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DOES WORKING CAPITAL MANAGEMENT IMPACT PROFITABILITY IN THE MEDICAL DEVICE INDUSTRY?

EVIDENCE FROM GERMANY AND THE UNITED STATES

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Abstract

Does Working Capital Management Impact Profitability in the Medical Device Industry? Evidence from Germany and the United States

This Work Project analyses the effect of working capital management (cash conversion cycle and its components) on profitability (gross profit margin) for the medical device industry, an industry not previously researched. It uses a sample of 151 observations from market leaders of the world (United States) and Europe (Germany) for the period 2016-2020. Findings indicate that managers may extend cash conversion cycle and days inventory outstanding to increase gross profit margin. German managers may also reduce days sales outstanding and expand days payable outstanding, while managers in the United States may not consider them due to insignificance.

Keywords: Financial Statement Analysis, Working Capital Management, Profitability, Cash Conversion Cycle, Days Inventory Outstanding, Days Sales Outstanding, Days Payable Outstanding, Gross Profit Margin, Medical Devices, Germany, United States

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1. Introduction

The Medical Device (MD)[1] industry is diverse with products ranging from plasters to machine resonance imaging devices (MedTech Europe 2021). Its relevance was visible during the COVID-19 pandemic, when demand for personal protective equipment peaked (EY 2020). It has a world market size of c. USD 432 billion (2020), which will increase with a compound annual growth rate (CAGR) of c. 5.4% (2021-2028) (Fortune Business Insights 2021). Currently, the United States of America (USA) are the global leader, while Germany (GER) leads the European market, which is the second largest market worldwide (Fitch Solutions quoted in MedTech Europe 2021). All MD firms need an efficient working capital management (WCM) to optimize profitability with a favourable risk and profitability trade-off (Deloof 2003; Aktas, Croci, and Petmezas 2015). The working capital (WC) structure is made up of current assets and current liabilities (Filbeck and Krueger 2005). WCM is a lever of value creation for firm stakeholders (Rappaport 1986; Shin and Soenen 1998) since it impacts corporate value, liquidity, risk and profitability (K. Smith 1980; Chang 2018). As part of liquidity management, it is crucial in daily business operations (Eljelly 2004).

Recent studies proved the WCM effect on profitability, yet with diverse results. Research uses a widely accepted measure of WCM – the cash conversion cycle (*CCC*) (Gitman 1974). *CCC* represents the period it takes for a firm to sell finished goods and "collect receivables [minus] the time it takes to [settle] payables" (Wang 2002, 472). Wens, Moldenhauer, Lindenberg, and Kengelbach (2019) showed that European MD firms reduced *CCC* from 2013 to 2018 but increased profitability. This is a sound reason to analyse the question if WCM, via *CCC* and its components, impacts profitability. This Work Project evaluates major MD firms in Germany (GER) and the United States (USA) between 2016 and 2020 with gross

[1] The MD industry is also often referred as medical technology industry in literature. A MD is an "instrument, apparatus, appliance, software, implant, […] or other item […] to be used […] for human beings" (World Health Organization 2021, 9). A complete overview of all abbreviations applied in this Work Project is provided in *Table A1* (*Appendix-Appx.*).

profit margin (*GPM*) as profitability proxy. It provides several contributions: (i) Given divergence in previous research results, it helps to clarify the effect of *CCC* by using a so far rarely applied profitability proxy. (ii) Past research focused less on specific subindustries (*Appx. Table A2*). To the best of our knowledge, no study has solely analysed the MD industry yet. (iii) Many studies concentrated on developing countries (Singh, Kumar, and Colombage 2017). There has been some research for the USA, but evidence for GER is very limited. (iv) Differences in country factors (e.g., investor protection or healthcare system) and market factors (e.g., MD portfolio) are considered. The results are especially useful for MD firm managers, who can apply the WCM suggestions to rise profitability at reasonable risk.

This Work Project proceeds as follows: Section 2 delves into the MD industry. Section 3 explains the theoretical framework. Section 4 develops the main hypotheses based on a literature review. Section 5 outlines the research methodology. Section 6 analyses the data and discusses the findings, including robustness check of results and limitations of the analysis. Section 8 concludes and gives suggestions to firm managers and for future research.

2. Medical device industry

Typical MD subsectors are the orthopaedic, cardiovascular, dental, surgical, or diagnostic imaging device fields (Fortune Business Insights 2021). MD diversity may lead to deviating WCM and *GPM* due to e.g., divergent raw materials or production processes. MD industry suppliers are MD raw material producers, while MD customers are mainly healthcare providers and private consumers (MarketLine 2021a). The German MD market size was estimated to c. USD 40.5 billion in 2020 (Marketline 2021b, 2) with a market share of c. 26% in Europe (Fitch Solutions quoted in MedTech Europe 2021, 27). It will grow with a CAGR of c. 5% from 2020 to 2025 (Euromonitor International 2021, 33). In comparison, the United States (U.S.) market size was c. USD 173.6 billion in 2020 (Marketline 2021c, 2), being c. 42% of the global market (Fitch Solutions quoted in MedTech Europe 2021, 26). It will expand with a CAGR of c. 4% from 2020 to 2025 (Euromonitor International 2021, 27). The U.S. market has large conglomerates, but the main market is comprised of small firms (SelectUSA n.d.), also applying for GER (SPECTARIS 2021). *Table 1* presents strengths, weaknesses, opportunities, and threats (SWOT) of the MD industry in both countries.

Table 1: *SWOT analysis for the German and U.S. MD industry*

Strengths	• Low dependence on economic cycles and low seasonality • High regulatory hurdles and innovation power are barriers for market entry • Highly diversified portfolio with niche products and short average lifecycles (1.5-2 years) • Stable and high profitability
Weaknesses	• Low supply chain resilience with interruption risk due to international raw material sourcing • Stricter regulations increase compliance costs and extend product approval processes • High research and development costs (R&D), being c. 7% (USA) to c. 9% (GER) of sales
Opportunities	• Rising demand due to aging population and higher prevalence of chronic diseases • Global market growth due to improvement of healthcare systems in developing countries • Rising importance of better healthcare services and lifestyles extends customer groups
Threats	• High competition from conglomerates, emerging markets, and outside industry players • Budget pressure for healthcare expenditure of countries • Purchasing groups, used to buy medical devices (MDs) for several healthcare providers due to provider consolidation, exercise high negotiation power, forcing MD firms to reduce prices • MD world market also hit by the pandemic due to lower demand for specific MDs resulting from reduction in elective medical procedures

Sources: Morabito 2020; Zhu, Gupta, Park, and Mukherjee 2020; apoBank 2021; Euromonitor International 2021; Fortune Business Insights 2021; MarketLine 2021a; MedTech Europe 2021; State Bank Baden-Wuerttemberg (*Landesbank Baden-Württemberg*) 2021; Federal Statistical Office (*Statistisches Bundesamt*) quoted in SPECTARIS 2021, 5; SelectUSA n.d.

In the USA, the Food and Drug Administration (FDA) is supervising the MD market (FDA 2020), while in GER it is the task of the Federal Institute for Drugs and Medical Devices (*Bundesinstitut für Arzneimittel und Medizinprodukte*), Paul Ehrlich Institute and notified bodies (BVMed 2020). Both countries structure MDs based on their malfunction risk in three main classes (Cheng and Fromer 2021; MedTech Europe 2021). Risk increases with class and respective controls (Wagner and Schanze 2019; FDA 2020).[2] Besides, GER and the USA differ in their healthcare systems. In 2019, healthcare spending had a slightly higher gross domestic product (GDP) share in the USA (17%) than in GER (12%) (OECD 2021b), but medical goods expenses represented a lower share of this spending in the USA (14%) than in GER (19%) (OECD 2021a). 88% of German citizen are covered by statutory health insurance (German Federal Ministry of Health 2020, 24), while in the USA only 34% have a public

[2] The new European Union "Medical Device Regulation" converges to U.S. regulation´s strictness. It augments requirements for premarket controls, clinical trials, and post-market surveillance, which increases the compliance costs in GER (Daigle and Torsekar 2019; BVMed 2020).

insurance (Berschick, Barnett, and Upton 2019, 2). Hence, the U.S. system tends to be driven by private and the German one by public payors (AiM 2021). Healthcare providers in both countries are reimbursed for MDs by payors. Based on care type, they are reimbursed in e.g., fixed lump sums, bundles, or one-time sums (Zhu et al. 2020; AiM 2021; AiM and iGES Institute 2021; ISPOR 2021). Overall, WCM policy may differ due to divergent healthcare systems (impact of reimbursement on MD firm´s receivables), MD portfolios and tax rates[3].

3. Theoretical framework

WCM can prevent liquidity shortage via efficient inventory and receivables management and timely discharge of liabilities (Shin and Soenen 1998). Since external financing is more costly than internal one, WC changes may lead to additional cost (Myers and Majluf 1984; Baños-Caballero, García-Teruel, and Martínez-Solano 2010). There are three policies of WCM: aggressive, moderate and conservative (Weinraub and Visscher 1998; Nazir and Afza 2009).

Aggressive WCM aims at a low net working capital[4] by having a low current assets and/or a high current liabilities share (scaled by total assets). It enables lower inventory storage and obsolescence costs (Kim and Chung 1990), shorter customer payment collection, and less need for short-term debt (Jose, Lancaster, and Stevens 1996). However, it may impede sales growth since lower inventory interrupts operations and shorter trade credits to customers increment churn rates (Blinder and Maccini 1991; Jose et al. 1996). Late supplier payments may lead to unused discounts, impaired supplier relationships and risk of future debt supply (C. Ng, J. Smith, and R. Smith 1999; Wang, 2002). Conservative WCM is opposite to aggressive WCM regarding common-sized current assets and current liabilities. The WC increase is firstly financed by internal resources and then by debt based on pecking-order theory

[3] The taxation regime, affecting sales and payables, is different for GER and the USA. Value-added tax (VAT) rate for MDs in GER is 19%, with exceptions of 7% (German Bundestag (*Deutscher Bundestag*) 2019). In the USA, application of the MD tax (2.3%) was interrupted for 2016-2019 and repealed in 2019 (Japsen 2019). States apply different sales taxes, ranging from 2.9% to 7.25% (KPMG n.d.). MDs are divergently taxed, including tax exemptions and reductions (Dumler 2020).

[4] Net working capital is the net form of WC and the difference of current assets and current liabilities.

(Myers and Majluf 1984). Costs of inventory shortage and interruptions (Blinder and Maccini 1991) are avoided. Higher sales and product pre-assessment by customers are enabled due to longer payment periods (J. Smith 1987). However, inventory handling and financing costs and receivables recovery risk increment (Deloof 2003; Chang 2018). Higher risk and return are typical for aggressive WCM policies, while the opposite applies for conservative ones (Weinraub and Visscher 1998). Moderate WCM balances between both policies.

Static liquidity ratios (current ratio *CR*, quick ratio *QR*, cash ratio *CASHR*), based only on balance sheet items, were proven to be unreliable to analyse WCM policies (Richards and Laughlin 1980; Kamath 1989). In contrast, *CCC* is a more dynamic metric, combining balance sheet and income statement items (Jose et al. 1996). Gitman (1974) initially suggested *CCC*. It is measured in time units (usually days) and it is the sum of days inventory outstanding (*DIO*) and days sales outstanding (*DSO*) minus days payable outstanding (*DPO*) (Richards and Laughlin 1980; Deloof 2003)[5]. *DIO* is the average period inventory is held, *DSO* is the average period a company needs to gather receivables and *DPO* is the average period a firm needs to fulfil supplier payments (García-Teruel and Martínez-Solano 2007). The sum of *DIO* and *DSO* is the operating cash cycle (Richards and Laughlin 1980). The formulas for *CCC* and its components (in days) in this Work Project [1]-[4] are the ones mainly used in past research (Lazaridis and Tryfonidis 2006; Gill, Biger, and Mathur 2010).[6]

$$CCC_t = DIO_t + DSO_t - DPO_t \quad [1]$$

$$DIO_t = \frac{Inventories\ at\ end\ of\ period\ t}{Cost\ of\ Goods\ Sold\ during\ period\ t} \times 365 \quad [2]$$

$$DSO_t = \frac{Accounts\ Receivables\ at\ end\ of period\ t}{Sales\ during\ period\ t} \times 365 \quad [3]$$

$$DPO_t = \frac{Accounts\ Payables\ at\ end\ of\ period\ t}{Cost\ of\ Goods\ Sold\ during\ period\ t} \times 365 \quad [4]$$

[5] *CCC* parts are also called inventory conversion (*DIO*), receivables conversion (*DSO*) and payables deferral period (*DPO*) (Wang 2002). A similar measure to *CCC*, applied by e.g., Soenen (1993) and Shin and Soenen (1998), is the net trade cycle. Contrary to *CCC*, it uses total sales in the denominator of *DIO* and *DPO*.

[6] Calculation of *CCC* components differs in research: Some researchers (Chang 2018) use average values for the balance sheet items to account for fluctuating values during the year, induced by seasonality and business cycles (e.g., substantial sales changes). Others (Lin and Wang 2021) apply different proxies for the number of days per year (e.g., 360).

A longer positive *CCC* implies conservative WCM (Lin and Wang 2021) and is common for manufacturing firms due to capital intensity (Uyar 2009). A shorter (and/or negative) *CCC* refers to aggressive WCM (Lin and Wang 2021). Related to this, longer *DPO* indirectly serves as cheap financing (Petersen and Rajan 1997). There is rare proof for the WCM policy of the MD industry. Wens, Moldenhauer et al. (2019) showed a relatively long *CCC*, which was also found by Chang (2018) and Wang (2019) for MD firms in their multisector analyses. It indicates conservative WCM, being plausible due to the manufacturing business character.

Besides, MD firms are impacted by country factors (such as investor protection laws, healthcare systems, financial reporting standards, interest levels, tax rates or gross domestic product growth (*GDPG*)) and by MD market factors (such as market size or MD portfolio). Investor protection law defends the position of owners against that of managers. Based on the agency theory (Jensen and Meckling 1976), the segregation of firm ownership and management lets agents pursue their own targets at costs of owners due to information asymmetry. GER and USA differ in their investor protection level (La Porta, Lopez-de-Silanes, Shleifer, and Vishny 2002). The USA follows common law, while GER adopts civil law (La Porta et al. 1997). Investors in civil law countries have lower protection, which is accompanied with less developed capital markets, due to greater agency problems, and higher capital costs (La Porta et al. 1997, 2002; Hail and Leuz 2006; Almeida, Campello, and Weisbach 2011). Hence, there are less financing and investment options and German firms are less capital market-focused than U.S. ones (La Porta et al. 1997). The relative importance of trade credits might be higher for GER due to its lower investor protection and the resulting limited financing sources (Demirgüç-Kunt and Maksimovic 2001; Marotta 2005; Ferrando and Mulier 2012). Generally, divergent variable levels between GER and the USA may appear due to country and market factors highlighted above. Based on investor protection, German firms may have longer payments periods for receivables and payables due to less established protection laws, extending *DSO* and *DPO*. Diverse MD portfolios result in the purchase of different raw material, divergently held on stock. Thus, *CCC* levels may deviate, probably also visible in *GPM* due to the assumed effect of *CCC* on it. Finally, it is expected:

Hypothesis 1*: DIO (a), DSO (b), DPO (c), CCC (d) and GPM (e) statistically significantly*[7] *differ between GER and the USA.*[8]

4. Hypotheses development based on literature review

Tables A2-A3 (Appx.) depict a literature overview of studies of the effect of *DIO, DPO, DPO* and *CCC* on profitability. It covers diverse regions, industries, profitability proxies and regression models but shows non-consensual outcomes. Since the MD industry was not analysed yet and *GPM* was only rarely used, research scope is extended to similar sectors and profitability proxies. As the MD industry, the pharmaceutical industry is part of healthcare supply chain and a manufacturing sector. Hence, pharmaceutical and manufacturing industry are covered. Gross operating income (GOI), scaled by assets, has the same numerator as *GPM*, making it a reliable proxy. However, there is no proof comparing the WCM effect in diverse investor protection and healthcare system settings. Also, research often uses periods before 2016. In conclusion, the Work Project adds value with bi- and multivariate analyses.

Bivariate analysis (Appx. Table A2)

DIO: Research indicates a significant correlation of *DIO* and profitability, e.g., *GPM* (Yilmaz and Acar 2019). The USA and manufacturing industry (Gill et al. 2010) show more often insignificant results and the pharmaceutical industry proof is inconsistent. Generally, there is a tendency for a significant correlation between *DIO* and *GPM*. It might be positive based on results for *GPM* and GOI, despite mainly negative other findings. A *DIO* increase, induced by inventory growth, leads to lower cost of goods sold and finally, higher *GPM*. Thus, it is set:

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[7] In the context of the Work Project, significance refers to statistical significance.
[8] The variable medians are used to test differences between the countries. The median is less distracted from outliers in case of non-normally distributed data, which may lead to large deviations between variable median and mean (Wooldridge 2012).

