated, model accuracy is expected to increase by implementing various trees.[557] The reason for this is visualized in Figure 10.

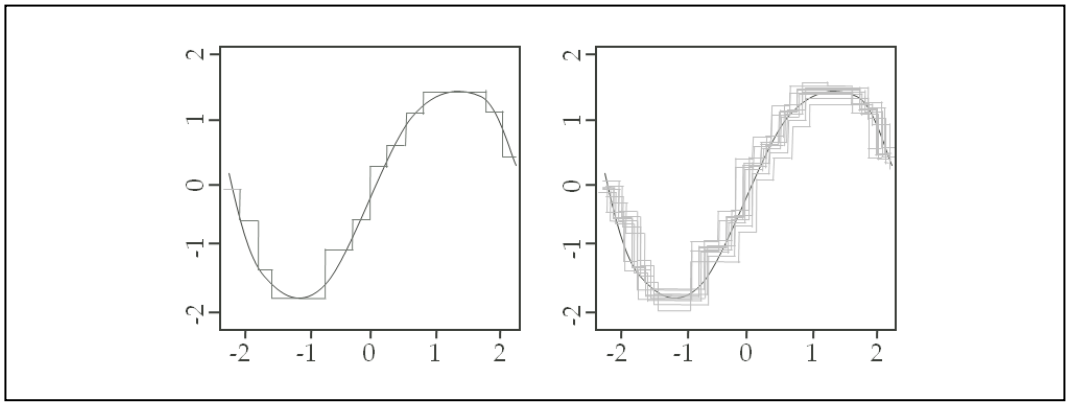
[554] Cf. Varian, H. R. (2014), p. 17.

[555] Cf. Hastie, T. et al. (2017), p. 588; Varian, H. R. (2014), p. 17.

[556] Cf. Hothorn, T. et al. (2004), p. 80.

[557] Cf. Breiman, L. (1996), p. 123 f.; Hastie, T. et al. (2017), p. 600.

Figure 10: Added value of multiple tree estimation



Source: own figure based on Cutler, A. (2010), p. 69.

On the left side there is a single regression tree and there are ten regression trees on the right side. As can be seen, the multiple tree estimation reduces the consequential variance.[558]

The random forest approach contributes to the investigation in this thesis by its high prognostic potential and the measurement of the relative importance of different variables.[559] Certainly, it is disadvantageous that the approach demands several parameters that have to be set (e.g. number of trees, number of variables for splitting) and the interpretation is more complex than is required for a single decision tree.

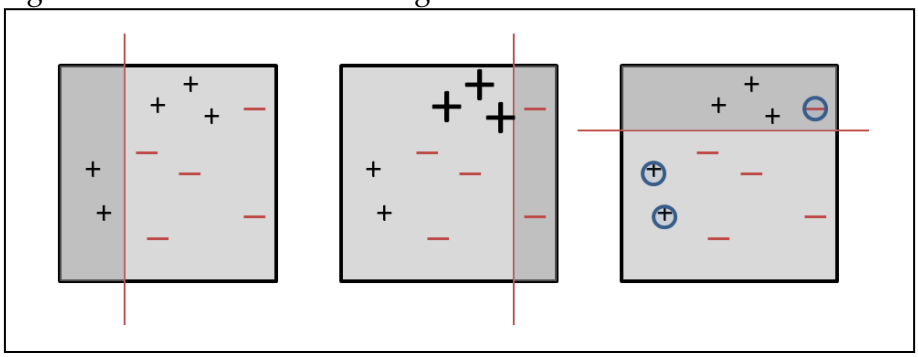
[558] Cf. Breiman, L. (2001), p. 207 f.

[559] Cf. Hastie, T. et al. (2017), p. 282.

4.1.4.3 Gradient boosting calculation

In addition to the tree-based methods, gradient boosting is a powerful machine learning algorithm that can optimize the prediction accuracy of many regression or classification models.[560] Compared with the random forest approach, for gradient boosting the sample selection is made more systematically.[561] After the first sample is randomly selected within gradient boosting, the following samples are not unsystematically selected but are based on observations that are hard to classify (gradients) in a forward stage-wise manner.[562] That means that boosting aims to turn several classifiers that do not show high correlation to the true classification (weak learners) into one classifier that is highly correlated with the classification (strong learner).[563]

Figure 11: Weak learner boosting



Source: own figure based on Schapire, R. E., Freund, Y. (2012), p. 418.

The first box in Figure 11 shows one vertical line that illustrates the first weak learner. On the right side of the box one can see three pluses that are misclassified. Gradient boosting puts more weight on those misclassified observations.[564]

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[560] Cf. Hastie, T. et al. (2017), p. 337; James, G. et al. (2016), p. 321.

[561] Cf. Strickland, J. S. (2014), p. 369.

[562] Cf. Warmuth, M. K. et al. (2006), p. 1002.

[563] Cf. Hastie, T. et al. (2017), p. 337.

[564] Cf. ibid.

To categorize them correctly, the vertical line on the right side in the second box is used. In the following, the weak learners are combined in suitable weight after repeating this process.[565] If the model finds appropriate weights for the learners it improves the classification accuracy as a result. The gradient boosting algorithm is given in Table 11.

Table 11: Boosting algorithm

1. Step	Set $f(x) = 0$ and $r_i = y_i$ for all i in the training set.
2. Step	For b = 1,2,…,B, repeat: a) Fit a tree f^b with d splits (d+1 terminal nodes) to the training data (x, r). b) Update f by adding in a shrunken version of the new tree: $f(x) \leftarrow f(x) + \lambda f^b(x)$. c) Update the residuals r <- r_i - $\lambda f^b(x_i)$.
3. Step	Output the boosted model, $f(x) \leftarrow \sum_{b=1}^{B} \lambda f^b(x)$.

Source: own table based on James, G. et al. (2016), p. 321.

After random sampling, further trees are based on the previous trees weight error function.[566] The advanced trees show the variables that are most important for the classification of the output variable.[567] That boosting solves possible problems of multicollinearity by lessening the selected estimates towards zero, is one appreciable advantage of the model. In addition, it can increase the predictive power of an estimator significantly and is suited to analyzing the classification problems of interest.[568]

[565] Cf. Schapire, R. E., Freund, Y. (2012), p. 418.

[566] Cf. James, G. et al. (2016), p. 321.

[567] Cf. Hastie, T. et al. (2017), p. 367.

[568] Cf. Varian, H. R. (2014), p. 16.

4.1.4.4 Measuring the importance of variables

The goal of the stochastic models and of the machine learning models is to quantify the importance of the liquidity variables for the classification of the response variable "dividend changes". To make that importance visible, the multinomial and binary panel logit model estimates the significance of influence with the mean absolute value of the t-test statistic (H0: $\beta_{ij} = 0 \; for \; i = 1., K - 1$). As the LDA can be linked to multivariate analysis of variance, a forward selection based on the P-Value of Wilks' lambda to determine the variable's importance is employed.[569]

For decision trees, the most important decision node, which corresponds to the best predictor, is called 'root'.[570] The variables that split on the top of the tree are more important in classifying the outcome variable than the ones that are closer to the terminal nodes.[571] Furthermore, random forest, as well as gradient boosting, provides an overview of the comparison of the importance of variables. The improvement in the split-criterion at each split of the tree contributes to measuring the importance.[572] The importance is calculated for each tree of the model and accumulated for the whole forest.[573] While the random forest approach calculates the importance of each variable, the boosting algorithm ignores some of them completely.[574] This is due to candidate split-variable selection that enhances the chance that the random forest approach will include every single measure in comparison to gradient boosting. Given that the candidate split-variable selection does not occur within the boosting algorithm, significantly fewer variables can be included.[575] In order to use the same criterion and make the measurement process

[569] Cf. Mardia, K. V. et al. (1979), among others.

[570] Cf. Rokach, L., Maimon, O. (2005), p. 477.

[571] Cf. James, G. et al. (2016), p. 315.

[572] Cf. Liao, T. W. (2007), p. 376.

[573] Cf. Hastie, T. et al. (2013), p. 588; Varian, H. R. (2014), p. 17.

[574] Cf. Schapire, R. E., Freund, Y. (2012), p. 418.

[575] Cf. Grabczewski, K. (2014), p. 92 f.

comparable, the plots of importance for random forest and for gradient boosting that are used in the investigation are based on the Gini splitting index.[576]

The respective variable importance measures are summarized in Table 12:

Table 12: Overview of variable importance measures

Method	Variable importance measure
• Panel logit	• Mean absolute value of the t-test statistic
• Linear discriminant	• P-Value of Wilks' lambda
• Decision tree	• Position in the tree
• Random forest	• Gini splitting index
• Gradient boosting	• Gini splitting index

4.1.5 Definition of variables

4.1.5.1 Sample selection and endogenous variable

The investigation of the influence of stock market liquidity on dividend changes in Europe covers the years 2006 to 2014, starting two years before the outbreak of the financial market crisis.[577] The initial sample consists of all companies that are listed in the STOXX Europe 600 index as of January 2015. The index contains firms with high importance for the European area and represents large and mid-capitalization companies across 18 countries in Europe. To be part of the index the country classification, free float, and market capitalization are the most important criteria. Furthermore, it must be ensured that foreign investors are able to freely buy and sell the stock.[578] Despite the danger of survivorship bias the index composition as of January 2015 is used to make sufficient valid statements, as it makes it possible to obtain a large number of liquidity

[576] In contrast to the Permutation Accuracy measure the Gini splitting index can be calculated for both random forest as well as gradient boosting.

[577] Cf. Bogle, J. C. (2016), p. 9 f.; Mancini, L. et al. (2013), p. 1821.

[578] Cf. STOXX (2017), p. 11.

observations from the database, because the recording of liquidity measures gained importance over time. Taking an index composed previously causes difficulties of insufficient availability of liquidity data.[579] Since 600 companies are listed in the STOXX Europe 600 index, the investigation starts with 5,400 yearly observations over the entire sample period, with the following adjustments.

First, 90 quarterly dividend payments are excluded from further investigation as they are underrepresented and less comparable to larger dividend intervals. The signaling value of quarterly dividend changes is valid for only three months while semi-annual and annual dividend-change signals last longer. For annual and semi-annual paying companies the annual figure "total dividends" is used for estimation. Using the annual figure makes companies comparable and keeps annual and semi-annual dividend paying companies in the dataset.[580]

Secondly, according to previous dividend policy studies, 1,818 yearly observation financials, utilities and REITs are dropped due to their external regulations.[581]

Thirdly, 1,102 observations of zero dividend policies[582], dividend omissions and initiations are discarded from the final sample due to their special character.[583] Zero dividend policies are eliminated from the final sample because they are not synonymous with unchanged dividend.

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[579] The index composition of January 2015 contains 176 and the index composition of December 2005 contains 429 observations with insufficient liquidity data.

[580] Cf. Aggarwal, R. et al. (2012), p. 408, among others.

[581] Cf. Deshmukh, S. (2003); Fama, E. F., French, K. R. (2002).

[582] They mean that companies have not paid dividends in the previous year and continue to retain earnings completely.

[583] Cf. Kindermann, S. (2005), p. 9 f.

When companies maintain the distribution of dividends on a constant level, solid free cash flows are necessary, while zero dividend polices can be either an active management choice or a signal of low cash flows. In detail, the investigation does not take 802 zero dividend policies, 124 dividend omissions and 176 initiations into account due to their special character.[584]

Fourthly, 204 yearly observations are excluded due to missing data, particularly data concerning the previously mentioned liquidity variables.

Finally, 14 yearly observations with negative book equity values are discarded because they make the calculation of a controlling variable that is scaled by the book value of equity impossible. The final sample has 2,172 yearly observations over the time period 2006-2014.

Table 13: Sample selection

Criterion	**Observations**
STOXX Europe 600 from 2006-2014	5,400
Quarterly payments	-90
Financials, utilities, REITs	-1,818
Dividend omissions, initiations and zero-dividend policies	-1,102
Missing data	-204
Negative book equity values	-14
Final Sample	**= 2,172**

Table 14 reports the annual summary statistics for the sample. Dividend changes (DC) are calculated as total annual dividend distributions compared to the previous year's figure.

[584] The elimination of dividend omissions and initiations is also done in Best, R. J., Best, R. W. (2001).

Table 14: Sample descriptive statistics on dividend changes

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014
Number of obs.	208	223	230	218	226	257	269	270	271
Mean DC %	22.79	22.91	18.87	-3.98	12.12	35.27	14.93	16.18	9.60
Std. dev DC	31.96	33.36	28.62	27.64	40.21	86.99	31.02	41.99	39.6
Increases absolute	176	197	200	112	140	214	211	200	186
Increases %	84.62	88.34	86.96	51.38	61.95	83.27	78.44	74.07	68.63
Decreases absolute	11	13	8	57	29	17	24	13	33
Decreases %	5.29	5.83	3.48	26.15	12.83	6.61	8.92	4.81	12.18
Constant absolute	21	13	22	49	57	26	34	57	52
Constant %	10.10	5.83	9.57	22.48	25,.22	10.12	12.64	21.11	19.19

The sample firms increase their annual distributions 1,636 yearly observation, whereas unchanged dividends occur 331 times and dividend decreases occur 205 times.

In an annual comparison, the proportion of dividend-increasing firms peaks in 2007 at 88.34 per cent, while the highest number of dividend decreases occurs in 2009, the year that follows the outbreak of the financial market crisis. In 2009, 26.15 per cent of the annual observed firms decrease dividends, while in the previous year only 3.48 per cent did so. It is conspicuous that even in the crisis-driven year 2009 more than half of the sample companies increase their dividends.

