THE FIRM-SPECIFIC DETERMINANTS OF DIVIDEND PAYOUT POLICY FOR GERMAN LISTED FIRMS

Master Thesis

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Abstract

This study investigates which firm-specific determinants affect the dividend payout policy of German listed firms in the time before the Covid-19 pandemic and during the Covid-19 pandemic. Therefore, financial and non-financial data about 301 German listed firms are exported from ORBIS. The firm-specific determinants are derived from the information asymmetry theory, the agency cost theory, and the life cycle theory. Both the propensity of dividend payout and the level of dividend payout are analyzed by a logit regression and an OLS regression, respectively. Overall, the results show that the propensity of dividend payout is dependent on the profitability, ownership structure, and firm size in both time periods. Second, the level of dividend payout is dependent on profitability and ownership structure between 2015-2018 and dependent on profitability and firm size between 2019-2021. For all other variables, firm age, leverage, and growth opportunities, no significant relation is found.

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1. Introduction

Research about the corporate payout policy started with the pathbreaking work of Lintner (1956) and Modigliani and Miller (1961) and since then has been a crucial part of financial research. However, also before, managers from companies around the globe used to pay out dividends to shareholders, for example, Alfred P. Sloan, the CEO of General Motors in 1935 (DeAngelo et al., 2008).

One of the first theories about payout policy was developed by Modigliani and Miller in 1961. They explain that in perfect capital markets without asymmetric information and when a firm's investment policy is fixed, the payout policy is irrelevant (Modigliani and Miller, 1961). However, in the real world, there are no perfect markets and the conditions according to Modigliani and Miller are not fulfilled. Despite of a high amount of research on this topic, the determinants of dividend payout policy have not been agreed on. Black (1976) calls this disagreement the dividend puzzle. For a company, there could be many determinants to either pay dividends or repurchase shares or none of these two options. Concerning Germany, there has been no extensive research aimed at answering the research puzzle proposed by Black (1976). Therefore, the purpose of this study is to discover firm-specific determinants for the dividend payout policy in German listed companies between 2016-2018 and 2019-2021. Especially in that time period, when a pandemic challenged the economy of the whole world, it is crucial to see what factors influence the dividend payout policy. Thus, the following research question has been formulated: "What are the effects of firm-specific determinants of the dividend payout policy of German listed companies before and during the Covid-19 pandemic?"

The contribution and importance of this research to past literature are multi-fold. First, despite of very extensive research, there still is no consensus about the determinants of payout policy. This research contributes to solving the payout puzzle by Black (1976) by having a look at firm-specific determinants in a developed country with a civil-law government. Second, this research adds to the scarce research on the determinants of the payout policy of German listed firms. Schmid et al. (2010) analysed the ownership structure of German listed companies over the period 1996-2005. After that, Smit and von Eije (2009) conveyed an analysis of ownership structure and payout policy over the period 2005-2008. Furthermore, Gugler and Yurtoglu (2003) examined the effect of corporate governance on payout policy between 1992-1998. This research will contribute to this literature stream as it adds the effects of firm-specific determinants which, to the author's best knowledge, have not been analysed in German companies.

Moreover, the research will analyse two separate periods. The first period consists of the years 2016-2018 and the second period consists of the years 2019-2021. The reason why these periods are especially interesting is that in 2019, the first Covid-19 cases have emerged in China and in January 2020 in the European Union[1]. This pandemic had an enormous impact on the world's

[1] World Health Organisation. https://www.euro.who.int/de/health-topics/health-emergencies/coronavirus-covid-19/news/news/2020/01/2019-ncov-outbreak-first-cases-confirmed-in-europe

economy in several ways (Akbulaev et al., 2020). First, it had an impact on production, second on employment, and third on exports and imports. The impact on Germany has also been enormous. Germany's prior prime chancellor Angela Merkel stated that the economic impact on Germany refers to the most difficult period since the end of the second world war.

Since most of the past literature based their determinants and hypotheses on them, this research will focus on the information asymmetry theory, the agency cost theory, and the firm life-cycle theory as these have been extensively used in prior research as determinants of payout policy (see e.g. Kent Baker and Kilincarslan, 2018; Al-Malkawi et al., 2010). This paper is organised as follows: First, past literature about the payout puzzle, the theories, and the Covid-19 pandemic is reviewed. Second, hypotheses are derived from these theories. Then, the applied research method and variables are described. Fourth, the sample and research are outlined. After that, the results are examined and analysed and at last, a conclusion is given with limitations and implications for further research.

2. Literature review

In this section, prior literature is reviewed. To understand the payout puzzle, the history of payout policy and the literature about it is reviewed. Then, to be able to pose hypotheses, the information asymmetry theory, the agency cost theory and the life-cycle theory are described. Third, the economic impact of the Covid-19 pandemic on Germany's economy is explained to understand the relevance of the periods used in this research. At last, the hypotheses are derived from these theories.

2.1 The history of payout policy

The theory about payout policy started in the early 1960s with the dividend irrelevance theorem by Modigliani and Miller (1961). It says that there are perfect markets, in which investors do not care about the payout policy because they can replicate the payout by purchases or sales of equity. Because of these "homemade" dividends, investors do not pay a premium for a company that pays out dividends. Perfect Capital Markets are characterised by the following conditions. First, there is no asymmetric information which means that information is costless and available to everyone. Second, there are no taxes. Third, there are no transaction costs associated with purchasing or selling securities. Fourth, there are no contracting or agency costs. Last, an investor or firm cannot influence the price of securities individually. Thereby, Modigliani and Miller (1961) do not predict what decisions managers select, but rather analyse "[…] whether any payout decisions that managers could generate more wealth for stockholders than other feasible payout decisions." (DeAngelo et al., 2008, p. 12).

However, the perfect market conditions are not given and once we enter the real world, the dividend payout decisions become relevant due to varied factors, such as information asymmetry, different tax rates, agency costs or transaction costs. In past literature, there are many hypotheses about why companies pay dividends and why investors care about dividends which is referred to as the dividend puzzle (Black, 1976). Concerning solutions to the pieces of the dividend puzzle, many researchers found different determinants and reasons for companies to pay dividends.

That is why the history of payout policy research is necessary to examine. The first steps in research about determinants of payout policy took place in U.S. markets. Fama and French (2001) showed that the number of firms paying cash dividends has declined from 1979 to 1999 and that the propensity to payout dividends is positively affected by firm size and profitability and negatively affected by growth options. While the meaning of share repurchases during that time period has increased, the importance of cash dividends has decreased. In 2003, Weston and Sui (2003) reveal a different trend: the cash dividends as a percentage of corporate earnings increased from 1971 to 1990. However, at that time, the increase in the payout ratio was only driven by highly profitable companies (DeAngelo et al., 2004). Two years later, DeAngelo et al. (2006) added one important piece to the payout puzzle in America by relating the dividend payments to the company's stage in the life cycle. Furthermore, some studies in the early 21st century analyze the influence of a company's ownership structure on its payout policy (Lie and Lie, 1999; Hsieh and Wang 2008).

Having a look at payout policy outside the U.S., there is little evidence of patterns. La Porta et al. (2000) argue that dividend decisions are influenced by agency costs, for example in countries with better investor protection, companies pay higher dividends. In a cross-country research, Denis and Osobov (2008) support the evidence from Fama and French (2001) about profitability, firm size and growth options. However, they do not find a decrease in dividend payouts outside the U.S. but rather constant (Denis and Osobov, 2008).

Regarding the payout policy within the EU, von Eije and Megginson (2008) analysed cash dividends for 15 countries in the EU between 1989 and 2005. They agreed on the firm-specific determinants found by Fama and French (2001) and DeAngelo et al. (2004) and also add that privatized firms (2% of the listed European firms in the given time period) account for almost a quarter of cash dividends.

2.2 Information asymmetry theory

The first crucial theory that has been looked at concerning the determinants of payout policy is the information asymmetry theory. As mentioned before, in Modigliani and Miller's (1961) perfect markets there is no information symmetry between the stakeholders of a company. However, in the real world, that is not given. Modigliani and Miller (1961) imply that dividends convey information about the company. First, managers are reluctant to change the number of dividends which could have to be reversed. Second, managers and investors focus more on the change of dividends and not on the number of dividends. Last, managers 'smooth' dividends. That means managers try to only increase or decrease dividends when the expected future cash flows are changing. On the other hand, investors focus on the change of dividends and not on the total level, because a change in dividends means a change in future cash flows (Brealey et al., 2020). Concerning share repurchases, the change and announcements do not imply that the company will ever buy back shares again. They are not as 'sticky' as cash dividends. As a result, dividends convey more information about the company than share repurchases.

One of the most famous models of the information asymmetry theory, the signaling theory, has been developed by Bhattacharya (1979) which explains that a company uses dividends to signal future cash flows to outsiders, for example, shareholders. That means dividends are used to minimize the existing asymmetric information between managers and shareholders. This asymmetric information exists because the managers of a company possess more information on their cash flows than individuals from outside. Thus, cash dividends are a signal to infer the true value of a company to investors (Bhattacharya, 1979). However, the information content of cash dividends can be both 'good' and 'bad'. An increase in dividends can be seen as a positive future prospect for cash flows. The announcement of a cash dividend led to a positive reaction in the market and makes the stock price of a company increase (Brealey et al., 2020). On the other hand, if a company cuts its dividends, the market will react seperately: the shareholders will interpret the dividend cut negatively and the stock price will consequently fall.

In past research, the effect of cash dividends has been explained in diverse ways. On the one hand, there is literature that supports the information content of cash dividends (Watts, 1973; Amihud and Murgia, 1997). Watts (1973) found a positive relationship between dividend changes and changes in future earnings, whilst Amihud and Murgia (1997) found an increase in the stock price of German companies after a dividend announcement which implies that dividends are important to convey information about a company's future performance. On the other hand, according to Denis and Osobov (2008), the signaling theory does not influence on payout policy but that more profitable companies that are larger and older are more likely to pay dividends. This result is further elaborated in section 2.4 about the life-cycle theory. At last, DeAngelo et al. (1996) find that managers may overestimate their future cash flows which would result in the fact that a dividend increase does not necessarily convey information about future earnings.

2.3 Agency cost theory

The second main theory to explain the decision to pay dividends is the agency cost theory which was firstly introduced by Jensen and Meckling (1976). They define an agency relationship as a contract in which the agents (managers) are engaged by one or more principals (shareholders) to perform a service on their behalf. By doing so, the principals also transfer some of their decision-making to the agents. In the case of the dividend payout policy, the principals are the shareholders, and the agents are the managers. In that agency relationship, there are three main types of costs arising. First, it is assumed that the managers, as well as the shareholders, try to maximise their own utility. For the managers, it then could be to not act in the best interest of the shareholders, which is why the shareholders have to limit these activities by monitoring them. These monitoring costs include for example budget restrictions, compensation policies and operating rules. Second, bonding costs occur when the managers expend resources in order to guarantee that they would not harm the shareholders with certain actions at their expense (Jensen and Meckling, 1976). The last type of agency costs refers to the amount of cash related to the reduction of welfare which is the consequence of a divergence between the managers' decisions and the decision that would maximise the shareholders' utility. These costs are referred to as residual costs. Thus, there are three distinct types of agency costs between managers and shareholders: monitoring costs, bonding costs and residual costs.

Moreover, there is the free cash flow hypothesis by Jensen and Meckling (1976) which hypothesizes that companies with much free cash flow have to hinder managers from overinvesting, for example in low-return projects. Consequently, in companies with higher cash flows, there is an interest conflict between shareholders and managers since the managers try to maximise their own wealth by using the free cash flows. To reduce these forms of overinvesting, highly profitable firms are more likely to pay higher dividends (Patra et al., 2012). Fama and French (2001) add that larger and more profitable firms are more likely to pay dividends and companies with high possibilities to grow are less likely to pay dividends.

Another form of agency costs can come with an increase in debt. Jensen and Meckling (1976) propose that debt can be used as a substitute for dividends and reduces the free cash available for managers because companies have to pay interest to debtholders. The higher the leverage of a company is, the higher the interest the company has to pay and the higher the risks of financial distress. Rozeff (1982) argues that the higher the leverage of a company, the less likely they are to pay dividends because they want to keep its internal funds to satisfy the interests of its bondholders. This result is also supported by Fama and French (2001) who also found a significant negative relationship between leverage and the probability to pay dividends but also between leverage and the level of cash dividends.

All in all, agency costs usually arise between the principal and agent, but they can also come into existence in relationships between different groups of principals, in this case between different groups of shareholders, for example, small and large shareholders. Occurring agency costs between separate groups of principals are also referred to as agency costs type 2. In the case of payout policy, these costs refer to the agency costs between diverse groups of shareholders that can differ in their size and concentration. With extremely low ownership concentration, there is the danger of free-riding of minority shareholders which means that minority shareholders act like the monitoring activities are performed by the large shareholders (Aguilera and Crespi-Cladera, 2016). Therefore, dividends are used as incentives to reduce these free-riding activities. However, when the ownership concentration of majority shareholders increases in respectively low levels, majority shareholders protect their investment through active monitoring rather than paying dividends (Harada and Nguyen, 2011). As a consequence, when the ownership concentration of the majority shareholders increases at respectively low levels, the probability to pay dividends decreases. However, at some point, the majority shareholder gets too much power and control so there is a higher need to pay dividends to ensure monitoring. That scenario only occurs when ownership concentration exceeds a certain threshold since the majority shareholder gains too much power, for example when holding 50.1% of a company's shares, they are the main shareholder who can decide on changes in a company's statutes and a company's liquidation[2]. Moreover, when a shareholder holds 25.1% of a company's shares or more, the shareholder has the right to block the aforementioned decisions, which is known as the blocking minority. As a conclusion, past literature supposes that there is a convex relationship between ownership concentration and dividend payout policy.

[2] https://www.gesetze-im-internet.de/aktg/__179.html

2.4 Life cycle theory

The last relevant theory when it comes to the influence on payout policy is the corporate life-cycle theory. It proposes that companies, similar to humans, go through different stages throughout their life (Miller and Friesen, 1984). In these stages, there are huge differences concerning decision-making, organization structure and strategy, and situations. Adizes (1979) states that there are behavioural patterns that companies follow within each of the different life-cycle stages.

In past literature, the life-cycle theory has been used in several diverse ways. First, Adizes (1979) developed a model with ten life-cycle stages: Courtship, Infancy, Go-Go, Adolescence, Prime, Stable, Aristocracy, Recrimination, Bureaucracy and Death. On the other hand, there is the model of Miller and Friesen (1984) that consists of five life-cycle stages: Birth, Growth, Maturity, Revival, and Decline. In contrast to the model of Adizes (1979), this model is not as detailed. After these two models, the literature most commonly used the one of Miller and Friesen (1984) and developed it further. To give a few examples, Mintzberg (1984) changed the model a bit and developed a new one with four stages which are similar to the ones from Miller and Friesen (1984): Formation, Development, Maturity and Decline. Furthermore, one of the most current developed models from Faff et al. (2016) uses similar stages with slightly different names which are Introduction, Growth, Maturity and Decline.

For this paper, the most relevant model regarding the life-cycle theory was developed by La Rocca et al. (2011) who developed three stages of the corporate life cycle derived from the age of the companies. They divide companies into young, middle-aged, and old firms. Grullon et al. (2002) used this model and developed links to corporate finance and accounting. They propose that young firms in the growth stage have many positive NPVs and need cash to finance these and the growth of the company. That means, there is less cash available for paying dividends. However, when the company grows, there are fewer growth opportunities and the company generate a higher amount of free cash flows. These free cash flows are then more likely to be used to pay dividends.

2.5 The Covid-19 pandemic

To better understand the relevance of the chosen periods of analysis, in the following, the impact of the Covid-19 pandemic on Germany's economy is explained. The first cases of Covid-19 emerged in China in December 2019. After a quick distribution around the globe, the first case in Germany was detected in January 2020[1]. The impact on Germany's economy is multi-fold.

First, the pandemic had an impact on the companies' production (Akbulaev et al., 2020). The first companies closed in China where the world's most electronic products and components are produced. As a consequence, many companies moved their orders outside of China in order to guarantee their production. In Germany, the production had a decrease by one-fourth from February 2020 to April 2020 (Linz et al., 2022).

Furthermore, the pandemic had an impact on imports and exports. In November 2021, 75% of a survey with a sample German industrial companies stated that their limit in production is a consequence of a lack of raw materials (Linz et al., 2022).

Both of the reasons mentioned above led to a decrease in the economic power of Germany. After a steady increase from 2015 to 2018, Germany's GDP started to decrease from 2019 to 2020 by -4.6%[3]. However, there has been some measures from the government. They allocated 1.4 trillion euros to overcome the economic recession (Akbulaev et al., 2020). That money consists of four hundred billion euros as interest-free loan for business, 156 billion as direct help for medium-sized business, and 50 billion as direct help for micro-businesses. Moreover, the government allocated one hundred billion euros to themselves to be able to buy back shares of companies with the risk of bankruptcy.

Overall, the Covid-19 pandemic had a great impact on Germany's economy, for example it led to a production shortage due to a lack of raw materials. As a consequence, Germany's economic power started to decrease which is visible in the decrease of the GDP. For this reason, it is interesting to have a look at the differences in German companies' payout policy before and during the Covid-19 pandemic and see if there are similarities and differences.

2.6 Hypotheses formulation

In order to answer the central research question: "What are the effects of firm-specific determinants of the payout policy of German listed companies?", in the next sections, a few hypotheses are derived from the theories mentioned above.

2.6.1 Profitability

Bhattacharya (1979) combines the signaling theory with payout policy and find that highly profitable firms are more likely to pay dividends to convey information about their financial status and also tend to pay out higher dividends as a good sign to the market. That is also supported by Fama and French (2001) and Kent Baker and Kilincarslan (2018) and leads to the following hypothesis:

H1: The *profitability* of German listed companies positively affects their decision to *pay dividends.*

2.6.2 Ownership concentration

As mentioned in 2.2, the agency cost theory is about conflicts between managers and shareholders. Prior studies indicate that large shareholders can reduce the costs that arise through monitoring these managers (Demsetz and Lehn, 1985; Kent Baker and Kilincarslan 2018). La Porta et al. (2000) add that especially founding families and their direct involvement in their company lead to fewer conflicts between managers and shareholders. That means, the higher the ownership concentration, the lower the number of conflicts. Thus, the need to pay dividends but also the need to buy back shares decreases. However, if the largest shareholder gets more shares and his or her power increases, the agency costs start to increase again. These agency costs can be offset by paying a cash dividend.