Hypothesis 2: *DIO is statistically significantly correlated to GPM in GER and the USA.*

DSO: A significant correlation to GOI, ROA (return on assets) or NOI (net operating income) was mostly found in past research, including proof for the USA (Gill et al. 2010) and the manufacturing industry (Kasozi 2017). The rare results for *GPM* are inconsistent, while in the pharmaceutical industry insignificance exceeds. Correlation tends to be negative (also for *GPM*) since shorter *DSO* lowers sales power and thus, *GPM*. Overall, research emphasises a significant (probably negative) correlation between *DSO* and profitability. Hence, it follows:

Hypothesis 3: *DSO is statistically significantly correlated to GPM in GER and the USA.*

DPO: Outcomes of a significant correlation between *DPO* and profitability (e.g., GOI) are slightly outweighing, supported by manufacturing industry findings (Kasozi 2017). In contrast, results for the USA (Gill et al. 2010) and for *GPM* are insignificant (Nijam 2016). There is enough proof for a significant correlation. Most past results show negative relations, but *GPM* and GOI (partly) have positive ones. Higher *DPO* may imply higher payables and inventory, which will lower cost of goods sold and increase *GPM*. As a result, it is expected:

Hypothesis 4*: DPO is statistically significantly correlated to GPM in GER and the USA.*

CCC: Research indicates a significant correlation to e.g., GOI, ROA or NOI, also for the USA (Jose et al. 1996). Despite contrary results for the rare proof for *GPM* (Yilmaz and Acar 2019) and for the manufacturing (Gill et al. 2010) and pharmaceutical industry (Sharif and Islam 2018), a significant correlation between *CCC* and *GPM* is expected from past results. It is potentially negative based on previous findings (also for *GPM* and GOI). Thus, it is assumed:

Hypothesis 5*: CCC is statistically significantly correlated to GPM in GER and the USA.*

Multivariate analysis (Appx. Table A3)

DIO: A significant impact of *DIO* on profitability, being e.g., *GPM* (Altaf and Shah 2018) or GOI (Abuzayed 2012), clearly exceeds. Proof was added for the USA (Gill et al. 2010), GER (Hoegerle, Charifzadeh, Ferencz, and Kostin 2020) and the manufacturing industry (S. Ng, Ye, Ong, and Teh 2017). The pharmaceutical industry has more insignificant results. Overall, there is strong evidence for a significant *DIO* effect. Although it is primary negative, it tends to be more positive for *GPM*, GOI and the manufacturing industry due to the above explained lower cost goods sold for *DIO* growth. Generally, **Hypothesis 6** is formulated:

Hypothesis 6: *DIO has a statistically significant impact on GPM in GER and the USA.*

DSO: Literature often found a significant influence of *DSO* on profitability, including *GPM* (Basyith, Djazuli, and Fauzi 2021) and GOI (Gill et al. 2010). Besides the USA, it was often discovered for the pharmaceutical (Sharif and Islam 2018) and manufacturing industry (S. Ng et al. 2017). For GER inconsistent results were analysed. Overall, a significant *DSO* impact is derived from findings. It might be negative based on most past outcomes and arguments in **Hypothesis 3**, despite a weak positive tendency for *GPM*. Thus, **Hypothesis 7** is outlined:

Hypothesis 7*: DSO has a statistically significant impact on GPM in GER and the USA.*

DPO: The impact on profitability, being e.g., GOI (Lazaridis and Tryfonidis 2006), is primary significant and negative. The pharmaceutical industry (Sharif and Islam 2018) also indicates this, but results for *GPM* show no clear tendency (Altaf and Shah 2018) and those for GER (Hoegerle et al. 2020), the USA (Gill et al. 2010) and the manufacturing industry (S. Ng et al. 2017) are insignificant. Generally, findings for a significant *DPO* effect still outweigh. Despite mainly negative results (for e.g., GOI or manufacturing industry), outcomes for *GPM* are positive (like in **Hypothesis 4**). Hence, *DPO* effect might be positive[9] and it follows:

Hypothesis 8*: DPO has a statistically significant impact on GPM in GER and the USA.*

CCC: Findings in *Table A4 in Appx.* show a prevailing significant *CCC* impact on profitability, being e.g., *GPM* (Yilmaz and Acar 2019) or GOI (Deloof 2003). Proof for GER (Hoegerle et al. 2020), the USA (Ebben and Johnson 2011) and the pharmaceutical (Sharif and Islam 2018) and manufacturing industry (Gill et al. 2010) primary support this. As a result, a significant *CCC* impact on *GPM* is expected. It might be negative based on most

[9] Also, the assumed positive effect of *DPO* on *GPM* is equivalent to the expected negative impact of *DSO* on *GPM*, since the opposite *CCC* components assume similar measures (aggressive WCM) to increase profitability.

results for many profitability ratios, GER, the USA or pharmaceutical industry, despite inconsistency for GOI and only a very weak positive tendency for *GPM*. Thus, **Hypothesis 9** is set:

Hypothesis 9*: CCC has a statistically significant impact on GPM in GER and the USA.*

5. Research methodology

This Work Project analyses the effect of *CCC* and *CCC* components on *GPM* for mostly large MD firms in GER and the USA in the years 2016 to 2020. The period comprises the most recent available data and captures the MD market growth between 2016 and 2019 as well as the COVID-19 pandemic effect (EY 2020; SPECTARIS 2021). To be comparable, the period length was derived from past research, which often evaluates shorter periods to account for changing economic conditions (*Appx. Table A3*). Sample firms were selected from major MD company overviews of industry associations, exchange traded funds, industry research and a social network.[10] This procedure together with financial statement data creates a more representable sample than the usage of databases as Orbis, despite the hand collection effort and inconsistent financial data calculation.[11] Data was retrieved from financial statements[12], which were downloaded from firm websites and the Federal Gazette (*Bundesanzeiger*)[13]. For comparability, financial data was partly adjusted and aggregated due to different financial statement structures resulting from divergent financial reporting standards (*Appx. Table B1*).[14]

Variables[15]

<u>*Dependent variable:*</u> Past research mostly used ROA (Singh et al. 2017). However, this Work Project contributes novelty by supporting the rare evidence for *GPM* as proxy, which in contrast to ratios as ROA shows not only the operating performance but also isolates the

[10] Industry associations are BVMed (2020, 2021) and SPECTARIS (n.d.). Exchange traded funds are from BlackRock (2021) and S&P Dow Jones Indices (2021). Industry research is from EY (2020), Freiland, Golenko, Philippi, Yzer, Beeres, Carius, Steckeler, Kressner, Leonhardt, Pott, and Koziol (2020) and Statista (2021). The social network is Xing (n.d.).
[11] Filtering by industry codes in Orbis excludes firms with code adjustments and wrongly assigned codes (Kalemli-Ozcan, Sorenson, Villegas-Sanchez, Volosovych and Yesiltas 2015). Also, Orbis often lacks consolidated accounts or financial data.
[12] For firms lacking consolidated financial statements, individual ones were used (only for BIOTRONIK SE & Co. KG).
[13] Federal Gazette is a website for obtaining the financial statements of German firms.
[14] For c. 90% of the firm observations (obs.), specific variables were changed for better comparability.
[15] *Table B2* (*Appx.*) includes the dataset variables. The dataset is an Excel file with 151 firm obs. (rows) for 62 variables (columns), hence 9,362 total obs. (cells). It is a contribution to this Work Project and a starting point for future research.

effectiveness of sales power and inventory as well as purchasing management. *GPM* is calculated with the frequently used formula of Damodaran (2021): Gross profit (difference of total sales and cost of goods sold) divided by total sales.

Independent variables: Like *GPM*, *CCC* reflects the operating activity (Lazaridis and Tryfonidis 2006). Formulas of *CCC* components and *CCC* were explained in Section 3. For the balance sheet items, values at the period end were used since MD industry exhibits low seasonality in activity and low changes in the business cycle.

Control variables (*Table 2*): They were selected based on the industry overview (Section 2) and their effect on profitability in past research (Section 4). The variables cover general firm characteristics, financing and liquidity ratios, and fixed assets and R&D activity investment.

Table 2: *Measurement, past application and expected impact of control variables*

Variable	Measurement	Application as control variable in research (incl. impact)	Impact
General firm characteristics			
Firm size ***SIZE***	*Natural logarithm of total sales$_t$*	Positive: Hoegerle et al. (2020)*; negative: Lin and Wang (2021); insignificant: Gill et al. (2010)*	+
Firm age ***AGE***	*Natural logarithm of age$_t$* (# years until t since formation)	Positive: Afrifa and Padachi (2016); negative: Yazdanfar and Öhman (2014)	+
Sales growth ***GROW***	$\frac{Sales_t - Sales_{t-1}}{Sales_{t-1}}$	Positive: Deloof (2003); insignificant: Hoegerle et al. (2020)*	+
Financing			
Debt ratio ***DEBT***	$\frac{Total\ Liabilities_t}{Total\ Assets_t}$	Negative: Sensini (2020); insignificant: Padachi (2006) Past research used financial debt for debt ratio. Due to the different liability structure of MD firms, financial debt is not consistently disclosed and total liabilities were taken instead to show leverage.	-
Investments in fixed assets and R&D activity			
Asset tangibility ***TANG***	$\frac{Fixed\ Assets_t}{Total\ Assets_t}$	Positive: Chang (2018); negative: Afrifa and Padachi (2016)	-
Goodwill & intangible assets ratio ***GWIA***	$\frac{Goodwill\ \&\ Intangibles_t}{Total\ Assets_t}$	To the best of our knowledge, *GWIA* has not yet been used as control variable in this context. It is relevant for MD firms since it includes i.a., goodwill, patents, and trademarks necessary for the R&D activity. Despite differences in accounting of R&D expenditure, a positive impact of *GWIA* on *GPM* can be expected because higher R&D activity may be related to higher growth opportunities and competitive advantage. Thus, there is a benefit for profitability (Tudor, Dima, Dima, and Rațiu 2014; Gamayuni 2015).	+
Liquidity			
Current ratio ***CR***	$\frac{Current\ Assets_t}{Current\ Liabilities_t}$	Positive: Enqvist, Graham and Nikkinen (2014); negative: Afrifa and Padachi (2016); insignificant: Sharma and Kumar (2011)	-

Note: "*" indicates research for GER and the USA. Impact is the primary effect in past research regressions. It is significant for all control variables. However, past research used other profitability proxies and partly also control variable formulas.

Dummy variables: Reasoning for inclusion of dummy variables *COUNTRY*, *LIST*, *IFRS*, *YEAR2017*, *YEAR2018*, *YEAR2019* and *YEAR2020* is outlined in *Table B3 in Appx*.

The statistical analysis tool is Stata. Despite winsorization, variables are mainly non-normally distributed. Based on the country sample sizes, they are approximately normally distributed.[16] To be robust, parametric and non-parametric methods are used for uni- and bivariate analysis.

Sample

Sorted by revenue in the latest annual report (minimum EUR/USD 200 million), the initial sample had 20 firms for GER and 28 for the USA (*Appx. Tables B5-6*). The inclusion criteria refer to requirements for e.g., business model, fiscal year end, equity as well as profitability (*Appx. Tables B7-B8).* After application, the final sample includes 19 firms for GER and 18 for the USA (*Appx. Tables B9-B10)*. From 172 total obs., 21 were excluded due to negative profitability. Finally, there are 151 obs. with 75 for GER and 76 for the USA (*Table 3*).

Table 3: *Sample size per country and year*

Country	2016	2017	2018	2019	2020	Total firms
GER	17	16	17	17	8	75
USA	16	14	15	18	13	76
Total firms	**33**	**30**	**32**	**35**	**21**	**151**

Six listed final sample firms (28 obs.) have been collected for GER and 18 listed ones (76 obs.) for the USA (*Appx. Table B11*). Industry diversity is already visible since larger MD firms in GER tend to be more non-listed, while their U.S. competitors are more publicly listed. Hence, major German MD firms may have more limited financing options. All 18 U.S. firms use national accounting standards (US GAAP), whereas in GER 10 firms (45 obs.) apply *IFRS* and the remaining national standards (HGB) (*Appx. Table B12*).[17] Financial reporting standards influence accounting of relevant variables (e.g., inventory) in GER but also between GER and the USA. To reflect a diverse MD portfolio, the sample covers several subsectors (*Appx. Tables B13-B14*). GER shows higher MD diversity (for e.g., optical and electromedical products) and its MD portfolio differs from that of the USA.

[16] Variables were winsorized at the 5th and 95th percentile (*Appx. Table B4*) to reduce outliers (Afrifa and Padachi 2006). Since the sample size per country exceeds 30 obs., variables are assumed to be approximately normally distributed (Wooldridge 2012).

[17] *IFRS* are the International Financial Reporting Standards, US GAAP the national U.S. Generally Accepted Accounting Principles and HGB the national German accounting standards of the Commercial Code (*Handelsgesetzbuch*).

Research models for multivariate analysis

This Work Project uses pooled ordinary least squares (OLS) and fixed effects (FE) regressions for higher robustness since both were frequently used in past research (*Appx. Table A3*). As in Deloof (2003), the FE model is assumed to be an appropriate model next to pooled OLS. The year and company effects are fixed in the FE model. Besides the general error term and a time dummy, the FE model captures individual firm effects, accounting for unobservable firm specific characteristics that are "constant over time" (Deloof 2003, 580) but impact independent variables (García-Teruel and Martínez-Solano 2007). Pooled OLS and FE models are run with normal and clustered standard errors (SDE) to be robust for heteroskedasticity and autocorrelation (Rogers 1993; Stata n.d.-a).[18] Clustered SDE are created via clustering by firms. Models 5.A and 6.A refer to the pooled OLS models and models 5.B and 6.B to the FE models.[19] The models are firstly estimated for the total sample by including *COUNTRY* to analyse if its effect is significant. It would indicate a variation in the effect of *DIO*, *DSO*, *DPO* and *CCC* on *GPM* between GER and the USA. Then, the models are applied to the sample of each country by conditioning via *COUNTRY*. The general methodology for the multivariate analysis is presented in *Figure B1* (*Appx.*).

$$GPM_{it} = \beta_0 + \alpha_1 DIO_{it} + \alpha_2 DSO_{it} + \alpha_3 DPO_{it} + \beta_1 SIZE_{it} + \beta_2 AGE_{it} + \beta_3 GROW_{it} + \beta_4 DEBT_{it} + \beta_5 TANG_{it} + \beta_6 GWIA_{it} + \beta_7 CR_{it} + \beta_8 LIST_{it} + \beta_9 IFRS_{it} + \beta_{10} YEAR2017_t + \beta_{11} YEAR2018_t + \beta_{12} YEAR2019_t + \beta_{13} YEAR2020_t + \varepsilon_{it} \quad [5.A]$$

$$GPM_{it} = \beta_0 + \alpha_1 DIO_{it} + \alpha_2 DSO_{it} + \alpha_3 DPO_{it} + \beta_1 SIZE_{it} + \beta_2 AGE_{it} + \beta_3 GROW_{it} + \beta_4 DEBT_{it} + \beta_5 TANG_{it} + \beta_6 GWIA_{it} + \beta_7 CR_{it} + \nu_i + \lambda_t + \varepsilon_{it} \quad [5.B]$$

$$GPM_{it} = \beta_0 + \alpha_4 CCC_{it} + \beta_1 SIZE_{it} + \beta_2 AGE_{it} + \beta_3 GROW_{it} + \beta_4 DEBT_{it} + \beta_5 TANG_{it} + \beta_6 GWIA_{it} + \beta_7 CR_{it} + \beta_8 LIST_{it} + \beta_9 IFRS_{it} + \beta_{10} YEAR2017_t + \beta_{11} YEAR2018_t + \beta_{12} YEAR2019_t + \beta_{13} YEAR2020_t + \varepsilon_{it} \quad [6.A]$$

$$GPM_{it} = \beta_0 + \alpha_4 CCC_{it} + \beta_1 SIZE_{it} + \beta_2 AGE_{it} + \beta_3 GROW_{it} + \beta_4 DEBT_{it} + \beta_5 TANG_{it} + \beta_6 GWIA_{it} + \beta_7 CR_{it} + \nu_i + \lambda_t + \varepsilon_{it} \quad [6.B]$$

[18] Model assumptions are linearity, normality of errors, homoskedasticity, and neither autocorrelation nor multicollinearity (Wooldridge 2012).

[19] Models 5.A and 6.A do not include *LIST* and *IFRS* for the U.S. sample since all firms are listed and do not apply *IFRS*. The subscript *i* measures the firm obs. (*i*=1 to 75 for GER; *i*=76 to 151 for USA) and the subscript *t* the year (t=2016 to 2020) (Padachi 2006). To account for different yearly sensitivities, year dummies are included in models 5.A and 6.A (Chang 2018). Year effects are automatically fixed in models 5.B and 6.B via the time dummy λ_t (García-Teruel and Martínez-Solano 2007). ε_{it} represents the idiosyncratic error term (Pais and Gama 2015) and ν_i the "unobservable heterogeneity" (García-Teruel and Martínez-Solano 2007, 171; Pais and Gama 2015) of each firm in models 5.B and 6.B.

6. Data analysis and results discussion

Univariate analysis – Descriptive statistics

Analysing means and medians per country in the descriptive statistics (2016-2020) in *Table 4* shows that *GPM* is generally high in the MD industry and exhibits higher levels for the USA. In contrast, the German *GPM* slightly fluctuates more. The MD industry has an overall long *CCC*, implying a more conservative WCM. The German *CCC* is weakly longer, but the U.S. *CCC* visibly shows more variation. For *DIO*, which mainly leads to the long *CCC*, the mean lies in GER slightly below that of the USA, but the median is higher in GER. *DSO* is shorter than half of *DIO* in both countries and contributes less to the long industry *CCC*. It is as the median *DIO* and the *CCC* slightly longer in the German MD industry. However, German *DPO* lies marginally below the U.S. one, supporting the longer *CCC* in GER. Generally, standard deviation (SD) for *DIO* is substantially higher in the USA, whereas for *DSO* and *DPO* it exceeds in GER. Since in both countries *DIO* is clearly longer than *DPO*, inventory is longer held than the period in which suppliers are paid for it. In contrast, *DSO* is outweighing *DPO* for both countries. Thus, firms fulfil supplier payment earlier than customer settle bills. Overall, there are slight WCM and *GPM* differences between German and U.S. firms.