From 2009 to 2011, the two years following the financial crisis, the yearly number of dividend-increasing firms grows more than 30 percentage points, while the number of constant dividends is halved and less than one quarter of the firms decrease their dividends. The post-crisis annual dividend increases peak in 2011, two years after the lowest point, with 83.27 per cent of firms increasing their dividend payout. From 2011 to 2014 yearly dividend increases and unchanged

dividend paying firms double, while only 68.63 per cent of the sample firms increase their dividends in 2014.

The fraction of firms that do not change their yearly dividend ranges from 25.22 per cent in 2010 to 5.83 per cent in 2007, with a weighted average of 15.24 per cent over the entire sample period.

As supposed, the findings show that the sample firms avoid decreasing dividends, while increases far outweigh unchanged and decreased dividends almost threefold. For further examination, two different variables are created to measure dividend changes; a multinomial and a binary one.

Multinomial dividend change classification (DCM):

The research focuses on managements' decision to decrease, maintain or increase dividends. Therefore, the dividend change variable is encoded as follows:[585]

$$Y = 0 \text{ if } y* \leq 0 \text{ (Decrease)}$$
$$Y = 1 \text{ if } 0 < y* \leq \mu \text{ (Maintain)}$$
$$Y = 2 \text{ if } 0\ \mu \leq y* \text{ (Increase)}$$

Binary dividend change classification (DCB):

As dividend increases are predominant in the sample, the endogenous variable is also measured binarily:

$$Y = 0 \text{ if } y* \leq 0 \text{ (Decrease, Maintain)}$$
$$Y = 1 \text{ if } 0 < y* \leq \mu \text{ (Increase)}$$

Balancing the categories makes the dataset more appropriate for data mining analysis, as the accuracy of measurement will improve with classes that are more closely matched.[586]

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[585] Based on Goergen, M. et al. (2005).

[586] Cf. Zhang, C., Soda, P. (2012), p. 256.

To make the different modeling techniques comparable to each other, their predictive ability is cross validated. This means the data are separated into training and test data. The "training set" is used to identify the best combination of parameters and contains 70 per cent of the observations. The results of the statistical investigation using the "training set" are generalized to a "test-set" of variables that is not used in estimation. It consists of the outstanding 30 per cent of the observations. The 70 to 30 division is frequently used to ensure that the training dataset includes as many possible patterns of the dataset as possible.[587] In addition to making the results comparable, cross validation is also used to limit overfitting problems and obtain reliable error estimates.[588]

4.1.5.2 Definition of the explanatory variables

Among other things, the existence of many different stock exchanges as well as dark pools[589] hampers the analysis. To overcome the problem, the present cross-national investigation provides data from the leading stock exchange in a specific country.

In particular, the mean values of the selected liquidity measures are calculated 10 days before the announcement day of the dividend event.[590] If the company pays dividends semi-annually, the respective 10 days before each dividend change announcement are calculated as a mean value for the specific liquidity variable. As the final sample includes trading days only, bank holidays and weekends are discarded. To quantify the level of stock market liquidity, the two previously selected measures are used for the investigation:

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[587] Cf. Saravanan, P., Kalpana, P. (2017), p. 97.

[588] Cf. Rodriquez, B. et al. (2008), p. 266.

[589] Private exchanges or forums that are not accessible by the investing public for trading securities. They have the primary function of inhibiting the market impact of trading.

[590] The 10-day period from t-10 to t0 that surround dividend changes is frequently used in the literature (e.g. Ball, et al. (2016); Corwin S. A., Lipson, M. L. (2000) and Nguyen, N. H., Wang, D. Y. (2013)).

The relative spread (SPREAD) as defined in chapter 3 helps to make the ability to trade measureable. As liquidity is a multidimensional phenomenon that can also be estimated after the trading takes place, a further post-trade measure is implemented; the turnover ratio (TR), as also defined in chapter 3.

Percentage liquidity variations compared to the previous year figure are also calculated for both the SPREAD (CHANGE_SPREAD) and the TR (CHANGE_TR) measure, and are adopted in the analysis.

4.1.5.3 Definition of the controlling variables

A broad set of firm-specific characteristics is employed to control for the presumed impact on dividend changes of, among other things, profitability, investment opportunities, size, leverage, growth and cash.[591]

Operating net income is one of the most intuitive profitability measures for the present investigation because more successful companies more likely distribute parts of their profits in the form of cash dividends.[592] It is calculated in relation to total assets (OI).[593] Further, the firm's ability to generate internal funds and payment surpluses is frequently measured by operating cash flow divided by the firms' turnover (CFTO).[594] In contrast to the net income figure, the cash flow does not take non-cash items that do not support cash generation, like depreciation and amortization, into account.[595] For all the European companies, Bloomberg calculates the cash from operations as the sum of net income, depreciation and amortization, other noncash adjustments and changes in non-cash working capital.

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[591] Cf. Eije, H., Megginson, W. (2008); Ferris, S. et al. (2009).

[592] Also investigated in Al-Najjar (2011); Grullon et al. (2002); Mizraei (2012).

[593] Also used in Bulan, L. et al. (2007).

[594] The cash flow is also stated to be an appropriate measure for the investigation of profitability in La Porta, R. et al. (2000), p. 1 f.; Faccio, M. et al. (2001), p. 54 f.

[595] Cf. Auer, K. V. (2000), p. 573; Goergen, M. et. al. (2005), p. 385.

The occurrence of a loss (OL) is calculated binarily and equals one if the company suffers a loss, zero otherwise.[596]

Firm size is measured to approximate the company-specific risk level, its maturity and its capital market access. To deal with the high correlation between total assets and market capitalization, a principal component analysis is employed, reducing the dimension to one latent variable (SIZE).

As more indebted firms' primary aim is to strengthen their equity base, leverage (DEBT) is included, with an assumed negative influence on dividends; and is calculated as total debt to total assets.[597]

Investment opportunities can influence financial management decisions.[598] To quantify the firms' investment opportunities net investments are calculated as capital expenditures minus depreciation and amortization scaled by total assets (NINV).[599]

Additionally, the turnover growth rate (TGR) indicates yearly company growth that requires investments.[600] The price to book ratio (PBR), defined as the market value of equity over the book value of common shareholder's equity, is a further frequently used variable for growth opportunities.[601] The higher the price to book ratio, the more the market valuation exceeds the accounting value.

The firm's cash reserves to total assets are captured with (CASH).[602]

Tobin's Q (TQ) indicates the market value of the firm to the replacement costs of its assets.[603] The figure is based on the assumption that the market valuation of the firm corresponds approximately to the replacement costs of its assets over a longer period. In comparison to PBR the TQ measures the costs of

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[596] Also used in DeAngelo, H. et al. (1992).

[597] Also investigated in Fama, E. F., French, K. R. (2002), p. 7; Jensen, M. C., Meckling, W. H. (1976), p. 308 f.

[598] Cf. Myers, S. C., Majluf, N. S. (1984), p. 190.

[599] Also used in Rojahn, J., Luebke, K. (2014).

[600] Also used in Maury, C. B., Pajuste, A. (2002), p. 15 f.

[601] Cf. Huang, R. D., Shiu, C-Y. (2009), among others.

[602] Also used in Li, W., Lie, E. (2006).

[603] Also used in Chang, K. et al. (2016).

replacing items at current prices and not at their original costs. The estimated influence on dividend increases is negative.[604]

The previous year's dividend policy includes the indicator variable "PREVIOUS", that is set at one if dividends increase, are maintained or are initiated in the previous year, zero if the previous years' dividends decrease.[605] Since companies pursue consistent dividend policies the effect is expected to be positive. Furthermore, dividend yields (YIELD) are measured as the previous year's annual total dividends to the previous year's total companies' revenues.

The issuance measure (ISSUANCE) captures the cash inflow from the issuance of new shares scaled by the company's total equity if new shares are issued, zero otherwise. Companies that issue new shares require equity capital and are expected to decrease dividends rather than enhance their payouts.

Besides dividend distributions, share buybacks also return assets to shareholders as an alternative capital allocation possibility.[606] Buyback of shares (BBS) are measured binarily because the database provides only the individual share repurchases in the companies' domestic currencies. "MA" captures the after-tax effect of the costs associated with conducting mergers and acquisitions scaled by the turnover. If no M&A transactions are realized in the relevant year, "MA" is valued at zero.[607]

Because owners and the property rights that are allocated to these owners are essential elements of companies, the ownership structure is a key variable of corporate governance. As discussed in subchapter 2.2.2.3, the conflicts between owners and managers and also between owners and owners are part of the literature of early corporate governance research. In a later stage, among other things, the investigation of the influence of ownership on firms' profitability and shareholders' diversification strategies is further evidence for the link between corporate governance and ownership structure.[608] Taking the agency costs of

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[604] Cf. Lee, C.-H., Alam, P. (2004), p. 329 f.

[605] Also used in Simons, K. (1994).

[606] Cf. Grullon, G., Michaely, R. (2002).

[607] The influence of Mergers on dividend policies is also investigated in Masulis, R. W., Trueman, B. (1988).

[608] Cf. Demsetz, H., Villalonga, B. (2001), p. 230; Banalieva, E. R., Eddleston, K. A. (2011), p. 1070.

equity into consideration, the firm's specific Bloomberg-Corporate-Governance-Score (CGS) is taken.[609] It is based on the extent of corporate governance disclosure and ranges from a minimum 0.1 scoring points to a maximum of 100 scoring points. The CGS score takes the ownership structure, the supervisory board structure, compensation programs and audit oversight quality into account.

The agency costs of debt are approximated with the coverage of the firm's total debt capital with secured debt capital (SECURED). The quota of secured debt capital is company-specific and extends from 0 per cent to 100 per cent.

The number of analysts covering a security is (ANALYST).[610] The information they provide makes dividends redundant for signaling purposes and dividends are expected to decrease with high analyst coverage.

Country dummy variables are implemented to control for local difference in dividend policies. Since more than three-quarters of the 2198 dividend changes of the final sample are companies from Britain (789), Germany (317), Sweden (192) and France (189), five indicator variables are implemented. "BRITAIN" values one, if the dividend changing company is British, zero otherwise. In the same way the variables "GERMANY", "SWEDEN" and "FRANCE" estimate whether the firm is from the specific country. Because less than one-fourth of the companies are from different countries "REST" is used as a reference category. Since the shareholder structure in Britain is less concentrated than in different European countries like Germany, Italy, France or Austria,[611] "BRITAIN" also approximates the agency costs of equity (ownership concentration). It is assumed that the granular shareholder structure of British firms makes dividend-changes more likely, while anchor shareholders do not urge for payouts.

Since the selected time interval covers some interesting events, such as the financial market crisis and the sovereign debt crisis, the yearly dummy variables are expected to influence dividend changes. For this reason, yearly dummy

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[609] That the Corporate Governance influences dividend changes is stated by Goergen, M. et al. (2005), among others.

[610] Also used in Aggarwal, R. et al. (2012).

[611] Cf. Aguilera, R. V., Crespi-Cladera, R. (2016), p. 55; Gugler, K. (2003), p. 1298.

variables are used to control for time effects (Y2007, …Y2014).[612] The first year of the time span from 2006 to 2014 is chosen to be the reference category.

Moreover, operating net income, operating cash flow, debt, price to book ratio, Tobin's Q, and abnormal returns are measured delta scaled as the difference between *t-1* and *t* if data is available for both consecutive years (denoted by "DELTA"). Also included are relative changes in spread, turnover ratio, size, cash reserves and corporate governance score that are denoted by "CHANGE".

The variance inflation factor is used to test for multicollinearity in the dataset. The results show that the residuals and the covariates are not correlated and the required exogeneity assumption is met.

No unequivocal measure of company age exists, because special events like corporate mergers can change the nature of the company entirely and the corporation appears to be "newborn". Even so, the distance to the IPO, which is available for only 196 firms and is not controlled further due to too few observations, is requested from the Bloomberg database. All controlling variables are lagged by one year to account for their causality on changes in the dividend during period t+1.

The performance of the company's annual returns in comparison to the STOXX 600 portfolio is not considered. The calculation of abnormal returns includes the beta factor, which in regression is assumed to be constant and time invariant. The stability assumptions are not met in reality and therefore the abnormal returns are not investigated further.[613]

The variable set that is included in the final investigation is summarized in Table 15.

[612] Also used in Luebke, K., Rojahn, J. (2016).

[613] Cf. Fama, E. F., French, K. R. (1992), p. 464.