[3] The World Bank. https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=DE

Overall, that means it is expected, that at a low level of ownership concentration, the increase in that concentration negatively affects the companies' decision to pay dividends or repurchase shares. However, at elevated levels of concentrated ownership, the need to pay dividends or repurchase shares tend to increase again. That leads to the following hypotheses:

H2: There is a convex relationship between *ownership concentration* and the decision to *pay dividends* in German listed firms.

2.6.3 Company Age/Size

Another determinant of dividend payout policy in prior literature is the age and the size of a company. Evidence shows that large firms with steady and higher earnings have better access to the capital market which reduces their dependence on internally generated earnings (Fama and French, 2001). This finding is also supported by Kent Baker and Kilincarslan (2018) who find a significant effect of company size on both the propensity to payout and the level of payout. That means, larger firms tend to be more likely to pay dividends and also higher dividends than smaller firms which leads to the following hypothesis:

H3: The *firm size* of German listed firms positively affects their decisions to *pay dividends.*

Regarding firm age, Grullon et al. (2002) propose the life cycle theory which says that firms in the early growth stage have many positive NPV projects and require cash to finance them which means that they tend to not pay dividends. However, when companies become older and more mature, they tend to pay dividends more likely and at a higher level (Kent Baker and Kilincarslan, 2018). DeAngelo et al. (2006) support these findings that there is a positive relation between firm age and dividend payments. Thus, the hypothesis about the influence of firm age on dividend payment decision is:

H4: The *firm age* of German listed firms positively affects their decision to *pay dividends.*

2.6.4 Growth

The next major influential determinant of the corporate payout policy is the growth (opportunity) of a company. According to prior literature, firms with a high potential to grow have a higher availability of investment opportunities and favour to reinvest cash into positive NPVs rather than paying dividends (Fama and French, 2001). The hypotheses are:

H5: The *growth (opportunities)* of German listed firms negatively affects their decision to *pay dividends.*

2.6.5 Leverage

The corporate payout policy also depends on the leverage of a company. With a high concentration of debt, companies tend to retain their funds to pay obligations and costs of financial distress (Miller and Rock, 1985). As a consequence, these firms with high leverage, need excess cash to follow these obligations and are supposed to less likely pay dividends. Moreover, high leverage refers to interest rates and other costs, a highly leveraged company has to pay. These payment obligations reduce the available cash to managers, for example to pay dividends. These findings are also supported by Kent Baker and Kilincarslan (2018) who find a negative effect of leverage on the propensity of payout as well as on the level of payout. Thus, the hypotheses concerning leverage are:

H6: The *leverage* of German listed firms negatively affects their decision to *pay dividends.*

2.6.6 Summary of hypotheses

In the previous sections, several hypotheses have been derived from the information asymmetry theory, the agency cost theory and the life-cycle theory. The predictive results from the hypotheses concerning dividend payouts are summarised in Table 1.

Table 1

Summary of the predictions from independent variables on dividend payout decisions

Hypothesis	Independent Variable	Prediction
H1	Profitability	+
H2	Ownership Concentration	Convex
H3	Firm Size	+
H4	Firm Age	+
H5	Growth Opportunities	-
H6	Leverage	-

3. Research methodology

In the following chapter, the research methodology is discussed. First, the research model for the propensity of payout will be developed. Second, the model for the total level of payout is developed. Third, the measurement of variables is examined. Overall, these models follow the paper of Kent Baker and Kilincarslan (2018). The variables in the model are the same except for ownership concentration (OWN^2) since in their paper, they introduce a few interaction terms to measure this variable. The similarities can be explained by the fact that the research at hand uses the same theories to pose the hypotheses and extract the variables as Kent Baker and Kilincarslan (2018).

Next to these two main models, two models with additional dependent variables are established to perform a robustness check for the main models. Moreover, it could be that for robustness reasons, new models are developed that does not contain a specific independent variable due to the evaluation of descriptive statistics or bivariate statistics.

3.1 Propensity of payout

The variables in this study are derived from the hypotheses. In the first model, the dividend payment is transferred into a dummy variable. By doing so, the companies' propensity to payout is measured and analysed. That means, the dependent variable takes a value of 1 if a company pay dividends or zero if not. The appropriate model for an analysis with a non-metric variable is the logit regression. In a logit regression model, a single, non-metric dependent variable is predicted by one or more independent variables. The intercept β_0 refers to the change in the dependent variable when all independent variables take a value of zero. The coefficients β_1 to β_8 refer to the changes in the corresponding dependent variable when there is a change in the independent variable, keeping all other independent variables constant. The residual term is the difference between the predicted and observed value of the dependent variable. This method is in line with the dividend payout paper of Kent Baker and Kilincarslan (2018).

For the logistic regression model, there are a few assumptions that must be met. First, the number of observations should at least be 15-20 times higher than the number of variables. Second, the dependent variable must be binary which means it can only take a value of 0 or 1. For the propensity of dividend payments, the logit regression models look like the following:

$$DPAY_{i,t} = \beta_0 + \beta_1 PROF_{i,t-1} + \beta_2 OWN^2{}_{i,t-1} + \beta_3 LN\_AGE_{i,t-1} + \beta_4 LN\_SIZE_{i,t-1} + \beta_5 GROW_{i,t-1} + \beta_6 DEBT_{i,t-1} + \beta_7 INDUSTRY_{i,t} + \beta_8 YEAR_t + \varepsilon_{i,t},$$

where:

$DPAYi,t$ = Dividend Payout decision of company i in year t

$\beta_1 PROF_{i,t-1}$ = Profitability of company i in year t-1

$\beta_2 OWN^2{}_{i,t-1}$ = Ownership Concentration of company i in year t-1

$\beta_3 LN\_AGE_{i,t-1}$ = Natural Logarithm of Firm Age of company i in year t-1

$\beta_4 LN\_SIZE_{i,t-1}$ = Natural Logarithm of Firm Size of company i in year t-1

$\beta_5 GROW_{i,t-1}$ = Growth opportunities of company i in year t-1

$\beta_6 DEBT_{i,t-1}$ = Leverage of company i in year t-1

$\beta_7 INDUSTRY_{i,t-1}$ = Dummy Variable for Industry

$\beta_8 YEAR_t$ = Dummy Variable for Year

$\varepsilon_{i,t}$ = Error Term

3.2 Level of payout

The second research model will measure the effect of the independent variables on the level of payout. Therefore, the OLS multiple regression will be used as it allows the dependent as well as the independent variables to be metric. In general, the OLS multiple regression analysis is remarkably similar to the logit regression except for the measurement of the dependent variable. Furthermore, the general approach to interpret results from both models is similar.

When running an OLS regression, there are some more assumptions that have to be fulfilled. First, there should be a linear relationship between the independent variables and the dependent variable (Henseler, J., 2021). That can be checked via scatterplots or partial regression plots. In the research at hand, the partial regression plots are only evaluated for all significant variables. However, the partial regression plots of all other variables are reviewed. Second, the error terms have to be homoscedastic which can be checked by looking at the scatterplots of the residuals (Henseler, J., 2021). Third, the error terms have to be independent of the dependent variable (Henseler, J., 2021). Since the independence is extremely hard to verify, in this research the independence is assumed due to theoretical reasoning. Fourth, the error term should be normally distributed which can be done by looking at the histograms of the error terms (Henseler, J., 2021). Although the central limit theorem sates that if the sample size is larger than two hundred, the error term is approximately normally distributed, in this research, the histograms are given. At last, there should be no perfect multicollinearity (Henseler, J., 2021) which can be checked by running VIF test for all variables. If the value of the VIF test is below the threshold of five, it would be expected that there is no perfect multicollinearity. The model for the dividend payout will look as follows:

$DPR\_NI_{i,t}$ = $\beta_0 + \beta_1 PROF_{i,t-1} + \beta_2 OWN^2_{i,t-1} + \beta_3 LN\_AGE_{i,t-1} + \beta_4 LN\_SIZE_{i,t-1} + \beta_5 GROW_{i,t-1} + \beta_6 DEBT_{i,t-1} + \beta_7 INDUSTRY_{i,t} + \beta_8 YEAR_t + \varepsilon,$

where:

$DPR\_NI_{i,t}$ = Dividend payout ratio by company i in year t scaled by net income in year t

3.3 Measurement of variables

After the models of the regression analysis have been developed and described, in the following, the measurement of the dependent variables, independent variables and the control variables is explained.

3.3.1 Dependent variables

In the first to models for the propensity of payout, the variable DPAY is a dummy variable which takes a value of 1 if a company pays dividends and a value of zero otherwise which follows the research of Denis and Osobov (2008) and Kent Baker and Kilincarslan (2018). In this study, dividends are defined by cash dividends on common stock in Dollar. In the OLS regression models, the variable DPR is measured as ordinary cash dividends in Dollar scaled by a company's net income, following Schmid et al. (2010).

To test this model for robustness, the dividend payout ratio is calculated by dividing the total amount of ordinary dividends paid by total assets.

3.3.2 Independent variables

In this section, the measurements of independent variables will be described. To begin with, it is crucial to state that all independent variables are lagged by on year to avoid reversed causality. First, profitability (PROF) is measured as the return on assets (ROA) following the studies of Kent Baker and Kilincarslan (2018). Jewell et al. (2011) find eleven different ways to measure the ROA ratio. The most common way to calculate it is by dividing the net income by total assets which is also used in this study. Second, ownership concentration (OWN^2) is measured as the proportion of the total number of shares held by the largest shareholder, as in Gugler and Yurtoglu (2003). To test the convex relationship of ownership concentration and payout decisions, the proportion is squared as in Farinha (2003). Third, firm age (LN_AGE) is measured as the years since the firm's incorporation date, following Kent Baker and Kilincarslan (2018). According to Dang et al. (2018), there are three main ways to measure firm size in corporate finance: total sales, total assets, and market capitalization. In this paper, firm size (LN_SIZE) is measured by total assets in Dollar, following de Jong et al. (2019). The variables firm age and firm size both are transferred into their natural logarithm, following Kent Baker and Kilincarslan (2018), Schmid et al. (2010) and de Jong et al. (2019). When it comes to growth opportunities (GROW), the paper uses the market-to-book ratio which refers to the market capitalisation divided by the total book value of a company, as in Kent Baker and Kilincarslan (2018), Schmid et al. (2010) and suggested by Fama and French (2001). The variable debt (DEBT) is measured as the proportion of total debt to total assets, following Kent Baker and Kilincarslan (2018), as the payout decisions tend to only be influenced by debt contracts and not by other liabilities.

3.3.3 Control variables

As control variables, this paper follows Kent Baker and Kilincarslan (2018) and uses the variable INDUSTRY which is used to classify the companies by their industry according to the first digits of their SIC Code. This variable will take a value of 1 if it operates in a certain industry and zero otherwise. To be more specific, the companies are classified following Dasilas and Papasyriopoulus (2015). This specification contains the following industries: forestry and fishing (SIC Code 0000-0999), mining and construction (SIC Code 1000-1999), manufacturing (SIC Code 2000-3999), transportation and communication (SIC Code 4000-4899), wholesale and retail trade (SIC Code 5000-5999), and Services (SIC Code 7000-8999). The reason certain categories are not included in the regression will be given in section 3.4. In the regression, the services industry is taken as the reference category. As a second control variable, this paper uses the control variable YEAR for the years between 2015 and 2021 which takes a value of one for a particular year and zero otherwise. The reference category for the period between 2015-2018 is the year 2015 and the reference category for the period between 2019-2021 is the year 2019.

Since most of the variables are measured differently, for example the total assets are measured as dollars and the profitability is measured as a ratio, the interpretation of the results has to be performed very carefully since a change of one unit in total assets is different from a change of one unit in profitability. A summary of all variables including the dependent variables, independent variables and control variables can be found in table 2.

Table 2

Summary of Variables and their Measurement

Variable	Abbreviation	Measurement
Dependent Variables		
Propensity of Dividend Payout	DPAY	Dummy Variable (0=No Dividends, 1=Dividends)
Total Level of Dividend Payout	DPR_NI	Ordinary Cash Dividends scaled by Net Income
Robustness Variable	DPR_TA	Ordinary Cash Dividends scaled by Total Assets
Independent Variables		
Profitability	PROF	Return on Assets (Net Income/Total Assets)
Ownership Concentration	OWN^2	Squared % of shares by largest shareholder
Firm Age	LN_AGE	Natural Logarithm of Years since the company's incorporation date
Firm Size	LN_SIZE	Natural Logarithm of Total Assets in Dollar
Growth Opportunities	GROW	Market-to-Book Ratio (Market Cap./Total Book Value)
Leverage	DEBT	Total Debt/Total Assets
Control Variables		
Industry	INDUSTRY	Dummy Variable
Year	YEAR	Dummy Variable

3.4 Data collection

As the study investigates the propensity and level of dividend payout of German listed companies, the primary data source for this study is ORBIS which contains both financial (Profitability, Dividends etc.) and non-financial data (ownership concentration, firm age etc.) for a long period of time. For missing values, this study concentrates on secondary data, for example balance sheets and income statements to provide the most thorough analysis possible. These balance sheets and income statements are taken from the companies' annual reports. Moreover, secondary data for companies' ownership structure is retrieved from news articles and company websites. Additionally, it is worthy to state that all data is presented in dollar. The sampled firms are all German listed companies that have been listed before 2015 as this study concentrates on the period between 2015-2021. That particular time frame for the analysis is chosen because of the start of the Covid-19 pandemic in 2019.

Moreover, financial companies and institutions are excluded from the sample according to their SIC codes 6000-6999. That is, because these companies follow different regulations concerning their payout policy. This procedure is in line with prior literature, for example Denis and Osobov

(2008), Chen et al. (2019) and Renneboog and Trojanowski (2011). Moreover, utilities are excluded since they follow different regulations concerning payout policies and their external financing, as in Renneboog and Trojanowski (2011). Therefore, companies with the SIC code between 4900-4949 are excluded. At last, companies that have a missing value for one year will be removed listwise for that specific year. However, the company is included for all other years so that the panel data is unbalanced. Moreover, when it comes to outliers, there are two main ways of dealing with them. After detecting the outliers with box plots and descriptive statistics, one can either delete outliers or winsorize them. This research uses winsorizing which deals with changing extreme outliers to the minimum or maximum value within the 95%-interval of non-outlier data. This procedure is used because the deletion of outliers would let the sample size, which already is relatively small, decrease. Since this study in general focusses on the time between 2015 and 2021 and the independent are intended to be lagged by one year, data for the years between 2014 and 2021 are retrieved from the database.

With all of these criteria given, the total sample size in this research is 301. This means that there is a maximum of 2107 observations per variable. However, due to listwise deletion of missing values and using an unbalanced panel data set, the number of observations may differ per variable.

Concerning the tests of the hypotheses, the alternative hypotheses formulated in section 2.6 are tested according to their independent variables together with their statistical significance. That means, they are accepted if the coefficient has the correct direction significance is below the threshold of 0.10. If the coefficient for a certain variable has the wrong direction or the coefficient is not significant, the corresponding alternative hypothesis is rejected.

4. Results

In this chapter, the most important results of the analysis are presented. First, in section 4.1 the descriptive statistics are discussed. Second, section 4.2 will present Pearson's correlation matrix that is described and discussed. Third, in section 4.3 the assumptions of regression analyses are evaluated. Then, section 4.4 will present the testing of the hypotheses and discusses the results of the regression analyses. At last, the robustness checks are evaluated.

4.1 Descriptive statistics

As already mentioned in chapter 3.4, some of the variables are winsorized at the 5%-level. These winsorized variables include DPR_NI, DPR_TA, PROF, LN_SIZE, GROW and DEBT. The variables age, ownership concentration and all dummy variables are not winsorized. First, the dummy variables are not winsorized since they can only take a value of 0 or 1 and thus cannot take any extreme outlying values. Second, age is not winsorized since there has not been any extreme values and the values are more or less moderated as the age of a company cannot take values below zero and can only increase by one per year. At last, ownership concentration is not winsorized as it does not contain any extreme values. For winsorizing, the 5% level which means that the lower and upper tails are winsorized at 2.5%, has been chosen because in comparison to a smaller level, it is more applicable to really eliminate outliers. In order to test the level of winsorizing, first, the 1% level (0.5% at each tail) and then the 2.5% level (1.25% at each tail) were tested. However, these winsorizing levels were observed to not eliminate a sufficient number of extreme values. In addition, the values for the dependent variables are taken from the period between 2015-2021, whilst the independent variables are lagged by one year. The descriptive statistics for all variables can be seen in table 3. However, the control variable YEAR is not included in the descriptive statistics because each dummy for a year would simply take a mean value of 1 divided by 7 because the analysis contains 7 years. For example, the mean value of the dummy variable for the year 2015 would have a mean of 0.1428. That would be the same value for all other year dummies since every company was operating in any year of observation. Thus, the mean value for the years is not crucial to include in the descriptive statistics.

For the analysis of the descriptive statistics, the paper for comparison is the one of Kent Baker and Kilincarslan (2018) because the models and variables are almost the same. Moreover, there is no comparable paper that analyses the effect of firm-specific characteristics on companies' dividend payout policy in Germany. However, when comparing, it is crucial to state that this paper focusses on German listed firms in the period between 2015-2021 whilst the paper to compare is focussing on Turkish listed firms in the period between 2009-2016. Comparing both of the statistics, some of them are very similar and some are differing a lot. First, the sample size in the descriptive statistics is differing a lot between the variables as the ORBIS database contains some missing values for all of them. Furthermore, the maximum observations for one variable in the descriptive statistics can be seen at the independent variable AGE in Panel B with 1204 as 301 companies are included in the final sample for 4 years in Panel A which results in a maximum value of 1204 for observations and for 3 years in Panel B which results in a maximum observations of 903.

Beginning with the dependent variable DPAY which takes a value of 1 if a company pays dividends in a specific year and zero otherwise, the mean of 0.94 in Panel A implies that in 94% of 1433 observed cases companies pay dividends between 2015-2018. In Panel B (2019-2021), the mean of DPAY is 0.89 showing that before the pandemic, the average likelihood of paying dividends was higher than during the pandemic. Compared to a mean of 0.406 in Kent Baker and Kilincarslan (2018), both means of the propensity to pay dividends in this research are higher. That means that German companies between 2015-2021 are more likely to pay dividends than Turkish firms between 2009-2016. Comparing the mean with past data about German dividend payers, one can see an increase compared to about 40% in 2005 (von Eije and Megginson, 2008).

Coming to the variables DPR_NI, since it measures the ordinary cash dividends scaled by net income, in both Panels the minimum values are negative because some companies can have a negative net income in one year. The maximum value of 1.978 indicates that one firm almost paid twice as much money on dividends than they have earned as net income in a particular year. This maximum value is valid for both periods. The mean for that variable is 0.38 in Panel A and 0.31 in Panel B which implies that on average, German listed companies pay 38% of their net income as cash dividends between 2015-2018 and 31% between 2019-2021. That shows that before the pandemic the level of payout seems to be higher than during the pandemic.