Table 4: *Summary statistics of independent, dependent and control variables for 2016-2020*

Statistics / Variables	N	Mean	Median	SD	N	Mean	Median	SD
	GER				**USA**			
Dependent								
GPM	75	0.5613	0.5687	0.1448	76	0.5954	0.6295	0.1177
Independent								
CCC (days)	75	171.8511	167.0122	55.7363	76	167.1295	145.4711	80.4014
DIO (days)	75	152.2073	145.7881	58.4093	76	155.3522	138.9854	74.1783
DSO (days)	75	65.2820	61.5914	20.4157	76	60.6048	61.3709	10.4689
DPO (days)	75	46.5277	43.2401	21.0197	76	48.1790	47.4804	17.3704
Control								
SIZE (in ln)	75	13.8146	13.4997	1.4096	76	15.2672	15.1332	1.1841
AGE (in ln)	75	4.1296	4.2905	0.8388	76	3.6178	3.3673	0.7645
AGE (years)	75	83.8400	73.0000	58.7096	76	49.6579	29.0000	37.7714
GROW	75	0.0641	0.0557	0.0672	76	0.1239	0.1046	0.1051
DEBT	75	0.4683	0.4471	0.1711	76	0.4829	0.5293	0.1500
TANG	75	0.2053	0.1780	0.1166	76	0.1378	0.1111	0.0719
GWIA	75	0.1702	0.1343	0.1470	76	0.4211	0.4779	0.2533
CR	75	2.8886	2.4109	1.4088	76	2.7559	2.4236	1.3026

Note: *SIZE* (in ln) is size as natural logarithm of total sales. *AGE* (in ln) is age as natural logarithm of years since formation.

According to control variables (*Table 4; Appx. Tables C1, C5*), U.S. MD firms are significantly larger than German ones (*SIZE)*, probably due to country (e.g., larger GDP and population size) and market factors (e.g., MD portfolio). The larger *SIZE* might influence e.g., supplier relations. However, German MD firms are significantly older (*AGE*). In contrast to *SIZE*, German firms might have more established relationships due to their longer market experience. Besides the appropriate *GROW* in both countries, U.S. MD firms have significantly higher *GROW*.[20] They may exceed in customer acquisition and R&D activity. Despite the higher investor protection in the USA, *DEBT* is only insignificantly higher in MD firms there. The reason could be that U.S. firms have more growth opportunities, increasing need for cheaper financing than equity. Nearly half of the capital in the MD industry is financed by *DEBT*. U.S. *GWIA* is significantly higher than the German one, contrary to the expected lower level since under *IFRS* and HGB development expenses can be capitalized, which is not permitted under US GAAP (FASB n.d.). Hence, U.S. firms show stronger innovation activity, driving *GROW*. But they have significantly lower *TANG*, maybe caused by a MD production that requires less capital or a higher knowledge level (thus higher *GWIA*) relative to German firms. As a result, MD portfolio diversity between firms in both countries may be visible. The *IFRS* fair value option might also contribute to the higher *TANG* for German firms. *CR* only insignificantly diverges and exhibits high liquidity for both countries. Further differences are detected for WCM items in the common-sized balance sheet and income statements. However, the other common-sized items are mainly similar. It probably results from an exceeding MD industry effect over country and market factors (*Appx. Tables C2-C5*).[21]

[20] *GROW* differences may not result from *GDPG* because it is only insignificantly higher in the USA (*Appx. Tables C4-C5*).

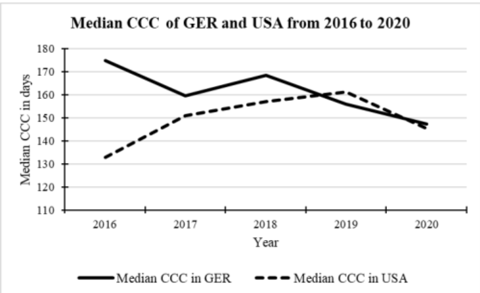
[21] The median common-sized balance sheet items (scaled by total assets except for *CASHR* and *QR*) show similarities for liquidity (*CASH*, *CASHR*, *QR*) and equity. However, significantly higher current assets *CARAT* and current liabilities ratios *CLRAT* for German firms are indicated, resulting in a significantly exceeding net working capital *NWC*. It suggests more conservative WCM. It is also visible in the significantly higher inventory *INV* and accounts receivable *RECEIV* levels and the significantly lower accounts payable *PAY* for German companies. In contrast, the median common-sized income statement items (scaled by total sales) highlight industry similarities for cost of goods sold *COGS*, operating expenses *OPEX*, operating profit *OPM*, earnings before interest and taxes *EBIT* and net income *NI*. Contrary, depreciation & amortization *DA* and net interest *INTEREST* were significantly higher in the USA.

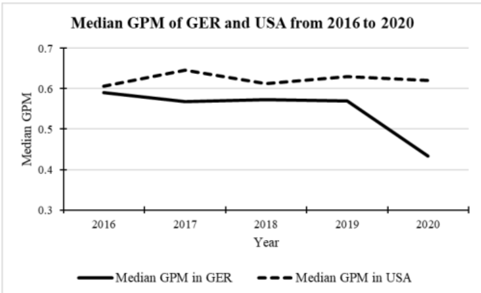
Generally, the MD industry is a highly profitable industry in both countries, which is visible from *GPM* and the profitability ratios in the common-sized income statements.

Univariate analysis – Evolution of median dependent and independent variables

From 2016 to 2020 (*Appx. Tables C6-C10; Figures C1-C3*), German *DIO* fell with variation, while U.S. *DIO* grew with fluctuations. There were divergent changes for *DIO* in both countries. First, *DIO* was primary longer in GER, this switched towards the period end. U.S. *DSO* weakly varied but stayed stable, whereas German *DSO* slightly rose. *DSO* levels of both countries were close, weakly exceeded in alternation and only began to diverge in 2020. U.S *DPO* gradually grew but slightly dropped in 2020, while German *DPO* initially remained stable and then weakly increased before falling. Generally, U.S. and German *DPO* diverged with generally longer U.S. *DPO*. U.S. *CCC* (*Figure 1*) steadily grew but decreased in 2020, whereas German *CCC* dropped. They converged and German *CCC* was mainly longer. U.S. and German *GPM* (*Figure 2*) started close together. Then, U.S. *GPM* weakly varied, being higher than German *GPM*, which slightly fell and remained stable. In 2020, German *GPM* crashed, diverging from the U.S. one. Evolutions for *DSO*, *CCC* and *GPM* indicate MD industry similarities, while those for *DIO* (main *CCC* contributor) and *DPO* imply diversity.

***Figures 1 and 2:** Median CCC and GPM for GER and USA from 2016-2020*





Univariate analysis – Test of significant differences in variables (Hypotheses 1a to 1e)

Median equality is tested with the non-parametric median test (*Table 5; Appx. Table C11*). Also, the equality of population distributions (Wilcoxon rank-sum test) is checked. Based on the p-values, differences in *DIO, DSO, DPO, CCC* and *GPM* between GER and the USA are insignificant at all conventional significance levels. To be robust, two-sample t-tests for equality of means were executed. They yielded similar results, except for *DSO*. At a level of 10%, mean of *DSO* is statistically different. However, due to non-normality of *DSO* in GER (*Appx. Table B4*), it is reasonable to rely on the non-parametric test, also considering the low significance (10%). As a result, **Hypotheses 1a-e** are rejected. Contrary to expectation, MD firms in GER and USA do not significantly differ in the length of *DIO*, *DSO* and *DPO* and the size of *GPM*. It reveals a higher industry effect on WCM relative to the impact of country (as investor protection law or healthcare system) and market factors (as product diversity).

Table 5: *P-values of population distribution, median and mean tests for 2016-2020*

Variable	Wilcoxon test – p-value	Median test – p-value	Mean test – p-value
DIO	0.5557	0.3270	0.7728
DSO	0.1739	1.0000	0.0780*
DPO	0.3110	0.2530	0.5993
CCC	0.1141	0.4140	0.6759
GPM	0.2902	0.1410	0.1141

Note: ***: p-value <0.01; **: p-value <0.05; *: p-value <0.1

Bivariate analysis (Hypotheses 2 to 5)

The bivariate analysis was done with the Spearman´s rank correlation matrix as non-parametric method and the Pearson matrix as parametric alternative. For GER (*Table 6; Appx. Table C12*), both correlation matrices yielded consistent results, except for a slight significance change for *DPO*. As expected, *DIO* exhibits a significant correlation to *GPM*, which is positive and supported by Yilmaz and Acar (2019). Thus, **Hypothesis 2** cannot be rejected, implying longer *DIO* is correlated to higher *GPM* for German MD firms. Also, as assumed and in line with Yilmaz and Acar (2019), *DSO* is significantly correlated to *GPM*. Hence, **Hypothesis 3** cannot be rejected and outcomes suggest that when *DSO* decreases a higher *GPM* is expected. Consistent with expectations and Lazaridis and Tryfonidis (2006), *DPO* is significantly related to *GPM* (at 10% significance level for Spearman and at 5% for Pearson). In conclusion, **Hypothesis 4** cannot be rejected, suggesting that longer *DPO* is associated with higher *GPM* for GER. Finally, *CCC* is, as expected, significantly related to *GPM* as discovered by Enqvist et al. (2014). Thus, **Hypothesis 5** cannot be rejected because

German MD firms with longer *CCC* tend to have higher *GPM*. Generally, *CCC* has positive correlation coefficients, which is contrary to initial expectation of a negative relation.

Table 6: *Correlation coefficients with GPM in Spearman´s rank and Pearson matrix*

Variable	GPM – GER Spearman	GPM – USA Spearman	GPM – GER Pearson	GPM – USA Pearson
DIO	0.7687***	0.4063***	0.7669***	0.4896***
DSO	-0.4354***	0.2883**	-0.3025***	0.2646**
DPO	0.1964*	0.0089	0.2503**	0.0261
CCC	0.5768***	0.3768***	0.6069***	0.4763***

Note: ***: p-value <0.01; **: p-value <0.05; *: p-value <0.1

For the USA (*Table 6; Appx. Table C13*), correlation matrices have consistent outcomes. As for GER, *DIO* is statistically positively related to *GPM*. Hence, **Hypothesis 2** cannot be rejected. Contrary to GER, *DSO* of U.S. firms is significantly but positively correlated to *GPM*, being consistent with Abuzayed (2012). As a result, **Hypothesis 3** cannot be rejected, implying that longer *DSO* is related to higher *GPM*. Like in GER, *DPO* is positively correlated to *GPM*, but the coefficient is not significant. It was also found by Yilmaz and Acar (2019). Thus, **Hypothesis 4** is rejected. Lastly, *CCC* behaves as assumed and has a statistically significant correlation to *GPM*, which is positive like in GER and in Enqvist et al. (2014). **Hypothesis 5** cannot be rejected, indicating that a longer *CCC* relates to a higher *GPM*. *DSO* and *CCC* have positive coefficients, contrary to initial assumption. Similarity in signs and significances for GER and the USA are only existent for *DIO* and *CCC*. Hence, **Hypotheses 3 and 4** show industry diversity, while **Hypotheses 1, 2 and 5** suggest similarity.

Multivariate analysis (Hypotheses 6 to 9)[22]

For all models (*Table 7*), explanatory, control, and dummy variables are jointly significant (except for model 6.B with clustered SDE for total sample). Adjusted R^2 is higher in the FE models, showing higher explanation power for *GPM* relative to OLS models (Deloof 2003).

[22] Pooled OLS and FE models mainly differ in the significance of the coefficients of the independent variables but not in their signs. Recommendations for managers are primary derived from the significant outcomes, which imply that there may be a significant effect. Coefficient interpretation considers the ceteris paribus effect of a particular variable. Significance levels are indicated inside brackets. Only major differences in significance of coefficients of the independent variables between normal and clustered SDE regressions are highlighted. Otherwise, discussion of results for a model applies for the regression with normal and with clustered SDE. Past research examples partially used different profitability proxies and regression methods.

For the total sample *(Table 7; Appx. Tables D1-D2)*, Model 5.A shows that *COUNTRY* is statistically significant (*at least 5%*) and thus, the impact of *CCC* components on *GPM* tends to be different between the USA and GER. The *COUNTRY* effect is positive and implies that being from the USA has a positive impact on *GPM* of a MD firm. As expected, models 5.A and 5.B indicate a significant (*at least 5%*) *DIO* effect, which is positive. The significantly *(at least 10%)* negative impact of *DSO* was confirmed in model 5.B together with insignificant outcomes in model 5.A. Aligned with the initial hypothesis, *DPO* significantly *(1%)* positively influences *GPM* in model 5.A, but only insignificantly in model 5.B. Analysing model 6.A, *COUNTRY* is also significantly *(1%)* positively associated with *GPM* but only for normal SDE. Moreover, higher *CCC* leads to significantly (*1%*) incremented *GPM* in model 6.A, but it is effectless in model 6.B. In conclusion, results show the WCM relevance to improve *GPM*, but they suggest splitting the sample per country.

Table 7: *Regression coefficients of independent variables for 2016-2020*

		Pooled OLS model				**FE model**			
Sample	**Varia-ble**	**Normal SDE**	**Adjusted R^2 (*F-test p-value*)**	**Deviation clustered SDE**	**Adjusted R^2 (*F-test p-value*)**	**Normal SDE**	**Adjusted R^2 (*F-test p-value*)**	**Deviation clustered SDE**	**Adjusted R^2 (*F-test p-value*)**
Total	*DIO*	0.00090***	0.7263 (*0.0000*)	-	0.7263 (*0.0000*)	0.00025**	0.9854 (*0.0000*)	-	0.9852 (*0.0220*)
	DSO	-0.00062		-		-0.00061**		*	
	DPO	0.00169***		-		0.00028		-	
	CCC	0.00074***	0.6081 (*0.0000*)	-	0.6081 (*0.0000*)	0.00010	0.9836 (*0.0005*)	-	0.9835 (*0.2602*)
GER	*DIO*	0.00013	0.8986 (*0.0000*)	-	0.8986 (*0.0000*)	0.00043***	0.9949 (*0.0000*)	**	0.9947 (*0.0000*)
	DSO	-0.00089**		***		-0.00023		-	
	DPO	0.00304***		-		0.00031		-	
	CCC	0.00025	0.7180 (*0.0000*)	-	0.7180 (*0.0000*)	0.00027*	0.9931 (*0.0000*)	**	0.9929 (*0.0008*)
USA	*DIO*	0.00091***	0.6978 (*0.0000*)	-	0.6978 (*0.0000*)	0.00020	0.9769 (*0.0477*)	-	0.9764 (*0.0279*)
	DSO	0.00028		-		0.00028		-	
	DPO	0.00051		-		0.00013		-	
	CCC	0.00080***	0.6708 (*0.0000*)	-	0.6708 (*0.0000*)	0.00014	0.9772 (*0.0283*)	-	0.9766 (*0.0152*)

Note: Deviation clustered SDE only refers to significance changes; ***: p-value <0.01; **: p-value <0.05; *: p-value <0.1

Starting with GER (*Table 7; Appx. Tables D3-D5*), model 5.A exhibits that *DIO* is positively but insignificantly associated with *GPM*. However, the effect is significant (*at least 5%*) in model 5.B (in line with Altaf and Shah 2018). It indicates that an extension of *DIO* by one day may result on average in an increase of *GPM* by 0.04 percentage points (pp.) for German MD firms. Hence, **Hypothesis 6** cannot be rejected for model 5.B but for model 5.A.

There is indication that German MD firm managers may lever *GPM* by lengthening *DIO* via higher inventory or lower cost of goods sold (conservative WCM measure). Thus, benefits of avoiding supply chain interruptions by holding more inventories may outweigh increased costs of inventory handling (Kim and Chung 1990). This is reasonable because MD firms in GER and the USA faced supply chain disruptions during the pandemic due to international raw material sourcing (EY 2020). As expected, and in line with Basyith et al. (2021), *DSO* has a negative effect on *GPM*, however it is only significant in model 5.A (*at least 5%*). In detail, a reduction of *DSO* by one day may rise *GPM* on average by 0.09 pp for German MD firms. As a result, **Hypothesis 7** cannot be rejected for model 5.A but for model 5.B (the latter in line with Enqvist et al. 2014). Managers may lower receivables or increase sales to favour *GPM* (aggressive WCM measure). Shorter *DSO* may crowd out customers with less liquidity, increase revenue collection and reduce financing cost, but it lowers *GROW* due to shorter customer payment periods (Deloof 2003). *DPO* significantly (*1%*) positively affects *GPM* in model 5.A (consistent with Altaf and Shah 2018) but only insignificantly in model 5.B (in line with Nijam 2016). An *DPO* expansion by one day may lead on average to growth in *GPM* by 0.3 pp. Hence, **Hypothesis 8** cannot be rejected for model 5.A but for model 5.B. There may be an outweighing benefit of cheap supplier financing relative to savings from discounts for earlier payments to suppliers (C. Ng et al. 1999). Managers may favour *GPM* by increasing payables or lowering cost of goods sold (aggressive WCM measure).