Table 15: Overview of the selected variables and its expected influence on dividend increases

Variable	Measure	Infl.
Dividend changes	• **Dividend change multinomial (DCM)** • **Dividend change binary (DCB)**	
Liquidity	• **Relative spread to mid price (SPREAD)** • **Turnover ratio (TR)**	- +
Profitability	• **Net income to assets (OI)** • **Cash flow to turnover (CFTO)** • **Occurrence of a loss (OL)**	+ + -
Size	• **Size (SIZE)**	+
Debt level	• **Leverage (DEBT)**	-
Investment opportunities	• **Net investments (NETINV)** • **Turnover growth rate (TGR)** • **Price to book ratio (PBR)**	+/- +/- +/-
Cash reserves	• **Cash and equivalents to total assets (CASH)**	+/-
Valuation level	• **Tobin's Q (TQ)**	+/-
Dividend-Payout ratio	• **Previous year's dividend change (PREVIOUS)** • **Previous year's dividend yield (YIELD)**	+ -
Issuance	• **Issuance of equity capital (ISSUANCE)**	+
Capital allocation	• **Merger and Acquisition to turnover (MA)** • **Share repurchases/Buybacks (BBS)**	+/- -
ency costs equity	• **Corporate Governance Score (CGS)**	+/-
Agency costs debt	• **Secured debt capital (SECURED)**	+/-
Analysts	• **Analyst coverage (ANALYST)**	+/-
Country	• **Britain (BRITAIN), Germany (GERMANY), Sweden (SWEDEN), France (FRANCE),** *Reference REST*	+/- +/-
Time	• **Year 2006-2014 (Y2007, …Y2014) ,** *Reference Y2006*	+/-
Delta scaled variables and relative changes that measure the differences from period *t-1* to period *t*	• **Change SPREAD (CHANGE_SPREAD)** • **Change TR (CHANGE_TR)** • **Change net income (DELTA_OI)** • **Change Cash flow (DELTA_CF)** • **Change size (CHANGE_SIZE)** • **Change debt (DELTA_DEBT)** • **Change price to book ratio (DELTA_PBR)** • **Change cash (CHANGE_CASH)** • **Change Tobin's Q (DELTA_TQ)** • **Change CGS (CHANGE_CGS)**	- + + + + - +/- +/- +/- +/-

4.2 ANALYSIS

4.2.1 Descriptive statistics

The distribution of the independent variables is given in the subsequent Table 16:

Table 16: Distribution of the independent variables

Variable	Mean	Std. Dev.	Min	Max
SPREAD	0.0019	0.0025	0.0001	0.0384
TR	1.7741	4.7116	0.0000	93.1216
OI	0.1440	0.2785	-1.4255	2.9828
CFTO	0.1530	0.1320	-0.5441	1.0087
LNSIZE	8.7858	1.3038	4.7497	12.2481
DEBT	0.2577	0.1449	0.0000	0.8043
NETINV	0.0049	0.0331	-0.2179	0.2416
TGR	0.0667	0.1605	-0.9463	2.5602
PBR	3.5699	6.8939	0.0244	183.9444
CASH	0.0889	0.0765	0.0000	0.5494
TQ	1.8004	0.9692	0.0000	18.0689
YIELD	0.0477	0.0561	0.0005	0.9657
ISSUANCE	0.0144	0.0626	0.0000	0.8270
MA	0.0004	0.0040	-0.0280	0.1655
CGS	52.8183	12.5701	3.5714	85.7143
ANALYST	21.3237	9.3529	1.0000	58.0000
ABNRT	0.1312	-0.3398	-1.1574	4.4163
CHANGE_SPREAD	0.0863	1.4513	-0.9601	40.0823
CHANGE_TR	0.2085	0.9667	-1.0000	22.2517
DELTA_OI	0.6835	7.8255	-37.3171	275.5
DELTA_CF	0.3879	3.6421	-9.1664	98.9775
CHANGE_SIZE	0.1099	0.2836	-0.8700	7.59
DELTA_DEBT	0.2607	3.7581	-1.0000	142.2826
DELTA_PBR	0.2143	3.3063	-0.9946	150.8835
CHANGE_CASH	1.0738	32.2767	-0.9999	1500.0000
DELTA_TQ	0.0317	0.2032	-1.0000	1.1247
CHANGE_CGS	0.0423	0.3478	-0.6667	14.0001

The liquidity proxies show a considerable range; the relative spread to mid price has a minimum value of 0.0001, while the maximum value is 0.0384. That means that the highest observation is 322 times larger than the lowest and illustrates that the liquidity variables range widely. On average, the ratio of turnover to shares outstanding is 1.77, with a minimum value of 0 and a maximum value of 93.12. The spread measures forty-fold at the top level and diminishes by 96 per cent in the minimum value. Also the CHANGE_TR measure ranges widely from -1 to 2.

Net income, which is expected to play a major role for dividend changes, is 14.4 per cent of total assets on average. Also, for profitability measurement purposes the cash flow coverage of the firm's revenues averages 15.30 per cent. While 0.5 per cent of the sample companies are exclusively equity-financed, the highest total debt to total assets ratio exceeds 80 per cent and the sample firms' average revenue increases 6 per cent.

The average market valuation of the company's equity capital exceeds the book value of equity 3.5 times on average, while the price to book ratio peaks with a value of 183. The specific value can be attributed to a high demand of the Rightmove PLCs' registered shares due to takeover speculation in 2010. Since these events are also accompanied by high stock market liquidity variations that are important for the present examination, the extreme values are kept in the final sample.

Cash reserves vary strongly from below 0.00 per cent to 54.94 per cent. The Tobin's Q is wide ranging around its mean value of 1.80, with a standard deviation of 0.97.

The popularity of cash distributions in corporate Europe is underlined by the dividend yield of 4.77 per cent. That means that almost five per cent of the company's revenue is distributed to the shareholders in form of cash dividends, while the largest dividend-payout ratio is above 96.57 per cent and the lowest level is 0.05 per cent.

The investigation shows considerable differences in corporate governance; the highest CG Score (85.71) is 24 times larger than the lowest (3.57).

On average, slightly more than nine analysts cover a stock that is listed in the final sample of the STOXX Europe 600. Analyst coverage varies from 1 to 58.

For the investigation of dividend changes the variations to the previous years' value (DELTA and CHANGE) are also notable. DELTA_OI increases slightly more than two-thirds, while DELTA_CF increases 38.79 per cent on average. The overall increase in profitability underlines the assumptions that despite the financial market crisis of 2008 the period investigated included more economic good than bad years. Company size grows by slightly more than 10 per cent, with an increasing leverage ratio of one quarter. That might indicate that rising profitability is used for growth that is partly funded with debt rather than for repaying liabilities.

In order to minimize the expected error of the linear discriminant analysis, it is a fundamental assumption that the variables are normally distributed. Since some of the described variables are right-skewed, they are transformed with the natural logarithm LN(X), where X is the specific independent variable. In detail, those variables are SPREAD, SIZE, PBR and YIELD. Because the rights screwed variables TR, CASH, ISSUANCE, MA, SECURED and all of the right-screwed delta-scaled variables can value zero or negative figures, those variables are transformed with LN(X+|min(X)|+0.0001). The addition of the minimum value of the variable with the small increment 0.0001 ensures that the logarithmic value is greater than zero.[614]

Additionally, all independent variables are normalized except for the nominal scale variables, so that dimensions and magnitude of these variables are comparable to each other.[615] This is commonly done for many machine-learning techniques as well as for logistic regression[616] and ensures that the algorithms work properly.[617]

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[614] For further information also see Svolba, G. (2015).

[615] Cf. Gujarati, D. N. (2009), p. 298.

[616] Cf. Jain, A. et al. (2005), p. 2274.

[617] Cf. Saravanan, P., Kalpana, P. (2017), p. 96.

4.2.2 Multinomial and binary analysis of dividend changes

4.2.2.1 Panel-logit estimation

The implementation of the analysis starts with the panel-logit estimation. In a first step, dividend changes are categorically measured for decreasing, maintaining or increasing distributions, where "maintain" is chosen to be the reference category. Since the number of dividend-maintaining firms is very low over the whole investigation period, the accuracy of the models is below 60 per cent. Because the sample sizes are very unequal in the groups, it is problematic not to use the largest group as the reference group.[618] Consequently, "increase" is chosen as a reference category. This selection is neither based on the content nor on the simplicity of interpretation but on methodological considerations.

In a second step, for a more equal distribution, the multinomial estimation is complemented with binary measurement of the dividend change variable that differentiates between a decrease/maintain group and increase group, whereas "maintain/decrease" is chosen to be the reference category. This might improve estimation accuracy, since the dependent variable is divided into fewer categories, because the predictive power strongly depends on how often each class occurs.[619] Table 17 summarizes the statistical outcome:

[618] Cf. Osborne, J. W. (2017), p. 79 f.

[619] Cf. Baldi, P. et al. (2000), p. 413.

Table 17: Multinomial and binary panel logit

Variable	Categorical [Decrease]		Categorical [Maintain]		Binary [Increase]	
Coefficient	**Est.**	**t-value**	**Est.**	**t-value**	**Est.**	**z-value**
(Intercept)	-1.35	-3.25**	-0.83	-2.61**	0.54	14.23***
LN(SPREAD)	0.05	0.40	-0.13	-1.28	0.01	0.40
LN(TR)	0.05	0.40	-0.02	-0.17	0.00	0.29
OI	-0.05	-0.36	0.01	0.11	0.00	0.20
CFTO	-0.52	-4.06***	-0.32	-2.92**	0.03	3.36***
OL	1.82	4.97***	1.28	3.61***	-0.30	-6.70***
LN(SIZE)	-0.27	-1.86.	-0.35	-2.82**	0.04	2.99**
DEBT	0.14	1.35	0.03	0.29	-0.01	-0.80
NETINV	0.11	1.32	-0.05	-0.63	-0.01	-0.82
TGR	-0.55	-5.57***	-0.39	-4.47***	0.05	5.96***
LN(PBR)	0.00	-0.05	-0.10	-1.00	0.01	1.28
LN(CASH)	-0.07	-0.73	0.20	2.24*	-0.01	-1.60
TQ	-0.45	-2.31*	-0.41	-2.68**	0.03	2.63**
PREVIOUS	-0.58	-4.79***	-0.56	-5.62***	0.12	8.80***
LN(YIELD)	0.69	5.84***	0.28	2.90**	-0.05	-4.60***
LN(ISSUANCE)	0.07	0.64	-0.13	-1.41	0.01	0.71
LN(MA)	0.13	0.84	-0.02	-0.18	0.00	0.18
BBS	0.01	0.05	-0.18	-0.92	0.02	0.94
CGS	-0.11	-1.03	-0.16	-1.96.	0.02	1.81.
LN(SECURED)	0.03	0.32	-0.05	-0.59	0.00	-0.24
ANALYST	0.28	2.00*	0.19	1.61	-0.03	-2.19*
BRITAIN	-1.27	-4.07***	-1.39	-5.10***	0.15	5.23***
GERMANY	-0.31	-1.02	0.01	0.03	0.01	0.32
SWEDEN	-0.57	-1.49	0.08	0.27	0.00	-0.12
FRANCE	-0.70	-1.82	0.48	2.12*	-0.05	-1.46
Y2007	0.28	0.61	-0.31	-0.78	0.00	0.01
Y2008	-1.20	-2.25***	-0.46	-1.25	0.09	2.28*
Y2009	0.68	1.49	0.40	1.05	-0.14	-3.08**
Y2010	0.82	1.84.	0.81	2.39*	-0.13	-3.06**
Y2011	-0.09	-0.20	-0.42	-1.19	0.05	1.25
Y2012	-0.02	-0.04	-0.31	-0.88	0.03	0.75
Y2013	-0.08	-0.17	0.73	2.22*	-0.07	-1.72.
Y2014	0.90	2.08*	0.69	2.07*	-0.11	-2.79**
LN(CHANGE_SPREAD)	0.11	1.05	0.05	0.69	-0.01	-1.13
LN(CHANGE_TR)	-0.26	-2.58*	-0.15	-1.80.	0.03	3.07**
LN(DELTA_OI)	0.11	0.50	-0.11	-0.88	0.01	1.12
LN(DELTA_CF)	0.02	0.15	-0.05	-1.11	0.01	0.65
LN(CHANGE_SIZE)	-0.29	-2.38*	-0.28	-2.33*	0.02	1.72.
LN(DELTA_DEBT)	0.07	0.60	0.06	0.62	0.00	0.03
LN(DELTA_PBR)	-0.02	-0.21	0.06	0.54	0.00	-0.43
LN(CHANGE_CASH)	-0.11	-1.35	-0.05	-0.55	0.01	1.61
DELTA_TQ	-0.43	-3.39***	-0.34	-3.33***	0.05	4.38***
LN(CHANGE_CGS)	0.09	0.74	0.18	2.11*	-0.02	-2.29*
Signif. codes: 0 '*' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1**						

Based on the multinomial panel regression, some variables decrease while other variables increase the probability of class affiliation. Within the overview presented, the t-values/z-values of the specific variable are given in parentheses. Taking a closer look at the liquidity dimension, neither LN(TR) nor LN(SPREAD) show statistical significance for the dividend change variable, in either the decrease or the maintain group.

The delta-scaled variable LN(CHANGE_TR) shows a significant positive impact on the probability of dividend decreases and unchanged dividends, while LN(CHANGE_SPREAD) has no statistically significant influence. In line with these results, the LN(CHANGE_TR) has a high significant positive impact on the propensity of dividend increases within the binary regression model. That means that worsening liquidity levels promote dividend decreases while a continuing enhancement of the tradability of shares makes dividend increases more likely.

First, the multinomial investigation provides information regarding the variables influencing dividend decreases. The most influential variables (values in parentheses denote t-values) of the multinomial estimation that make dividend decreases more likely are LN(YIELD) (5.84) and loss OL (4.97). When companies distributed large parts of their revenues in the previous year or when the company has suffered a loss, payouts are likely to decline in the following year. In the year Y2014 companies reduce their distributions; the t-value is 2.08. ANALYST (2.00) and Y2010 (1.84) complete the set of variables that enhance the probability of affiliation to the decrease group.

Contrarily, eleven variables make dividend reductions less likely. In decreasing order of importance those variables are TGR, PREVIOUS, BRITAIN, CFTO, DELTA_TQ, LN(CHANGE-TR), LN(CHANGE_SIZE), TQ, Y2008, LN(SIZE) and FRANCE. Profitability and turnover growth play a major role in the decision not to reduce dividends. TGR (-5.57) and CFTO (-4.06) reduce the propensity of dividend reductions. Also, TQ (-2.31) and LN(DELTA_TQ) (-3.39), as well as LN(CHANGE_SIZE) (-2.38) and LN(SIZE) (-1.86), diminish the propensity of dividend decreases. Once again, time and local effects on dividend change decisions could be observed; companies did not reduce their dividends in Y2008 (-2.25); BRITAIN (-4.07) and FRANCE (-1.82) lowers the probability of dividend decreases.