In contrast to DPR_NI, the minimum value for DPR_TA is zero because when a company does not pay dividends in a particular year, the ratio is zero divided by total assets and total assets cannot be negative. The maximum value as well as the mean, compared to the maximum value and the mean of DPR_NI are smaller because the absolute values of total assets are larger than the absolute values of net income. The mean of 0.028 in Panel A indicates that on average, German listed companies pay 2.8% of their total assets as cash dividends. In the period between 2019-2021, the companies pay on average 2.1% of their total assets as cash dividends. For the variables DPR_NI and DPR_TA, the descriptive statistics cannot be compared with Kent Baker and Kilincarslan (2018) because they do not give descriptive statistics about their second model in which they analyse the total level of payout. Comparing the observations for all of the dependent variables, all of them have a value of 841 in Panel A and 592 in Panel B which shows that if there is data on the dividend payout of a company in a particular year, there is also data on the net income and the total assets in that year.

When it comes to the independent variables, PROF which is measured as the ROA using net income divided by total assets, has a minimum of -35% and a maximum of 20.9%, and a mean of 2.3% in Panel A. In Panel B, the minimum and maximum value is the same as in the previous period but the mean decreases to 1.2% which indicates that the profitability of German listed firms decreased during the Covid-19 pandemic. Compared with Turkish firms with an average of 3.7% (Kent Baker and Kilincarslan, 2018), the German companies' average is more than twice as low. One reason for that could be that the research at hand includes years during an economic crisis from 2019 to 2021. Then, the variable OWN measures the ownership concentration by using the percentage of shares held by the largest shareholder. In both time periods, the minimum value of 0.0001 indicates that the lowest amount of shares held by the largest shareholder of a company is 0.01% and the maximum value of 1 shows that the maximum of shares held by the largest shareholder is 100%. Moreover, the mean of 0.5277 implies that the average amount of shares held by the largest shareholder of a company is 52.77% in Panel A and 57.93% in Panel B which implies that the ownership concentration increased during the pandemic. For clarity reasons, the variable OWN^2 is used in the descriptive statistics in order to give a better understanding of the real data. However, in the models the ownership concentration is squared (OWN^2) because the hypothesized impact on dividend payout is quadratic. Again, the variable cannot be compared with the Turkish sample because the variable ownership concentration differs in the measurement. Looking at the observed cases, one can see that almost all companies have data about their largest shareholder. However, some companies only give the ownership structure between groups, for example public ownership or institutional ownership. Consequently, these data are missing in the analysis.

Considering the variable AGE, there is a difference of 261 years between the youngest and the oldest firm. To be precise, the oldest firm was found in 1748 and the youngest firm was found in 2004. The extreme values for AGE have been checked manually and confirmed. On average, the companies used in the sample are 66.58 years old. Again, to allow an easier interpretation of the companies' age, the original age is given in the descriptive statistics. However, in the regression analyses, the natural logarithm of the age is used. Compared to Kent Baker and Kilincarslan (2018), the natural logarithm of age is very similar, for example the mean of LN_AGE in this research has a value of 3.84 in Panel A and 3.93 in Panel B and in the Turkish sample of 3.521. For both AGE and LN_AGE, there are 2107 cases which means that all companies from the sample have data on their incorporation date.

As table 3 shows, the minimum value for firm size, measured as total assets in dollar, in Panel A and Panel B is 4,211,091.356 and the maximum value is 72,719,934,836. In both periods, the minimum and maximum values are the same because of winsorizing the data. With a mean of 4,275,621,560 and a standard deviation of 13.006.825.303 in Panel A and a mean of 4,787,228,004 and a standard deviation of 13,900,979,883 one can see that despite of earlier winsorizing, the data contains extreme outliers. Therefore, the natural logarithm of the variable, LN_SIZE, is used in the analysis. Both variables have 2068 observed values which shows that almost all firms have data on their total assets for almost all years.

Regarding GROW, which is measured as the market-to-book ratio, the minimum value is 0.0083 and the maximum value is 13.6084 in Panel A and Panel B. Again, the values are the same due to winsorizing the data. Moreover, that shows that there might be huge differences between the companies. The mean values of 2.66 in Panel A and 2.97 in Panel B indicate that on average, German companies are overvalued and thus have a lot of growth opportunities. Compared to Kent Baker and Kilincarslan (2018), Turkish companies on average have a lower market-to-book ratio with a mean of 1.521.

The last independent variable DEBT, measured as total debt scaled by total assets, has a minimum value of 0.01 indicating that the least leverage a company has in the sample is 1%. On the other hand, the maximum value of 4.4 shows that the highest leverage a company takes in the sample is 440%. Since this maximum value is very high, a difference between the companies can be observed. The mean values of 0.88 (93%) in Panel A and 0.99 (99%) in Panel B, compared to Turkish firms (0.223), are four times as high which shows that German companies tend to finance themselves with debt more likely than Turkish companies (Kent Baker and Kilincarslan, 2018). Moreover, the leverage of German listed companies seems to have increased during the pandemic.

Regarding the dummy variables, one can see that 0.33% of the companies are operating in the forestry and fishing industry, 2.66% in the mining and construction industry, 57.14% in manufacturing, 10.3% in the transportation and communication industry, 7.97% in the wholesale and retail industry, and 21.59% in the services industry. Moreover, these means do not change from Panel A to Panel B since companies usually operate in one specific industry throughout their lifetime.

Table 3

Descriptive Statistics

Panel A: Time Period between 2015-2018

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Dependent Variables:					
DPAY	841	0	1	0.94	0.230
DPR_NI	841	-0.9200	1.9780	0.387207	0.4427340
DPR_TA	841	0.0000	0.1400	0.028192	0.0308158
Independent Variables:					
PROF %	1169	-0.3505	0.2094	0.023900	0.1000644
OWN	1172	0.00010000	1	0.5739201860	0.35927883536
OWN^2	1172	0.0000000100	1	0.453678003100	0.3983256405597
AGE	1204	11	269	65.08	54.197
LN_AGE	1204	2.3979	5.5947	3.844175	0.8131380
SIZE	1172	4,211,091.36	72,719,934,835.63	4,275,621,560.32	13,006,825,303.02
LN_SIZE	1172	15.2532	25.0099	19.625040	2.2112791
GROW	1094	0.0083	13.6084	2.661356	2.6776129
DEBT %	1122	0.0104	4.4003	0.887396	0.9296560
Control Variables:					
INDUSTRY_FORFISH	1204	0	1	0.0033	0.058
INDUSTRY_MINCON	1204	0	1	0.0266	0.161
INDUSTRY_MANUFACT	1204	0	1	0.5714	0.495
INDUSTRY_TRANSCOM	1204	0	1	0.1030	0.304
INDUSTRY_WHOLERETAIL	1204	0	1	0.0797	0.271
INDUSTRY_SERVICES	1204	0	1	0.2159	0.412
Valid N (listwise)	778				

Panel B: Time Period between 2019-2021

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Dependent Variables:					
DPAY	592	0	1	0.89	0.317
DPR_NI	592	-0.9200	1.9780	0.314885	0.5243334
DPR_TA	592	0.0000	0.1400	0.021526	0.0256899
Independent Variables:					
PROF %	892	-0.3505	0.2094	0.011690	0.0949635
OWN	879	0.00010000	1	0.5277989761	0.35932998189
OWN^2	879	0.0000000100	1	0.407542903106	0.3983823457547
AGE	903	15	272	68.58	54.199
LN_AGE	903	2.7081	5.6058	3.937862	0.7541074
SIZE	896	4,324,667.18	72,719,934,835.63	4,787,228,004.41	13,900,979,883.91
LN_SIZE	896	15.2798	25.0099	19.850098	2.2019292
GROW	868	0.0083	13.6084	2.977013	3.0736864
DEBT %	862	0.0104	4.4003	0.989657	0.9886722
Control Variables:					
INDUSTRY_FORFISH	903	0	1	0.0033	0.058
INDUSTRY_MINCON	903	0	1	0.0266	0.161
INDUSTRY_MANUFACT	903	0	1	0.5714	0.495
INDUSTRY_TRANSCOM	903	0	1	0.1030	0.304
INDUSTRY_WHOLERETAIL	903	0	1	0.0797	0.271
INDUSTRY_SERVICES	903	0	1	0.2159	0.412
Valid N (listwise)	563				

Note: This Table shows the descriptive statistics for all variables, except the control variable YEAR. The data of the dependent variables are based on the years 2015-2021 and the data of the independent variables are lagged by one year. Panel A shows the descriptive statistics for the period between 2015-2018 and Panel B shows the descriptive statistics for the period between 2019-2021. All metric variables are winsorized at the 5% level except for AGE. The maximum number of observed values is 2107 because 301 companies are included in the sample for a period of seven years. For a better interpretation, the original data for OWN, AGE and SIZE are given although in the analysis the variables are converted into OWN^2, LN_AGE and LN_SIZE. The abbreviations for the industry dummies stand for the following industries in the order of which they are appearing in the table: forestry and fishing, mining and construction, manufacturing, transportation and communication, wholesale and retail, and services.

4.2 Pearson's correlation matrix

In order to analyse the association between the variables, for the bivariate analysis Pearson's correlation matrix is used. In general, the values can take a value between -1 and +1 which indicates the strength of the variables' correlation. In the correlation matrix, a value below -0.5 or above 0.5 indicates a strong correlation between two variables. A moderate correlation is given when the value is between -0.5 and - 0.3 or between 0.3 and 0.5 and a low correlation is given for all values between -0.3 and 0.3. The correlation matrix for the variables included in the regression analysis can be found in table 4.

When it comes to high correlations, the table indicates that there is a high correlation between PROF and DPAY_TA with a significant value of 0.61**. That could be explained since both variables are measured as a ratio with total assets in the denominator. Although the independent variable is lagged by one year, there seems to be some multicollinearity issues. Therefore, one additional robustness check is performed for the model with DPR_TA as dependent variable without the independent variable PROF.

Furthermore, there are some moderate correlations, for example between DPR_TA and DPR_NI with a correlation value of 0.394**. However, these variables both are dependent and consequently not used in the same model. That is why this moderate correlation is not problem when conducting the regression analyses. Moreover, all other moderate or small correlations are checked with a VIF test for checking multicollinearity.

All in all, there are many significant small and moderate correlations between the variables. In order to be sure to exclude multicollinearity issues, a VIF test is conducted. The results of that VIF test are analysed in the next section.

Table 4

Pearson's Correlation Matrix

	DPAY	DPR_NI	DPR_TA	PROF	OWN^2	LN_AGE	LN_SIZE	GROW	DEBT %
DPAY	1	.207**	.248**	.379**	-.124**	0.000	.166**	0.013	-0.047
DPR_NI	.207**	1	.394**	.185**	-0.001	-0.014	-.057*	.072**	-.059*
DPR_TA	.248**	.394**	1	.610**	0.018	-.143**	-.142**	.414**	-.303**
PROF	.379**	.185**	.610**	1	-0.026	-.106**	-.066*	.360**	-.299**
OWN^2	-.124**	-0.001	0.018	-0.026	1	-0.045	-.376**	-0.020	-.089**
LN_AGE	0.000	-0.014	-.143**	-.106**	-0.045	1	.275**	-.196**	0.015
LN_SIZE	.166**	-.057*	-.142**	-.066*	-.376**	.275**	1	-.115**	.341**
GROW	0.013	.072**	.414**	.360**	-0.020	-.196**	-.115**	1	-0.013
DEBT %	-0.047	-.059*	-.303**	-.299**	-.089**	0.015	.341**	-0.013	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

c. Listwise N=1341

4.3 Assumptions

Next to the bivariate analysis of data, there are some assumptions for both logit regression and OLS regression that have to be checked.

First of all, in addition to Pearson's correlation matrix, the VIF scores between the variables have been checked to test for multicollinearity. The results of that test can be seen in Appendix A. Since all VIF values are below the threshold of five, there is no issue of multicollinearity. Despite of that fact, the robustness check for the model of DPR_TA is still run without PROF.

Then, the number of observations should be at least 15 to 20 times larger than the number of variables. In this research, the number of variables is six and the number of maximum observations is 2107 which means that the sample size is sufficiently large.

For the logit regression, there are some more assumptions that have to be fulfilled. First, the dependent variable has to be binary which is the case since the dependent variable of the logit regression at hand can only take the values of 0 (no dividends paid) or 1 (dividends paid). Second, there should not be significant outliers. This assumption is also met since the data was winsorized at the 5%-level.

Considering the OLS regression, there are some more assumptions that must be fulfilled. The results of these assumptions can be found in Appendix B for all OLS regression analyses. First, the P-P Plots are presented for all regressions. Although none of these plots show perfect linearity, for all the plots, linearity can be assumed. Moreover, the histograms in Appendix B show the standardized residuals of the regression models. All residuals follow a normal distribution but also include some extreme values that affect that normal distribution. Next to the normal distribution, which is visible in the histograms, the Central Limit Theorem is given. The Central Limit Theorem states that if the sample size is larger than two hundred, the distribution is expected to be approximately normal. Third, to test the regression models for homoscedasticity, the scatterplots of the standardized observed values against the standardized residuals are shown in Appendix B. Having a look at these scatterplots, the variances in the residuals seem to be equal due to the winsorizing of the data.

All in all, as can be seen in Appendix A, the multicollinearity issues that were supposed to occur because of high correlations could not be verified with the VIF test. Furthermore, all normality histograms, P-P Plots and scatterplots in Appendix B show that all assumptions regarding the OLS regression models are fulfilled.

4.4 Regression results

This section analyses and discusses the regression results for all regression models. In all tables that are presented, there are two models: first, the full model including the control variables and second the model with the control variables being omitted. However, the coefficients from the models without the control variables are only analysed if there is a significant difference to the full model. In the following, first the results from the logistic regression with the dependent variable DPAY are discussed. Second, the results of the OLS regression with the dependent variable DPR_NI are discussed.

4.4.1 Logistic regression

Table 5 shows the results for the logistic regression model with the dependent variable DPAY. The table is divided into two panels. Panel A gives the coefficients and significant levels for the period between 2015-2018 and Panel B for the period between 2019-2021. Regarding the first independent variable PROF, measured as return on assets, there is a significant positive impact at the one percent level on the propensity of payout in both time periods. Between 2015-2018, the coefficient is 33.531 and between 2019-2021, the coefficient has a value of 28.929, which means if there is a change in the return on assets by one unit, the log odds of paying dividends increases by 33.531 or 28.929 units respectively, keeping all other variables constant. That means, when a company's profitability increases by one percent, the likelihood of paying dividends increases by 3.65 between 2015-2018 and by 3.66. Comparing both of the coefficients, the impact from profitability on the propensity of paying dividends is almost the same within the two time periods. Regarding the model without control variables, the coefficients are still significant for both periods. Overall, these results are in line with Denis and Osobov (2008), Kent Baker and Kilincarslan (2018), and Fama and French (2001).

Second, the independent variable OWN^2 has a significant negative coefficient for the period between 2015-2018 at the one percent level with a coefficient of -1.923. That means, that there is a concave rather than the expected convex impact from ownership concentration on the propensity of payout. To be specific, at low levels of ownership concentration, the propensity of payout tends to increase until a specific level of ownership concentration is given. After that specific level is reached, the propensity of payout starts to decrease. However, for the period between 2019-2021, the coefficient is positive but also not significant.

When looking at the independent variable LN_AGE which is the linear algorithm of the years since the firm's incorporation date, for both periods there is a negative, but insignificant, coefficient. However, for the model without control variables in the second period between 2019-2021, the negative effect of age on the propensity of dividend payout is significant at the 5% level. That indicates that a change in one unit of LN_AGE indicates that with an increase of one unit in the natural logarithm of a company's age multiplies the odds of paying dividends by 0.649.

Next, table 5 shows the impact of the independent variable LN_SIZE on the propensity of paying dividends. In both time periods, there is a significant positive coefficient at the one percent level. For the period between 2015-2018, the coefficient has a value of 0.393 which means that a change of one unit in LN_SIZE would multiply the odds of paying dividends by 1.481, keeping all other variables constant. In the period between 2019-2021, the coefficient of 0.452 means that a one-unit change would multiply the odds of paying dividends by 1.57, keeping all other variables constant. That effect supports the findings of Kent Baker and Kilincarslan (2018), Denis and Osobov (2008), and Fama and French (2001).

At last, both independent variables GROW, and DEBT have no significant impact on the propensity of dividend payout. For the variable GROW, measured as the market-to-book ratio, in contrast to the findings of Denis and Osobov (2008) and Fama and French (2001), the model in this research indicates a negative impact on the likelihood to pay dividends, although not significant. The variable DEBT has negative coefficients in both time periods which would support prior research. However, the coefficients are not significant. In order to check the model for robustness, the logistic regression will be performed only including the significant variables from table 5.

All in all, the variables LN_AGE, GROW and DEBT have no significant impact on the propensity of payout of German listed firms, except for LN_AGE in the model without control variables in Panel B. The variables LN_SIZE and PROF have a significant positive impact on the dependent variable DPAY, as predicted in section 2.6.1 and 2.6.3. Furthermore, the negative coefficient of OWN^2 indicate that there is a concave impact on DPAY rather than the predicted convex impact. Possible reasons and explanations for these results are discussed in section 5. For the reasons that OWN^2, LN_AGE and LN_SIZE are not significant in both periods, a separate robustness check is performed that includes the full model with these variables in their original form.

Table 5

Logistic Regression Model for the dependent variable DPAY.

Panel A: 2015-2018

	Model 1: Full Model DPAY			Model 2: Control Var. Omitted		
	B	S.E.	Sig.	B	S.E.	Sig.
Constant	27.096	21292.395	0.999	-3.622	2.866	0.206
PROF	33.531	4.504	0.000	33.170	4.382	0.000
OWN^2	-1.923	0.613	0.002	-1.895	0.597	0.002
LN_AGE	-0.047	0.297	0.875	-0.087	0.277	0.754
LN_SIZE	0.393	0.152	0.009	0.410	0.147	0.005
GROW	-0.136	0.097	0.161	-0.139	0.094	0.140
DEBT	-0.233	0.267	0.382	-0.226	0.253	0.372
Industry Dummy	Included			Omitted		
Year Dummy	Included			Omitted		
Pseudo R^2	0.492			0.486		

Panel B: 2019-2021

	Model 1: Full Model DPAY			Model 2: Control Var. Omitted		
	B	S.E.	Sig.	B	S.E.	Sig.
Constant	14.025	22309.30	0.999	-6.064	2.020	0.003
PROF	28.929	4.387	0.000	23.779	3.568	0.000
OWN^2	0.266	0.484	0.582	0.248	0.452	0.583
LN_AGE	-0.342	0.240	0.154	-0.433	0.212	0.041
LN_SIZE	0.452	0.104	0.000	0.485	0.101	0.000
GROW	-0.081	0.094	0.386	-0.045	0.085	0.593
DEBT	-0.119	0.227	0.601	-0.205	0.206	0.321
Industry Dummy	Included			Omitted		
Year Dummy	Included			Omitted		
Pseudo R^2	0.446			0.359		

Note: Table 5 shows the unstandardized coefficients, standard error and significance levels for the logistic regression model with dependent variable DPAY. Panel A shows the coefficients for the period between 2015-2018 and Panel B for the period between 2019-2021. The definitions of the variables can be found in table 2. All independent variables and control variables are lagged by one year. The variables PROF, LN_SIZE, GROW and DEBT are winsorized at the 5% level.