CCC weakly significantly positively affects *GPM* (*at least 10%)* in model 6.B (in line with Altaf and Shah 2018), but this effect is insignificant in model 6.A. It indicates that managers may slightly uplift *GPM* by 0.03pp for each day of prolonging *CCC* (conservative WCM measure). It may be induced by e.g., extending *DIO* based on results above. Thus, **Hypothesis 9** cannot be rejected for model 6.B but for model 6.A. The positive impact of *CCC* is contrary to the negative effect initially expected. Besides, models 5.A to 6.B indicate that *SIZE*, *AGE*, *GROW* and *GWIA* (as expected) may have a positive impact on *GPM*, while *DEBT* and *TANG* (as expected) as well as *LIST* and *IFRS* (contrary to assumption) may have a negative one. Also, *CR* (contrary to assumption) has an insignificant influence on *GPM*.[23]

For the USA (*Table 7; Appx. Tables D6-D8*), the assumption of a significant *GPM* change for a higher *DIO* was found to be significant (*1%*) and positive in model 5.A, which is in line with Altaf and Shah (2018). However, the positive effect was insignificant for model 5.B. Findings are like those for GER, but the other way around in terms of models. The significant effect is slightly larger for the USA. MD firm managers may raise *GPM* on average by 0.09 pp. for each day of *DIO* expansion (conservative WCM measure). The effect may be triggered by the same reason as for GER. Hence, the influence of being from the same industry on the impact of *DIO* on *GPM* is superordinated relative to impact differences induced by country and market factors. Thus, **Hypothesis 6** cannot be rejected for model 5.A but for model 5.B. *DSO* is, contrary to expectations, in both models insignificantly related to *GPM*. These results are consistent with Nijam (2016). That is why **Hypothesis 7** is rejected. Findings are partially deviating from those in GER and coefficients are overall slightly lower. There appears to be diversity since managers in U.S. MD firms may put their effort on other *CCC* parts and *CCC* itself, whereas their colleagues in GER may implement *DSO* measures based on model 5.A outcomes. *DSO* may not be an effective measure for the USA as it is in GER, where reimbursement regulation for MD customers, investor protection law and product portfolio may push earlier payment of receivables for higher *GPM*, supporting the negative *DSO* effect. Since investor protection mechanism is higher in the USA, the trade credit is probably less relevant for financing relative to other sources (Demirgüç-Kunt and Maksimovic 2001; Marotta 2005; Ferrando and Mulier 2012). Hence, *DSO* has lower relevance, favouring the insignificant *DSO* effect on *GPM*. Contrary to initial assumption, *DPO* has an insignificant

[23] Results for control and dummy variables mainly differ between pooled OLS and FE models for coefficient significances and signs, implying that further robustness tests are needed. A detailed analysis was done in *Table D5* (*Appx.*).

influence on *GPM* in both models, which is consistent with Nijam (2016). Thus, **Hypothesis 8** is rejected. Findings match with those of GER for signs and partially for significance. Coefficients are slightly lower than those for GER. In contrast to GER, leveraging *DPO* may not be efficient for managers. Besides divergent financial reporting standards (influencing e.g., cost of goods sold) and a less diverse U.S. MD portfolio (impacting e.g., raw material sourcing), higher investor protection in the USA may lower the *DPO* relevance and its impact on *GPM*. Other country and market factors, outlined before, may also affect the *DPO* impact.

CCC shows the expected significant (*1%*) effect only in model 6.A, where it is positive and in line with Altaf and Shah (2018). In model 6.B, the positive impact is insignificant. Model 6.A suggests that an extension of *CCC* by one day may be on average associated with a *GPM* growth by 0.08 pp. (conservative WCM measure). Concluding, **Hypothesis 9** cannot be rejected for model 6.A but for model 6.B. Like in GER, there seems to be a positive effect of *CCC* on *GPM*, but the coefficient significance and size (the effect) is higher in the USA and differs between the models for the countries. Contrary to initial expectation, *DSO* and *CCC* have a positive impact on *GPM*. Besides, models 5.A to 6.B imply that *TANG* and *CR* (as expected) as well as *GWIA* (contrary to assumption) may negatively affect *GPM*, while the effect of *SIZE*, *AGE*, *GROW* and *DEBT* (contrary to assumption) may be insignificant.[24] Compared to GER, only the impact of *TANG* may be similar across the MD industry. The different effects of the control variables between GER and the USA may result from divergent control variable levels, caused by the influence of country (e.g., financial reporting standards, investor protection or healthcare systems) and market factors (e.g., size or MD portfolio).

Overall, for each independent variable for GER and the USA, the significant coefficients are larger than the insignificant ones, showing a larger impact on *GPM*. Despite the small size of the effects of *CCC* and its components, their economic significance for profitability,

[24] Results for control and dummy variables partly differ between pooled OLS and FE models for coefficient significances and signs, implying that further robustness tests are needed. A detailed analysis was done in *Table D8* (*Appx.*).

liquidity and risk is high (K. Smith 1980; Chang 2018). Due to an already high profitability in the MD industry, further *GPM* growth might be more difficult to achieve. Also, the industry effect partially outweighs country and market differences. Managers in both countries may apply longer *CCC* and *DIO* (conservative WCM) as lever for higher *GPM*, but diversity for *DSO* and *DPO* is visible between GER and USA, requiring different WCM measures.

Robustness check and limitations

The robustness check analyses changes in the results for the hypotheses when data of the year 2020 is deleted from the sample. Hence, the effect of the COVID-19 pandemic is excluded. Median and mean testing (*Appx. Table E1*) came to similar results. This applies also for correlation coefficients (*Appx. Table E2*) except for *DPO* in GER. In this case, the coefficient is insignificant in the Spearman matrix, leading to the rejection of **Hypothesis 4** when relying on Spearman due to non-normality of *DPO*. For the multivariate analysis (*Appx. Tables E3-E6*), findings for GER and the USA are equivalent to those in Section 6. Hence, outcomes are mainly robust to the pandemic impact, except for *DPO* in **Hypothesis 4** in GER.

This Work Project has some limitations, which may affect findings. First, only major firms of two countries and one profitability proxy were analysed, potentially stressing the result robustness for small and medium enterprises (SME), other countries and different profitability ratios. Second, *CCC* component formulas can be altered: Purchases can be used for cost of goods sold (García-Teruel and Martínez-Solano 2007) to better reflect the purchasing process. Average values for numerators (Chang 2018) can be applied in case of potential business activity changes. Also, *DSO* and *DPO* can be adjusted for the VAT rate in GER and the sales tax in the USA to avoid overweighting (Lyngstadaas and Berg 2016). Third, different financial reporting standards require assumptions for data adjustments and aggregations due to divergent financial data measurement and recognition. It results in deviations in dependent, independent or control variables between German and U.S. firms but also between German firms. Moreover, different exercise of accounting options by managers lead to divergences in measurement and recognition of financial statement items, which cannot be captured.

7. Conclusion

This Work Project analysed the WCM impact on *GPM* for 37 major MD firms in GER and the USA in the years 2016 to 2020. Median values of *CCC* and *CCC* components were insignificantly different between GER and the USA. The MD industry has a long *CCC* in both countries, implying conservative WCM. Bivariate analysis suggests that higher *DIO* and *CCC* are significantly related to higher *GPM* in both countries, but lower *DSO* significantly correlates to higher *GPM* in GER and to lower *GPM* in the USA. *DPO* has a positive relation to *GPM* in GER, but it is insignificant in the USA. Multivariate analysis shows that in both countries MD firm managers may significantly favour the already high *GPM* level by extending *DIO* and *CCC*. German managers may also consider to lower *DSO* and extend *DPO*, while their U.S. colleagues may focus on *DIO* and *CCC* due to their slightly higher effect in the USA and the insignificant *DSO* and *DPO* impact. Based on the effect size, managers may adapt larger *DIO*, *DSO*, *DPO* and *CCC* adjustments to drive *GPM*. Overall, WCM, measured by *CCC* and its components, impacts profitability in the MD industry in GER and the USA, but partially in different ways. It may help managers to improve or maintain the already high profitability. Overall, similarities between GER and the USA imply that the MD industry effect outweighs different country (e.g., investor protection) and market factors (e.g., MD portfolio), while it is subordinated when differences were analysed.

Future research should expand the scope of analysis to earlier sample periods, SME, firms with other MD portfolios and additional countries. Alternative regression methods, profitability proxies and formulas of *CCC* components should be also covered. In addition, other investor protection, financial reporting and healthcare system settings should be tested. All in all, it ensures the robustness of the Work Project findings for the whole MD industry.

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Appendices

Appendix E

Appendix F

Appendix A

Table A1: List of abbreviations, acronyms and siglas used in Work Project

Abbreviation	Explanation
AGE	Firm age
Appx.	Appendix
AT	Asset turnover
c.	circa
CAGR	Compound annual growth rate
CASH	Cash to total assets ratio
CASHR	Cash ratio
CARAT	Current assets to total assets ratio
CCC	Cash conversion cycle
CLRAT	Current liabilities to total assets ratio
COGS	Cost of goods sold to total sales ratio
COUNTRY	Dummy variable for country
CR	Current ratio
DA	Depreciation and amortization to total sales ratio
DAX	*Deutscher Aktienindex* (German Stock Index)
DEBT	Debt to total assets ratio
DIO	Days inventory outstanding
DPO	Days payable outstanding
DSO	Days sales outstanding
EBIT	Earnings before interest and taxes to total sales ratio
EBITDA	Earnings before interest, taxes, depreciation, and amortization to total sales ratio
e.g.	Exempli gratia
EQUITY	Equity to total assets ratio
EUR	Euro
FDA	U.S. Food and Drug Administration
FE	Fixed effects regression
US GAAP	U.S. Generally Accepted Accounting Principles
GDP	Gross domestic product
GDPG	Gross domestic product growth
GER	Germany
GLS	Generalized least squares model
GMM	Generalized method of moment model
GOI	Gross operating income (scaled by assets)
GPM	Gross profit margin
GROW	Sales growth
GWIA	Goodwill and intangible assets ratio
HGB	*Handelsgesetzbuch* (German Commercial Code)
i.a.	Inter alia
IFRS	Dummy variable for International Financial Reporting Standards
INTEREST	Interest to total sales ratio
INV	Inventory to total sales ratio
LIST	Dummy variable for listed firms
MD	Medical Device
MDs	Medical Devices
MVA	Market value added
NI	Net income to total sales ratio
NOI	Net operating income (scaled by assets)
NPM	Net profit margin
NWC	Net working capital to total sales ratio
obs.	Observations
OLS	Pooled ordinary least squares regression
OPEX	Operating expenses to total sales ratio
OPM	Operating profit margin
PAY	Accounts payable to total assets ratio
pp.	Percentage points
QR	Quick ratio
R&D	Research and development
RE	Random effects regression
RECEIV	Accounts receivable to total assets ratio
ROA	Return on assets
ROCE	Return on capital employed
ROE	Return on equity
ROI	Return on investment
ROIC	Return on invested capital
SD	Standard deviation
SDE	Standard errors
SE	Stock exchange

(to be continued)

Table A1 *(continued).*

Abbreviation	Explanation
SIC	Standard industry classification
SIZE	Firm size
SME	Small and medium enterprises
SUR	Seemingly unrelated regression model
SWOT	Strengths, weaknesses, opportunities, and threats
TANG	Asset tangibility
U.S.	United States
USA	United States of America
USD	U.S. Dollar
VAT	Value added tax
WC	Working Capital
WCM	Working Capital Management
WLS	Weighted least squares model
YEAR2017	Dummy variable for year 2017
YEAR2018	Dummy variable for year 2018
YEAR2019	Dummy variable for year 2019
YEAR2020	Dummy variable for year 2020

Table A2: Overview of past research about impact of CCC and its components on profitability and findings for correlation coefficients

Authors and year	Period	Country	Sample	Industry	Dependent variable	Correlation coefficients of independent variables			
						CCC	**DIO**	**DSO**	**DPO**
Jose, Lancaster and Stevens (1996)	1974-1993	USA	Large firms	Multiple industries (i.a., manufacturing)	ROA ROE (for manufacturing industry)	-*** -***	n.a. n.a.	n.a. n.a.	n.a. n.a.
Lyroudi and Lazaridis (2000)	1997	Greece	Small to large firms	Food industry	ROI ROE NPM	+* + +***	n.a.	n.a.	n.a.
Wang (2002)	1985-1996	Taiwan Japan	n.a.	Multiple industries (i.a., manufacturing)	ROA (Japan) ROE (Japan) ROA (Taiwan) ROE (Taiwan) (for manufacturing industry)	-*** -*** -*** -***	n.a. n.a. n.a. n.a.	n.a. n.a. n.a. n.a.	n.a. n.a. n.a. n.a.
Deloof (2003)	1991-1996	Belgium	Large firms	Non-financial firms	GOI	-	-	-	-
Lazaridis and Tryfonidis (2006)	2001-2004	Greece	Firms listed on Athens Stock Exchange (SE)	Non-financial firms	GOI	-***	-***	-***	+***
Padachi (2006)	1998-2003	Mauritius	Small firms	Manufacturing industry	ROA OPM AT	+ + -	- - -	- - -	- - -
García-Teruel and Martínez-Solano (2007)	1996-2002	Spain	Small and medium enterprises (SME)	Multiple industries (i.a., manufacturing)	ROA	-***	-***	-***	-***
Raheman and Nasr (2007)	1999-2004	Pakistan	Firms listed on Karachi SE	Non-financial firms	NOI	-**	-***	-***	-***
Uyar (2009)	2007	Turkey	Firms listed on Istanbul SE	Multiple industries	ROA ROE	-*** +	n.a. n.a.	n.a. n.a.	n.a. n.a.
Gill, Biger and Mathur (2010)	2005-2007	USA	Firms listed on New York SE	Manufacturing industry	GOI	+	+	-***	+
Raheman, Afza, Qayyum and Bodla (2010)	1998-2007	Pakistan	Firms listed on Karachi SE	Manufacturing industry (i.a., pharmaceutical)	NOI	-	-***	-***	-***
Ebben and Johnson (2011)	2002-2004	USA	Small and private	Manufacturing and retail industries	AT ROIC (for manufacturing industry)	-*** -	n.a. n.a.	n.a. n.a.	n.a. n.a.

(to be continued)

Table A2 *(continued).*

Authors and year	Period	Country	Sample	Industry	Dependent variable	CCC	DIO	DSO	DPO
Sharma and Kumar (2011)	2000-2008	India	Firms listed at Bombay SE	Multiple non-financial industries (i.a., healthcare)	ROA	+	-	+**	-
Abuzayed (2012)	2000-2008	Jordan	Firms listed on Amman SE	Multiple industries (i.a., pharmaceutical & medical)	GOI	+***	+***	+***	-***
Baños-Caballero, García-Teruel and Martínez-Solano (2012)	2002-2007	Spain	SME	Multiple industries (i.a., manufacturing)	GOI NOI	-*** -***	n.a. n.a.	n.a. n.a.	n.a. n.a.
Tauringana and Afrifa (2013)	2005-2009	UK	SME listed on London SE	Alternative Investment Market	ROA	+	+	-**	-***
Enqvist, Graham and Nikkinen (2014)	1990-2008	Finland	Firms listed on Nasdaq OMX Helsinki SE	Non-financial firms	ROA GOI (for normal period)	+ +**	+ +	- +	- -**
Yazdanfar and Öhman (2014)	2008-2011	Sweden	SME	Multiple industries (i.a., metal & retail)	ROA	-***	n.a.	n.a.	n.a.
Pais and Gama (2015)	2002-2009	Portugal	SME	Multiple industries (i.a., manufacturing & human health activities)	ROA	-***	-***	-***	-***
Ahmed, Awan, Safdar, Hasnain and Kamran (2016)	2005-2012	Pakistan	Firms listed on Karachi SE	Pharmaceutical industry	ROI ROE	-*** -***	n.a.	n.a.	n.a.
Afrifa and Padachi (2016)	2005-2010	UK	SME listed on London SE	Alternative Investment Market	ROA ROCE ROE	-*** -*** -***	n.a. n.a. n.a.	n.a. n.a. n.a.	n.a. n.a. n.a.
Lyngstadaas and Berg (2016)	2010-2013	Norway	SME	Multiple industries (i.a., manufacturing)	ROA	-***	-***	-***	-***
Nijam (2016)	2011-2013	Sri Lanka	Firms listed on Colombo SE	Hotel and travel industry	GPM NPM ROA ROE	+ +*** + +	+** -** -*** -	+ +*** +** +	+ - - -
Kasozi (2017)	2007-2016	South Africa	Firms listed on Johannesburg SE	Manufacturing industries	ROA	+*	-	-**	-***
Usman, Shaikh and Khan (2017)	2003-2015	Denmark Norway Sweden	n.a.	Non-financial firms	ROA	-***	-***	-***	-***
Chowdhurry, Alam, Sultana and Hamid (2018)	2001-2015	Bangladesh	Firms listed on Dhaka SE	Pharmaceutical industry	ROA ROE	- -	- -	- +	+ -

(to be continued)

Table A2 *(continued).*

Authors and year	Period	Country	Sample	Industry	Dependent variable	CCC	DIO	DSO	DPO
Sharif and Islam (2018)	2010-2014	Bangladesh	Firms listed on Dhaka and Chittagong SE	Pharmaceutical industry	ROA	-	+**	-	-
Yilmaz and Acar (2019)	2013-2016	Oman	Firms from Muscat Securities Market	Non-financial firms	GPM EBIT ROA	- - -	+** + -	-** -** -	+ -* -
Sensini (2020)	2010-2016	Italy	SME	Agri-food industry	GPM	-	-	-	-
Lin and Wang (2021)	2008-2019	China	A-share listed firms	Non-financial firms	ROA	-***	n.a.	n.a.	n.a.