Second, the multinomial investigation selects several variables that influence the probability that dividends remain unchanged with statistical significance. The most important variable that influence the maintain group affiliation negatively is PREVIOUS, with a t-value of –5.62; managers do not stick exactly to their previous year's dividends payout. BRITAIN, TGR, DELTA_TQ, CFTO, LN(SIZE), TQ, LN(CHANGE_SIZE), CGS and LN(CHANGE_TR) complete the set of variables that cause companies not to maintain their dividends. TGR (-4.47) and CFTO (-2.92), which also influence dividend decreases negatively, are also high in significance for the selection of the maintain group. Comparable to the decrease group, company size and the change in company size calculated with LN(SIZE) (-2.82) and LN(CHANGE_SIZE) (-2.33) and the valuation level TQ (-2.68), matter for group affiliation. Not keeping dividends constant also seems to be a country-specific phenomenon, while BRITAIN (-5.10) shows significant estimates. That shows that British firms change their dividends regularly and are not interested in holding them on a constant level.

In total there are eight determinants that influence dividend continuity positively, most of which are time specific: OL (3.61), LN(YIELD) (2.90), Y2010 (2.39), Y2013 (2.22), FRANCE (2.12), LN(CHANGE_CGS) (2.11) and Y2014 (1.91) have significant positive t-values. Also, profitability is a key condition when companies maintain their dividends when a loss occurs. Finally, LN(CASH) (2.24), completes the bundle of driving determinants that can be derived from the multinomial panel logit estimation.

Third, the binary panel logit model (values in parentheses denote z-values) shows that dividend increases are mostly determined by PREVIOUS (8.80) and BRITAIN (5.23), while TGR (5.96) and CFTO (3.36) are also high in significance. The high statistically significant influence of PREVIOUS shows that managers do not hold their dividends on a constant level but aim to pay more cash in the form of dividends in comparison to the previous year. It can be summarized, that dividends are not likely to fall below the previous year's dividend payout and dividends are sticky in terms of minimum distributions.

In decreasing order of importance, DELTA_TQ (4.38), LN(CHANGE_TR) (3.07), LN(SIZE) (2.99), TQ (2.63), Y2008 (2.28), CGS (1.81) and LN(CHANGE_SIZE) (1.72) complete the variable set with statistically significant positive influence on dividend increases.

Overall, eight variables influence the binary endogenous variable in the opposite direction. OL (-6.70), LN(YIELD) (-4.60), LN(CHANGE_CGS) (2.29) and ANALYST (-2.19) make dividend increases less likely, while companies also forego enhancement of cash distributions in the years Y2009 (-3.08), Y2010 (-3.06), Y2014 (-2.79) and Y2013 (-1.72). The significant intercept might show that having more determinants can help to increase the prediction accuracy of the endogenous variable or, inversely, that the variable set has to be cleaned up.

The classification quality is given in the cross-validated confusion matrix that shows the out-of-sample prediction.

Table 18: Confusion matrix for multinomial panel logit

Reference / Predicted	Decrease in %	Maintain in %	Increase in %	Total in %
Decrease in %	2.30	2.45	1.84	6.59
Maintain in %	1.84	1.38	1.38	4.60
Increase in %	4.29	11.97	72.55	88.81
Total in %	8.43	15.80	75.77	100.00

The diagonal line shows the percentage of all correctly predicted classifications and the other lines all misspecifications.[620] The table shows that in total 76.23 per cent of the observations are correctly classified with a misclassification rate of 23.77 per cent. It is conspicuous that the low rate of correct classification of decrease (2.30%) and maintain (1.38%) only contribute little to the overall accuracy while increases account for 72.55 per cent.

[620] Cf. Hastie, T. et al. (2017), p. 301.

The binary panel logit increases the model's accuracy to 80.83 per cent with less than one fifth misclassifications. That means that the model quality improves by more than 4.5 per cent compared to the multinomial panel logit estimation.

Table 19: Confusion matrix for the binary panel logit estimation

Reference / Predicted	Maintain/Decrease in %	Increase in %	Total in %
Maintain/Decrease in %	7.82	2.76	10.58
Increase in %	16.41	73.01	89.42
Total in %	24.23	75.77	100.00

4.2.2.2 Linear discriminant analysis

The discrimination of the firm's distribution policy between decreases, maintenance and increases by the selected variables is displayed in Table 20.

Table 20: Estimated class means in the LDA

	Multinomial			Binary	
Variable	**Decrease**	**Maintain**	**Increase**	**Dec./Main.**	**Increase**
SPREAD	0.0023	0.0020	0.0018	0.0022	0.0018
TR	1.3284	0.9317	2.0004	1.0834	2.0005
OI	0.1039	0.1285	0.1521	0.1191	0.1521
CFTO	0.1458	0.1303	0.1585	0.1362	0.1585
OL	0.1366	0.0846	0.0165	0.1045	0.0165
SIZE	8.9070	8.8691	8.7537	8.8836	8.7537
DEBT	0.2952	0.2618	0.2521	0.2746	0.2521
NETINV	0.0058	0.0010	0.0056	0.0029	0.0056
TGR	-0.0038	0.0176	0.0855	0.0094	0.0855
PBR	3.2069	2.5901	3.8136	2.8260	3.8136
CASH	0.0819	0.0899	0.0895	0.0869	0.0895
TQ	1.4678	1.5040	1.9020	1.4901	1.9020
PREVIOUS	1.4341	1.4048	1.7573	1.4160	1.7573
YIELD	0.0669	0.0391	0.0471	0.0497	0.0471
ISSUANCE	0.0112	0.0081	0.0161	0.0093	0.0161
MA	0.0003	0.0002	0.0004	0.0003	0.0004
BBS	0.1707	0.1390	0.1510	0.1511	0.1510
CGS	52.4739	50.9491	53.2396	51.5323	53.2396
SECURED	0.0263	0.0207	0.0239	0.0229	0.0239
ANALYST	23.0488	22.8610	20.7965	22.9328	20.7965
BRITAIN	0.2634	0.1329	0.4224	0.1828	0.4224
GERMANY	0.1463	0.2024	0.1241	0.1810	0.1241
SWEDEN	0.0780	0.1239	0.0825	0.1063	0.0825
FRANCE	0.0488	0.1782	0.0733	0.1287	0.0733
Y2007	0.0634	0.0393	0.1204	0.0485	0.1204
Y2008	0.0390	0.0665	0.1222	0.0560	0.1222
Y2009	0.2780	0.1480	0.0685	0.1978	0.0685
Y2010	0.1415	0.1722	0.0856	0.1604	0.0856
Y2011	0.0829	0.0785	0.1308	0.0802	0.1308
Y2012	0.1171	0.1027	0.1290	0.1082	0.1290
Y2013	0.0634	0.1722	0.1222	0.1306	0.1222
Y2014	0.1610	0.1571	0.1137	0.1586	0.1137
CHANGE_SPREAD	0.5057	0.1599	0.0188	0.2921	0.0188
CHANGE_TR	-0.0232	0.0691	0.2658	0.0338	0.2658
DELTA_OI	0.7373	0.2092	0.7727	0.4112	0.7727
DELTA_CF	0.5547	0.1762	0.4099	0.3210	0.4099
CHANGE_SIZE	0.0314	0.0517	0.1315	0.0439	0.1315
DELTA_DEBT	0.2929	0.2532	0.2581	0.2684	0.2581
DELTA_PBR	0.7427	0.0613	0.1790	0.3219	0.1790
CHANGE_CASH	0.3594	0.2807	1.3238	0.3108	1.3238
DELTA_TQ	-0.0535	-0.0009	0.0489	-0.0210	0.0489
CHANGE_CGS	0.0418	0.0743	0.0358	0.0619	0.0358

The variable means differ between the three groups: the TR and CHANGE_TR variables have their highest mean value and analogues SPREAD and CHANGE_SPREAD their lowest mean value in the "Increase" group.

To measure a variable's importance, the results of all discriminate functions have to be taken into account. Therefore, a stepwise variable selection using the Wilks' lambda criterion is done to explore the independent variables that have explanatory power at the one per cent level.[621]

Table 21: Results of the stepwise selection with Wilks' lambda

Categorical			**Binary**		
Rank	Variable	Lamb.	Rank	Variable	Lamb.
1	PREVIOUS	0.9481	1	PREVIOUS	0.9482
2	Y2009	0.8958	2	Y2009	0.9061
3	BRITAIN	0.8591	3	BRITAIN	0.8723
4	TGR	0.8239	4	TGR	0.8373
5	OL	0.8008	5	OL	0.8169
6	DELTA_TQ	0.7903	6	DELTA_TQ	0.8068
7	FRANCE	0.7817	7	Y2010	0.8012
8	LN(YIELD)	0.7740	8	Y2014	0.7940
9	Y2010	0.7681	9	Y2013	0.7873
10	Y2013	0.7613	10	LN(CHANGE_TR)	0.7832
11	Y2014	0.7524			
12	CFTO	0.7469			
13	TQ	0.7426			
14	LN(CHANGE_TR)	0.7390			

In decreasing order of importance the selection starts with the variable that discriminates best between categories while the gain in explanatory power decreases. PREVIOUS, Y2009 and BRITAIN are the three most important variables, but also the liquidity change variable LN(CHANGE_TR) meets the predetermined one per cent significance level, unaffected by binary or multinomial measurement. The three other liquidity and liquidity change

[621] Cf. Collignon, O., Monnez, J.-M. (2016), p. 1641 f.

indicator variables do not reach the required significance level; similar to the logit estimation, the cross validated accuracy is above 75 per cent. The outcome is unaffected by the use of normalized or not normalized data.

The maintain group has the weakest accuracy measure while, contrarily, the most variables are classified correctly in the increase group.

Table 22: Confusion matrix for multinomial LDA

Reference / Predicted	Decrease in %	Maintain in %	Increase in %	Total in %
Decrease in %	1.84	2.15	4.45	8.44
Maintain in %	2.45	1.69	11.66	15.80
Increase in %	1.83	2.15	71.78	75.76
Total in %	6.12	5.99	87.89	100.00

The binary linear discriminant analysis estimates more than three–fourths of the test-data properly, with an overall accuracy of 79.75 per cent.

That result means that binary measurement improves the model's quality considerably, with more than 4.4 per cent.

Table 23: Confusion matrix for binary LDA

Reference / Predicted	Maintain/Decrease in %	Increase in %	Total in %
Maintain/Decrease in %	8.89	15.34	24.23
Increase in %	4.91	70.86	75.77
Total in %	13.80	86.20	100.00

4.2.2.3 Decision tree analysis

Both the liquidity and liquidity change variables split the tree using binary measurement. LN(DELTA_OI) is the most important variable in determining dividend decreases and splits the binary tree on the treetop. If the operating net income increases more than -0.033 per cent, British companies enlarge their dividends. If the company is not from Great Britain, and LN(TR) is above -0.22, that also leads companies to increase their distributions in comparison to the previous year. Also LN(CHANGE_TR) splits the tree at the bottom of the tree, where it has a positive influence on the probability of dividend increases.

The multinomial tree also displays the influence of LN(DELTA_OI) and BRITAIN; a high operating income and British companies with operating incomes below -0.003 increase their dividends.