4.4.2 OLS regression

Table 6 shows the unstandardized and standardized coefficients and the significance of those for the OLS regression model with the dependent variable DPR_NI, measured as ordinary cash dividends paid scaled by net income. Panel A shows the regression results for the time period between 2015-2018 and Panel B for the time period between 2019-2021. The table shows the unstandardized beta values that are discussed first together with the significance levels. By doing so, the significant results are supported by partial regression plots to show the significant effects visually. Second, the standardized values are discussed to examine which variables are affecting the dependent variable the most. At last, the adjusted R^2 is discussed.

First, the variable PROF is significantly positive at the one percent level in all models. In the period between 2015-2018, the coefficient has a value of 1.739 which indicates that a one-percent change in PROF will lead to a change of 1.739 percent in DPR_NI, keeping all other variables constant. In the period between 2019-2021, a change of one percent in PROF leads to a change of 1.446 percent in DPR_NI. Looking at the models without the control variables, the coefficients are also significantly positive. These results support the findings of Kent Baker and Kilincarslan (2018) who found a positive impact of the return on assets on the dividend payout ratio. In order to visualize the effect and give a better opportunity of understanding, the partial regression plots showing the impact of PROF on DPR_NI in both time periods are shown in Figures 1 and 2. There, the positive impact is shown by the positive linear line which, according to table 6, is significant. Both the tables and the plots support the hypothesis that profitability has a positive effect on the dividend payout ratio, developed in section 2.6.1. Moreover, these results add to the logistic regression since in both models the coefficients are significantly positive. That means, companies with a higher profitability are not only more likely to pay dividends but also pay a higher level of dividends.

Figure 1

Partial Regression Plot between Profitability and Dividend Payout Ratio for the period between 2015-2018

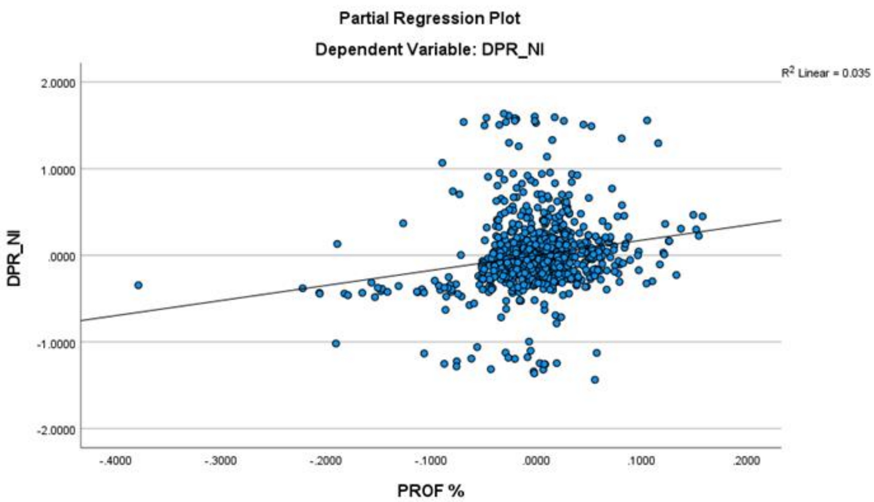
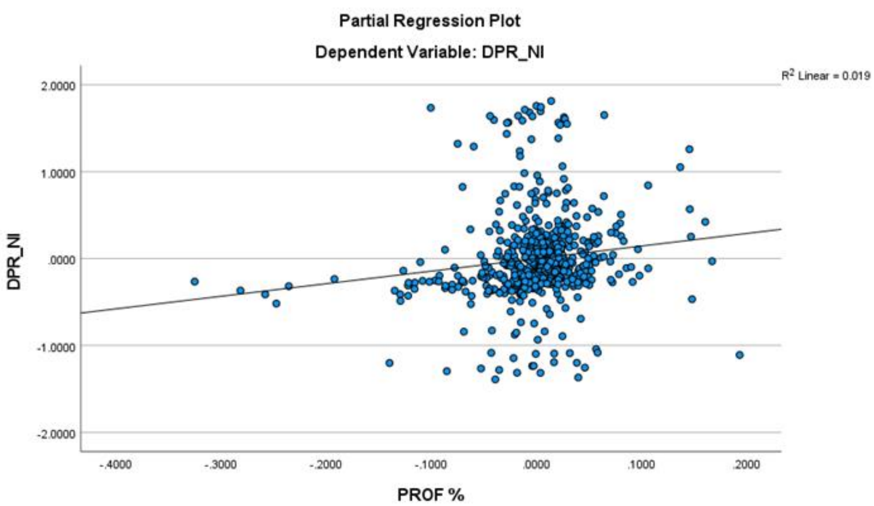


Figure 2

Partial Regression Plot between Profitability and Dividend Payout Ratio for the period between 2019-2021



The next significant coefficient can be found for the independent variable OWN^2 in Panel A of table 6. In the period between 2015-2018, a change of one percent in squared ownership concentration will lead to a decrease in DPR_NI of 0.094 percent with a significance level of 5%. However, this effect cannot be seen in Panel B for the time period between 2019-2021. First, the coefficient is positive and second the coefficient is not significant. The partial regression plots of the effect of OWN^2 can be found in Figure 3. For the period between 2015-2018, one can see a negative slope of the linear regression model supporting the negative coefficient in Panel A. That means, the ownership concentration of German listed firms negatively affects the dividend payout ratio. However, looking at Figure 4, the partial regression plot for the second time period, one can see a positive relation but with a small slope, already indicating that the effect is not significant. Comparing both periods with coefficients and partial regression plots, the effect between 2015-2018 is significantly positive and between 2019-2021, the positive effect is not significant. Regarding the hypothesis developed in 2.6.2, the predicted convex effect of ownership concentration cannot be validated by the results. On the contrary, for the period between 2015-2018, there is a concave effect. Compared to the results from the logistic regression, the significantly negative coefficient indicates that next to a concave effect from OWN^2 on DPAY, there is a concave effect from OWN^2 on DPR_NI. That means at low levels of ownership concentration, the level of dividend payout increases. Then, at a certain level of ownership concentration, the level of dividend payout starts to decrease. In both regression models, the effect of OWN^2 is positive but not significant for the time period between 2019-2021.

Figure 3

Partial Regression Plot between Ownership Concentration and Dividend Payout Ratio for the period between 2015-201

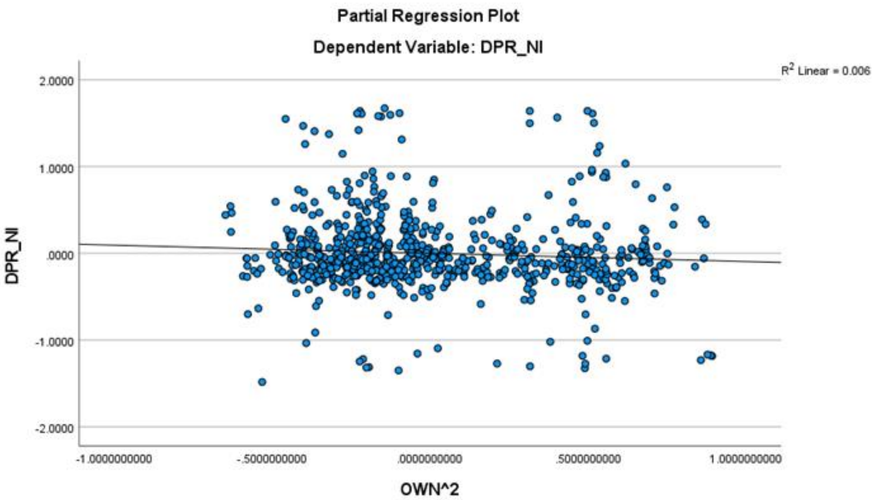
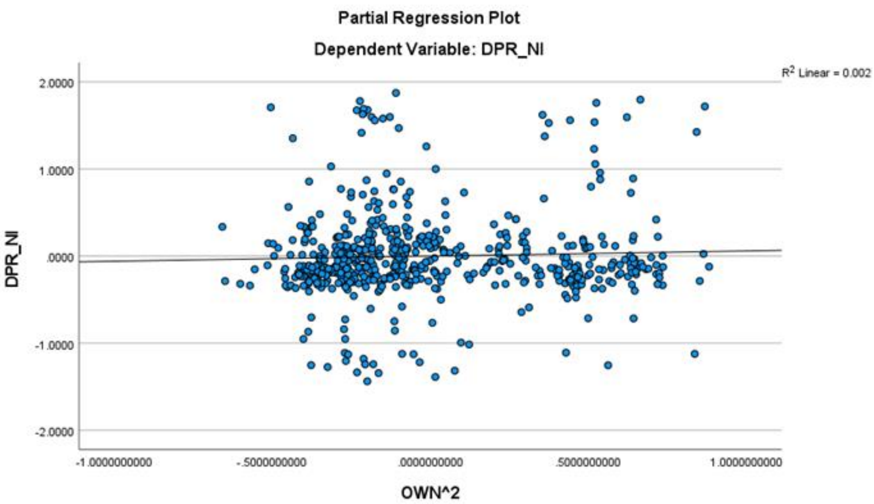


Figure 4

Partial Regression plot between Ownership Concentration and Dividend Payout Ratio for the period between 2019-2021



The last significant effect of an independent variable on DPR_NI can be found for LN_SIZE in Panel B for the time period between 2019-2021. The coefficient of -0.021 at a significance level of 10% indicates that a change of one unit in LN_SIZE leads to a change of -0.021 units in DPR_NI. However, looking at the model without control variables but also at Panel A, the effect of LN_SIZE on DPR_NI is not significant. Looking at the partial regression plots in Figure 5 and 6, the effect of LN_SIZE on DPR_NI in the second period seems to have a higher negative slope than in the first period. That is supported by table 6 since the negative coefficient is larger in Panel B and also significant, compared to the non-significant coefficient in Panel A. Both results do not support the predicted positive effect from company size on the dividend payout ratio from section 2.6.3. In one period, the effect is negative and significant and in the other period the effect is positive but not significant which indicates that overall, the effect is negative. Then, compared to the logistic model where LN_SIZE has a significantly positive effect on DPAY, in the OLS regression model, there are different results. The difference indicates, that in the time period between 2019-2021, the size of a company positively affects the likelihood of paying cash dividends but negatively affects the level of payout.

Figure 5

Partial Regression Plot between Company Size and Dividend Payout Ratio for the period between 2015-2018

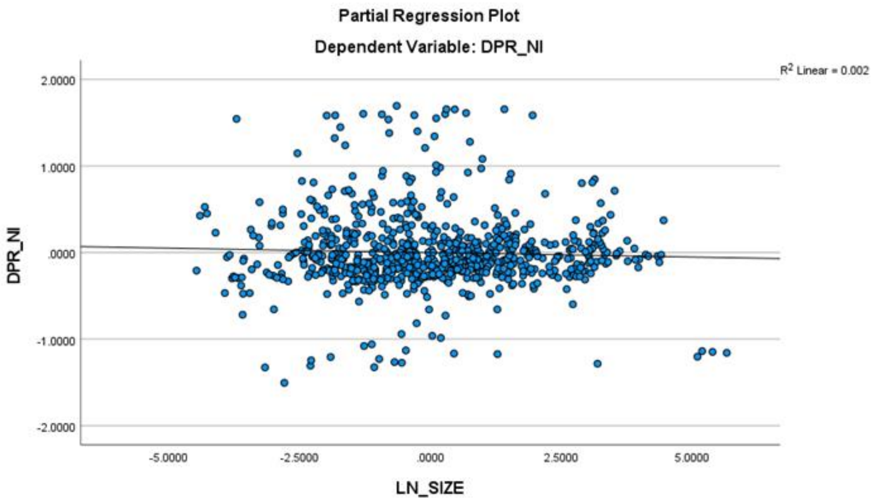
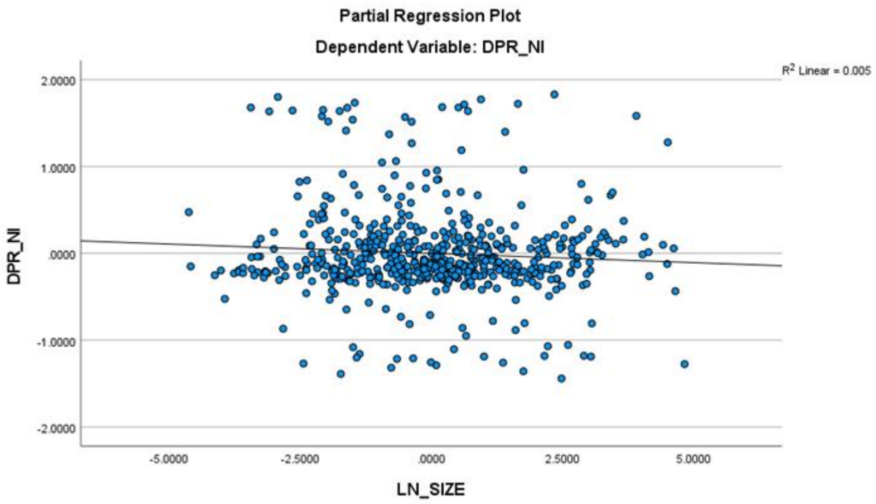


Figure 6

Partial Regression Plot between Company Size and Dividend Payout Ratio for the period between 2019-2021



At last, all other variables which are LN_AGE, GROW and DEBT have no significant impact on the dividend payout ratio using net income. That is not in line with Kent Baker and Kilincarslan (2018) who found a significant negative effect from GROW and DEBT on the dividend payout ratio and a significant positive effect from a company's age on the dividend payout ratio. Moreover, they found a positive relationship between a company's size and the dividend payout ratio, compared to a significant effect in this study. Due to the non-significance of all these variables in that regression, the hypotheses from sections 2.6.3, 2.6.4 and 2.6.5 are not supported. In order to test the regression model for robustness, another regression will be performed only including the significant variables of table 6.

Next to the unstandardized beta values, which indicate the change in the dependent variable DPR_NI if there is a change of unit in a certain independent variable, there are standardized values for beta. The standardized beta compares the strength of the effects of all independent variables. By doing so, it simplifies the comparison of the effects of different variables. Regarding table 6, the standardized beta values imply that profitability has the strongest effect on the dividend payout ratio with a value of 0.213 in Panel A and 0.158 in Panel B. In Panel A, the next strongest effect can be seen at ownership concentration, followed by size and age. The weakest effects on the dividend payout ratio refer to the variables of growth opportunities and leverage. In Panel B, the strongest effect of profitability is followed by size, debt and ownership concentration. In this period, the weakest effects refer to growth opportunities and age. With sole regard to the significant effects, in both periods, profitability has the strongest effect, followed by ownership concentration in Panel A and followed by size in Panel B.

Having a look at the value of the adjusted R^2, the values are relatively low for all of the OLS regression models. In Panel A, model 1 has an adjusted R^2 of 0.042 and model 2 has an adjusted R^2 of 0.041 which indicates that 4.2% and 4.1% of the variance in the variable DPR_NI can be predicted by the independent variables respectively. In Panel B, the values of 0.024 and 0.022 indicate that 2.4% and 2.2% of the variance in the dependent variable can be explained by the independent variables of the full model and the model without control variables respectively. Compared to Kent Baker and Kilincarslan (2018), where the value for adjusted R^2 in the model for payout ratio is 13.23%, the values in this research are relatively low. That could be reasoned since in the models in table 6, there are many independent variables that do not affect the dependent variable significantly which lets the adjusted R^2 decrease.

All in all, the independent variables PROF, LN_SIZE and OWN^2 have a significant effect on DPR_NI at least in one of the models, whilst all other independent variables have not. Reasons and explanations for that are given in section 5. Since OWN^2, LN_SIZE and LN_AGE are either not significant in both time periods or not at all, a separate robustness check is performed that contains the full model with these three variables in their original form.

Table 6:
OLS Regression for the dependent variable DPR_NI

Panel A: 2015-2018

	Model 1: Full Model DPR_NI			Model 2: Control Var. Omitted		
	Unstandardized Beta	Standardized Beta	Sig.	Unstandardized Beta	Standardized Beta	Sig.
(Constant)	0.454		0.013	0.428		0.017
PROF	1.739	0.213	0.000	1.624	0.199	0.000
OWN^2	-0.094	-0.080	0.038	-0.079	-0.067	0.080
LN_AGE	0.022	0.039	0.326	0.021	0.038	0.303
LN_SIZE	-0.010	-0.050	0.243	-0.008	-0.040	0.346
GROW	0.002	0.011	0.780	0.002	0.010	0.796
DEBT	-0.012	-0.020	0.610	-0.012	-0.020	0.607
Industry Dummy	Included			Omitted		
Year Dummy	Included			Omitted		
Adjusted R^2	0.042			0.041		

Panel B: 2019-2021

	Model 1: Full Model DPR_NI			Model 2: Control Var. Omitted		
	Unstandardized Beta	Standardized Beta	Sig.	Unstandardized Beta	Standardized Beta	Sig.
(Constant)	0.676		0.010	0.597		0.022
PROF	1.446	0.158	0.001	1.458	0.159	0.001
OWN^2	0.059	0.043	0.350	0.057	0.041	0.365
LN_AGE	0.019	0.027	0.572	0.004	0.006	0.899
LN_SIZE	-0.021	-0.087	0.087	-0.020	-0.080	0.110
GROW	-0.001	-0.004	0.932	0.001	0.005	0.922
DEBT	0.036	0.057	0.238	0.035	0.055	0.245
Industry Dummy	Included			Omitted		
Year Dummy	Included			Omitted		
Adjusted R^2	0.024			0.022		

Note: Table 6 shows the unstandardized coefficients, standardized coefficients, and significance levels for the OLS regression model with dependent variable DPR_NI. Panel A shows the coefficients for the period between 2015-2018 and Panel B for the period between 2019-2021. The definitions of the variables can be found in table 2. All independent variables and control variables are lagged by one year. The variables PROF, LN_SIZE, GROW and DEBT are winsorized at the 5% level.