*Note: Table serves as overview of past research. Calculation of CCC components may differ from calculation in the Work Project. Pearson correlation matrix was mainly used. Cells with n.a.: information is not available; dark grey highlighted cells: no availability of significance for correlation coefficients; PEA: Pearson correlation matrix; GOI: gross operating income; NOI: net operating income; OPM: operating profit margin; GPM: gross profit margin; NPM: net profit margin; EBIT: EBIT margin; ROA: return on assets; ROI: return on investment; ROIC: return on invested capital; ROE: return on equity; ROCE: return on capital employed; AT: asset turnover; ***: p-value <0.01; **: p-value <0.05; *: p-value <0.1.*

Table A3: Overview of past research about impact of CCC and its components on profitability and findings for regression coefficients

							Regression coefficients of independent variables			
Authors and year	**Period**	**Country**	**Sample**	**Industry**	**Model**	**Dependent variable**	**CCC**	**DIO**	**DSO**	**DPO**
Jose, Lancaster and Stevens (1996)	1974-1993	USA	Large firms	Multiple industries (i.a., manufacturing)	n.a.	ROA ROE (for manufacturing industry)	-*** -***	n.a. n.a.	n.a. n.a.	n.a. n.a.
Wang (2002)	1985-1996	Taiwan Japan	n.a.	Multiple industries (i.a., manufacturing)	Cross-sectional regression	ROA (Japan) ROA (Taiwan) (for manufacturing industry)	-*** -***	n.a. n.a.	n.a. n.a.	n.a. n.a.
Deloof (2003)	1991-1996	Belgium	Large firms	Non-financial firms	FE OLS	GOI GOI	- -***	-** -***	-*** -***	-*** -***
Lazaridis and Tryfonidis (2006)	2001-2004	Greece	Firms listed on Athens SE	Non-financial firms	n.a.	GOI	-***	-***	-***	+***
Padachi (2006)	1998-2003	Mauritius	Small firms	Manufacturing industry	FE OLS	ROA ROA	+ -	+ -	-** -	- -*
García-Teruel and Martínez-Solano (2007)	1996-2002	Spain	SME	Multiple industries (i.a., manufacturing)	FE FE/IV	ROA ROA	-*** -***	-*** -***	-*** -***	-*** -
Raheman and Nasr (2007)	1999-2004	Pakistan	Firms listed on Karachi SE	Non-financial firms	OLS GLS	NOI NOI	-** -***	-*** -***	-*** -***	-*** +***
Şamiloğlu and Demirgüneş (2008)	1998-2007	Turkey	Firms listed on Istanbul SE	Manufacturing industry	n.a.	ROA	-	-***	-***	n.a.
Gill, Biger and Mathur (2010)	2005-2007	USA	Firms listed on New York SE	Manufacturing industry	WLS	GOI	+**	+*	-**	-
Raheman, Afza, Qayyum and Bodla (2010)	1998-2007	Pakistan	Firms listed on Karachi SE	Manufacturing industry (i.a., pharmaceutical)	FE OLS	NOI NOI	-*** -	-*** -***	+ -***	+ -***
Ebben and Johnson (2011)	2002-2004	USA	Small and private	Manufacturing and retail industry	n.a.	AT ROIC (for manufacturing industry)	-*** -**	n.a. n.a.	n.a. n.a.	n.a. n.a.
Nobanee, Abdullatif and AlHajjar (2011)	1990-2004	Japan	Small to large firms listed on Tokyo SE	Multiple industries (i.a., healthcare, pharma-ceutical & biotechnological)	GMM	ROI	-***	n.a.	n.a.	n.a.
Sharma and Kumar (2011)	2000-2008	India	Firms listed at Bombay SE	Multiple non-financial industries (i.a., healthcare)	OLS	ROA	+	-	+**	-

(to be continued)

Table A3 *(continued).*

Authors and year	Period	Country	Sample	Industry	Model	Dependent variable	Regression coefficients of independent variables			
							CCC	DIO	DSO	DPO
Abuzayed (2012)	2000- 2008	Jordan	Firms listed on Amman SE	Multiple industries (i.a., pharmaceutical & medical)	FE OLS GMM	GOI GOI GOI	+* +*** +	+** +*** +*	+* +*** +**	- -* -***
Baños-Caballero, García-Teruel and Martínez-Solano (2012)	2002- 2007	Spain	SME	Multiple industries (i.a., manufacturing)	GMM	GOI NOI	-*** -***	n.a. n.a.	n.a. n.a.	n.a. n.a.
Woehrmann, Knauer, and Gefken (2012)	2007- 2010	GER	Medium and large firms	Multiple industries (i.a., healthcare & manufacturing)	Panel data	ROCE	n.a.	-***	+	+***
Akoto, Awunyo-Vitor and Angmor (2013)	2005- 2009	Ghana	Firms listed on Ghana SE	Manufacturing industry	OLS	ROE	+**	n.a.	-**	+
Tauringana and Afrifa (2013)	2005- 2009	UK	SME listed on London SE	Alternative Investment Market	RE	ROA	-	-	-**	-***
Enqvist, Graham and Nikkinen (2014)	1990- 2008	Finland	Firms listed on Nasdaq OMX Helsinki SE	Non-financial firms	n.a.	ROA GOI (for normal period)	-*** -***	-*** -**	- -	- -***
Yazdanfar and Öhman (2014)	2008- 2011	Sweden	SME	Multiple industries (i.a., metal & retail)	SUR	ROA	-***	n.a.	n.a.	n.a.
Pais and Gama (2015)	2002- 2009	Portugal	SME	Multiple industries (i.a., manufacturing & human health activities)	FE FE/IV OLS OLS	ROA ROA ROA ROIC	-*** -*** -*** -***	-*** -*** -*** -***	-*** +*** -*** -***	-*** -*** -*** -***
Afrifa and Padachi (2016)	2005- 2010	UK	SME listed on London SE	Alternative Investment Market	RE	ROA ROCE ROE	+* +*** +***	n.a. n.a. n.a.	n.a. n.a. n.a.	n.a. n.a. n.a.
Ahmed, Awan, Safdar, Hasnain and Kamran (2016)	2005- 2012	Pakistan	Firms listed on Karachi SE	Pharmaceutical industry	n.a.	ROI ROE	-*** -***	n.a. n.a.	n.a. n.a.	n.a. n.a.
Lyngstadaas and Berg (2016)	2010- 2013	Norway	SME	Multiple industries (i.a., manufacturing)	FE FE OLS OLS	ROA ROIC ROA ROIC	-*** -*** -*** -***	-*** -*** -*** -***	-*** -*** -*** -***	-*** -** -*** -**
Nijam (2016)	2011- 2013	Sri Lanka	Firms listed on Colombo SE	Hotel and travel industry	OLS OLS OLS OLS	GPM NPM ROA ROE	+ +*** + +	+ - - -	+ +*** + +	+ - - -

(to be continued)

Table A3 *(continued).*

Authors and year	Period	Country	Sample	Industry	Model	Dependent variable	Regression coefficients of independent variables CCC	DIO	DSO	DPO
Kasozi (2017)	2007-2016	South Africa	Firms listed on Johannesburg Securities Exchange	Manufacturing industries	OLS RE FE	ROA ROA ROA	+ + +**	+ +* +**	- -** -	-*** -*** -***
S. Ng, Ye, Ong and Teh (2017)	2007-2012	Malaysia	Listed firms from industrial products industries on Bursa Malaysia Main market	Manufacturing industry	OLS	GOI	+***	+***	-***	+
Usman, Shaikh, and Khan (2017)	2003-2015	Denmark Norway Sweden	n.a.	Non-financial firms	OLS	ROA	-***	-***	-**	-***
Altaf and Shah (2018)	2007-2016	India	Firms from BSE ALLCAP Index	Multiple industries (i.a., chemical and chemical products)	GMM GMM	ROA GPM	+*** +***	+*** +**	+*** +***	+*** +***
Chang (2018)	1994-2011	Global (i.a., GER and USA)	n.a.	Multiple industries (i.a., medical equipment, pharmaceutical products & healthcare)	OLS OLS OLS 3SLS	ROA ROA (GER) ROA (USA) ROA	-*** - +*** -***	n.a. n.a. n.a. n.a.	n.a. n.a. n.a. n.a.	n.a. n.a. n.a. n.a.
Chowdhurry, Alam, Sultana, and Hamid (2018)	2001-2015	Bangla-desh	Firms listed on Dhaka SE	Pharmaceutical industry	n.a.	ROA ROE	-*** +	- +	-** +	+*** -***
Samosir (2018)	2012-2014	Indonesia	Firms listed on Indonesia SE	Manufacturing industry	FE	ROA	+***	n.a.	n.a.	n.a.
Sharif and Islam (2018)	2010-2014	Bangla-desh	Firms listed on Dhaka and Chitta-gong SE	Pharmaceutical industry	n.a.	ROA	+**	+**	+***	+**
Yilmaz and Acar (2019)	2013-2016	Oman	Firms from Muscat Securities Market	Non-financial firms	GMM GMM GMM	GPM EBIT ROA	-*** +** -	+ - -	+ + +	+*** -** -
Hoegerle, Charifzadeh, Ferencz and Kostin (2020)	2011-2017	GER	Firms listed on German stock index (DAX)	Multiple industries (i.a., pharma & healthcare)	FE	ROCE	-***	-***	-**	+
Sensini (2020)	2010-2016	Italy	SME	Agri-food industry	OLS	GPM	-*	n.a.	n.a.	n.a.

(to be continued)

Table A3 *(continued).*

Authors and year	Period	Country	Sample	Industry	Model	Dependent variable	Regression coefficients of independent variables: CCC	DIO	DSO	DPO
Basyith, Djazuli and Fauzi (2021)	2008-2019	Indonesia	Firms listed on Indonesia SE	Multiple industries (i.a., pharmaceutical)	OLS	ROA GPM	- +***	- +***	-*** -***	+*** +
Lin and Wang (2021)	2008-2019	China	A-share listed firms	Non-financial firms	FE	ROA	-***	n.a.	n.a.	n.a.

*Note: Table serves as overview of past research. Calculation of CCC components may differ from calculation in the Work Project. Cells with n.a.: information is not available; GOI: gross operating income; NOI: net operating income; GPM: gross profit margin; OPM: operating profit margin; NPM: net profit margin; EBIT: EBIT margin; ROA: return on assets; ROI: return on investment; ROIC: return on invested capital; ROE: return on equity; ROCE: return on capital employed; AT: asset turnover; OLS: pooled ordinary least squares model; FE: fixed effects model; FE/IV: fixed effects model with instrumental variables; RE: random effects model; GLS: generalized least squares model; WLS: weighted least squares model; SUR: seemingly unrelated regression model; GMM: generalized method of moment model; 3SLS: three-stage least squares model; ***: p-value <0.01; **: p-value <0.05; *: p-value <0.1.*

Table A4: Literature review of the impact of *CCC* on profitability

Significantly negative and linear impact of *CCC* on profitability
For the variable of interest, *GPM*, Yilamz and Acar (2019) and Sensini (2020) supported with proof for non-financial Omani firms and Italian small and medium enterprises (SME) from the agri-food industry, respectively. Jose et al. (1996) found evidence of a negative impact of *CCC* on ROA and ROE for U.S. companies from seven industries companies. Similar evidence for the USA was later analysed by Ebben and Johnson (2011) for small manufacturing firms using return on invested capital (ROIC) and by Wang (2019) for listed firms (including MD firms) using return on equity (ROE). Proof for GER was delivered by Hoegerle et al. (2020) for listed firms from the German stock index *DAX* with return on capital employed (ROCE) as proxy. With regard to ROA, additional evidence was added for Japanese and Taiwanese firms (Wang 2002), Spanish SME (García-Teruel and Martínez-Solano 2007), Finish listed firms (Enqvist, Graham, and Nikkinen 2014), Swedish SME (Yazdanfar and Öhman 2014), Portuguese SME (Pais and Gama 2015), Norwegian SME (Lyngstadaas and Berg 2016), listed pharmaceutical firms in Bangladesh (Chowdhurry, Alam, Sultana, and Hamid 2018) and Chinese listed firms (Lin and Wang 2021). Chang (2018) supported with equivalent findings for a global sample including medical equipment firms. For GOI, Lazaridis and Tryfonidis (2006) recommended a negative influence for firms listed on the Athens Stock SE, which was confirmed by Enqvist et al. (2014) for Finland. Deloof (2003) only provided a significantly negative effect in one model for large firms in Belgium. Further evidence for the manufacturing industry (i.e., pharmaceutical) was provided by Raheman et al. (2010) for Pakistani firms using NOI. A negative *CCC* influence on ROE and return on investment (ROI) was proven for the pharmaceutical industry in Pakistan by Ahmed, Awan, Safdar, Hasnain, and Kamran (2016).
Significantly positive and linear impact of *CCC* on profitability
A positive *CCC* impact on *GPM* was analysed for Indian firms by Altaf and Shah (2018). Dalci, Tanova, Özyapici, and Bein (2019) provided additional proof for a positive effect on profitability for large German companies. With respective to ROA, evidence was analysed for firms in the USA (Chang 2018), manufacturing firms in Indonesia (Samosir 2018) and listed pharmaceutical firms in Bangladesh (Sharif and Islam 2018). Similar results for GOI were found by Gill et al. (2010) for listed U.S. manufacturing firms, by Abuzayed (2012) for listed firms from Amman SE and by S. Ng et al. (2017) for listed Malaysian manufacturing firms. Akoto, Awunyo-Vitor, and Angmor (2013) and Kasozi (2017) strengthened the results for the manufacturing industry.
Insignificant and linear impact of *CCC* on profitability
An insignificant effect was suggested for *GPM* for listed hotel and travel firms in Sri Lanka (Nijam 2016) and for listed firms in Indonesia (Basyith et al. 2021). For ROA, small Mauritian firms (Padachi 2006), listed Turkish manufacturing firms (Şamiloğlu and Demirgüneş 2008), listed Indian firms (Sharma and Kumar 2011) and German firms (Chang 2018) showed an insignificant effect of *CCC*.
Significant and non-linear impact of *CCC* on profitability
Baños-Caballero et al. (2012) found a concave influence of *CCC* on GOI for Spanish SME. It was supported for ROA, ROE and ROCE by Afrifa and Padachi (2016) for SME of the Alternative Investment Market of London SE.

Appendix B

Table B1: Adjustments and aggregations applied to balance sheet and income statement items

Item	Adjustment
Accounts receivables	Receivables include trade receivables (short-term, sometimes also long-term), in some cases also receivables to related parties.
Accounts payable	Payables include trade payables (short-term, sometimes also long-term), in some cases also payables to related parties.
Provisions	Provisions with missing term (current or non-current) were assumed to be long-term.
Cost of goods sold	In case of missing cost of goods sold (for income statements with total cost structure), sum of cost of material and changes in inventory were used as proxy for cost of goods sold.
Operating profit	Operating profit only includes operating expenses and income. Non-recurring and non-operating income and expenses were excluded.
Earnings before interest and taxes	Earnings before interest and taxes include all earnings except for interest and taxes. Hence, it also comprise non-recurring and non-operating income and expenses, making it different from operating profit.
Net interest	Interest includes interest expense and income. Thus, it is the net interest expense. In some cases, other income is not separated from net interest expense, hence it is not included in earnings before interest and taxes but in interest.

Note: Adjustments and aggregations were applied to the extent of available information. They ensure the comparability of the financial data between firms in GER itself and between companies in GER and the USA due to different financial reporting standards. Selling, general and administration expenses and R&D expenses were not included since they were not consistently available for each sample firm.