Figure 12: Multinomial decision tree

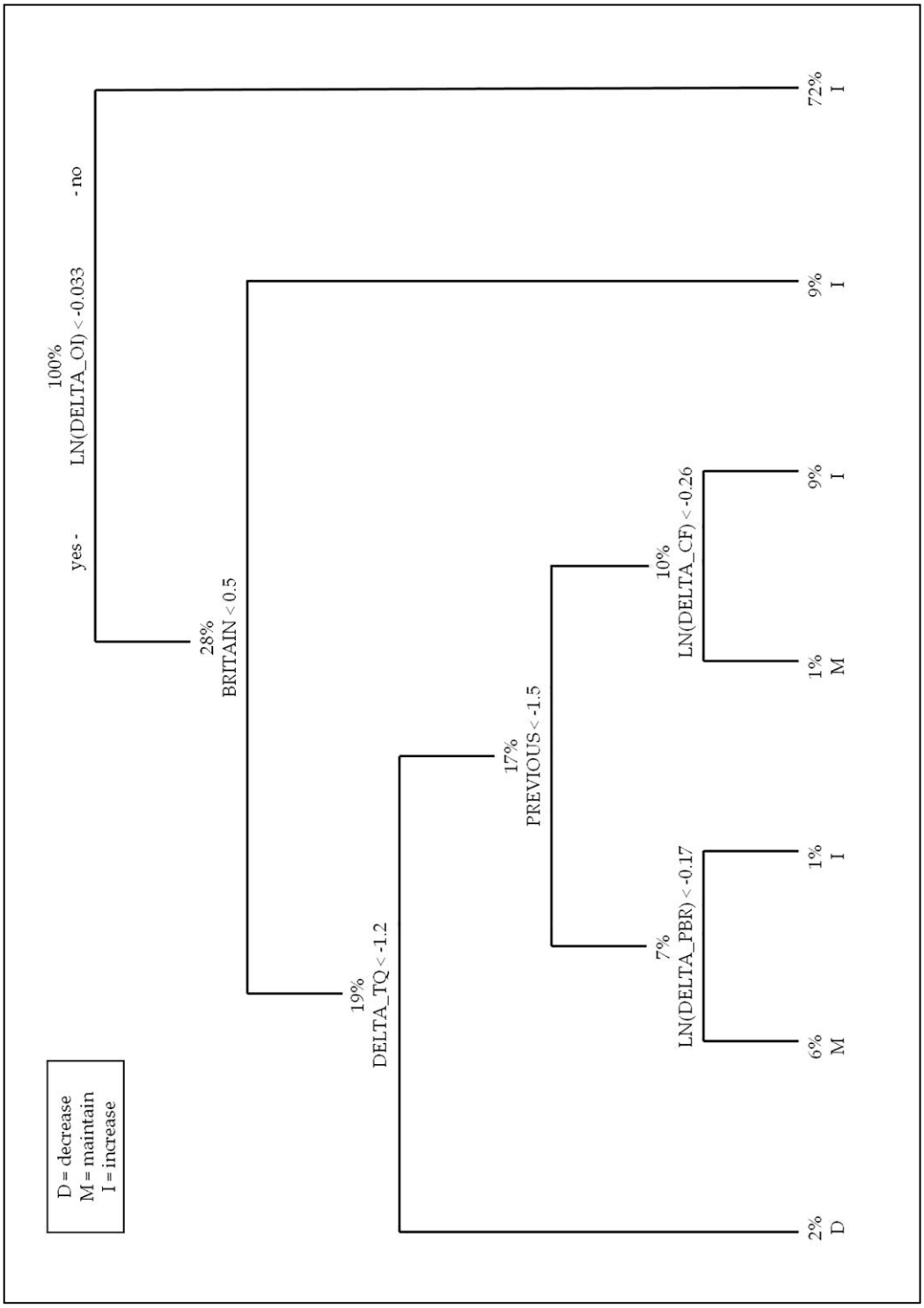
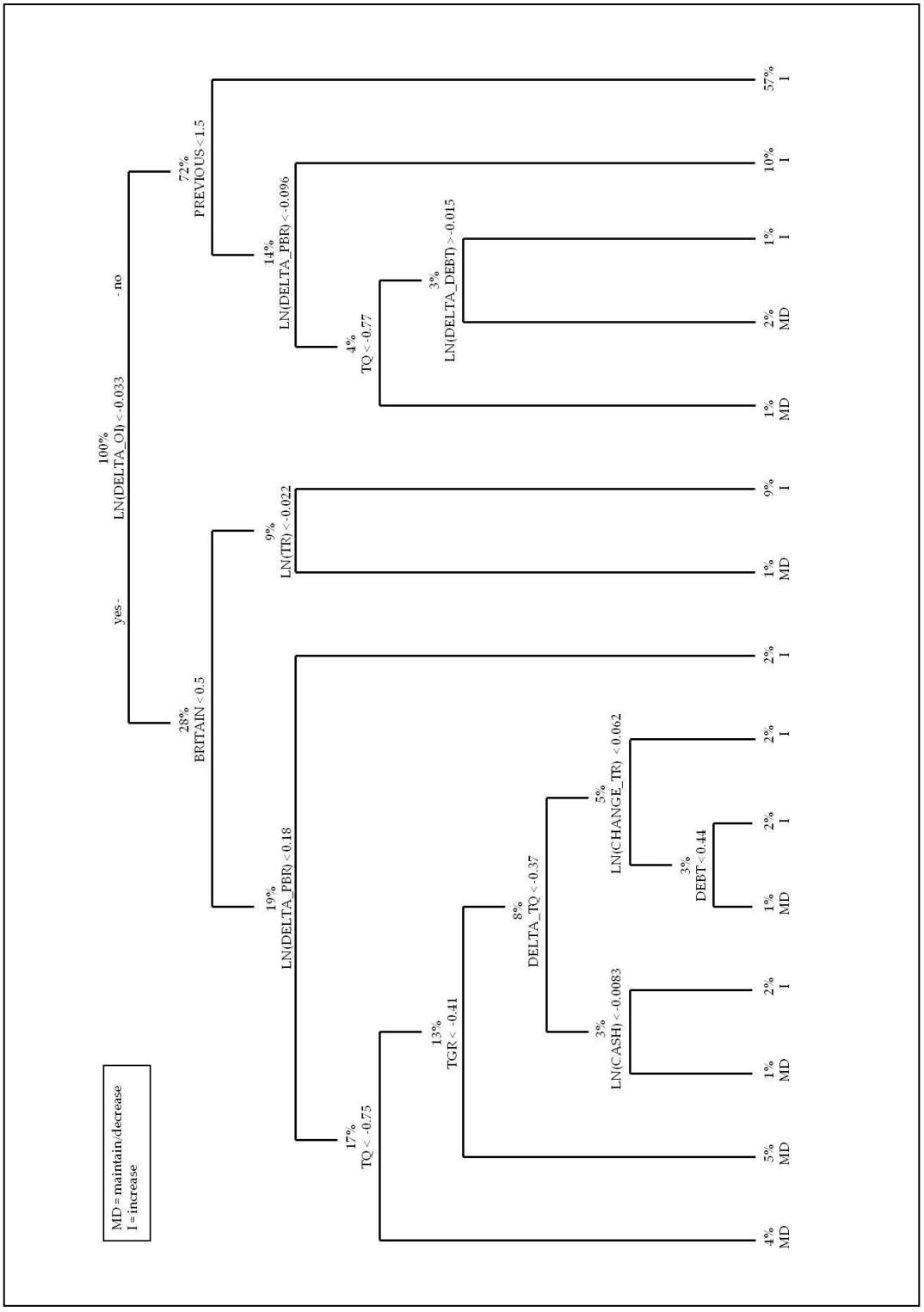


Figure 13: Binary decision tree



The calculated accuracy of the categorical classification tree is 75.77 per cent. The table shows that there are no "decrease" and "maintain" observations within the random selected dataset. Therefore, the model misclassifies the outcomes at a relatively high rate.

Table 24: Confusion matrix for categorical classification tree

Reference / Predicted	Decrease in %	Maintain in %	Increase in %	Total in %
Decrease in %	0.00	0.00	0.00	0.00
Maintain in %	0.00	0.00	0.00	0.00
Increase in %	8.44	15.79	75.77	100.00
Total in %	8.44	15.79	75.77	100.00

Binary measurement advances the model quality to 77.76 per cent. That shows an improvement of almost two per cent in comparison to the categorical classification tree.

Table 25: Confusion matrix for binary classification tree

Reference / Predicted	Maintain/Decrease in %	Increase in %	Total in %
Maintain/Decrease in %	6.44	4.45	10.89
Increase in %	17.79	71.32	89.11
Total in %	24.23	75.77	100.00

4.2.2.4 Random forest analysis

The liquidity variables show high significance for shifting distributions within the multinomial random forest analysis (values in parentheses denote the mean decrease in Gini impurity); the liquidity measure LN(TR) (38.43) ranked sixth out of 42 variables. The second liquidity variable, LN(SPREAD) (22.47), also shows comparatively high influence on dividend changes and ends in the midfield of the ranking. Both liquidity change variables - LN(CHANGE_TR) (35.05) and LN(CHANGE_SPREAD) (27.05) - are in the upper third. LN(TR) and LN(CHANGE_TR) are in the top eight of the variable selection.

Compared to the multiclass estimation, the binary random forest analysis underlines the importance of the liquidity proxies. LN(TR) (37.34) and LN(CHANGE_TR) (32.26) remain essential influencing factors for dividend changes, while LN(DELTA_OI) (74.93) is the most important variable by far. These results do not correspond to the presumption that managers are focused primarily on keeping dividends constant. LN(CHANGE_SPREAD) (24.29) is in the top 15, whereas LN(SPREAD) (19.11) remains in the midfield position.

In both the multinomial and the binary investigation, only LN(DELTA_OI), TGR, LN(DELTA_PBR), OIA and DELTA_TQ are better positioned than the liquidity measure LN(TR).

To concentrate on the most important variables in particular, the following table presents all of the variables that have a mean decrease Gini that is larger than 10.

Table 26: Variable importance of the multinomial and binary random forest

Variable	**mean decrease Gini [Multinomial RF]**	**mean decrease Gini [Binary RF]**
LN(DELTA_OI)	68.18	74.93
TGR	43.01	42.76
LN(DELTA_PBR)	40.89	41.02
OI	39.55	40.08
TQ	38.12	39.10
LN(TR)	38.43	37.34
DELTA_TQ	38.85	34.44
LN(CHANGE_TR)	35.05	32.26
PREVIOUS	30.81	31.30
LN(CHANGE_SIZE)	32.16	30.29
LN(DELTA_CF)	31.85	28.27
LN(PBR)	29.97	27.27
CFTO	29.00	24.68
LN(DELTA_DEBT)	26.00	24.51
LN(CHANGE_SPREAD)	27.05	24.29
LN(YIELD)	28.93	23.95
LN(CHANGE_CASH)	25.92	22.58
LN(SIZE)	24.10	21.62
LN(CASH)	26.12	21.00
NET_INV	24.98	20.75
DEBT	23.94	20.41
CGS	23.31	20.10
LN(SPREAD)	22.47	19.11
ANALYST	21.66	17.93
LN(CHANGE_CGS)	16.56	13.46
BRITAIN	12.67	13.27
LN(ISSUANCE)	12.70	11.91

It can be demonstrated from Table 26 that the profitability level of the firm, which is represented by the LN(DELTA_OI) variable is by far the most important factor for correct classification of the dividend change variable.

On the next level TGR represents investment opportunities. LN(DELTA_PBR) is ranked in third place and tends to be of special importance for dividend change categorization. The variables OI, DELTA_TQ and LN(TR) complete the set of the most important variables.

The calculated accuracy for the random forest analysis is 76.23 per cent. The resulting confusion matrix supports previous findings that the "decrease" and "maintain" observations are largely underrepresented in the dataset. In comparison to the decision tree estimation, the goodness of fit increases slightly (by 0.15 per cent) by implementing further trees.

Table 27: Confusion matrix for categorical random forest

Reference / Predicted	Decrease in %	Maintain in %	Increase in %	Total in %
Decrease in %	0.16	0.30	0.00	0.46
Maintain in %	0.30	0.30	0.00	0.60
Increase in %	7.98	15.19	75.77	98.94
Total in %	8.44	15.79	75.77	100.00

The confusion matrix for the binary random forest shows that in comparison to the multinomial random forest more observations are classified in the "maintain/decrease" group. The more balanced distribution leads to 2.3 per cent more correctly classified predictions, in comparison to the categorical investigation. Accuracy is greater than three-quarters and is 78.53 per cent.

Table 28: Confusion matrix for binary random forest

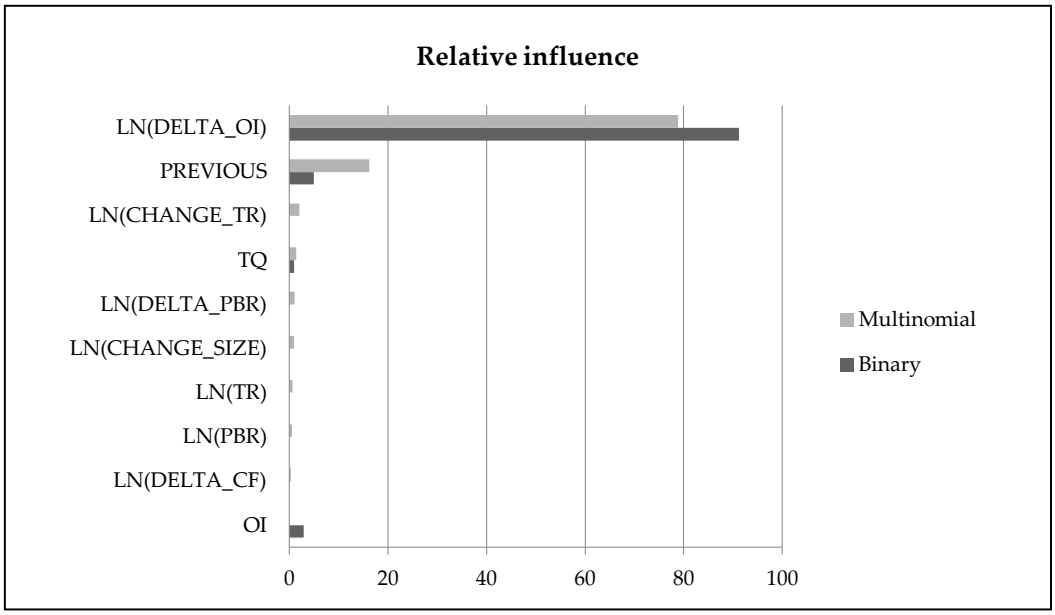
Reference / Predicted	Maintain/Decrease in %	Increase in %	Total in %
Maintain/Decrease in %	2.76	0.00	2.76
Increase in %	21.47	75.77	97.24
Total in %	24.23	75.77	100.00

4.2.2.5 Gradient boosting analysis

The boosting algorithm trains samples that are difficult to categorize, to obtain models that are good at learning parts of the training data. Consequently, the quantitative outcome of variables with important influence is reduced with a simultaneous increase in the quality of variables used for classification.

The relative influence of the multinomial and binary estimation is visualized in the following figure. The liquidity change variable LN(CHANGE_TR) and LN(TR) are selected by the gradient boosting algorithm as the third and seventh most influencing variable for dividend changes, with a relative influence of 2.07 per cent and 0.62 per cent. Neither of the liquidity variables LN(SPREAD) and LN(CHANGE_SPREAD) has any influence when performing multinomial gradient boosting.

Figure 14: Relative influence of the multinomial and binary gradient boosting analysis



Seven further variables have weight in the gradient boosting selection. The change of operating net income is the most important factor by far, with 78.87 per cent relative influence. The combination of the variables LN(DELTA_OI) and PREVIOUS explains more than 95 per cent of the dividend changes. In summary, 32 variables do not show any importance in gradient boosting, which highlights the relevance of the stock market liquidity change measure LN(CHANGE_TR) on the response variable in particular.

The binary gradient boosting model shows that only four measures remain significant for the classification of dividend changes: LN(DELTA_OI), PREVIOUS, OI and TQ. Liquidity variables have no explanatory power within the binary gradient boosting model. In comparison to the categorical estimation of dividend changes the influence of LN(DELTA_OI) increases significantly in binary gradient boosting. The results support previous assumptions that the earning situation is most important for the binarily measured dividend change classification.

LN(DELTA_OI) has a very high influence on dividend changes, with 91.26 per cent. Consequently, the additional three variables combined impact is lower than 9 per cent.