4.5 Robustness check

In this section, the regression models are tested for robustness. As mentioned in the previous sections, there are several robustness checks due to distinct reasons. First, as an alternative measurement of the dividend payout ratio, the variable DPR_TA is introduced which scales the cash dividends paid by total assets. As mentioned in section 4.2, this variable has a significantly high correlation with the variable PROF. Although the VIF tests showed that there is not issue of multicollinearity, the model is run twice, once with PROF and once without PROF. Then, both regression models are testes for robustness by only including significant variables from sections 4.4.1 and 4.4.2. At last, a robustness check is performed that contains the full models but with the variables OWN^2, LN_AGE and LN_SIZE in their original form. Since for the robustness checks, the most crucial matter is to compare the full models, these checks are only run for the full model and not for the models without the control variables. Explanations and reasons for the differences between the models in section 4.4.1 and 4.4.2 are given in the conclusion.

The first regression table for the robustness checks is presented in table 7. In this model, the dependent variable is DPR_TA, the total amount of ordinary cash dividends scaled by total assets. In Panel A, the variables PROF, GROW and DEBT have a significant effect on DPR_TA. Compared to the dependent variable DPR_NI, the total amount of ordinary cash dividends scaled by net income, ownership concentration becomes insignificant and growth opportunities and leverage become significant. In the period between 2019-2021, the results for the robustness check are similar. The independent variables PROF, GROW and SIZE have a significant effect on DPR_TA. Again, GROW and SIZE are significant whilst they are not significant in the model in section 4.4.2. In contrast to Panel A, the ownership concentration is significant at the 10%-level which is also not in line with the model in section 4.4.2.

Table 7

Robustness Check 1 – Dependent Variable DPR_TA

	Panel A: 2015-2018			Panel B: 2019-2021		
	Unstandardized Beta	Standardized Beta	Sig.	Unstandardized Beta	Standardized Beta	Sig.
(Constant)	0.026		0.004	0.011		0.262
PROF	0.290	0.532	0.000	0.182	0.408	0.000
OWN^2	-0.002	-0.024	0.388	0.004	0.063	0.074
LN_AGE	-0.001	-0.024	0.414	-0.001	-0.030	0.390
LN_SIZE	0.000	-0.035	0.269	5.358E-05	0.004	0.909
GROW	0.003	0.223	0.000	0.003	0.307	0.000
DEBT	-0.008	-0.194	0.000	-0.004	-0.118	0.002
Industry Dummy	Included			Included		
Year Dummy	Included			Included		

Note: Table 7 shows the unstandardized coefficients, standardized coefficients and significance levels for the OLS regression model with dependent variable DPR_TA. Panel A shows the coefficients for the period between 2015-2018 and Panel B for the period between 2019-2021. The definitions of the variables can be found in table 2. All independent variables and control variables are lagged by one year. The variables LN_SIZE, GROW and DEBT are winsorized at the 5% level.

In table 8, the results from the second robustness check are presented. This check deals with DPR_TA as the dependent variable but excludes the independent variable PROF, since there is a significant high correlation between those, as mentioned in section 4.2. Regarding the coefficients in table 8, there are no major differences in the coefficients, except for the standardized beta for GROW and DEBT. In the model without PROF, the standardized beta for these variables is higher than in table 7, which could be because the standardized beta of PROF is not given in table 8. Thus, the effects of other variables can be stronger. Overall, table 8 support the robustness checks from table 7.

Table 8

Robustness Check 2 – Dependent Variable DPR_TA excluding independent variable PROF

	Panel A: 2015-2018 Unstandardized Beta	Panel A: 2015-2018 Standardized Beta	Panel A: 2015-2018 Sig.	Panel B: 2019-2021 Unstandardized Beta	Panel B: 2019-2021 Standardized Beta	Panel B: 2019-2021 Sig.
(Constant)	0.025		0.020	0.019		0.082
OWN^2	-0.001	-0.013	0.703	0.003	0.049	0.206
LN_AGE	-0.002	-0.042	0.229	-0.001	-0.038	0.357
LN_SIZE	0.000	0.036	0.331	0.000	0.030	0.489
GROW	0.005	0.410	0.000	0.004	0.444	0.000
DEBT	-0.014	-0.353	0.000	-0.008	-0.253	0.000
Industry Dummy	Included			Included		
Year Dummy	Included			Included		

Note: Table 8 shows the unstandardized coefficients, standardized coefficients and significance levels for the OLS regression model with dependent variable DPR_TA, excluding the variable PROF. Panel A shows the coefficients for the period between 2015-2018 and Panel B for the period between 2019-2021. The definitions of the variables can be found in table 2. All independent variables and control variables are lagged by one year. The variables LN_SIZE, GROW and DEBT are winsorized at the 5% level.

The next robustness check that is performed is dealing with the logistic regression from section 4.4.1. To test this model for robustness, a new model was used only including the significant variables from section 4.4.1., which are PROF, OWN^2 and LN_SIZE. When only these variables are included in the model, there are some significant differences to the original model. Concerning Panel A, there are no differences in the significant variables, and they all remain significant. Moreover, the directions of the coefficients are the same as in the full model. For Panel B, there is a difference in the coefficient for OWN^2 which is positive in the original model but negative in the robustness check. However, that can be neglected since the coefficient in the full model as well as in the robustness check is not significant. The variables PROF and LN_SIZE have the same directions in their coefficients as in the full model and also both are significant.

Table 9

Robustness Check 3: Dependent Variable DPAY only including significant independent variables from the full model

	Panel A: 2015-2018			Panel B:2019-2021		
Variable	B	S.E.	Sig.	B	S.E.	Sig.
PROF	27.930	3.734	0.000	23.927	3.191	0.000
OWN^2	-2.096	0.542	0.000	-0.001	0.415	0.998
LN_SIZE	0.299	0.116	0.010	0.404	0.088	0.000
Constant	-2.261	2.340	0.334	-6.455	1.817	0.000
Industry Dummy	Omitted			Omitted		
Year Dummy	Omitted			Omitted		

Note: Table 9 shows the unstandardized coefficients, standardized coefficients and significance levels for the logistic regression model with dependent variable DPAY, only including significant variables from section 4.4.1. Panel A shows the coefficients for the period between 2015-2018 and Panel B for the period between 2019-2021. The definitions of the variables can be found in table 2. All independent variables and control variables are lagged by one year. The variables PROF and LN_SIZE are winsorized at the 5% level.

The second last robustness check that is performed deals with a model for the dependent variable DPR_NI, only including significant variables from section 4.4.2. In table 10, the coefficients and significance levels for that robustness check are presented. Having a look at Panel A, there is no difference in the coefficients for PROF and OWN^2. However, for the independent variable LN_SIZE the coefficient changes from significantly positive to insignificant negative. Although that change is important to state, it is not crucial for the analysis since the effect in the robustness check is not significant. In Panel B, there is no difference in the variables PROF and OWN^2 as well compared to the full model from section 4.4.2. However, the effect of the independent variable LN_SIZE becomes negative, but also insignificant, in the robustness model.

Table 10

Robustness Check 4 – Dependent Variable DPR_NI only including significant independent variables from the full model

	Panel A: 2015-2018			Panel B: 2019-2021		
	Unstandardized Beta	Standardized Beta	Sig.	Unstandardized Beta	Standardized Beta	Sig.
(Constant)	0.512		0.001	0.524		0.029
PROF	1.583	0.205	0.000	1.301	0.147	0.000
OWN^2	-0.080	-0.069	0.062	0.055	0.040	0.375
LN_SIZE	-0.008	-0.042	0.260	-0.014	-0.055	0.220
Industry Dummy	Ommited			Ommited		
Year Dummy	Ommited			Ommited		

Note: Table 10 shows the unstandardized coefficients, standardized coefficients and significance levels for the OLS regression model with dependent variable DPR_NI, only including significant variables from section 4.4.2. Panel A shows the coefficients for the period between 2015-2018 and Panel B for the period between 2019-2021. The definitions of the variables can be found in table 2. All independent variables and control variables are lagged by one year. The variables PROF and LN_SIZE are winsorized at the 5% level.

The last robustness check was performed by using the full model for both dependent variables DPAY and DPR_NI but instead of using the variables OWN^2, LN_AGE and LN_SIZE, the original form of these variables is included. The results of that robustness check are shown in table 11 for the OLS regression with independent variable DPR_NI and in table 12 for the logit regression with dependent variable DPAY.

Comparing the original model with the model in table 11, it directly becomes visible that profitability remains significant. Moreover, the variables AGE compared to LN_AGE, and GROW and DEBT remain insignificant. The main differences between the original model and the robustness check are the significance levels of the variables OWN and SIZE. In the original model, when using the squared ownership variable OWN^2 it shows a concave relation in the first time period and no significant relationship in the second time period. In the robustness model, when using the original ownership concentration, the effect is significantly negative in the first time period and significantly positive in the second time period. That would indicate that there is a shift in the meaning of ownership concentration from one period to another from negative to positive. In addition, the original variable of SIZE becomes insignificant, compared to its natural logarithm LN_SIZE which is significantly positive in the second period.

Table 11

Robustness Check 5 – Dependent Variable DPR_NI with original variables OWN, AGE and SIZE

	Panel A: 2015-2018			Panel B: 2019-2021		
	Unstandardized Beta	Standardized Beta	Sig.	Unstandardized Beta	Standardized Beta	Sig.
(Constant)	0.341		0.000	0.291		0.001
PROF	1.715	0.210267	0.000	1.356	0.148	0.002
OWN	-0.087	-0.068066	0.071	0.118	0.078	0.083
AGE	0.000073	0.009290	0.811	0.000082	0.009	0.849
SIZE	0.000000	-0.035114	0.375	0.000000	0.019	0.691
GROW	0.001	0.007396	0.852	0.002	0.008	0.868
DEBT	-0.015	-0.025219	0.524	0.016	0.024	0.606
Industry Dummy	Included			Included		
Year Dummy	Included			Included		

Note: Table 11 shows the unstandardized coefficients, standardized coefficients and significance levels for the OLS regression model with dependent variable DPR_NI, including the original variables OWN, SIZE and AGE instead of OWN^2, LN_SIZE and LN_AGE. Panel A shows the coefficients for the period between 2015-2018 and Panel B for the period between 2019-2021. The definitions of the variables can be found in table 2. All independent variables and control variables are lagged by one year. The variables PROF, GROW DEBT and SIZE are winsorized at the 5% level.

Then, table 12 shows a similar robustness check for the logit regression with dependent variable DPAY. Comparing that to the main model with the adjusted variables, there are some slight differences. First, the variable GROW, which refers to growth opportunities becomes significantly positive in the robustness check. Second, the when using the original variable SIZE instead of LN_SIZE, the effect becomes insignificant in the first time period. However, the robustness check supports the main findings regarding the following effects. First, profitability is significantly positive in both models. Second, LN_AGE and the corresponding variable AGE are not significant in both models. Third, DEBT is not significant in both models. Furthermore, the robustness check does not confirm the concave relation between the ownership concentration and the likelihood to pay dividends since in the robustness check, the original form of the variable suggests a negative linear relation for that time period.

Table 12

Robustness Check 6 – Dependent Variable DPAY with original variables OWN, SIZE and AGE

	Panel A: 2015-2018			Panel B: 2019-2021		
	B	S.E.	Sig.	B	S.E.	Sig.
PROF	35.082	4.656	0.000	30.535	4.550	0.000
OWN	-2.671	0.773	0.001	0.399	0.540	0.460
AGE	0.002	0.005	0.598	-0.001	0.003	0.723
SIZE	0.000	0.000	0.153	0.000	0.000	0.003
GROW	-0.195	0.101	0.053	-0.093	0.092	0.311
DEBT	-0.096	0.259	0.711	-0.082	0.233	0.725
Industry Dummy	Included			Included		
Year Dummy	Included			Included		

Note: Table 12 shows the unstandardized coefficients, standardized coefficients and significance levels for the logistic regression model with dependent variable DPAY, including the original variables OWN, SIZE and AGE instead of OWN^2, LN_SIZE and LN_AGE. Panel A shows the coefficients for the period between 2015-2018 and Panel B for the period between 2019-2021. The definitions of the variables can be found in table 2. All independent variables and control variables are lagged by one year. The variables PROF, GROW DEBT and SIZE are winsorized at the 5% level.

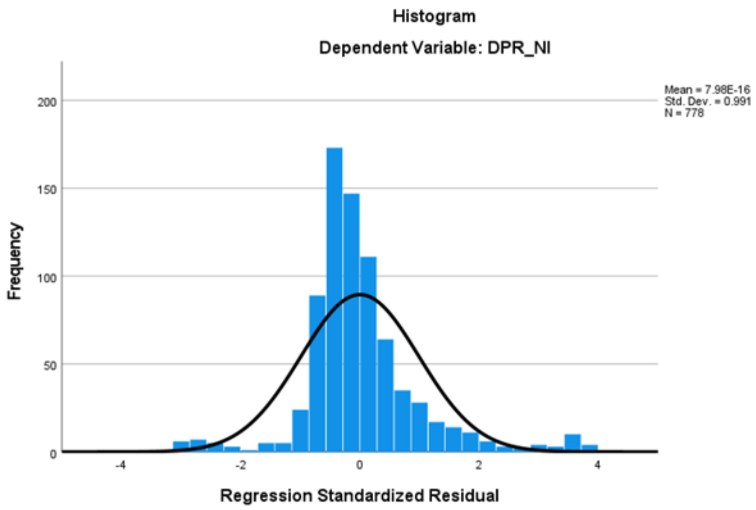
4.6 Residual analysis

The following section discusses the residual plots shown in Appendix B. Although all of them together have been shortly described in section 4.3, having a thorough look at residuals could be crucial to support the model fit and the overall results of the models. The residual plots in Appendix B show the histogram of the standardized residuals, the P-P Plots of the standardized residual, and the scatterplots of the standardized predicted value against the standardized residual. First, the standardized residual histogram is based on the assumption that the standardized residuals of a multiple regression follow a normal distribution (Sutton et al., 2000). Second, the P-P plots show the observed cumulative probability of the standardized residual on the x-axis against the predicted cumulative probability of the standardized residual on the y-axis. If the dots in a P-P plot follow the 45-degree line, the residuals are perfectly normally distributed. At last, the scatterplots show the distribution of the predicted value of the regression against the standardized residual.

In the following, the residuals of the full model with the independent variable DPR_NI are discussed with special attention since this is the main OLS regression model in this paper. Having a look at Figure 7, the histogram of the standardized residuals show that the residuals are approximately distributed in a bell shape around the centre which means that they follow an approximate normal distribution. Moreover, it can be seen that there are some residuals that take a standardized value of -2 to -3 or 2 to 3 which means that on both sides of the distribution, there are potential extreme values. These extreme values have a high frequency on one standardized residual value since the data has been winsorized at the 5%-level and all winsorized data take the same value of standardized residual.

Figure 7

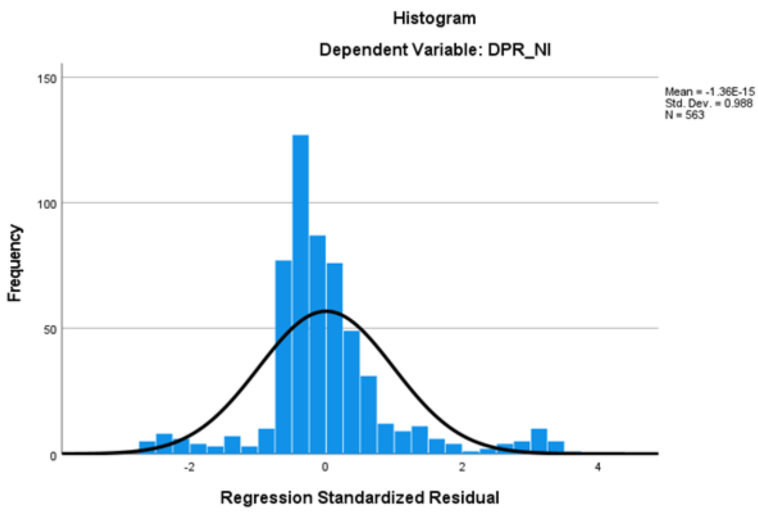
Histogram of the standardizes residual for Panel A (2015-2018) of the full model with dependent variable DPR_NI



Compared to Figure 8, which shows the histogram for the second time period, the histograms look very similar. Both of them have the highest frequency of residuals between 0 and -0.5, and both of them have some extreme values. Moreover, they are both approximately normal distributed.

Figure 8

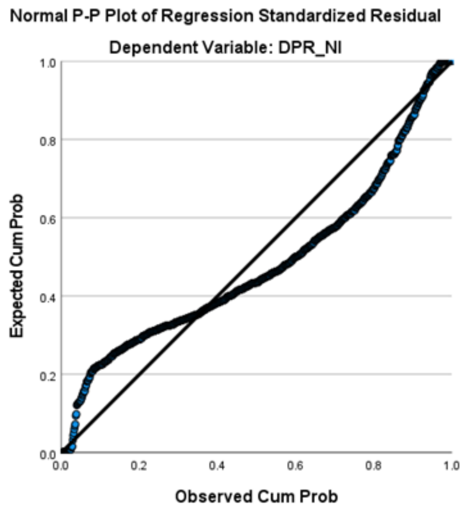
Histogram of the standardizes residual for Panel B (2019-2021) of the full model with dependent variable DPR_NI



Another figure that supports the histograms of standardized residuals is the P-P plot. In figure 9, the P-P plot for Panel A of the full model with the dependent variable DPR_NI is presented. It shows a 45-degree linear line and the values for the observed cumulative probability against the expected cumulative probability of the standardized residual. It can be seen that the values do not exactly follow the linear line which would indicate that the residuals are not normally distributed. However, that violation can be neglected since the sample size is large enough to make the central limit theorem valid.

Figure 9

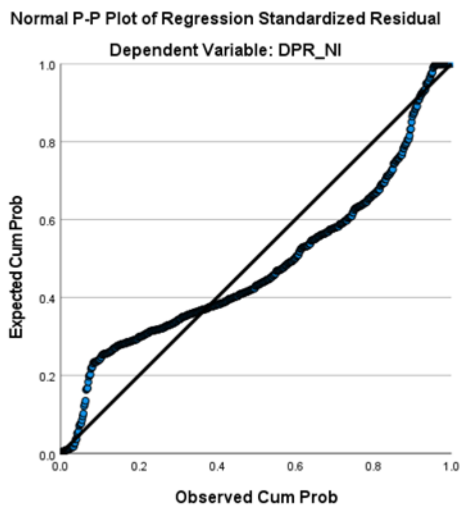
P-P Plot of the standardized residual for Panel A (2015-2018) of the full model with dependent variable DPR_NI



In figure 10, the P-P plot of the time period between 2019-2021 is presented. It shows that the residuals approximately follow a normal distribution but with a moderate skewness. The P-P plot supports the findings of the histogram in figure 8. Compared to figure 9, the P-P plots almost look the same which means that the residuals in both time periods are distributed similarly.