Table B2: Overview of variables in dataset

Variable	Explanation
COUNTRY	Dummy for country indication
COMPANY	Name of company
SICCODE	U.S. SIC Code
YEAR	Year of reporting
YEAR2017	Dummy variable for year 2017
YEAR2018	Dummy variable for year 2018
YEAR2019	Dummy variable for year 2019
YEAR2020	Dummy variable for year 2020
PERIOD_END	End of reporting period
INCORPORATION	Year of incorporation
AGE_ABS	Age in years
AGE	Age in natural logarithm of years
IFRS	Dummy variable for financial reporting according to International Financial Reporting Standards
ACCOUNTING	Financial Reporting Standards
LIST	Dummy variable for a public listing of a firm
TA_ABS	Absolute value of total assets (in thousand EUR/USD)
CA_ABS	Absolute value of current assets (in thousand EUR/USD)
CARAT	Common-sized current assets (current assets to total assets ratio)
CASHR	Cash ratio (cash to total liabilities ratio)
QR	Quick ratio (current assets minus inventories to current liabilities ratio)
CR	Current ratio (current assets to current liabilities ratio)
NWC	Common-sized net working capital (net working capital to total assets ratio - net working capital is current assets minus current liabilities)
CASH_ABS	Absolute value of cash (in thousand EUR/USD)
CASH	Common-sized cash (cash to total assets ratio)
INV_ABS	Absolute value of inventory (in thousand EUR/USD)
INV	Common-sized inventories (inventories to total assets ratio)
RECEIV_ABS	Absolute value of accounts receivable (in thousand EUR/USD)
RECEIV	Common-sized accounts receivable (accounts receivable to total assets ratio)
NCA_ABS	Absolute value of non-current assets (in thousand EUR/USD)
NCARAT	Common-sized non-current assets (non-current assets to total assets ratio)
TANG_ABS	Absolute value of fixed assets (in thousand EUR/USD)
TANG	Common-sized fixed assets (fixed assets to total assets ratio)
GWIA_ABS	Absolute value of goodwill and intangible assets (in thousand EUR/USD)
GWIA	Common-sized goodwill and intangible assets (goodwill and intangible assets to total assets ratio)
EQUITY_ABS	Absolute value of equity (in thousand EUR/USD)
EQUITY	Common-sized equity (equity to total assets ratio)
DEBT_ABS	Absolute value of total liabilities (in thousand EUR/USD)
DEBT	Common-sized total liabilities (total liabilities to total assets ratio)
CL_ABS	Absolute value of current liabilities (in thousand EUR/USD)
CLRAT	Common-sized current liabilities (current liabilities to total assets ratio)
PAY_ABS	Absolute value of accounts payable (in thousand EUR/USD)
PAY	Common-sized accounts payable (accounts payable to total assets ratio)
NCL_ABS	Absolute value of non-current liabilities (in thousand EUR/USD)
NCLRAT	Common-sized non-current liabilities (non-current liabilities to total assets ratio)
SALES_ABS	Absolute value of total sales (in thousand EUR/USD)
SIZE	Firm size (natural logarithm of sales)
GROW	Annual sales growth
COGS_ABS	Absolute value of cost of goods sold (in thousand EUR/USD)
COGS	Common-sized cost of goods sold (cost of goods sold to total sales ratio)
GP_ABS	Absolute value of gross profit (in thousand EUR/USD)
DA_ABS	Absolute value of depreciation and amortization expenses (in thousand EUR/USD)
DA	Common-sized depreciation and amortization (depreciation and amortization expense to total sales ratio)
OP_ABS	Absolute value of operating profit (in thousand EUR/USD)
EBIT_ABS	Absolute value of earnings before interest and taxes (in thousand EUR/USD)
EBIT	Common-sized earnings before interest and taxes (earnings before interest and taxes to total sales ratio)
INTEREST_ABS	Absolute value of net interest expenses (in thousand EUR/USD)
INTEREST	Common-sized net interest (net interest expense to total sales ratio)
EBT_ABS	Absolute value of earnings before taxes (in thousand EUR/USD)
EBT	Common-sized earnings before taxes (earnings before taxes to total sales ratio)
NI_ABS	Absolute value of net income (in thousand EUR/USD)
NI	Common-sized net income (net income to total sales ratio)
GDPG	Annual gross domestic product growth
DIO	Days inventory outstanding (inventory divided by cost of goods sold multiplied by 365)
DSO	Days sales outstanding (accounts receivable divided by total sales multiplied by 365)
DPO	Days payable outstanding (accounts payable divided by cost of goods sold multiplied by 365)
CCC	Cash conversion cycle (sum of days inventory and sales outstanding minus payable outstanding)
GPM	Gross profit margin (gross profit to total sales ratio)
OPM	Operating margin (operating profit to total sales ratio)

Note: Variables are ordered as in the dataset, which is a hand-collected data collection from MD firms in GER and the USA.

Table B3: Listing and explanation of dummy variables

Dummy variable	Possible values of the variable	Explanation
COUNTRY	*COUNTRY* = 1 if a company is from the USA; else COUNTRY = 0.	*COUNTRY* is necessary to differentiate between GER and USA sample data.
YEAR2017	YEAR2017 = 1 if data is from the year 2017; else YEAR2017 = 0.	*YEAR2017* accounts for e.g., the specific inflation, interest and *GDPG* levels in the particular year 2017.
YEAR2018	YEAR2018 = 1 if data is from the year 2018; else YEAR2018 = 0.	*YEAR2018* accounts for e.g., the specific inflation, interest and *GDPG* levels in the particular year 2018.
YEAR2019	YEAR2019 = 1 if data is from the year 2019; else YEAR2019 = 0.	*YEAR2019* accounts for e.g., the specific inflation, interest and *GDPG* levels in the particular year 2019.
YEAR2020	YEAR2020 = 1 if data is from the year 2020; else YEAR2020 = 0.	*YEAR2020* accounts for e.g., the specific inflation, interest and *GDPG* levels in the particular year 2020.
LIST	*LIST* = 1 if a company is publicly listed; else *LIST* = 0. *LIST* only applies for regressions for GER since in all U.S. firms are listed.	Listed firms are less dependent on WC as financing method than unlisted companies due to additional (potentially cheaper) financing sources (Brav 2009). Simultaneously, they have increased agency costs resulting from the splitting of ownership and management (Jensen 1989; Asker, Farre-Mensa, and Ljungqvist 2015). For larger firms, as it is primary the case for the sample firms, the benefits of improved capital market access may exceed agency costs and thus, being listed might positively affect profitability (Doidge, Karolyi, and Stulz 2017). In conclusion, *LIST* is expected to have a positive effect on *GPM*.
IFRS	*IFRS* = 1 if a company adopts *IFRS* standards; else *IFRS* = 0. *IFRS* only applies for regressions for GER since all U.S. firms do not apply *IFRS*.	Sample firms apply different financial reporting regulation: international standards, being International Financial Reporting Standards (*IFRS*), and national standards, being U.S. Generally Accepted Accounting Principles (US GAAP) and German Commercial code (*Handelsgesetzbuch*) (HGB). The divergent accounting standards will lead to differences in financial statement items between German and U.S. firms but also between German firms because German firms differ in the application of international (*IFRS*) and national standards (HGB). The divergent exercise of accounting options by managers may lead to further deviations in the financial statement items. Apart from many divergences, the regulations differ in the consecutive valuation of inventory. First-in-first-out (FIFO) can be applied under *IFRS* (IAS 2), US GAAP (ASC 330) and HGB (§253), whereas last-in-first-out (LIFO) is only permitted under HGB and US GAAP (IFRS Foundation 2021b; FASB n.d.; Commercial Code n.d.). Hence, the adopted financial reporting standards may induce different inventory measurement, which influences *COGS* and ultimately, *DIO, DPO, CCC* and *GPM*. As a result, there might be an influence on the effect of *CCC* and *CCC* components on *GPM*. R&D has an important role in the MD industry and hence, divergent recognition and measurement of R&D expenses might also impact the value of *GWIA* and its relationship to *GPM*. In detail, U.S. firms according to US GAAP (ASC 730) need to expense R&D costs in the income statement (FASB n.d.), whereas German firms may capitalize development cost, either according to *IFRS* (IAS 38) or HGB (§248, §255) (IFRS Foundation 2021a; Commercial Code n.d.). Hence, US GAAP might have a negative impact on profitability. Furthermore, the consecutive measurement of fixed assets differs between *IFRS* and US GAAP as well as HGB. Fixed assets are subsequently valued at initial cost reduced by accumulated depreciation under IFRS (IAS 16), US GAAP (ASC 360) and HGB (§253), but there is an additional option for fixed assets under *IFRS* (IFRS Foundation 2021c; Commercial Code n.d.; FASB n.d.). They can be also revalued at fair value minus accumulated depreciation, reflecting a valuation that is more in accordance with the current market price. The divergent subsequent measurement methods between *IFRS* and US GAAP/HGB may impact depreciation and thus profitability but also the value of *TANG* and its influence on profitability.

Table B4: Shapiro-Wilk and skewness and kurtosis tests after winsorization per country for 2016-2020

Test / P-value	Shapiro-Wilk test p-value for GER	Shapiro-Wilk test p-value for USA	Skewness and kurtosis test p-value for GER	Skewness and kurtosis test p-value for USA
GPM	0.0017***	0.0002***	0.0115**	0.0000***
DIO	0.3408	0.0000***	0.4010	0.0051***
DSO	0.0045***	0.4861	0.5574	0.8631
DPO	0.0019***	0.3948	0.0537*	0.5892
CCC	0.0051***	0.0000***	0.0660*	0.0004***
SIZE	0.0001***	0.0045***	0.0286**	0.0000***
AGE	0.0025***	0.0002***	0.0015***	0.0000***
GROW	0.0002***	0.0279**	0.0031***	0.0604*
DEBT	0.4309	0.0000***	0.1208	0.0094***
TANG	0.0007***	0.0000***	0.0138**	0.0076***
GWIA	0.0000***	0.0000***	0.0072***	0.0000***
CR	0.0004***	0.0002***	0.0005***	0.0247**

*Note: If p-value of Shapiro-Wilk test is below 10%, the null hypothesis, which implies normality of that variable, is rejected. Similarly, if p-value of joint test for skewness and kurtosis is below 10%, then skewness and kurtosis exist for the variable. ***: p-value <0.01; **: p-value <0.05; *: p-value <0.1.*

Table B5: Initial sample of companies for GER

Company	Website	Listed firm	IFRS	End of reporting period	Type of financial statements	Income statement structure
Fresenius Medical Care AG & Co. KGaA	https://www.freseniusmedicalcare.com/en/home/	Yes	Yes	31^{st} December	Consolidated	Cost of sales
Siemens Healthineers AG	https://www.siemens-healthineers.com/	Yes	Yes	30^{th} September	Consolidated	Cost of sales
B. Braun SE	https://www.bbraun.com/en.html	No	Yes	31^{st} December	Consolidated	Cost of sales
Drägerwerk AG & Co. KGaA	https://www.draeger.com/en-us_us/Home	Yes	Yes	31^{st} December	Consolidated	Cost of sales
Paul Hartmann AG	https://www.hartmann.info/en-corp/	Yes	Yes	31^{st} December	Consolidated	Total cost
Karl Storz SE & Co. KG	https://www.karlstorz.com/de/en/index.htm?target=	No	No	31^{st} December	Consolidated	Cost of sales
Carl Zeiss Meditec AG	https://www.zeiss.com/meditec/int/home.html	Yes	Yes	30^{th} September	Consolidated	Cost of sales
Näder Holding GmbH & Co. KG - before 2018 Otto Bock Holding GmbH & Co. KG (Parent company of Ottobock SE & Co. KGaA)	https://www.ottobock.com/en/	No	No	31^{st} December	Consolidated	Total cost
Eppendorf AG	https://www.eppendorf.com/OC-en/	No	Yes	31^{st} December	Consolidated	Cost of sales
BIOTRONIK SE & Co. KG	https://www.biotronik.com/en-de	No	No	31^{st} December	Individual	Total cost
Lohmann GmbH & Co. KG	https://www.lohmann-tapes.com/en/home__2/	No	No	31^{st} December	Consolidated	Total cost
Lohmann & Rauscher International GmbH & Co. KG	https://www.lohmann-rauscher.com/us-en/	No	No	31^{st} December	Consolidated	Total cost
Sarstedt AG & Co. KG	https://www.sarstedt.com/en/home/	No	No	31^{st} December	Consolidated	Total cost
Brainlab AG	https://www.brainlab.com/	No	Yes	30^{th} September	Consolidated	Total cost
Karl Leibinger GmbH & Co. KG (Parent company of KLS Martin Group)	https://www.klsmartin.com/en-na/	No	No	31^{st} December	Consolidated	Total cost
C. Erbe GmbH (Parent company of Erbe Elektromedizin GmbH)	https://de.erbe-med.com/de-en/	No	No	31^{st} December	Consolidated	Total cost
Dürr Dental SE	https://www.duerrdental.com/en/GL/	No	Yes	31^{st} December	Consolidated	Total cost
Stratec SE	https://www.stratec.com/home	Yes	Yes	31^{st} December	Consolidated	Cost of sales
Bauerfeind AG	https://www.bauerfeind.com/worldmap/	No	No	31^{st} December	Consolidated	Total cost
Richard Wolf GmbH	https://www.richard-wolf.com/en/	No	No	31^{st} December	Consolidated	Total cost

Note: Firms are ranked according to the revenue in the most recent available annual report. Some companies were not included in the initial sample since they deviated from the inclusion criteria. For the companies, for which financial statements were downloaded from the firm websites, sources are included in the reference list.

Table B6: Initial sample of companies for the USA

Company	Website	Listed firm	IFRS	End of reporting period	Type of financial statements	Income statement structure
Johnson & Johnson	https://www.jnj.com/	Yes	No	3rd January	Consolidated	Cost of sales
Abbott Laboratories	https://www.abbott.com/	Yes	No	31st December	Consolidated	Cost of sales
Thermo Fisher Scientific Inc.	https://corporate.thermofisher.com/us/en/index.html	Yes	No	31st December	Consolidated	Cost of sales
3M Company	https://www.3m.com/	Yes	No	31st December	Consolidated	Cost of sales
GE Healthcare	https://www.gehealthcare.com/	Yes	No	31st December	Consolidated	Cost of sales
Becton, Dickinson and Company	https://www.bd.com/en-us	Yes	No	30th September	Consolidated	Cost of sales
Stryker Corporation	https://www.stryker.com/	Yes	No	31st December	Consolidated	Cost of sales
Danaher Corporation	https://www.danaher.com/	Yes	No	31st December	Consolidated	Cost of sales
Baxter International Inc.	https://www.baxter.com/	Yes	No	31st December	Consolidated	Cost of sales
Boston Scientific Corporation	https://www.bostonscientific.com/en-US/Home.html	Yes	No	31st December	Consolidated	Cost of sales
Zimmer Biomet Holdings Inc.	https://www.zimmerbiomet.com/en	Yes	No	31st December	Consolidated	Cost of sales
Edwards Lifesciences Corporation	https://www.edwards.com/	Yes	No	31st December	Consolidated	Cost of sales
Intuitive Surgical Inc.	https://www.intuitive.com/en-us	Yes	No	31st December	Consolidated	Cost of sales
Dentsply Sirona Inc.	https://www.dentsplysirona.com/en	Yes	No	31st December	Consolidated	Cost of sales
ResMed Inc.	https://www.resmed.com/en-us/	Yes	No	30th June	Consolidated	Cost of sales
Hill-Rom Holdings Inc.	https://www.hillrom.com/	Yes	No	30th September	Consolidated	Cost of sales
Teleflex Incorporated	https://teleflex.com/usa/en/index.html	Yes	No	31st December	Consolidated	Cost of sales
Align Technology Inc.	https://www.aligntech.com/	Yes	No	31st December	Consolidated	Cost of sales
Cooper Companies Inc.	https://www.coopercos.com/	Yes	No	31st October	Consolidated	Cost of sales
Envista Holdings Corporation	https://www.envistaco.com/en	Yes	No	31st December	Consolidated	Cost of sales
Dexcom Inc.	https://www.dexcom.com/	Yes	No	31st December	Consolidated	Cost of sales
Integra Lifesciences Holdings Corporation	https://www.integralife.com/de/home	Yes	No	31st December	Consolidated	Cost of sales
ICU Medical Inc.	https://www.icumed.com/	Yes	No	31st December	Consolidated	Cost of sales
Masimo Corporation	https://www.masimo.com/	Yes	No	2nd January	Consolidated	Cost of sales
NuVasive Inc.	https://www.nuvasive.com/	Yes	No	31st December	Consolidated	Cost of sales
Insulet Corporation	https://www.insulet.com/	Yes	No	31st December	Consolidated	Cost of sales
Abiomed Inc.	https://www.abiomed.com/	Yes	No	31st March	Consolidated	Cost of sales
Merit Medical Systems Inc.	https://www.merit.com/	Yes	No	31st December	Consolidated	Cost of sales

Note: Firms are ranked according to the revenue in the most recent available annual report. Some companies were not included in the initial sample since they deviated from the inclusion criteria. For the companies, for which financial statements were downloaded from the firm websites, sources are included in the reference list. If SEC filings for the U.S. firms were available, they were used for data retrieval from the financial statements.

Table B7: Inclusion criteria for final sample companies

Criterion	Explanation
Registered office	Headquarter/registered office should be in GER or the USA.
Business model/ segment	Firms with business segments that do not significantly differ in the end-industries are included (otherwise segment reporting is necessary). Main revenue streams should result from products and services related to MD.
Fiscal year end	Fiscal year should end on 31st December. Certain exceptions for this criterion were made for Siemens Healthineers AG, Carl Zeiss Meditec AG, Brainlab AG and Becton, Dickinson and Company. They were included since they represent a significant constituent of the market and have a high share of the overall market.
Mergers and initial public offerings	Financial data (for more than one year) after merger of standalone companies or initial public offerings is included. *Table B8* includes the formation years of the sample firms.
Revenue	Revenue of latest available annual report should be above USD/EUR 200 million to ensure that mainly large firms are covered in the sample.
Equity	Equity should be nonnegative.
Earnings before interest and taxes	Earnings before interest and taxes should be nonnegative.
Operating income	Operating income should be nonnegative.
Net income	Net income should be nonnegative.