The gradient boosting algorithm misclassifies almost one fourth of observations, giving 75.77 per cent accuracy.

Table 29: Confusion matrix for categorical gradient boosting

Reference / Predicted	Decrease in %	Maintain in %	Increase in %	Total in %
Decrease in %	0.00	0.00	0.00	0.00
Maintain in %	0.00	0.00	0.00	0.00
Increase in %	8.43	15.80	75.77	100.00
Total in %	8.43	15.80	75.77	100.00

Compared to the multinomial measurement techniques presented, gradient boosting accuracy remains constant at the 75.77 per cent level.

Table 30: Confusion matrix for binary gradient boosting

Reference / Predicted	Maintain/Decrease in %	Increase in %	Total in %
Maintain/Decrease in %	0.00	0.00	0.00
Increase in %	24.23	75.77	100.00
Total in %	24.23	75.77	100.00

4.2.2.6 Exploration of the link between company size and liquidity

The results presented so far show that stock market liquidity is one of most important determinants of dividend changes in the multinomial and binary random forest analyses as well as the multinomial gradient boosting and binary decision tree estimation. Moreover, liquidity variations rank among the ten most important variables for dividend changes in seven of the ten estimation techniques used.

Since larger companies tend to have easy access to capital markets on the one hand and stable cash flows and low debt ratios on the other hand, it remains to be investigated if company size promotes both stock liquidity as well as dividend changes. Accordingly, a binary logistic moderation analysis explores whether liquidity has a statistically significant weight on the influence of company size on the propensity for dividend changes.[622] Company size (SIZE) is the independent variable, liquidity the moderation variable and the four most important variables of dividend increases of the previous investigations TGR, LN(DELTA_OI), PREVIOUS and LN_YIELD are used as controlling variables. All covariates are z score transformed, so that the company size and liquidity proxies have the same weight in the interaction term. The interaction term of "TR" and "SIZE" (INTER_SIZE_TR) influences the dividend increase variable DCB significantly negatively.

Table 31: Results of the binary logit moderation analysis with the independent variable company size

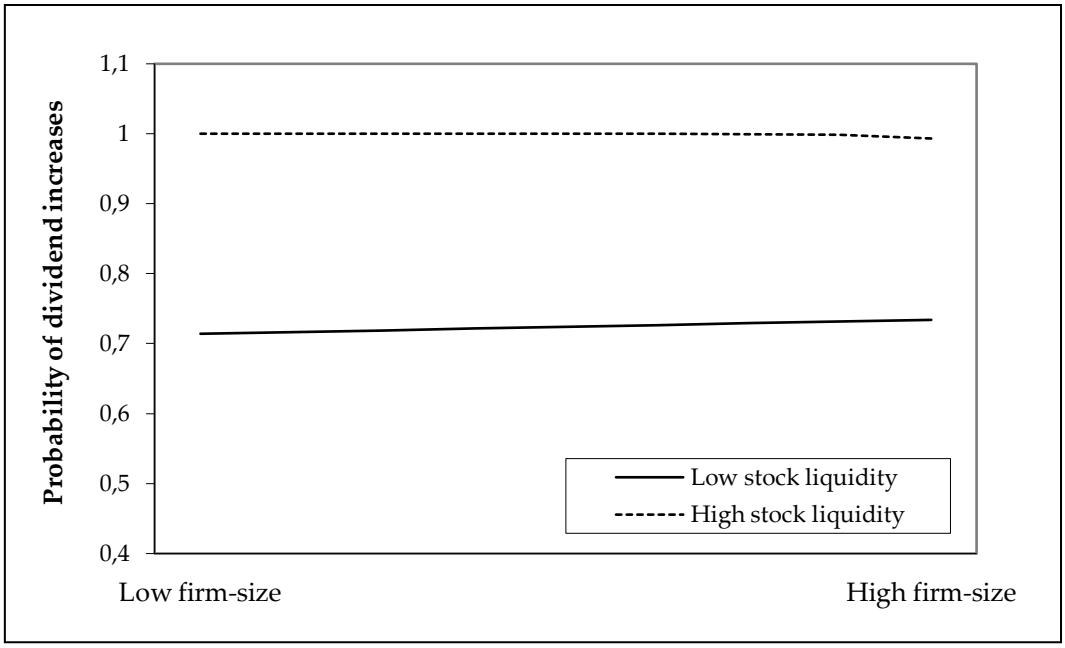
	Estimate	**Std. Error**	**z value**	**Pr(>|z|)**
(Intercept)	1.2496	0.0563	22.2050***	0.0000
SIZE	-0.0481	0.0549	-0.8760	0.3813
TR	0.4954	0.1154	4.2930***	0.0000
INTER_SIZE_TR	-0.3280	0.1025	-3.2010**	0.0014
TGR	0.5173	0.0640	8.0830***	0.0000
LN(DELTA_OI)	0.3925	0.1943	2.0200*	0.0434
PREVIOUS	0.4015	0.0481	8.3520***	0.0000
LN_YIELD	-0.0695	0.0525	-1.3240	0.1855
Signif. codes: 0 '*' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1**				

[622] Cf. Ai, C., Norton, E. C. (2003), p. 123 f.

The main effect of TR on the probability of affiliation in the dividend increase group is statistically significant and positive with a z-value of 4.293, whereas the interaction term's influence is statistically significant and negative (z-value -3.201).

The interaction term in logistic regression cannot simply be evaluated by the sign, magnitude or statistical significance of the variable.[623] Therefore, to facilitate the interpretation of the results, the corrected effect of stock liquidity on dividend changes and the moderation effect of company size are visualized in Figure 15.

Figure 15: Moderation effect of liquidity on the influence of company size on dividend changes



The figure above shows that the propensity to increase cash distributions varies only infinitesimally with company size, while it is substantially different in stock markets with low and high liquidity. When companies' stock liquidity is high, firms increase their dividends rather than in low liquidity surroundings, regardless of their company size.

[623] Cf. Ai, C., Norton, E. C. (2003), p. 129.

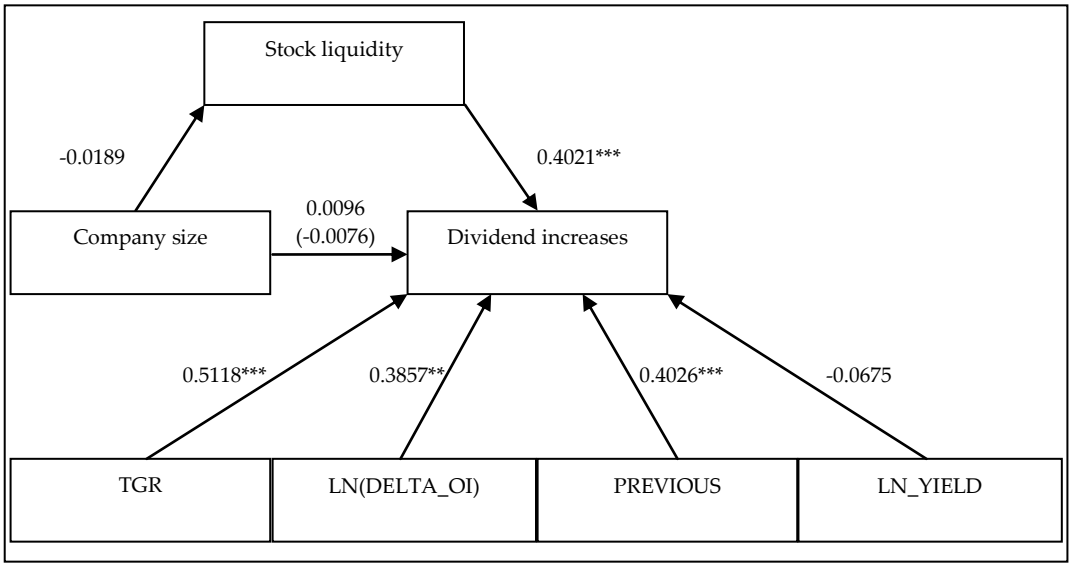
Accordingly, the statistical outcome supports the suggestion that liquidity is the major reason for the influence of company size on dividend changes. The results strengthen the position that access to capital markets improves with increasing firm size and dividends are more likely to be increased.[624]

Besides the moderating effect of stock liquidity on the impact of company size on dividend changes, stock liquidity could also be a mediator that affects dividend increases indirectly.

Thus, a binary logistic mediation analysis following Hayes (2013) is used to determine whether the effect of company size on dividend changes is transmitted through stock liquidity. Despite there being a statistically significant positive main effect between liquidity and dividend changes, no mediating effect could be observed.

Figure 16 gives the standardized regression coefficients for the relationship between stock liquidity (measured with TR) and dividend increases as mediated by company size. It also includes the four previously presented controlling variables. The indirect effect is given in parentheses.

Figure 16: Path diagram of stock liquidity, company size and dividend increases



[624] Cf. Fama, E. F., French, K. R. (2002), p. 8.

The path diagram visualizes the absence of a statistically significant effect of company size on stock liquidity. Furthermore, the indirect effect is statistically insignificant. Accordingly, stock liquidity is not a mediator of the influence of company size on dividend increases.

4.2.2.7 Investigation of the relationship between analysts and liquidity

In addition to company size, the numbers of analysts that cover a stock are frequently stated to influence a firm's dividend policy and liquidity level.[625] The previously impact of analysts on dividend changes is negative when analyst coverage indicates a high-information environment that makes dividend increases redundant.[626] The influence of analysts can also be positive, if their reporting is followed by institutional investors, who make dividend increases more likely.[627]

To test whether stock liquidity impacts the relationship between analyst coverage and dividend changes, a moderation analysis is performed as a first step:

Table 32: Results of the binary logit moderation analysis with the independent variable analyst coverage

	Estimate	**Std. Error**	**z value**	**Pr(>|z|)**
(Intercept)	1.2447	0.0561	22.2000***	0.0000
ANALYST	-0.1989	0.0574	-3.4680***	0.0005
TR	0.3623	0.1069	3.3900***	0.0007
INTER_ANALYST_TR	-0.0968	0.1248	-0.7760	0.4379
TGR	0.5045	0.0639	7.8970***	0.0000
LN(DELTA_OI)	0.3610	0.1911	1.8900.	0.0588
PREVIOUS	0.4054	0.0482	8.4110***	0.0000
LN_YIELD	-0.0560	0.0525	-1.0670	0.2860
Signif. codes: 0 '*' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1**				

[625] Cf. Brennan, M. J., Tamarowski, C. (2000), p. 26 f.; Francis, J. et al. (1997), p. 363 f.

[626] Cf. Aggarwal, R. et al. (2012), p. 403 f.

[627] Cf. Reeding, L. (1997), p. 246.

Table 32 shows that the interaction term has no statistically significant influence on dividend changes. Accordingly, stock liquidity does not moderate the main effect of analyst coverage and dividend increases.

In addition to the moderation analysis, a subsequent binary logistic mediation analysis explores, as a second step, whether stock liquidity mediates the influence of analyst coverage on the propensity for dividend increases.[628]

The following path diagram illustrates the relationship between analyst coverage and dividend increases as mediated by stock liquidity. The indirect effect is stated in parentheses.

Figure 17: Path diagram of stock liquidity, analyst coverage and dividend increases

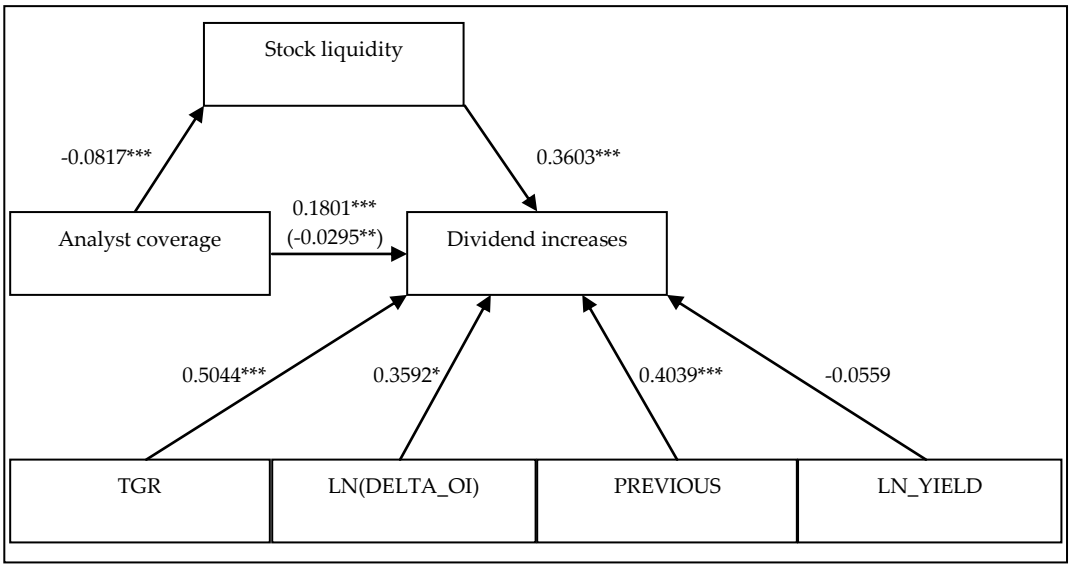


Figure 17 illustrates that the direct effect of analyst coverage on dividend increases is statistically significant. Furthermore, it can be found from the above figure with high statistical significance that analyst coverage influences stock liquidity, and stock liquidity influences dividend increases.

[628] Cf. Ai, C., Norton, E. C. (2003), p. 123 f.

Both bootstrapping for standard errors[629] and the Sobel test (z-value -2.4782) show that the indirect effect is also significant, with low error probabilities; the influence of analyst coverage on dividend increases is mediated by stock liquidity.