Figure 10

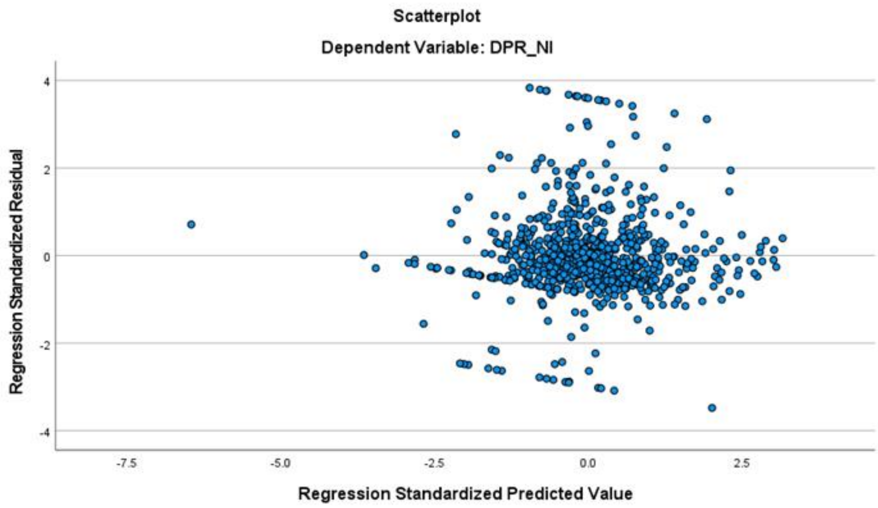
P-P Plot of the standardized residual for Panel B (2019-2021) of the full model with dependent variable DPR_NI



At last, the scatterplot of the standardized predicted value against the standardized residual is presented in figure 11. It shows that the standardized residuals are distributed around the centre which is the standardized predicted value of 0. Moreover, there is one extreme value which has an extreme negative predicted value, indicating that there is an extreme outlier left over after winsorizing the data. In addition, it can be seen that at the top and at the bottom of the distribution, there seems to be some linear patterns in the standardized residual which could be because of the winsorized data which all take the same value in DPR_NI but have different predictions based on the independent variables.

Figure 11

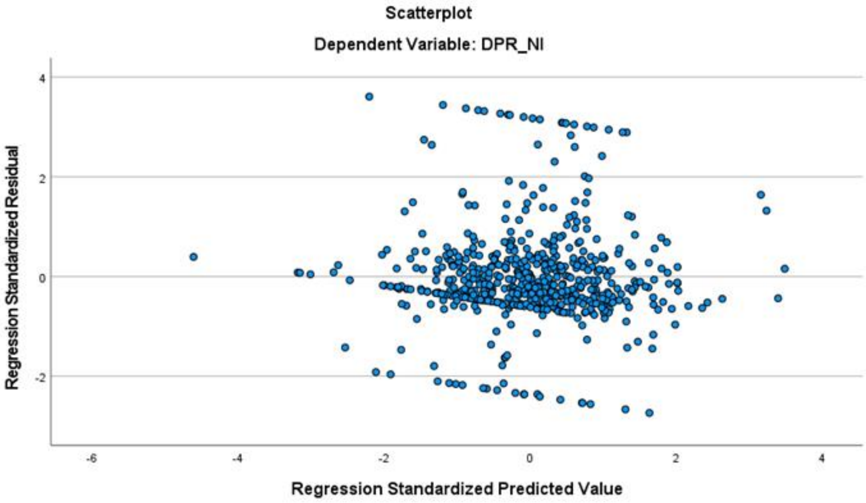
Scatterplot of the standardized residual for Panel B (2015-2018) of the full model with dependent variable DPR_NI



Regarding figure 12, it can be seen that the scatterplot of residuals shares the same characteristics in the second time period as in the first time period. In both of them, the residuals are distributed around zero. Moreover, the linear lines at the top and at the bottom refer to the winsorized extreme values.

Figure 12

Scatterplot of the standardized residual for Panel B (2019-2021) of the full model with dependent variable DPR_NI



Regarding the histograms, P-P plots and scatterplots in Appendix B, concerning the robustness checks, they all show similar results as the figures 7, 8, 9, 10, 11, and 12. It might be that for one of the robustness checks, the residuals are not as normally distributed as in the main model, or that there are more outliers in one or another robustness check. However, they all share the same characteristics. The histograms show that all of the residuals are approximately normally distributed. The highest frequency of extreme values can be seen in Appendix BB and Appendix BH whose models are remarkably similar since one refers to Panel B of the full model and the other to Panel B of the same model just including significant variables. Regarding the P-P plots, they are all similar which is congruent with the similarities of the histograms. Moreover, the scatterplots in the Appendix show that in all models, the residuals are distributed around zero. However, all models show the linear behaviour for some specific values in the residual. That can be explained by the procedure of winsorizing. By winsorizing, the observed value in the dependent variables take the same value for all extreme values, although the expected values differ according to the independent variables. Additionally, in some models there are more extreme values in the predicted values than in other models. Specifically, the scatterplots in Appendix BG and Appendix BH show most extreme values which means that for the independent variable DPR_TA, measured as cash dividends scaled by total assets, the model contains the highest predicted scores based on the independent variables.

5 Conclusion

In the concluding section of this paper, first the results presented in section 4 are critically reviewed and discussed with special regard to the hypotheses and theories. Second, the limitations of this research are examined and discussed. At last, implications for future research are presented.

5.1 Discussion of main findings

Based on the payout policy irrelevance theory by Modigliani and Miller (1961), Black (1976) introduced the dividend puzzle dealing with the question why and to what extent companies pay dividends or not. After decades of research on the American continent and in Great Britain (Fama and French, 2001; DeAngelo et al., 2006), the literature started to focus on the European continent including Germany (Schmid et al., 2010; Smit and van Eije, 2014; von Eije and Megginson, 2008). However, there has been scarce literature focussing on the firm-specific determinants of dividend payout policy of German listed firms, especially in recent years. Therefore, the following research question emerged: "What are the effects of firm-specific determinants of the dividend payout policy of German listed companies before and during the Covid-19 pandemic?" To answer this research question, prior literature was reviewed for theories from which six hypotheses has been derived concerning the determinants profitability, ownership structure, firm age, firm size, growth opportunities, and leverage. After performing several regression analyses, the hypotheses can now be supported or rejected.

The first hypothesis (H1) states that a company's profitability, measured as return on assets, has a positive effect on the dividend payout decisions of German listed firms. The results of both main models, and the results from the robustness checks, show that there is a significant positive effect from profitability on both the propensity to pay dividends, and the level of dividend payout. That means, the first hypothesis, concerning the determinant profitability, can be supported. The more profitable a German listed company is, the higher the likelihood and level of dividend payouts. This results firstly supports prior literature since Fama and French (2001) found the same effect from profitability on the dividend payout decisions of US firms. Furthermore, Kent Baker and Kilincarslan (2018) found the same relation between profitability and dividend payout policy for Turkish listed firms. All of these results support the information asymmetry theory which supposes that highly profitable companies are more likely to pay dividends and also pay higher dividends to minimize the differences in available information between managers and shareholders. In addition, the payment of cash dividends conveys information about future cash flows and signals a company's advantageous position in the market which supports the signaling theory. Moreover, the results support the agency cost theory since highly profitable firms pay out more dividends to limit the waste of cash by managers. These agency costs are mitigated by paying dividends. With regard to the Covid-19 pandemic, there are no differences between the period before Covid and the period during Covid which means that the importance of profitability for dividend payout decisions has not changed due to the pandemic. All in all, the hypothesis about the positive effect from profitability on the dividend payout decisions of German listed firms is significantly supported. The results support both prior literature and the theories from which the hypotheses have been derived.

Second, it was hypothesized that there is a convex effect from ownership structure on the dividend payout decisions of German listed firms (H2). However, the results are different from the hypothesis. For both the likelihood and the level of payout, the results show a significant concave effect from ownership concentration for the period between 2015-2018. The original model would indicate that at low levels of ownership structure, the likelihood and level of payout increases when the ownership of the major shareholder increases. Then, at a certain level of major ownership, the likelihood and level of dividend payout starts to decrease. That result does not support the agency costs theory which states that the higher the concentration of the largest shareholder, the higher the agency costs and the higher the need to pay dividends. Moreover, it was expected that at low levels of ownership concentration, the shareholders want to protect their investment through monitoring and the need to pay dividends decrease (Truong and Heaney, 2007). However, in the robustness checks, neither the concave relation from the full model nor the expected convex relation is supported. Having a look at table 11 and table 12, where the original form of ownership concentration is used, it is visible, that there is a negative linear relation in that time period. Regarding the period between 2019-2021, there is no significant effect, neither convex nor concave. That means that the importance of ownership structure for dividend payment decisions has decreased during the pandemic. Companies seem to have a look at other factors, for example profitability, to decide on their dividend payments.

Next, the third hypothesis is derived from the life cycle theory and states that there is a positive effect from firm size on the dividend payout decisions of German listed firms (H3). When it comes to the propensity of payout, the hypothesis can be accepted. There is a significant positive effect from firm size on the propensity of payout. In addition, this result is robust since the robustness check only including significant variables support the finding. Moreover, the effect is significant for both time periods which means that there are no differences between the time before the pandemic and during the pandemic. These results support the findings of Fama and French (2001) and Kent Baker and Kilincarslan (2018) which both find a positive relation between firm size and dividend payout decisions. Companies that are larger are more likely to pay dividends which supports the life cycle theory that states that larger firms are less likely to have positive NPV projects and growth opportunities and therefore, those companies pay dividends to limit the waste of excess cash. Moreover, large companies tend to have higher levels of information asymmetries and agency costs which are also mitigated by paying dividends. However, the hypothesis can not be supported for the level of payout. For the time before the pandemic, there is no significant effect from firm size on dividend payout decisions and for the time during the pandemic there seems to be a negative effect from firm size on the level of payout, but this result is not robust. Combining the results from both models, the firm size has a positive effect on the likelihood to pay dividends but no significant effect on the level of dividends. That means, the hypothesis can only be accepted for the propensity of payout and no for the level of payout.

Next to firm size, the life cycle theory also gives reasons to assume that there is a positive effect from firm age on dividend payout decisions (H4). In all of the models, there is no significant relation between firm age and the likelihood and levels of dividend payouts. That means, the life cycle theory with regard to firm age cannot be supported and consequently, the hypothesis for firm age is rejected. However, this result is not in line with prior research. Kent Baker and Kilincarslan (2018) found a positive effect from firm age on the likelihood and level of dividend payout, as well as DeAngelo et al. (2006).

Fifth, it is hypothesized that growth opportunities have a negative effect on the dividend payout decisions of German listed firms (H5). For the full models, this hypothesis cannot be accepted since there is no significant effect. However, in the robustness check with the dependent variable DPR_TA, measured as cash dividends scaled by total assets, there is a positive effect from growth opportunities on dividend payout decisions. In combination, the full models and the significant positive effect in the robustness check leads to a rejection of the hypothesis that there is a negative effect from growth opportunities on dividend payout decisions.

At last, the sixth hypothesis states that there is a negative effect from leverage on the dividend payout decisions of German listed firms (H6). In the full models, there is no significant effect since all of the coefficients are not significant. However, in the robustness check with dependent variable DPR_TA, there is a significant negative effect from leverage on the dividend payout ratio which would support prior research by Kent Baker and Kilincarslan (2018). This result alone would lead to an acceptation of the hypothesis. Since the full models show no significant results, the hypothesis cannot be accepted and is rejected.

All in all, the study at hand contributes to the dividend payout puzzle posed by Black (1976) as it focusses on the questions why and to what extent companies pay dividends. By having a look at German listed firms, the answer to the research question is twofold. First, the propensity of dividend payouts is dependent on the companies' profitability, ownership concentration and firm size. Whilst profitability and firm size have a positive effect on the payout propensity, meaning that an increase in these variables lead to an increase in the propensity, the ownership structure has a concave effect which means that at low levels of ownership concentration, the likelihood to pay dividends increases with an increase in ownership structure. However, at a certain level of ownership structure, the likelihood to pay dividends decreases with a further increase in ownership structure. All of the effects that are significant for the propensity of payout hold for both periods which means there is no change in the importance of payout before and during the pandemic. Second, the level of dividend payout is dependent on profitability, ownership concentration and firm size as well. In the period between 2015-2018, the level of payout was dependent on profitability and ownership structure. Whilst profitability has a positive effect, the effect of ownership structure is concave. In the time during the pandemic, ownership structure loses its significance, and the firm size becomes significant. Regarding differences between the time periods, before and during the pandemic, the difference in the significance of ownership structure in the model for the level of payout is the only one. In the other models, there is no difference between the time periods.

This study's contribution to prior literature is multi-fold. First, it contributes to the payout puzzle posed by Black (1976). Although there has been extensive research on the determinants of payout policy, there is still no consensus on what really affects the likelihood and level of dividend payouts. That is supported by this paper since it is not always supporting prior literature, for example looking at the effects of leverage and growth opportunities which are significant in prior literature but not in the research at hand. Second, this study contributes to existing literature that focusses on German firms. There have been several studies that included Germany in an European setting (Denis and Osobov, 2008; von Eije and Megginson, 2008) that analysed the determinants on the dividend payout policy and one study that focussed on Germany but only on ownership structure (Schmid et al., 2010). This study uses the models and variables from prior studies and thereby mainly focus on the research from Kent Baker and Kilincarslan (2018). Although they focus on a less developed country, the variables that they use are derived from past literature as well as from surveys, which is not the case in other studies.

5.2 Limitations and implications for future research

After critical reflection of the literature, methodology, data, and results, several limitations of the research are made. First, the regression models contain different measurements in the independent variables. The variables profitability, ownership structure, leverage and growth opportunities all are ratios, whilst age and size are absolute numbers. Therefore, it is important to examine the difference between the standardized beta and the unstandardized beta to be able to analyse the real effect of the variables. In future research, it is advisable to include variables that are all measured in the same way, for example in ratios, in order to make the interpretation better understandable.

Second, the hypothesis and variables are derived from theories only. In contrast to Kent Baker and Kilincarslan (2018) where the hypotheses are derived from theory and from a qualitative survey, in this study, it could be that crucial determinants are missing or determinants that are not crucial at all are included. In order to tackle this problem in future research, it is recommended to perform a qualitative analysis, for example with a survey, in order to derive relevant determinants of payout policy. Then, in combination with theory, the most crucial determinants are used for a quantitative analysis.

Third, some of the robustness checks show different results from the original models. In order to see in future research, if the robustness is significant and could be more crucial than the original model, it is advisable to use more robustness checks to examine whether a deviation of the main model is coincidence or regular.

Fourth, the model used in this research is similar to the one from Kent Baker and Kilincarslan (2018) who analyse the effect of firm-specific determinants in Turkey, which is an emerging market in contrast to the developed market in Germany. For future research, it is recommended to use or develop a model that has before been used for the same level of economic standard, for example the United States or Great Britain.

Fifth, the contribution to the payout puzzle posed by Black (1976) is limited. The model in this research only consists of three significant determinants on payout policy whilst three other variables are not significant at all. Thereby, the research does not add to the solution to the payout puzzle but produces additional questions, for example why leverage and growth opportunities are not significant determinants in German context. For future research, this context has to be analysed with special consideration since it deviates a lot from prior research.

Sixth, the study at hand concentrates on two different time periods, one before the Covid-19 pandemic and one during the pandemic. It shows that there are no major differences in the determinants of payout policy. However, in a few years, it is recommended to look back to the pandemic and include time periods before during and even after the pandemic to see the real effect of an economic crisis on the development of the determinants of payout policy.

At last, this study focusses on different industry sectors. In the descriptive statistics, it can be seen that more than half of the companies are operating in the manufacturing sector. It is not clear, how this fact affects the results. For future research, it is interesting to test differences between the industry sectors by performing individual regression analyses for each industry to examine differences and similarities between them.