Table B8: Formation years of firms

Company	Year	Comment	Source
GER			
Fresenius Medical Care AG & Co. KGaA	1996	-	Company Website
Siemens Healthineers AG	2017	Formerly included as business segment in Siemens Group; then initial public offering on 16/03/2018	Annual Report 2018 Company Website
B. Braun SE	1938	-	Company Website
Drägerwerk AG & Co. KGaA	1889	-	Company Website
Paul Hartmann AG	1818	-	Company Website
Karl Storz SE & Co. KG	1945	-	Company Website
Carl Zeiss Meditec AG	2002	Prior business unit of Zeiss Group	Company Website
Otto Bock Holding GmbH & Co. KG (Ottobock SE & Co. KGaA)	1919	-	Company Website
Eppendorf AG	1945	-	Company Website
BIOTRONIK SE & Co. KG	1963	-	Company Website
Lohmann & Rauscher International GmbH & Co. KG	1998	Merger of Lohmann Medical and Rauscher	Company Website
Sarstedt AG & Co. KG	1961	-	Company Website
Brainlab AG	1989	-	Company Website
Karl Leibinger GmbH & Co. KG (KLS Martin Group)	1896	-	Company Website
C. Erbe GmbH (Erbe Elektromedizin)	1851	-	Company Website
Dürr Dental SE	1941	-	Company Website
Stratec SE	1979	-	Company Website
Bauerfeind AG	1929	-	Company Website
Richard Wolf GmbH	1906	-	Company Website
USA			
Abbott Laboratories	1894	-	Company Website
Thermo Fisher Scientific Inc.	2006	Merger of Thermo Electron Corporation and Fisher Scientific International	BioSpace (2006)
Becton, Dickinson and Company	1897	-	Company Website
Stryker Corporation	1941	-	Company Website
Baxter International Inc.	1931	-	Company Website
Boston Scientific Corporation	1979	-	Company Website
Zimmer Biomet Holding Inc.	1927	Zimmer Holdings acquired Biomet in 2015, however it was not a merger.	Company Website
Edwards Lifesciences Corporation	1999	-	Orbis and Bloomberg
Intuitive Surgical Inc.	1995	-	Orbis and Bloomberg
Dentsply Sirona Inc.	2016	Merger of Dentsply International and Sirona Dental Systems	Company Website
Teleflex Incorporated	1943	-	Orbis and Bloomberg
Align Technology Inc.	1997	-	Orbis and Bloomberg
Dexcom Inc.	1999	-	Orbis and Bloomberg
Integra Lifesciences Holdings Corporation	1989	-	Orbis and Bloomberg
ICU Medical Inc.	1992	-	Orbis and Bloomberg
NuVasive Inc.	1997	-	Orbis and Bloomberg
Insulet Corporation	2000	-	Orbis and Bloomberg
Merit Medical Systems Inc.	1987	-	Orbis and Bloomberg

Note: For companies, for which formation information was taken from the firm websites, sources are included in the reference list. Year of formation can be also the year of the merger of two standalone companies.

Table B9: Transition from initial to final sample for GER and USA via exclusion

Samples and exclusions \ Countries	GER	USA
Initial sample: # Firms	20 firms	28 firms
Exclusion of firms: Business model/segment criterion Fiscal year end criterion Mergers and initial public offerings criterion	1 firm 0 firms 0 firms	4 firms 5 firms 1 firm
Intermediate sample: # Firms # Total firm obs.	19 firms 82 obs.	18 firms 90 obs.
Exclusion of firm obs: Earnings before interest and taxes, operating income, and net income criterion	7 obs.	14 obs.
Final sample: # Firms # Total firm obs.	19 firms 75 obs.	18 firms 76 obs.

Table B10: Firms excluded from final sample for GER and USA

Excluded companies \ Countries	GER	USA
Business model/segment criterion	• Lohmann GmbH & Co. KG	• Johnson & Johnson • Danaher Corporation • 3M Company • GE Healthcare
Fiscal year end criterion	-	• ResMed Inc. • Hill-Rom Holdings Inc. • Cooper Companies Inc. • Masimo Corporation • Abiomed Inc.
Mergers and initial public offerings criterion	-	• Envista Holdings Corporation

Table B11: Number of listed and unlisted firms per country and year

LIST \ Year	2016	2017	2018	2019	2020	Total firms
GER						
0	12	11	11	11	2	47
1	5	5	6	6	6	28
Total	**17**	**16**	**17**	**17**	**8**	**75**
USA						
0	0	0	0	0	0	0
1	16	14	15	18	13	76
Total firms	**16**	**14**	**15**	**18**	**13**	**76**

Table B12: Number of firms with and without IFRS reporting per country and year

IFRS \ Year	2016	2017	2018	2019	2020	Total firms
GER						
0	9	7	7	7	0	30
1	8	9	10	10	8	45
Total	**17**	**16**	**17**	**17**	**8**	**75**
USA						
0	16	14	15	18	13	76
1	0	0	0	0	0	0
Total firms	**16**	**14**	**15**	**18**	**13**	**76**

Table B13: Number of firms per U.S. SIC code per country and year

Year / SIC code	2016	2017	2018	2019	2020	Total firms
GER						
2834	2	2	2	2	2	10
2842	1	1	1	1	0	4
3826	1	1	1	1	1	5
3827	0	1	1	1	1	4
3841	6	5	5	5	1	22
3842	2	2	1	1	0	6
3843	1	1	1	1	0	4
3845	4	3	4	4	2	17
8071	0	0	1	1	1	3
Total	**17**	**16**	**17**	**17**	**8**	**75**
USA						
2834	1	1	1	1	1	5
3829	1	1	1	1	1	5
3841	9	8	10	11	8	46
3842	4	4	3	4	3	18
3843	1	0	0	1	0	2
Total firms	**16**	**14**	**15**	**18**	**13**	**76**

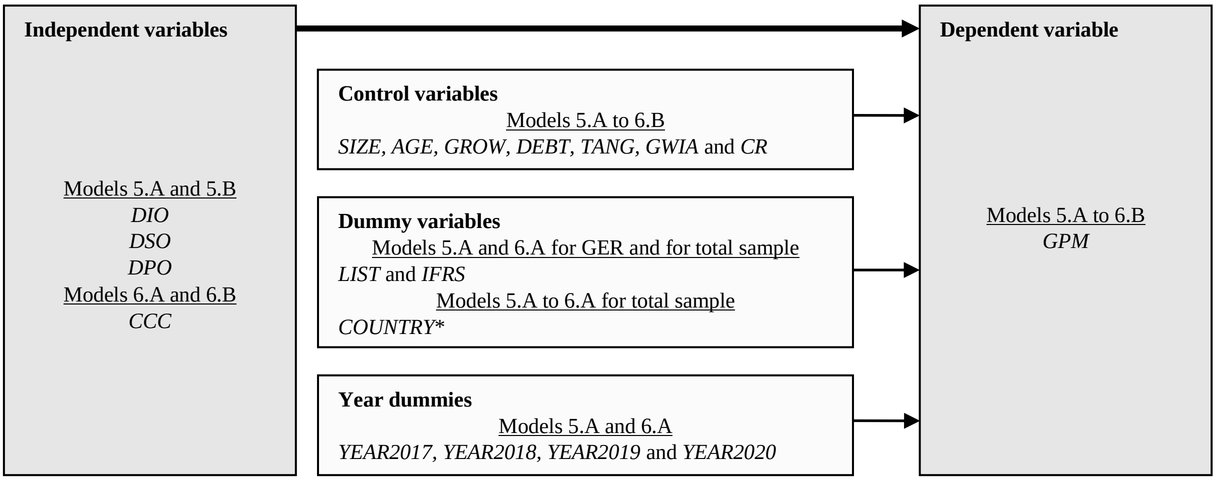
Note: SIC codes are industry classifications based on the U.S. Securities and Exchange Commission (2021). The codes were taken from Orbis, Bloomberg and U.S. Securities and Exchange Commission (2017). 2834: Pharmaceutical Preparations; 2842: Speciality Cleaning, Polishing and Sanitation Preparations, 3826: Laboratory Analytical Instruments; 3827: Optical Instruments and Lenses; 3829: Measuring & Controlling Devices; 3841: Surgical & Medical Instruments and Apparatus; 3842: Orthopaedic, Prosthetic & Surgical Appliances & Supplies; 3843: Dental Equipment & Supplies; 3845: Electromedical & Electrotherapeutic Apparatus; 8071: Service-medical Laboratories.

Table B14: Total number of firms per U.S. SIC code per country for all years

Country / SIC Code	Total firms per SIC code for GER for all years	Total firms per SIC code for USA for all years
2834	10	5
2842	4	0
3826	5	0
3827	4	0
3829	0	5
3841	22	46
3842	6	18
3843	4	2
3845	17	0
8071	3	0
Total firms	**75**	**76**

Note: SIC codes are industry classifications based on the U.S. Securities and Exchange Commission (2021). The codes were taken from Orbis, Bloomberg and U.S. Securities and Exchange Commission (2017). 2834: Pharmaceutical Preparations; 2842: Speciality Cleaning, Polishing and Sanitation Preparations, 3826: Laboratory Analytical Instruments; 3827: Optical Instruments and Lenses; 3829: Measuring & Controlling Devices; 3841: Surgical & Medical Instruments and Apparatus; 3842: Orthopaedic, Prosthetic & Surgical Appliances & Supplies; 3843: Dental Equipment & Supplies; 3845: Electromedical & Electrotherapeutic Apparatus; 8071: Service-medical Laboratories.

Figure B1: Generalized overview of the research model for multivariate analysis



*Note: * COUNTRY is also used as condition to split the total sample into the country samples.*

Appendix C

Table C1: Summary statistics of independent, dependent and control variables per country for 2016-2020)

Variables	N	Mean	Median	SD	Min	Max	p25	p75
GER								
Dependent								
GPM	75	0.5613	0.5687	0.1448	0.3087	0.7692	0.4353	0.7142
Independent								
CCC (days)	75	171.8511	167.0122	55.7363	97.9447	304.4310	128.3097	212.9754
DIO (days)	75	152.2073	145.7881	58.4093	50.2534	276.5034	112.7149	194.8032
DSO (days)	75	65.2820	61.5914	20.4157	15.4568	103.6916	54.4376	80.6100
DPO (days)	75	46.5277	43.2401	21.0197	19.9234	93.2467	27.4236	64.4937
Control								
SIZE (in ln)	75	13.8146	13.4997	1.4096	12.1432	16.6231	12.4630	14.7047
AGE (in ln)	75	4.1296	4.2905	0.8388	2.6391	5.2933	3.3673	4.8442
AGE (years)	75	83.8400	73.0000	58.7096	14.0000	199.0000	29.0000	127.0000
GROW	75	0.0641	0.0557	0.0672	-0.0474	0.2392	0.0234	0.0846
DEBT	75	0.4683	0.4471	0.1711	0.1567	0.7949	0.3315	0.5984
TANG	75	0.2053	0.1780	0.1166	0.0470	0.4975	0.1280	0.2736
GWIA	75	0.1702	0.1343	0.1470	0.0117	0.4912	0.0615	0.2340
CR	75	2.8886	2.4109	1.4088	1.0442	5.6269	1.5026	4.0761
USA								
Dependent								
GPM	76	0.5954	0.6295	0.1177	0.4050	0.7504	0.4796	0.7103
Independent								
CCC (days)	76	167.1295	145.4711	80.4014	82.5301	375.2994	106.6727	196.9336
DIO (days)	76	155.3522	138.9854	74.1783	61.6966	336.0342	98.1925	199.1035
DSO (days)	76	60.6048	61.3709	10.4689	40.9800	81.4843	53.5895	66.1567
DPO (days)	76	48.1790	47.4804	17.3704	13.8655	85.4616	34.3011	58.2712
Control								
SIZE (in ln)	76	15.2672	15.1332	1.1841	13.4979	17.2358	14.1772	16.2905
AGE (in ln)	76	3.6178	3.3673	0.7645	2.3979	4.8122	3.0201	4.3373
AGE (years)	76	49.6579	29.0000	37.7714	11.0000	123.0000	20.5000	76.5000
GROW	76	0.1239	0.1046	0.1051	-0.0312	0.3347	0.0368	0.2001
DEBT	76	0.4829	0.5293	0.1500	0.1477	0.7003	0.4147	0.5782
TANG	76	0.1378	0.1111	0.0719	0.0620	0.2782	0.0826	0.1781
GWIA	76	0.4211	0.4779	0.2533	0.0366	0.7428	0.1638	0.6505
CR	76	2.7559	2.4236	1.3026	0.9657	5.5769	1.8386	3.5103

Note: SIZE (in ln) is size measured as natural logarithm of total sales. AGE (in ln) is age measured as natural logarithm of years since formation. N: number of obs.; Mean: mean; Median: median; SD: standard deviation; Min: minimum value of sample; Max: maximum value of sample; p25: 25th percentile; p75: 75th percentile.

Table C2: Common-sized balance sheet (based on median) per country for 2016-2020

Common-sized balance sheet GER			
Assets	**in %**	**Equity and Liabilities**	**in %**
Fixed Assets	17.80%	*Total Equity*	*55.29%*
Goodwill & Intangible Assets	13.43%		
Non-Current Assets	*45.74%*	Non-Current Liabilities	23.93%
Inventories	15.47%	Accounts Payable	3.99%
Accounts Receivable	15.62%	Current Liabilities	20.78%
Cash	10.27%	*Total Liabilities*	*44.71%*
Current Assets	*54.26%*		
Total Assets	**100%**	**Total Equity and Liabilities**	**100%**
Common-sized balance sheet USA			
Fixed Assets	11.11%	*Total Equity*	*47.07%*
Goodwill & Intangible Assets	47.79%		
Non-Current Assets	*65.02%*	Non-Current Liabilities	40.54%
Inventories	7.45%	Accounts Payable	2.46%
Accounts Receivable	8.12%	Current Liabilities	12.39%
Cash	11.34%	*Total Liabilities*	*52.93%*
Current Assets	*34.98%*		
Total Assets	**100%**	**Total Equity and Liabilities**	**100%**

Note: All items are winsorized at the 5th and 95th percentile to reduce outliers, except for non-current assets, non-current liabilities, and equity. Non-current assets are calculated by deducting current assets from total assets, non-current liabilities by deducting current liabilities from total liabilities, and equity by deducting total liabilities from total assets. Hence, the calculated non-current assets, non-current liabilities and equity slightly differ from their actual median values.

Table C3: Common-sized income statement (based on median) per country for 2016-2020

Common-sized income statement GER		**Common-sized income statement USA**	
Sales	**100%**	**Sales**	**100%**
Cost of Goods Sold	43.13%	Cost of Goods Sold	37.05%
Gross Profit	*56.87%*	*Gross Profit*	*62.95%*
Operating Expenses	45.02%	Operating Expenses	48.80%
Earnings before Interest, Taxes, Depreciation, and Amortization	*16.22%*	*Earnings before Interest, Taxes, Depreciation, and Amortization*	*20.25%*
Operating Profit	*11.85%*	*Operating Profit*	*14.15%*
Depreciation and Amortization	4.58%	Depreciation and Amortization	7.24%
Earnings before Interest and Taxes	*11.64%*	*Earnings before Interest and Taxes*	*13.01%*
Interest	0.46%	Interest	2.16%
Net Income	*8.04%*	*Net Income*	*10.20%*

Note: All items are winsorized at the 5th and 95th percentile to reduce outliers except for operating expenses and earnings before interest, taxes, depreciation, and amortization. Operating expenses are calculated by deducting operating profit from gross profit and earnings before interest, taxes, depreciation, and amortization are the sum of depreciation and amortization and earnings before interest and taxes. Hence, the calculated operating expenses and earnings before interest, taxes, depreciation, and amortization slightly differ from their actual median values.

Table C4: Summary statistics of other financial statement items and *GDPG* per country for 2016-2020

Variables	N	Mean	Median	SD	Min	Max	p25	p75
GER								
INV	75	0.1542	0.1547	0.0572	0.0559	0.2546	0.1172	0.2019
RECEIV	75	0.1635	0.1562	0.0633	0.0404	0.2931	0.1198	0.2088
CASH	75	0.1274	0.1027	0.1069	0.0070	0.3820	0.0402	0.1762
CASHR	75	0.7672	0.4792	0.7721	0.0305	3.0435	0.1585	1.1985
QR	75	2.0768	1.7389	1.0991	0.6891	4.2962	1.0467	2.9894
CARAT	75	0.5345	0.5526	0.1453	0.2699	0.7283	0.4154	0.6517
PAY	75	0.0504	0.0399	0.0289	0.0079	0.1252	0.0275	0.0637
CLRAT	75	0.2160	0.2078	0.0884	0.1033	0.4137	0.1352	0.2822
NWC	75	0.3093	0.3202	0.1761	0.0269	0.5842	0.1373	0.4601
COGS	75	0.4387	0.4313	0.1448	0.2308	0.6913	0.2858	0.5647
OPEX	75	0.4390	0.4676	0.1408	0.1684	0.7185	0.3548	0.5406
OPM	75	0.1223	0.1185	0.0587	0.0332	0.2251	0.0703	0.1750
DA	75	0.0497	0.0458	0.0186	0.0244	0.0903	0.0356	0.0590
EBIT	75	0.1204	0.1164	0.0582	0.0332	0.2253	0.0704	0.1626
INTEREST	75	0.0066	0.0046	0.0064	-0.0014	0.0219	0.0016	0.0103
NI	75	0.0827	0.0804	0.0451	0.0122	0.1680	0.0456	0.1196
GDPG	75	0.0095	0.0127	0.0217	-0.0490	0.0260	0.0056	0.0223
USA								
INV	76	0.0813	0.0745	0.0361	0.0281	0.1657	0.0526	0.0991
RECEIV	76	0.0855	0.0812	0.0299	0.0453	0.1772	0.0663	0.0976
CASH	76	0.1211	0.1134	0.0938	0.0104	0.3536	0.0457	0.1825
CASHR	76	0.8771	0.7104	0.6771	0.0546	2.7958	0.3971	1.1262
QR	76	2.0948	1.7118	1.2801	0.6412	5.1948	1.2930	2.3912
CARAT	76	0.3613	0.3498	0.1612	0.1529	0.6826	0.2124	0.4900
PAY	76	0.0268	0.0246	0.0130	0.0063	0.0544	0.0174	0.0327
CLRAT	76	0.1396	0.1239	0.0535	0.0755	0.2803	0.1055	0.1596
NWC	76	0.2209	0.1997	0.1505	-0.0055	0.5558	0.1042	0.3449
COGS	76	0.4046	0.3705	0.1177	0.2496	0.5950	0.2897	0.5204
OPEX	75	0.4497	0.4455	0.1088	0.2548	0.6684	0.3664	0.5411
OPM	76	0.1458	0.1415	0.0726	0.0454	0.3171	0.0920	0.1834
DA	76	0.0714	0.0724	0.0308	0.0238	0.1260	0.0492	0.0932
EBIT	76	0.1472	0.1301	0.0751	0.0417	0.3221	0.0919	0.1856
INTEREST	76	0.0205	0.0216	0.0153	-0.0044	0.0441	0.0080	0.0337
NI	76	0.1212	0.1020	0.0849	0.0113	0.3085	0.0552	0.1767
GDPG	76	0.0130	0.0216	0.0223	-0.0349	0.0300	0.0171	0.0233

Note: All items are winsorized at the 5th and 95th percentile to reduce outliers. GDPG data was obtained from World Bank (2021). N: number of obs.; Mean: mean; Median: median; SD: standard deviation; Min: minimum value of sample; Max: maximum value of sample; p25: 25th percentile; p75: 75th percentile.