4.3 SUMMARY AND INTERPRETATION OF THE RESULTS

4.3.1 Overview of the results

4.3.1.1 Comparison of the models' accuracy

To show how well the models classify the dividend change observations, the cross validated accuracy is measured for the different models. For the logistic regression, LDA, and for the machine learning techniques used, the criterion laid down is that accuracy has to exceed the 70 per cent level.[630]

Table 33 illustrates that all models satisfy the quality criterion and vary between 75.31 per cent and 80.83 per cent.

Table 33: Comparison of accuracy values

Model	**Accuracy multinomial**	**Accuracy binary**
Panel logistic regression	76.23	80.83
Linear discriminant analysis	75.31	79.75
Decision tree	75.77	77.76
Random forest	76.23	78.53
Gradient boosting	75.77	75.77

[629] BootLLCI x BootULCI ≠ 0

[630] Cf. Baldi, P. et al. (2000), p. 413.

Despite the minimum accuracy level being reached, the multinomial machine learning techniques in particular base their accuracy valuation on positively estimated dividend increases only. Since dividend reductions and maintained dividends are not predicted, the accuracy of the model is a large limitation of those analyses.

Within all ten of the estimations presented the cross validated accuracy changed by more than 5.5 per cent from the lowest to the highest value. Within the categorical and binary investigation random forest outperformed the other machine learning techniques. Surprisingly, both the panel logit and linear discriminant analysis provide better model accuracy than the machine learning algorithms using a binary outcome variable. Because the machine learning algorithms focus on increasing the model accuracy, these results deviate from the initial expectations.

Due to the binary measurement of the dividend change variable and the reduction of the categories, the accuracy of the LDA increases by more than four per cent and the random forest prediction model improves from 76.23 per cent to 78.53 per cent. The logistic regression improves most, from 76.23 per cent to 80.83 per cent.

In summary, all models except gradient boosting improve with the binary classification technique. Unexpectedly, the accuracy table displays the highest value for binary logistic regression; unaffected whether using normalized or not normalized estimates. The results show that multiple tree estimation, such as random forest and gradient boosting, does not per se outperform classical stochastic models.[631]

[631] Cf. Breiman, L. (2001), p. 214.

4.3.1.2 Ranking multinomial variables by importance

The ranking of variables by importance is interesting mainly for the evaluation of the first hypothesis, that stock market liquidity influences dividend changes. The ten most important variables of the multinomial investigation are summarized in Table 34. The liquidity measure LN(TR) ranks in sixth place in random forest and seventh place in gradient boosting, while LN(CHANGE_TR) is in tenth place in the panel logit model, eighth place in random forest and third place in the gradient boosting model. Despite LN(SPREAD) and LN(CHANGE_SPREAD) not showing statistically significant influence in either of the models, the results show support for the assumed importance of stock market liquidity on dividend changes for stochastic techniques as well as for data mining. LN(CHANGE_SPREAD) outperforms 27 further variables using random forest and ends in fifteenth place.

Table 34: Multinomial variable importance ranking

Rank	Logit	LDA	Tree	RF	GBM
1	LN(YIELD)	PREVIOUS	LN(DELTA_OI)	LN(DELTA_OI)	LN(DELTA_OI)
2	PREVIOUS	Y2009	BRITAIN	TGR	PREVIOUS
3	TGR	BRITAIN	DELTA_TQ	LN(DELTA_PBR)	LN(CHANGE_TR)
4	BRITAIN	TGR	PREVIOUS	OI	TQ
5	OL	OL	DELTA_PBR	DELTA_TQ	LN(DELTA_PBR)
6	CFTO	DELTA_TQ	DELTA_CF	LN(TR)	LN(CHANGE_SIZE)
7	DELTA_TQ	FRANCE		TQ	LN(TR)
8	LN(SIZE)	LN(YIELD)		LN(CHANGE_TR)	LN(PBR)
9	TQ	Y2010		LN(CHANGE_SIZE)	LN(DELTA_CF)
10	LN(CHANGE_TR)	Y2013		LN(DELTA_CF)	

As can be seen from Table 34, LN(DELTA_OI) is the most important determinant for dividend change classification using machine learning. Also, PREVIOUS is collectively ranked high by the panel logit model, LDA, decision tree and gradient boosting.

LN(YIELD) is in first place for the panel logit, eighth in LDA and second using decision trees, but does not make the top ten using random forest and gradient boosting. That dividend changes vary in a country-specific manner is also underlined by the FRANCE measure, which is in seventh place using LDA.

The stepwise forward selection selects Y2009, the year subsequent to the financial market crisis, in second place. The years Y2010 are Y2013 also in the top ten.

TGR is in the top ten for every estimation technique, except the decision tree and the boosting algorithm. Companies that suffer a loss influence management's propensity to reduce dividends (fifth in Panel Logit and LDA). LN(CHANGE_SIZE) contributes to the estimation of dividend changes in the random forest and the gradient boosting models.

4.3.1.3 Ranking binomial variables by importance

The ranking of variables using the binary measurement is highlighted in Table 35.

Table 35: Ranking binomial variables by importance

Rank	Logit	LDA	Tree	RF	GBM
1	PREVIOUS	PREVIOUS	LN(DELTA_OI)	LN(DELTA_OI)	LN(DELTA_OI)
2	OL	Y2009	BRITAIN	TGR	PREVIOUS
3	TGR	BRITAIN	PREVIOUS	LN(DELTA_PBR)	OI
4	BRITAIN	TGR	LN(DELTA_PBR)	OI	TQ
5	LN(YIELD)	OL	LN(TR)	TQ	
6	DELTA_TQ	DELTA_TQ	TGR	LN(TR)	
7	CFTO	Y2010	TQ	DELTA_TQ	
8	Y2009	Y2014	LN(DELTA_DEBT)	LN(CHANGE_TR)	
9	LN(CHANGE_TR)	Y2013	DELTA_TQ	PREVIOUS	
10	Y2010	LN(CHANGE_TR)	LN(CHANGE_TR)	LN(DELTA_CF)	

Y2014 and LN(DELTA_DEBT) are the only new variables within the binary measurement, compared to categorical estimation. Despite changes in the position of some variables, the influencing variables remain the same overall.

In summary, binary measurement of the dependent variable for dividend change also shows the importance of stock market liquidity on dividend changes.

4.3.2 Interpretation of the empirical findings

Despite the random forest selection ranking the liquidity variable LN(SPREAD) and the liquidity change variable LN(CHANGE_SPREAD) in a midfield position, they have no statistical impact on the classification of the endogenous variable in the panel logit model, the linear discriminant analysis, the decision tree algorithm and the gradient boosting investigation.

Support for the presumed influence of stock market liquidity on dividend changes could be found for the liquidity variable LN(TR) within the binary and multinomial random forest, binary decision tree and the multinomial gradient boosting analysis.

Additionally, the liquidity change variable LN(CHANGE_TR) contributes significantly to the propensity for dividend changes, regardless of binary or categorical measurement. LN(CHANGE_TR) has significant influence on dividend changes in all applied binary analyses except gradient boosting. The variable ranks highly in the multinomial random forest and gradient boosting selection and also has significant influence in the multinomial panel logit model and linear discriminant analysis.

Correspondingly, the analysis fails to reject the hypothesis H1, *Stock market liquidity significantly affects the probability of dividend changes*, regardless of whether stochastic or logarithmic modeling is used.

Although the outcome highlights the general importance of stock liquidity for dividend changes, the direction of influence is also important. Recalling the current state of research, two contradictory views on the impact of liquidity on dividends exist: Kale et al. (2012), Aggarwal et al. (2012) and Banerjee et al. (2007) claim that the relationship is substitutive and companies with highly liquid shares have no need for cash distributions. If investors require cash, they create

homemade dividends by selling shares, since liquidity goes hand in hand with low transaction costs of trading.

Contrarily, Jiang, F. et al. (2017) state that the effect is complementary, and also Fama and French (2002) assume that companies pay more dividends with increasing liquidity as a function of their access to capital markets, which differs with firm size. To review the second hypothesis H2, *Stock market liquidity has a negative effect on the probability of dividend decreases* and the third hypothesis H3, *Stock market liquidity has a positive effect on the probability of dividend increases*,[632] a closer look at the results of the panel logit, linear discriminant and the decision tree model is taken.

Because increasing turnover ratios approximate increasing liquidity, a positive impact of LN(TR) and LN(CHANGE_TR) on dividend increases would show that the null hypotheses could be rejected. Within the binary and multinomial panel logit model rising liquidity also increases the propensity for dividend increases. The positive effect of LN(CHANGE_TR) on the group affiliation of dividend increases in the panel logit model supports the previous results that the relationship of stock liquidity on dividend changes is complementary.

This is also supported by the LDA, where the variable reaches the defined 0.01 level using Wilks' lambda. The class means are lower in the increase group than in the decrease (decrease/maintain) group, which also suggests that high liquidity tends to encourage distributions to increase. The null hypothesis of H2 and H3 is rejected with respect to the presented results.

Moreover, LN(TR) and LN(CHANGE_TR) split the binary decision tree and influence the probability of dividend increases positively and make dividend decreases less likely.

[632] Derived from Fama, E. French, K. (2002).

In order to find an explanation for the complementary influence of liquidity on dividend changes, the impact of company size is investigated in more detail in line with Fama and French (2002). Due to existing fixed costs of issuance, good access to capital markets is a privilege of large companies and the firms' stock liquidity level might vary depending on size.[633] In view of that, stock market liquidity might be the reason company size matters for dividend changes. Using a binary logistic moderation analysis, it is found that the influence of firm size on dividend changes depends greatly on the liquidity level. That supports the previous assumption that larger companies face better surroundings for capital market access and dividend distributions than do smaller companies.

Also the influence of analyst coverage on dividend changes, as argued by Brennan and Tamarowski (2000), turns out to be influenced by stock market liquidity. The statistically significant positive indirect effect of analyst coverage shows the stock liquidity level mediates the influence of analyst coverage on dividend changes.

Summarized, the analysis supports the complementary theory of liquidity and dividend changes in large part, while company size appears to be a driver for this direction of influence. The impact is significant for the present liquidity level and when liquidity changes in comparison to the previous year. Changes of liquidity level in the sample companies are size-dependent, so that it is assumed that the size of the enterprise facilitates a superior entry to the capital market. Moreover, large companies face optimal conditions to distribute parts of their profits in the form of dividends due to their constant cash flow and their low leverage.

Additionally, stock liquidity reduces the negative effect of analyst coverage on dividend increases. Since there is a positive relationship between buy side and sell side analysts and institutional investors, the investor's desire for current income might be the reason for management's increasing propensity to dividend increases.[634]

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[633] Cf. Fama, E. French, K. (2002), p. 8.

[634] Cf. Reeding, L. (1997), p. 246.

4.3.3 Peculiarities and limitation of the research

Since models help to reduce the complexity of reality, they contain only the features selected for the model maker's purpose. That means that any model fails to reflect reality entirely and is accompanied by restrictions. The most meaningful limitations of the present research are presented here.

Firstly, the sample companies are not randomly selected, as the STOXX Europe 600 reflects only significant European firms. Important information that is carried by smaller companies is not taken into account. In this connection, banks and other financial entities have a significant influence on the European economy, but are discarded from the final sample. Even though, on the one hand, the index composition as of January 2015 increases the availability of data, on the other hand it increases the probability of survivorship bias.[635]

Secondly, the liquidity measures fail to distinguish between transitory and permanent price movements. Therefore, they do not measure liquidity as an equivalent of efficiency and the results might be biased by the volatility component.

Thirdly, the multinomial observations of dividend changes show that decreases, maintenance and increases are unequally distributed. The final dataset contains many more dividend increases than unchanged and reduced dividends. This unequal distribution could lead to decreasing estimation accuracy within the categorization, as the information on dividend-decreasing companies as well as dividend-maintaining firms is underrepresented.

Fourthly, some potential independent variables are missed out because they cannot be obtained from the database. In particular, those variables are ownership structure and shareholder identity. Apart from the fact that they are frequently used to measure the agency costs of equity, institutional investors might also be the reason for the mediation effect of stock liquidity on the influence of stock analysts on dividend changes. As a substitute, the rather gross CGS score is used.

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[635] For further information see Brown, S. J., Goetzmann, W. (1992).

Although the scoring system for CGS takes the ownership structure into account, it respects numerous further criteria such as the supervisory board structure, compensation programs and audit oversight quality. Accordingly, CGS fails to measure the precise influence of the ownership structure. Moreover, abnormal returns and company age are not included in the investigation due to measurement problems.

Fifthly, the different approaches that are implemented in the present investigation do not provide a uniform measure of variable importance. In particular, a comparison of the statistic methods with data mining is not possible without friction. As a consequence, the comparison of the different variable rankings might be biased by the chosen methodology.

Sixthly, the models' accuracy is a factor that could be improved to allow more reliable assumptions regarding the influence of stock market liquidity on dividend changes to be made. When investigating dividend changes multinomially, a misclassification rate of almost 25 per cent leaves room for optimization. Because fewer dividend decreases and unchanged dividends than increased dividends are given in the sample period, the cross validated accuracy frequently includes only a small number of decreases and maintain observations. The overall goodness of fit increases achieved using the binary measurement remains lower than 81 per cent.

Seventhly, besides stock liquidity influencing dividend changes, there might also be reverse causality; dividend changes can impact the liquidity of securities. When firms change their dividends, it can cause shareholders to invest or disinvest, which in turn increases the trading volume. The potential reverse causations can produce biased and inconsistent parameter estimates. Among other things, the described problem can be solved with a "Two Stage Least Square Estimation". In the present study lagged explanatory variables are used in response to endogeneity concerns.