Appendix

Appendix A: VIF Scores

Coefficients[a]

Model	Collinearity Statistics Tolerance	VIF
(Constant)		
DPR_NI	0.824	1.214
DPR_TA	0.479	2.087
PROF %	0.588	1.702
OWN^2	0.849	1.178
LN_AGE	0.880	1.137
LN_SIZE	0.685	1.459
GROW	0.757	1.322
DEBT %	0.750	1.333

a. Dependent Variable: DPAY

Coefficients[a]

Model	Collinearity Statistics Tolerance	VIF
(Constant)		
DPAY	0.796	1.256
DPR_TA	0.555	1.801
PROF %	0.530	1.888
OWN^2	0.846	1.182
LN_AGE	0.881	1.135
LN_SIZE	0.672	1.488
GROW	0.748	1.338
DEBT %	0.755	1.325

a. Dependent Variable: DPR_NI

Coefficients[a]

Model	Collinearity Statistics Tolerance	VIF
(Constant)		
DPAY	0.781	1.281
DPR_NI	0.937	1.068
PROF %	0.647	1.546
OWN^2	0.847	1.181
LN_AGE	0.882	1.133
LN_SIZE	0.669	1.495
GROW	0.810	1.234
DEBT %	0.779	1.284

a. Dependent Variable: DPR_TA

Coefficients[a]

Model	Collinearity Statistics Tolerance	VIF
(Constant)		
DPAY	0.872	1.147
DPR_NI	0.813	1.229
DPR_TA	0.589	1.698
OWN^2	0.846	1.182
LN_AGE	0.879	1.137
LN_SIZE	0.669	1.494
GROW	0.774	1.291
DEBT %	0.778	1.285

a. Dependent Variable: PROF %

Coefficients[a]

Model	Collinearity Statistics Tolerance	VIF
(Constant)		
DPAY	0.782	1.278
DPR_NI	0.808	1.238
DPR_TA	0.479	2.087
PROF %	0.526	1.902
LN_AGE	0.882	1.134
LN_SIZE	0.768	1.302
GROW	0.745	1.343
DEBT %	0.752	1.331

a. Dependent Variable: OWN^2

Coefficients[a]

Model	Collinearity Statistics Tolerance	VIF
(Constant)		
DPAY	0.781	1.281
DPR_NI	0.809	1.236
DPR_TA	0.481	2.081
PROF %	0.526	1.901
OWN^2	0.849	1.178
LN_SIZE	0.725	1.379
GROW	0.751	1.331
DEBT %	0.759	1.317

a. Dependent Variable: LN_AGE

Coefficients[a]

Model	Collinearity Statistics Tolerance	VIF
(Constant)		
DPAY	0.799	1.251
DPR_NI	0.811	1.232
DPR_TA	0.479	2.089
PROF %	0.526	1.900
OWN^2	0.972	1.029
LN_AGE	0.953	1.049
GROW	0.747	1.339
DEBT %	0.847	1.180

a. Dependent Variable: LN_SIZE

Coefficients[a]

Model	Collinearity Statistics Tolerance	VIF
(Constant)		
DPAY	0.795	1.257
DPR_NI	0.814	1.229
DPR_TA	0.523	1.913
PROF %	0.549	1.822
OWN^2	0.849	1.177
LN_AGE	0.890	1.124
LN_SIZE	0.673	1.485
DEBT %	0.776	1.289

a. Dependent Variable: GROW

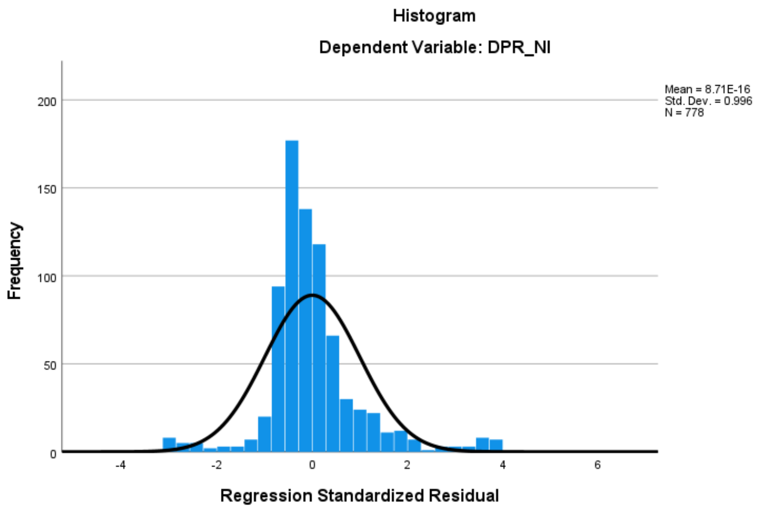
Coefficients[a]

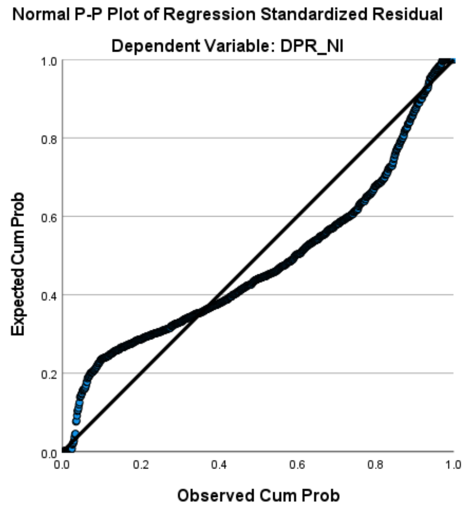
Model	Collinearity Statistics Tolerance	VIF
(Constant)		
DPAY	0.781	1.281
DPR_NI	0.813	1.230
DPR_TA	0.497	2.010
PROF %	0.546	1.832
OWN^2	0.848	1.179
LN_AGE	0.890	1.123
LN_SIZE	0.756	1.323
GROW	0.768	1.302

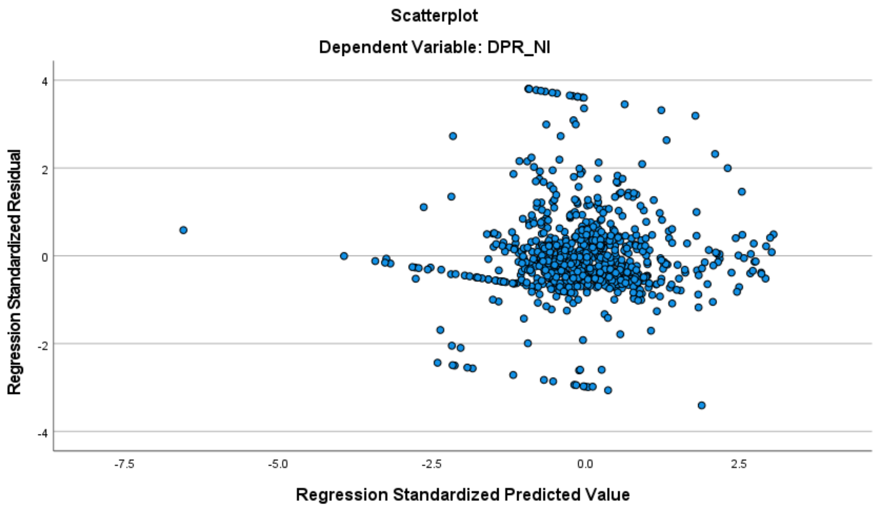
a. Dependent Variable: DEBT %

Appendix B: Assumption Testing for OLS Regression Models

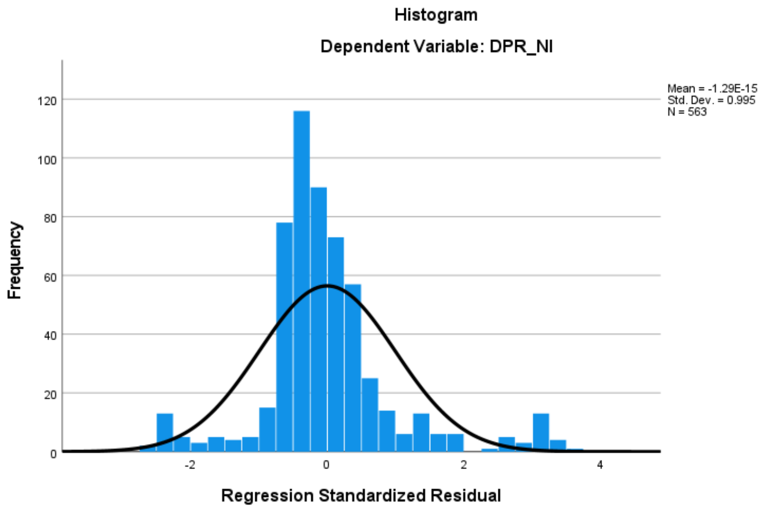
Appendix BA: Histogram, P-P Plot and Scatterplot for Table 6 – Model without control variables DPR_NI – Panel A (2015-2018)

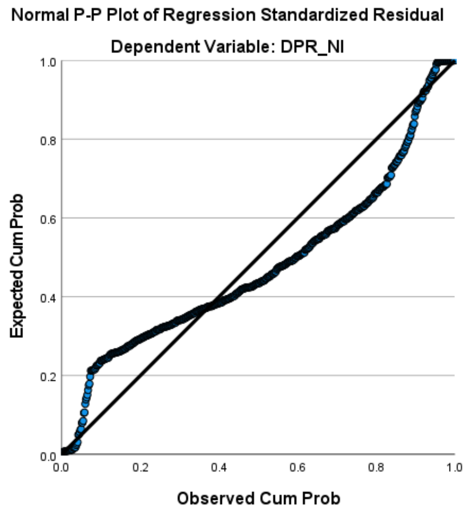


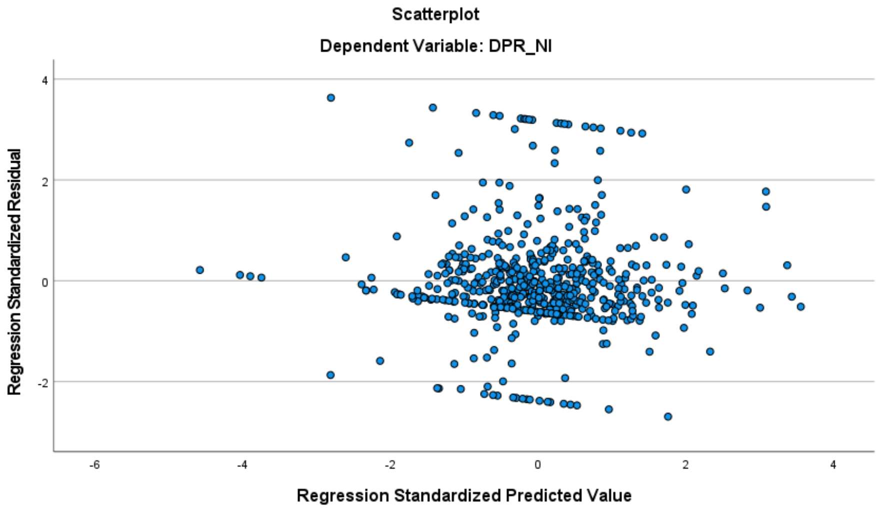




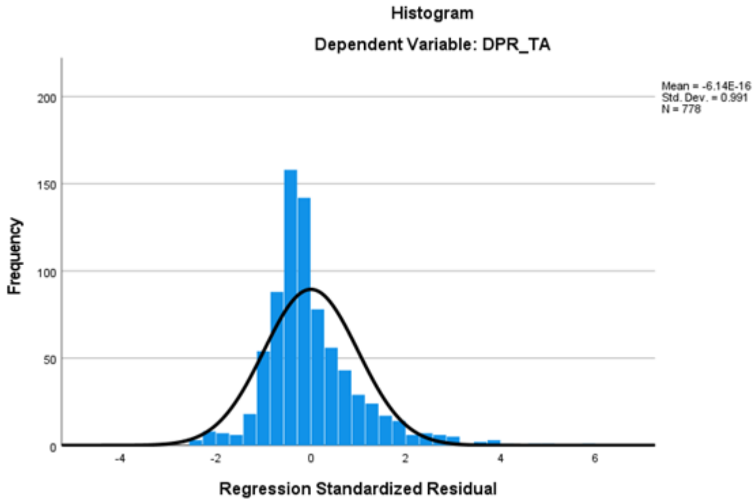
Appendix BB: Histogram, P-P Plot and Scatterplot for Table 6 – Model without control variables DPR_NI – Panel B (2019-2021)

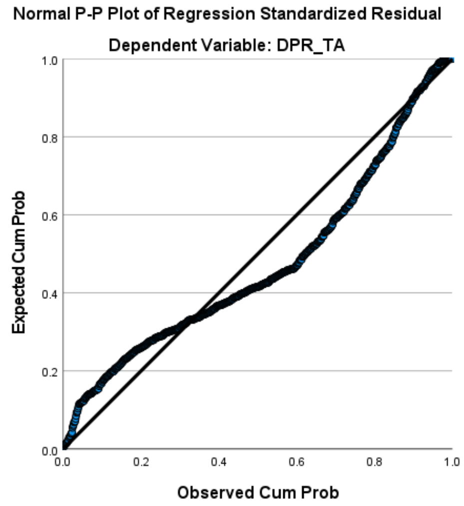


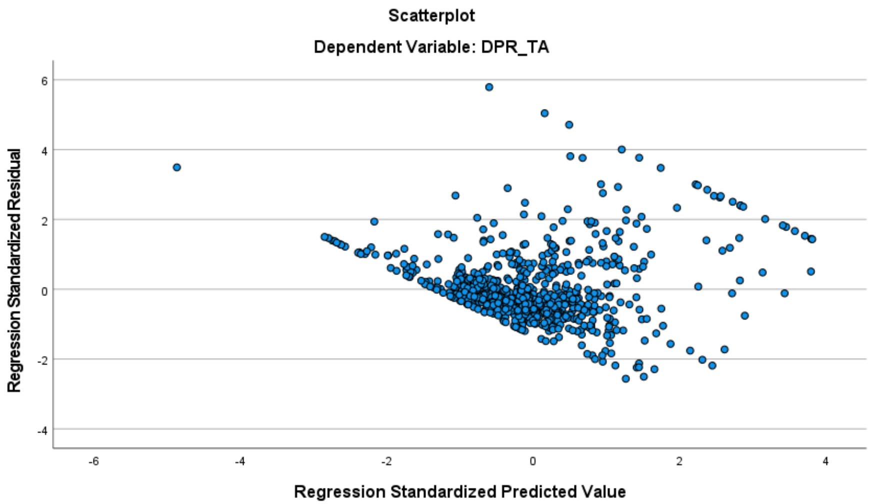




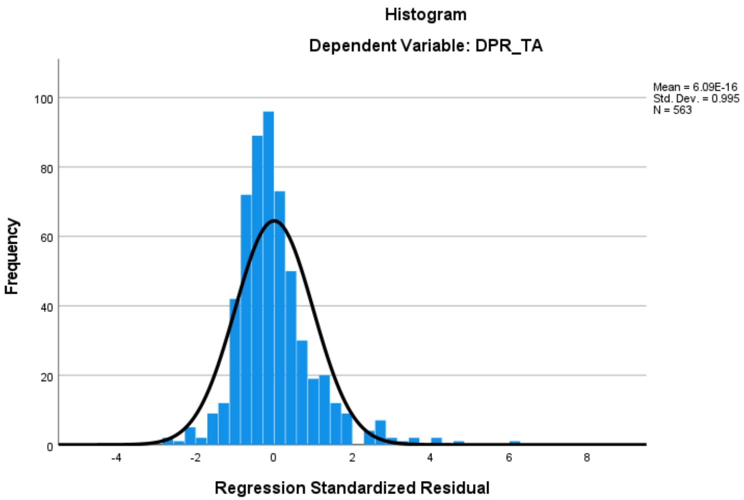
Appendix BC: Histogram, P-P Plot and Scatterplot for Table 7 – Full Model DPR_TA – Panel A (2015-2018)

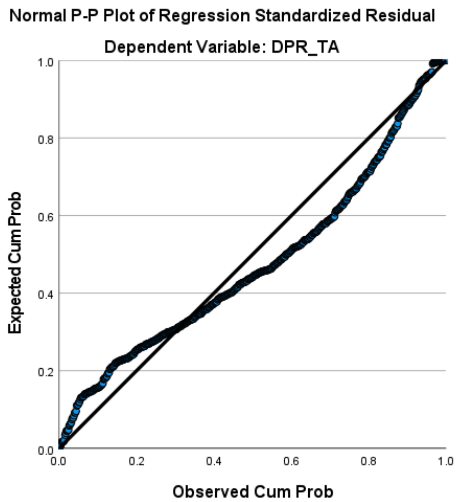


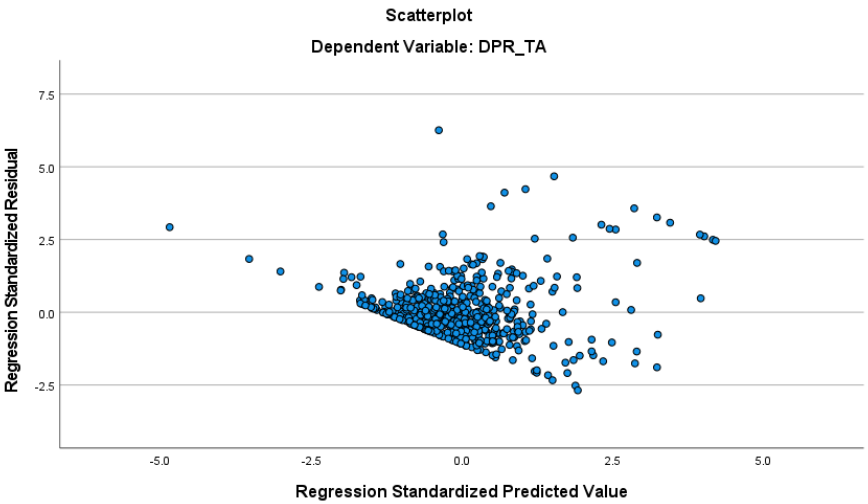




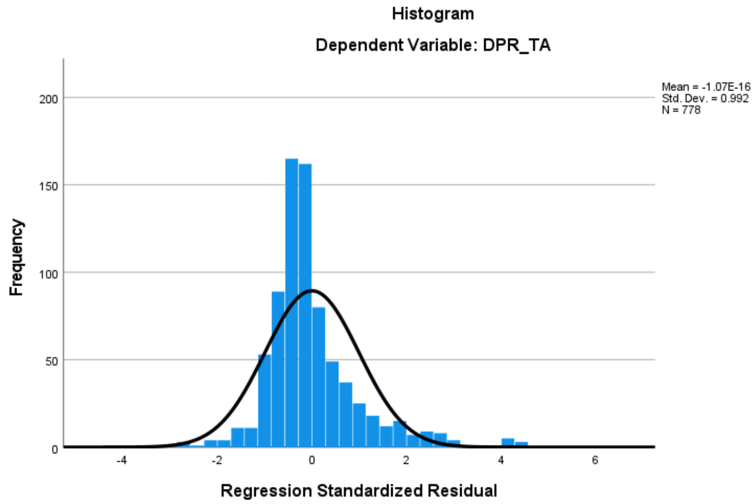
Appendix BD: Histogram, P-P Plot and Scatterplot for Table 7 – Full Model DPR_TA – Panel B (2019-2021)

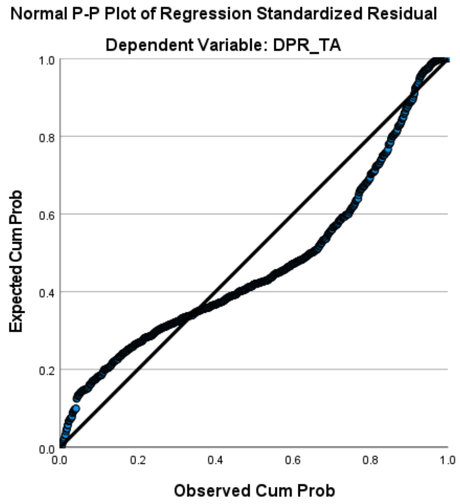


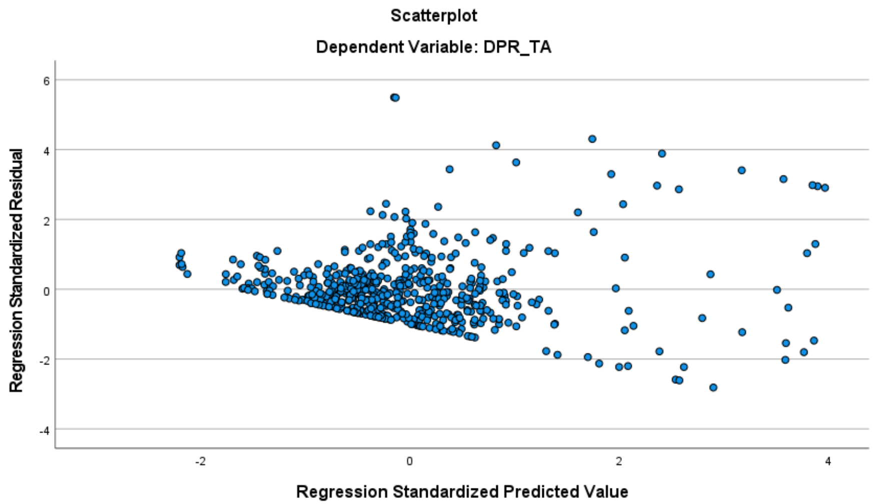




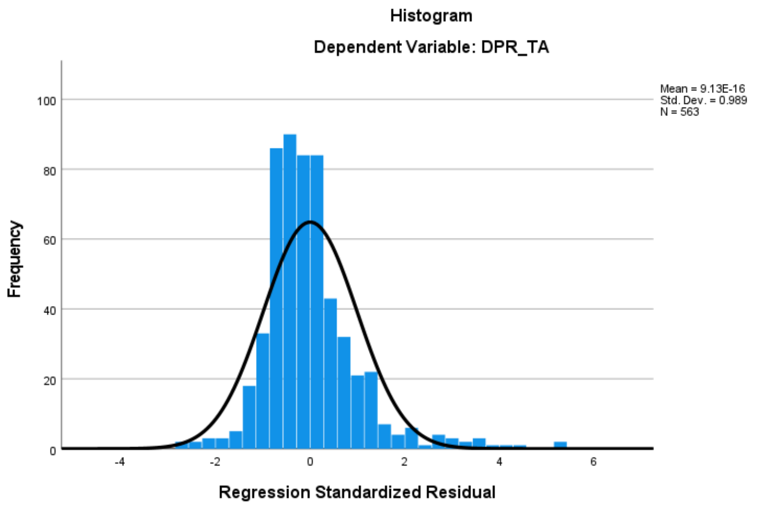
Appendix BE: Histogram, P-P Plot and Scatterplot for Table 8 – DPR_TA without PROF – Panel A (2015-2018)

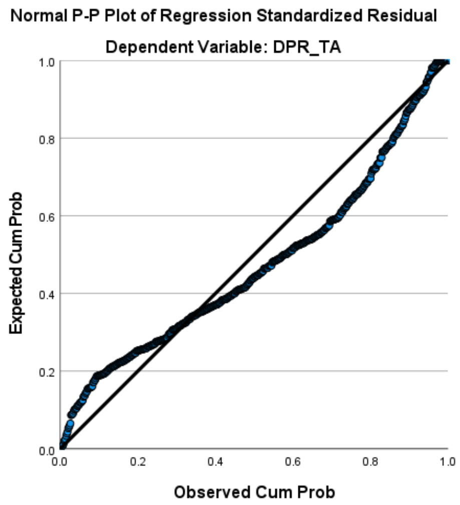


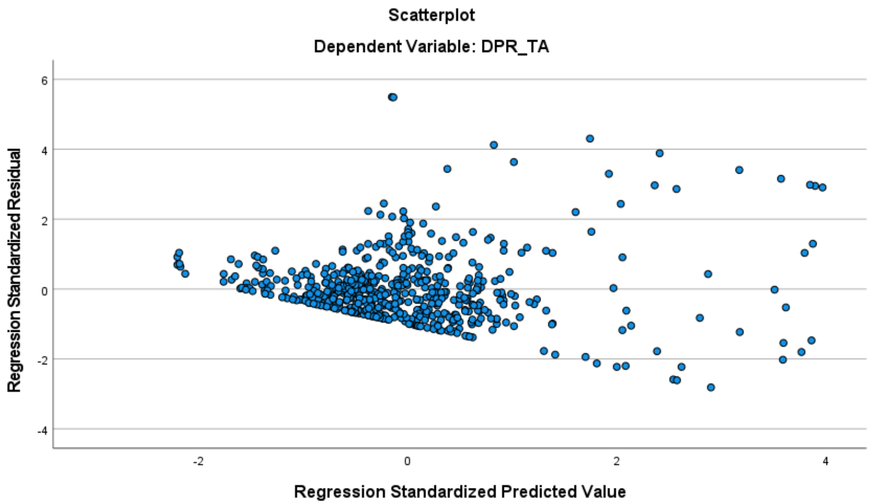




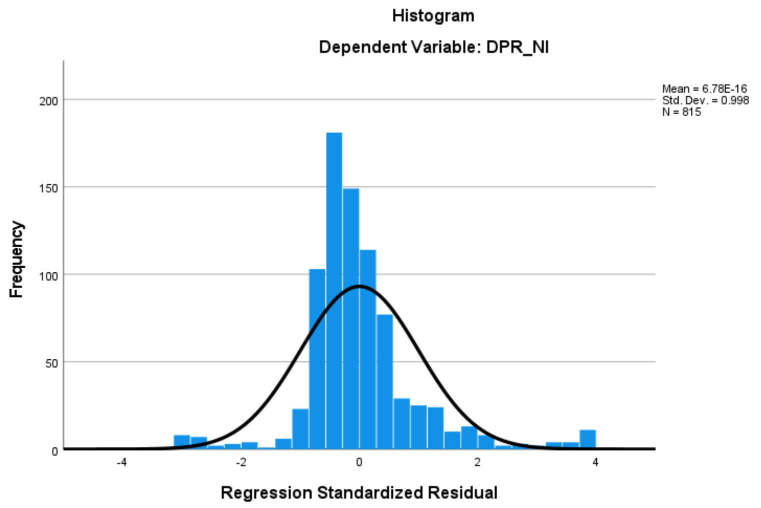
Appendix BF: Histogram, P-P Plot and Scatterplot for Table 8 – DPR_TA without PROF – Panel B (2019-2021)

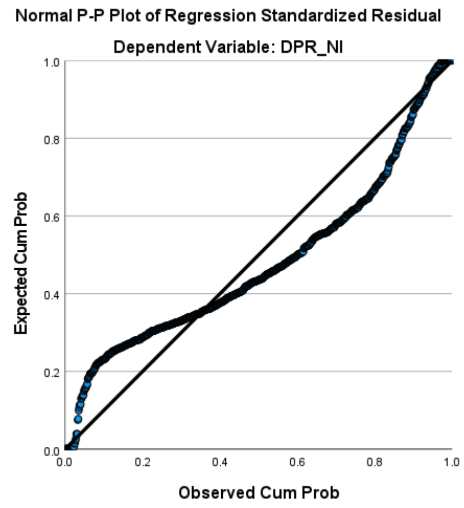


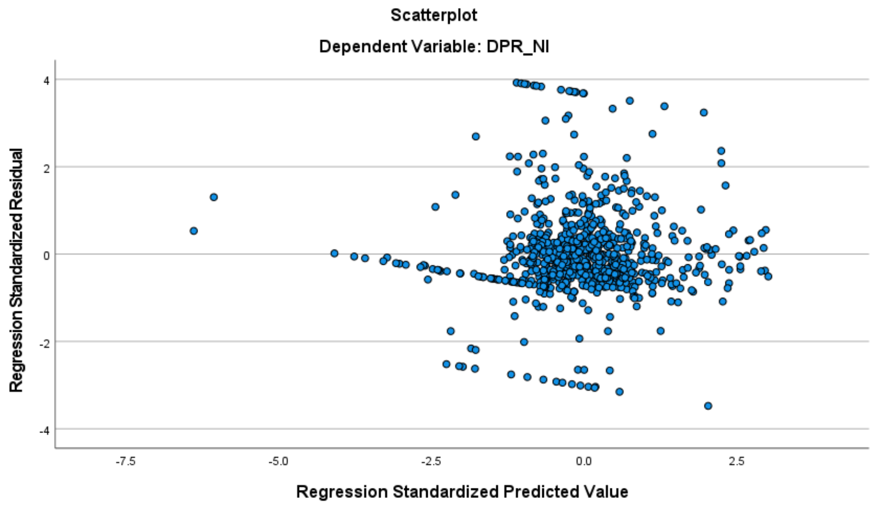




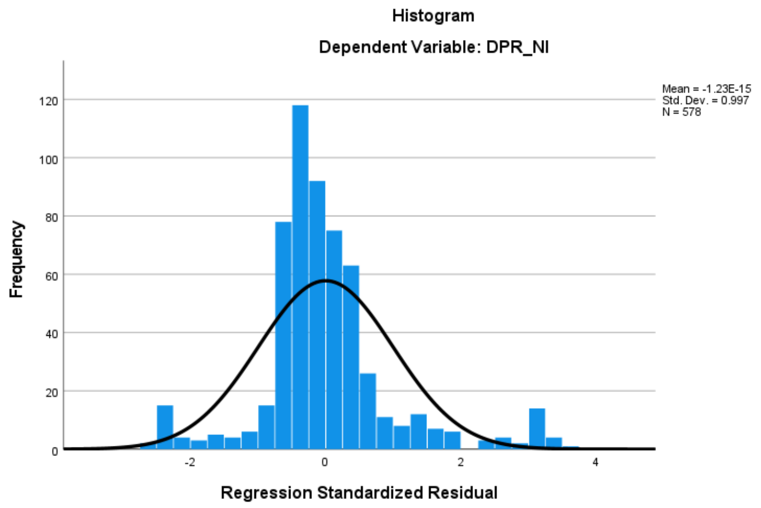
Appendix BG: Histogram, P-P Plot and Scatterplot for Table 10 – DPR_NI only with significant variables – Panel A (2015-2018)

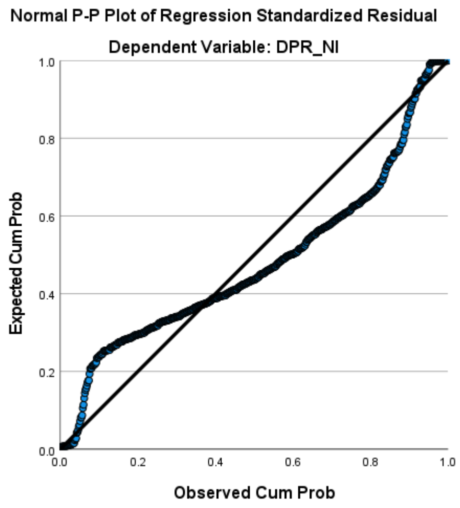


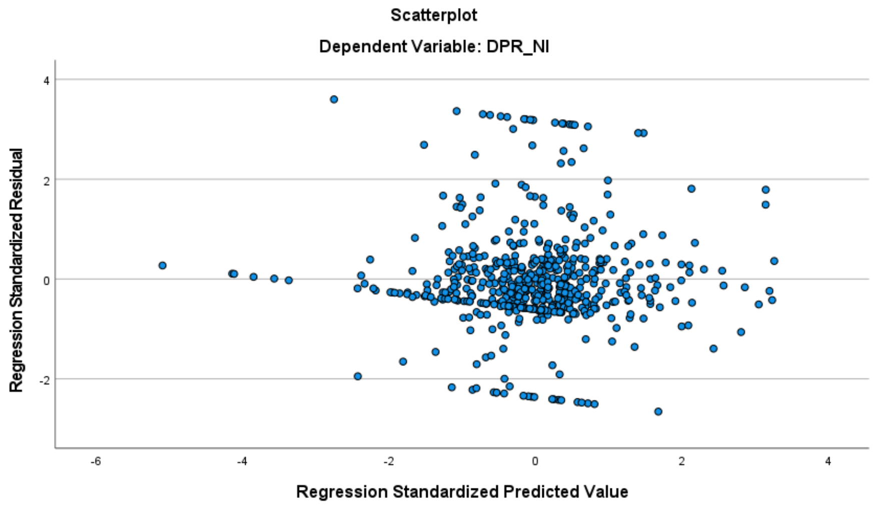




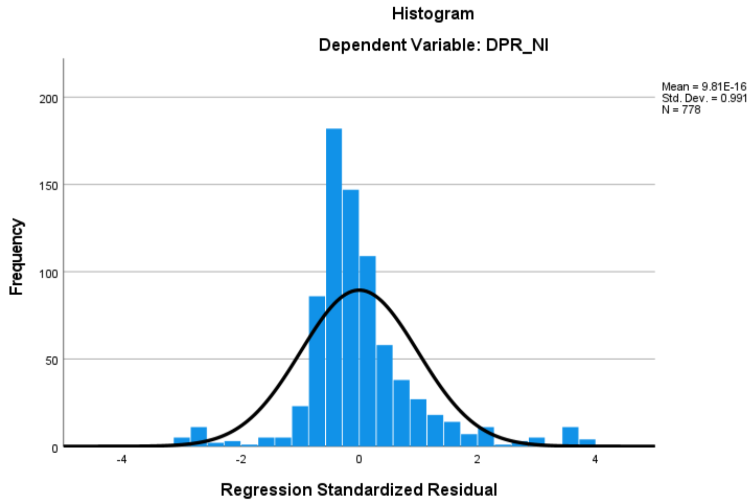
Appendix BH: Histogram, P-P Plot and Scatterplot for Table 10 – DPR_NI only with significant variables – Panel B (2019-2021)

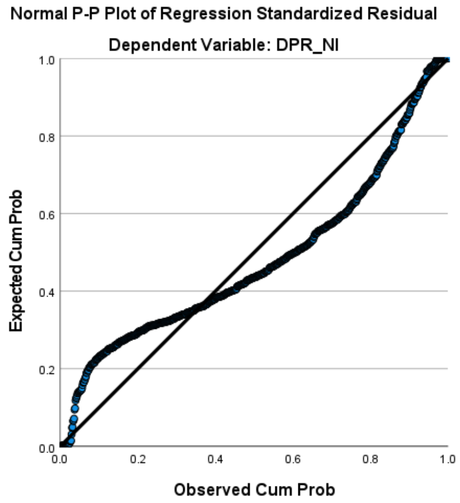


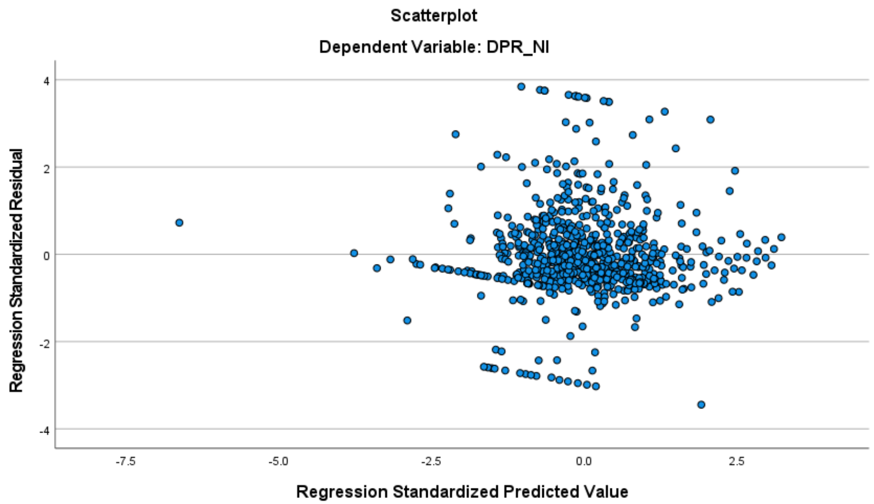




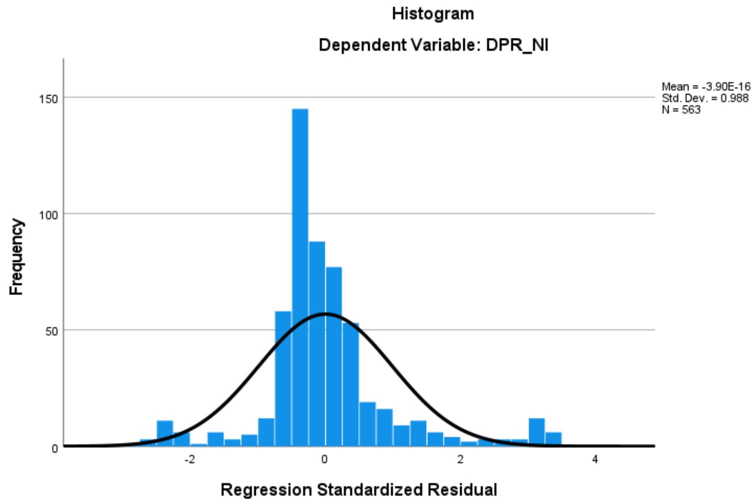
Appendix BI: Histogram, P-P Plot and Scatterplot for Table 11 – DPR_NI with original variables – Panel B (2015-2018)

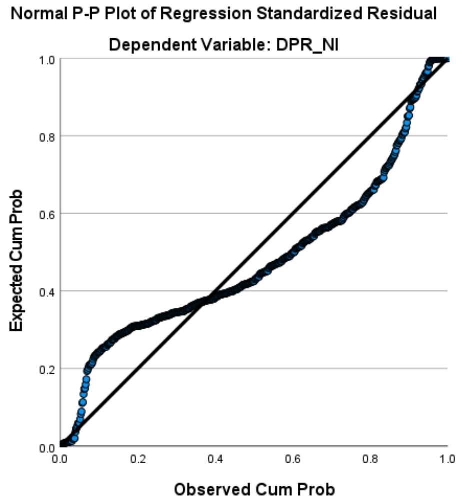


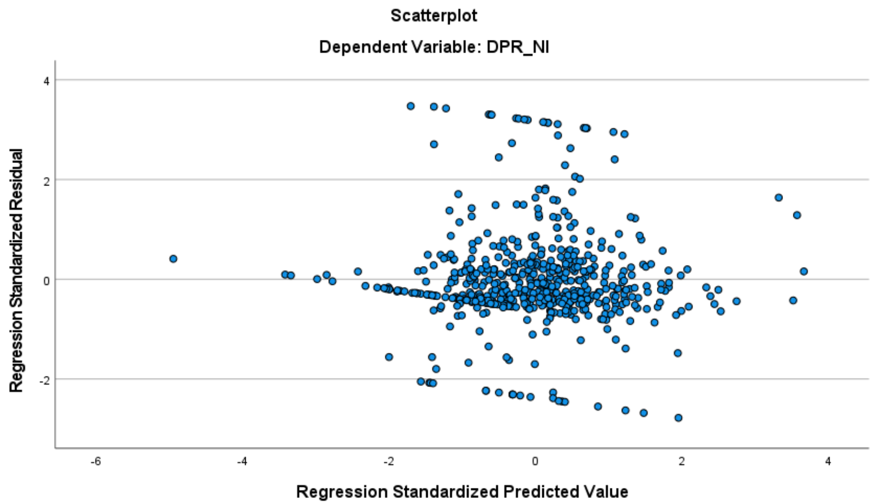




Appendix BJ: Histogram, P-P Plot and Scatterplot for Table 12 – DPR_NI with original variables – Panel B (2019-2021)







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