Eighthly, size is used as a proxy for access to capital markets in the present investigation but it can also be used to measure companies' specific operating risk. Larger companies have more self-funding capabilities and are less likely to face the risk of insolvency. Accordingly, the influence of company size on dividend changes calls for additional research that is beyond the scope of this work.

5 SUMMARY AND CONCLUSION

5.1 SUMMARY

The dissertation aims to answer the specific question as to whether the tradability of shares determined shifting dividend payouts in Europe within the time period from 2006 to 2014. It is copiously documented in the literature that investors rely on dividend signals, which frequently lead to stock price reactions.[636] Following the dividend discount model, the fair firm valuation is the sum of the firm's present values of future cash flows such as dividend payments.[637] Since not every dividend change event makes investors review the valuation of the company, the information content of dividend changes appears to be multifaceted.[638] To create a deeper understanding, the signaling hypothesis of dividends is assessed to find whether or not the relevant conditions are satisfied.[639] There is evidence to support the view that investors take dividends into account when they make investment decisions; and also that dividend changes commonly follow increases in firm's earnings.[640]

Because managers hesitate to cut dividends, dividend initiations have a special signaling role.[641] First time cash distributions lead to high expectations that the cash distribution will be followed by many further payouts.[642] Dividend initiations have a positive effect on the share valuation as investors desire

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[636] Cf. Benesh, G. A. et al. (1984), p. 131 f.; Best, R. J., Best, R. W. (2001), p. 361 f.; Denis, D. J. et al. (1994), p. 567 f.; Yoon, P. S., Starks, L. T. (1995), p. 995 f.; Woolridge, J. R. (1982), p. 245.

[637] Cf. Gordon, M. J., Shapiro, E. (1956), p. 102 f.

[638] Cf. Bajaj, M., Vijh, A. M. (1990), p. 193 f.; Dhillon, U. S., Johnson, H. (1994), p. 281 f., among others.

[639] Cf. Liu, C., Chen, A.-S. (2015), p. 205.

[640] Cf. Chen, T.-Y., Kao, L.-J. (2014), p. 508; Iqbal, Z., Rahmann, M. H. (2002), p. 23; Nissim, D., Ziv, A. (2001), p. 2131.

[641] Cf. Ross, S. A. et al. (2005), among others.

[642] Cf. Kale, J. R. et al. (2012), p. 393.

dividends, but they can also indicate that investment opportunities have declined.[643] On another note, dividend omissions are frequently the result of weak current and historical profitability.[644] Nonetheless, they can also display enhanced investments and growth opportunities.[645]

To find the driving factors of dividend changes, possible determinants of dividend probabilities and dividend yields are derived from different theories such as trade-off theory and agency implications, because dividend change literature is somewhat limited. Generally, managers decide to pay or not to pay dividends as a sum of the disbursement costs and benefits, individual tax rates, investors' demand for dividends and the influence on the company's agency costs.[646] The evaluation of the existing dividend change literature expands the variables available for selection by analyst coverage, abnormal returns, historical dividend yields and index membership.[647]

In addition to dividend changes, the company's stock liquidity level also plays a noteworthy role within the refinancing process.[648]

Stock liquidity can lessen financing costs and make additional funding easier to source because agency costs decrease if shareholders can reverse their investment decision easily.[649] This in turn can increase the firm's valuation.[650] The management decision to change the distribution policy can also vary with

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[643] Cf. Wansley, J. W., Lane, W. R. (1987), p. 434.

[644] Cf. Ghosh, C., Woolridge, J. R. (1991), p. 328; Healy, P. M., Palepu, K. G. (1988), p. 173, Liu et al. (2008), p. 1015.

[645] Cf. Christie, W. G. (1994), p. 473.

[646] Cf. Rozeff, M. S. (1982), p. 255 f.

[647] Cf. Aggarwal, R. et al. (2012), p. 420 f.; Bulan, L. et al. (2007), p. 20; De Cesari, A., Huang-Meier, W. (2015), p. 8 f.; Deshmukh, S. (2003), p. 364 f.; Goergen, M. et al. (2005), p. 387 f.; Kale, J. R. et al. (2012), p. 365 f.; Li, W., Lie, E. (2006), p. 303 f.; Luebke, K., Rojahn, J. (2016), p. 335 f.

[648] Cf. Gopalan, R. et al. (2012), p. 333 f.; Hoshi, T. et al. (1991), p. 57; Kale, J. R. et al. (2012), p. 365 f.

[649] Cf. Acharya, V. V., Pedersen, L. H. (2004), p. 382.

[650] Cf. Acharya, V. V., Pedersen, L. H. (2004), p. 392; Husman, C. (2003), p. 81.

feedback from stock prices.[651] Liquidity generates positive feedback prices, while illiquidity is penalized by adverse price movements that make ensuring stock trading with low friction an overarching management goal.[652]

Although stock liquidity is an important driver of value for shareholders, the definition and measurement of liquidity are difficult due to its multi-dimensional character.[653] In the present investigation liquidity is synonymous with efficiency, which means that the highest form of liquidity is immediate trading.[654]

Due to the complexity of the measurement of liquidity, the literature approximates liquidity with transaction costs.[655] The higher the transaction costs of trading are, the more the definition of liquidity moves away from being synonymous with efficiency.[656] The overview of the different transaction costs that trading implies concentrates particularly on the market makers' order processing, inventory holding and adverse information costs.[657]

Based on the liquidity dimensions of tightness, depth, resilience and time, possible liquidity measures are selected for the present investigation. They are further categorized into pre-trade and post-trade measures.[658] Although pre-trade measures can be influenced by "gaming" and do not take potential traders that monitor the order book into consideration, they provide valuable insights because they do not overrate trading opportunities as post-trade measures do.[659] When liquidity is approximated after the trade takes place, those measures are free from gaming and take potential traders into account.[660] Both measures provide

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[651] Cf. Fang, V. et al. (2009), p. 150 f.; Subrahmanyam, A., Titman, S. (2001), p. 2389 f.

[652] Cf. Loukil, N. (2015), p. 415.

[653] Cf. Brunner (1996), p. 3; Chai, D. et al. (2010), p. 181 f.; Grullon, G. et al. (2004), p. 457; Makower, H., Marschak, J. (1986), p. 284. Ranaldo, A. (2001), p. 312.

[654] Cf. Wyss, R. (2004), p. 8.

[655] Cf. Kindermann, S. (2005), p. 9 f.

[656] Cf. Aitken, M., Comerton-Forde, C. (2003), p. 46.

[657] Cf. Madhavan, A. (2000), p. 208 f.

[658] Cf. Collins, B. M., Fabozzi, F. J. (1991), p. 27 f.

[659] Cf. Collins, B. M., Fabozzi, F. J. (1991), p. 32.

[660] Cf. Kindermann, S. (2005), p. 47.

important information, so that one pre-trade and one post-trade measure that meet the defined criteria of symmetry, data availability and comparability are selected for the final investigation.

The relative spread to mid price (pre-trade) as well as the turnover ratio (post-trade) meets those requirements[661] and are selected to be the most suitable proxies for the present investigation due to their difficulty of interpretation, liquidity valuation and consideration of potential traders and invisible orders.[662] While the spread primarily measures the tightness of the limited order book, the turnover ratio covers the depth and the time dimension.[663] To control for liquidity changes, the two proxies are also estimated, scaled by the previous year's figure.[664]

Reviewing current studies, the theoretical influence of stock liquidity on dividend changes is ambiguous: The relationship can either be substitutive[665] or complementary.[666] Transaction costs are stated to be one of the key drivers for the negative influence of stock liquidity on dividends, when investors satisfy their liquidity needs by cheap home-made dividends in highly liquid capital markets.[667] Furthermore, both stock market liquidity and dividend changes are informative regarding the current situation of a firm, which makes them look interchangeable.[668] Dividends, as well as liquidity, can reduce investment risk and help to minimize agency problems.[669]

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[661] Cf. Kindermann, S. (2005), p. 112.

[662] See sub-chapter 3.2.4 for further information.

[663] Cf. Elyasiani, E. et al. (2000), p. 2; Wyss, R. (2004), p. 9.

[664] Cf. Wyss, R. (2004), p. 14.

[665] Cf. Banerjee, S. et al. (2007), p. 369 f.; Kale, J. R. et al. (2012), p. 365 f.

[666] Cf. Fama, E. F., French, K. R. (2002), p. 1 f.; Jiang, F. et al. (2017), p. 295 f.

[667] Cf. Banerjee, S. et al. (2007), p. 369 f.

[668] Cf. Kale, J. R. et al. (2012), p. 365 f.

[669] Cf. Gugler, K., Yurtoglu, B. B. (2003), p. 753; Jensen, M. C., Meckling, W. H. (1976), p. 342 f.

A reason for the positive influence of liquidity on dividend changes is the decreasing sensitivity of stock prices to new information in liquid markets. If share prices do not respond to new information, it becomes easier for informed traders to hide information.[670] Consequently, acquiring information rises in significance for uninformed traders to assimilate information asymmetries. If they do so, the increased information level will also help them to detect management's opportunistic behavior and managers will react with cash distributions.

The complementary effect of stock market liquidity and dividend changes is further supported by the better access to capital markets of large companies that provides them with shares that are more liquid.[671] Despite increasing liquidity, those companies are more likely to distribute dividends due to their constant cash flows and low leverage. Accordingly, liquidity is a possible explanation of why company size matters for dividend probabilities, dividend yields and also dividend changes.

To test which effect dominates, classical stochastic techniques (panel logit regression, LDA) are complemented by machine learning techniques (decision tree, random forest, gradient boosting) that are comparatively innovative in this research field.[672]

The machine learning models, using different algorithms, show that stock liquidity and stock liquidity changes contribute to the classification of dividend changes. The LN(TR) variable is one of the seven most important variables in the multinomial random forest and gradient boosting selection as well as in the binary decision tree and random forest analysis. The binary decision tree shows that the direction of influence is positive; stock liquidity makes dividend increases more likely.

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[670] Cf. Jiang, F. et al. (2017), p. 295 f.

[671] Cf. Fama, E. F., French, K. R. (2002), p. 1 f.

[672] Cf. Breiman, L. (2001), p. 214.

The importance of the change in turnover ratio for shifting dividends is also underlined by all of the binary estimation techniques except gradient boosting and the multinomial panel logit, random forest and gradient boosting algorithm. The positive t-values of the logistic regression, the mean values of the linear discriminant analysis and the structure of the decision tree show that the influence of changing stock market liquidity on dividend changes is positive. The results presented support the complementary assumption that dividends increase when stock market liquidity rises.

To investigate whether stock liquidity influences the effect of company size and stock analysts on dividend changes, binary logistic moderation and binary logistic mediation analyses are conducted, with the result that stock liquidity moderates the effect of company size and mediates the effect of analyst coverage on dividend changes. These findings provide a potential explanation as to why company size and stock analysts are frequently analyzed as having influence on dividend changes.

5.2 CONCLUDING REMARKS

The investigation of the STOXX Europe 600 index during a nine-year time period shows that stock market liquidity and liquidity variations can influence dividend changes in Europe. The results are found regardless of whether traditional stochastic models or machine learning techniques are used.

Table 36 illustrates the key findings of the dissertation:

Table 36: Answers to the initial research questions

"Does stock liquidity influence dividend changes in Europe?"	
Multinomial and binary panel logit	Yes (section 4.2.2.1)
Multinomial and binary LDA	Yes (section 4.2.2.2)
Binary decision tree	Yes (section 4.2.2.3)
Multinomial and binary random forest	Yes (section 4.2.2.4)
Multinomial gradient boosting	Yes (section 4.2.2.5)
"What is the direction of influence?"	
Multinomial and binary panel logit	Positive (section 4.2.2.1)
Multinomial and binary LDA	Positive (section 4.2.2.2)
Binary decision tree	Positive (section 4.2.2.3)

The analysis shows that stock market liquidity is a statistically significant positive driver for dividend changes in Europe. When the liquidity level is high or increases in comparison to the previous year, companies more likely increase and less likely decrease their dividends. One possible explanation for the complementary effect is company size. Larger firms have superior access to capital markets than small firms have, which improves the liquidity of the stocks

of larger companies. Besides more liquidly traded shares, large companies are usually not greatly indebted and have constant earnings and cash flows so that the propensity for dividend increases rises.

The finding that stock market liquidity increases makes dividend increases (decreases) more likely (more unlikely) puts a further piece of the puzzle in place and amplifies business understanding. Stock liquidity helps to anticipate dividend changes and shareholders can benefit from the resulting stock price reactions, whereas managers can prevent negative feedback from share prices.

5.3 OUTLOOK

Investigating the liquidity phenomenon and its influence on dividend changes provides additional fruitful avenues for further research.

Previous investigations state that US firms do not lessen dividend payments due to management's reluctance for dividend decreases.[673] That shows that the dividend change decision depends in large part on management's subjective attitude and can be seen as an active management choice. Consequently, managements' risk attitude is one important factor for shifting dividends. Since risk is especially driven by what is unknown by management, lacking information is a further driver for distribution assumptions. This additional analysis can contribute to the agency-oriented view on dividend changes by focusing on managers' attitudes towards cash payouts.

In addition, future analysis can investigate whether the influence of the shareholder structure on dividend changes is influenced by stock liquidity. The impact on dividend changes of different shareholder concentrations and shareholder identities might be moderated or mediated by stock market liquidity. This possible connection is not well studied in the current state of research.

Finally, several further possible proxies for liquidity exist that are frequently not available for long-term research. The resilience dimension, especially, has not been adequately measured. As modern databases put more importance on the electronic archiving of stock market liquidity data, they pay more attention to collecting information relevant to liquidity. Further

[673] Cf. DeAngelo, H., DeAngelo, L. (1990), p. 1415 f.

investigation of the liquidity dimension can add value to this multidimensional phenomenon in future investigations.

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