Table C5: Non-parametric median and parametric mean tests for control variables, other financial statement items and *GDPG* for 2016-2020

			Non-parametric median test		**Parametric mean test**	
Ratios	**Shapiro-Wilk test p-value for GER**	**Shapiro-Wilk test p-value for USA**	**Fisher´s exact p-value**	**Statistically different median**	**P-value**	**Statistically different mean**
SIZE	0.00010***	0.00449***	0.000***	Yes	0.0000***	Yes
AGE	0.00251***	0.00016***	0.001***	Yes	0.0001***	Yes
GROW	0.00019***	0.02785**	0.001***	Yes	0.0001***	Yes
INV	0.29993	0.00284***	0.000***	Yes	0.0000***	Yes
RECEIV	0.78170	0.00000***	0.000***	Yes	0.0000***	Yes
TANG	0.00072***	0.00000***	0.000***	Yes	0.0000***	Yes
GWIA	0.00000***	0.00004***	0.000***	Yes	0.0000***	Yes
CASHR	0.00000***	0.00000***	0.191	No	0.3535	No
CASH	0.00001***	0.00010***	0.744	No	0.6997	No
QR	0.00071***	0.00000***	1.000	No	0.9264	No
CR	0.00041***	0.00019***	1.000	No	0.5486	No
CARAT	0.00281***	0.00201***	0.000***	Yes	0.0000***	Yes
DEBT	0.43093	0.00004***	0.141	No	0.5776	No
PAY	0.00012***	0.00476***	0.000***	Yes	0.0000***	Yes
CLRAT	0.00205***	0.00000***	0.000***	Yes	0.0000***	Yes
NWC	0.00752***	0.03664**	0.000***	Yes	0.0011***	Yes
COGS	0.00171***	0.00018***	0.141	No	0.1141	No
OPEX	0.03070**	0.05482*	0.744	No	0.6036	No
OPM	0.00512***	0.00583***	0.253	No	0.0307**	Yes
DA	0.00027***	0.05457*	0.000***	Yes	0.0000***	Yes
EBIT	0.00941***	0.00332***	1.000	No	0.0154**	Yes
INTEREST	0.00001***	0.02201**	0.000***	Yes	0.0000***	Yes
NI	0.14852	0.00160***	0.253	No	0.0007***	Yes
GDPG	0.00000***	0.00000***	0.599	No	0.3364	No

*Note: If p-value of Shapiro-Wilk test is below 10%, the null hypothesis, which implies normality of that variable, is rejected. The non-parametric median test was done with the Stata option "medianties(drop)", which drops values equal to the median from the analysis to run an unbiased analysis (Stata n.d.-b). The splitting option "medianties(split)" was not possible since mainly one value was equal to the median, making the split option (splitting the number of values equally between the group above and the group below the median) impossible. For the median test, p-value of Fisher´s exact test is used since it is more reliable than that of Pearson chi-squared test in samples with less than 200 obs. (Fisher 1935; Stata n.d.-b). In case of divergent results for median and mean tests, result of mean test will be focused for a normally distributed variable in both countries and that of the median test for divergent findings for the normality of the variable between both countries. ***: p-value <0.01; **: p-value <0.05; *: p-value <0.1.*

Table C6: Summary statistics of independent, dependent and control variables per country for 2016

Variables	N	Mean	Median	SD	Min	Max	p25	p75
GER								
Dependent								
GPM	17	0.5927	0.5908	0.1416	0.3329	0.7692	0.5325	0.7261
Independent								
CCC (days)	17	186.8688	174.7389	61.7532	98.1055	304.4310	133.7965	232.7952
DIO (days)	17	164.8046	154.2655	61.2510	50.2534	276.5034	137.8364	199.2827
DSO (days)	17	65.8421	59.4822	21.2854	15.4568	103.6916	57.8302	81.5161
DPO (days)	17	43.9866	40.8959	16.6986	21.0093	75.9742	30.6274	58.0165
Control								
SIZE (in ln)	17	13.5297	13.3871	1.3225	12.1432	16.6231	12.3152	14.2689
AGE (in ln)	17	4.2294	4.3175	0.7994	2.6391	5.2883	3.9703	4.7875
GROW	17	0.0604	0.0508	0.0621	-0.0326	0.2392	0.0356	0.0696
DEBT	17	0.4663	0.3988	0.1937	0.1567	0.7949	0.3354	0.5667
TANG	17	0.2148	0.1875	0.1158	0.0470	0.4975	0.1404	0.2736
GWIA	17	0.1474	0.0818	0.1565	0.0117	0.4912	0.0486	0.1593
CR	17	2.9939	2.6425	1.5047	1.0442	5.6269	2.0275	4.1098
USA								
Dependent								
GPM	16	0.5992	0.6060	0.1189	0.4050	0.7504	0.5054	0.7052
Independent								
CCC (days)	16	165.1203	132.8012	83.3698	82.5301	367.8053	107.8014	198.8364
DIO (days)	16	146.2873	119.1110	77.7387	61.6966	316.5735	91.4815	187.7270
DSO (days)	16	59.4743	59.3743	9.7459	45.0138	81.4843	53.5895	63.7321
DPO (days)	16	39.3162	38.4189	12.4936	13.8655	67.3082	30.5560	46.9707
Control								
SIZE (in ln)	16	15.1155	15.0190	1.1960	13.4979	16.8530	13.8500	16.1884
AGE (in ln)	16	3.5711	3.3316	0.8282	2.3979	4.8040	2.9444	4.3801
GROW	16	0.1483	0.1295	0.0934	0.0196	0.3347	0.0938	0.2013
DEBT	16	0.4566	0.4695	0.1650	0.1477	0.7003	0.3581	0.5711
TANG	16	0.1220	0.1119	0.0661	0.0620	0.2782	0.0766	0.1270
GWIA	16	0.4449	0.5091	0.2583	0.0397	0.7428	0.2082	0.6643
CR	16	2.9264	2.5933	1.3632	0.9657	5.5769	2.1148	4.0133

Note: SIZE (in ln) is size measured as natural logarithm of total sales. AGE (in ln) is age measured as natural logarithm of years since formation. N: number of obs.; Mean: mean; Median: median; SD: standard deviation; Min: minimum value of sample; Max: maximum value of sample; p25: 25th percentile; p75: 75th percentile.

Table C7: Summary statistics of independent, dependent and control variables per country for 2017

Variables	N	Mean	Median	SD	Min	Max	p25	p75
GER								
Dependent								
GPM	16	0.5805	0.5679	0.1416	0.3121	0.7692	0.4999	0.7088
Independent								
CCC (days)	16	170.7758	159.4252	59.3241	97.9447	304.4310	121.0102	224.3448
DIO (days)	16	149.2841	142.1446	60.7996	50.2534	276.5034	105.9270	197.4838
DSO (days)	16	65.2254	61.3882	22.4892	15.4568	103.6916	53.0188	81.6078
DPO (days)	16	45.9071	40.8786	22.9463	19.9234	93.2467	24.7137	67.8350
Control								
SIZE (in ln)	16	13.5963	13.3766	1.3381	12.1432	16.6231	12.4079	14.4249
AGE (in ln)	16	4.1796	4.3037	0.8269	2.7081	5.2933	3.4849	4.8239
GROW	16	0.0565	0.0562	0.0284	0.0137	0.1220	0.0359	0.0748
DEBT	16	0.4537	0.4023	0.1790	0.1567	0.7949	0.3282	0.5894
TANG	16	0.2060	0.1886	0.1169	0.0470	0.4922	0.1343	0.2725
GWIA	16	0.1584	0.1385	0.1484	0.0117	0.4912	0.0558	0.1727
CR	16	3.0479	3.7303	1.3783	1.0442	5.6269	1.7974	4.0090
USA								
Dependent								
GPM	14	0.6125	0.6454	0.1234	0.4227	0.7504	0.4933	0.7267
Independent								
CCC (days)	14	183.1054	150.9488	96.0875	82.5301	375.2994	113.4522	233.7880
DIO (days)	14	168.3231	144.6811	90.3582	61.6966	336.0342	94.5436	231.3932
DSO (days)	14	64.1081	63.4587	9.7061	46.6118	80.3095	58.8195	71.1808
DPO (days)	14	47.7573	46.4567	18.1953	13.8655	78.7534	34.4688	56.5066
Control								
SIZE (in ln)	14	15.3435	15.4598	1.1904	13.4979	17.1257	14.2031	16.3081
AGE (in ln)	14	3.7093	3.5194	0.8006	2.3979	4.8122	2.9957	4.4543
GROW	14	0.1383	0.1468	0.1042	-0.0312	0.3347	0.0671	0.1977
DEBT	14	0.5153	0.5496	0.1383	0.1725	0.7003	0.4672	0.6068
TANG	14	0.1272	0.1029	0.0673	0.0620	0.2681	0.0838	0.1313
GWIA	14	0.4681	0.4891	0.2386	0.0499	0.7428	0.2814	0.6740
CR	14	2.5526	2.3247	1.2043	0.9657	5.5754	1.7952	2.7341

Note: SIZE (in ln) is size measured as natural logarithm of total sales. AGE (in ln) is age measured as natural logarithm of years since formation. N: number of obs.; Mean: mean; Median: median; SD: standard deviation; Min: minimum value of sample; Max: maximum value of sample; p25: 25th percentile; p75: 75th percentile.

Table C8: Summary statistics of independent, dependent and control variables per country for 2018

Variables	N	Mean	Median	SD	Min	Max	p25	p75
GER								
Dependent								
GPM	17	0.5650	0.5728	0.1490	0.3087	0.7692	0.4270	0.7142
Independent								
CCC (days)	17	176.7180	168.3460	58.3858	97.9447	304.4310	134.0675	212.9754
DIO (days)	17	155.5275	147.9795	58.7505	50.2534	276.5034	123.5482	181.3182
DSO (days)	17	67.1285	62.8064	22.6259	15.4568	103.6916	58.6202	80.6100
DPO (days)	17	48.2481	43.2401	22.8445	19.9234	93.2467	32.6217	62.4789
Control								
SIZE (in ln)	17	13.7650	13.4511	1.4562	12.1432	16.6217	12.4630	14.5665
AGE (in ln)	17	4.0739	4.2905	0.8610	2.6391	5.2933	3.3673	4.8040
GROW	17	0.0300	0.0221	0.0680	-0.0474	0.2392	-0.0127	0.0563
DEBT	17	0.4613	0.4471	0.1772	0.1567	0.7949	0.3238	0.5609
TANG	17	0.1989	0.1780	0.1139	0.0470	0.4975	0.1435	0.2625
GWIA	17	0.1713	0.1394	0.1489	0.0117	0.4912	0.0615	0.2110
CR	17	2.9414	2.2598	1.5417	1.0442	5.6269	1.6271	4.1726
USA								
Dependent								
GPM	15	0.5894	0.6119	0.1258	0.4072	0.7477	0.4472	0.7136
Independent								
CCC (days)	15	162.0618	156.9040	76.9151	82.5301	375.2994	99.5559	196.3522
DIO (days)	15	150.4944	136.2984	67.6893	61.6966	320.5244	102.6641	179.0505
DSO (days)	15	58.8101	60.6415	10.1487	40.9800	81.4843	52.9585	65.0965
DPO (days)	15	46.4504	46.3266	15.0975	13.8655	85.4616	40.4087	52.0652
Control								
SIZE (in ln)	15	15.2332	15.1300	1.2637	13.4979	17.2358	14.1520	16.4257
AGE (in ln)	15	3.5957	3.3673	0.7480	2.4849	4.8122	3.0445	4.3175
GROW	15	0.1600	0.1407	0.0900	0.0487	0.3347	0.0837	0.2156
DEBT	15	0.4837	0.5114	0.1495	0.1477	0.7003	0.4101	0.5845
TANG	15	0.1543	0.1126	0.0809	0.0689	0.2782	0.0849	0.2540
GWIA	15	0.4254	0.4763	0.2691	0.0399	0.7428	0.0912	0.6802
CR	15	2.5290	2.1223	1.1744	0.9657	5.2805	1.7285	3.4448

Note: SIZE (in ln) is size measured as natural logarithm of total sales. AGE (in ln) is age measured as natural logarithm of years since formation. N: number of obs.; Mean: mean; Median: median; SD: standard deviation; Min: minimum value of sample; Max: maximum value of sample; p25: 25th percentile; p75: 75th percentile.

Table C9: Summary statistics of independent, dependent and control variables per country for 2019

Variables	N	Mean	Median	SD	Min	Max	p25	p75
GER								
Dependent								
GPM	17	0.5618	0.5700	0.1496	0.3087	0.7692	0.4274	0.7049
Independent								
CCC (days)	17	165.2645	155.8830	49.6381	99.5432	273.0820	127.0715	200.4980
DIO (days)	17	151.4076	140.2213	62.5527	50.2534	276.5034	112.5158	171.2158
DSO (days)	17	61.6019	60.4809	18.2696	15.4568	88.4846	52.7523	74.7801
DPO (days)	17	46.9294	43.2763	21.3970	20.7532	93.2467	27.4236	64.4937
Control								
SIZE (in ln)	17	13.8558	13.5323	1.4296	12.2745	16.6231	12.6195	14.5979
AGE (in ln)	17	4.0931	4.3041	0.8485	2.6391	5.2933	3.4012	4.8122
GROW	17	0.0996	0.0846	0.0621	0.0298	0.2392	0.0571	0.1091
DEBT	17	0.4753	0.4689	0.1662	0.1567	0.7949	0.3347	0.5984
TANG	17	0.2077	0.1620	0.1232	0.0510	0.4975	0.1272	0.2814
GWIA	17	0.1726	0.1343	0.1438	0.0117	0.4744	0.0665	0.2373
CR	17	2.7452	2.2354	1.3644	1.0442	5.4089	1.5026	3.7891
USA								
Dependent								
GPM	18	0.5962	0.6295	0.1188	0.4050	0.7437	0.4794	0.7097
Independent								
CCC (days)	18	168.8754	161.1727	87.3809	82.5301	375.2994	100.0755	196.4612
DIO (days)	18	160.2519	146.5381	78.0481	61.6966	336.0342	104.5695	204.2918
DSO (days)	18	61.0502	62.1066	9.8159	40.9800	81.4843	57.0017	66.2137
DPO (days)	18	53.5318	54.2047	18.0096	13.8655	85.4616	44.2768	64.9598
Control								
SIZE (in ln)	18	15.2697	15.2471	1.1865	13.5120	17.2358	14.2049	16.2458
AGE (in ln)	18	3.5748	3.3485	0.7696	2.3979	4.8122	2.9957	4.3307
GROW	18	0.1048	0.0710	0.1040	-0.0312	0.3347	0.0306	0.1679
DEBT	18	0.4876	0.5212	0.1405	0.1488	0.7003	0.4594	0.5711
TANG	18	0.1429	0.1139	0.0757	0.0620	0.2782	0.0843	0.2155
GWIA	18	0.4188	0.4476	0.2581	0.0366	0.7409	0.1434	0.6478
CR	18	2.6173	2.4126	1.2177	0.9657	5.4675	1.6823	3.5505

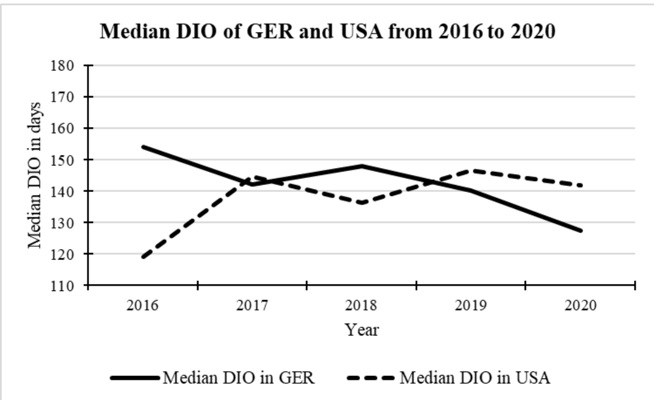
Note: SIZE (in ln) is size measured as natural logarithm of total sales. AGE (in ln) is age measured as natural logarithm of years since formation. N: number of obs.; Mean: mean; Median: median; SD: standard deviation; Min: minimum value of sample; Max: maximum value of sample; p25: 25^{th} percentile; p75: 75^{th} percentile.

Table C10: Summary statistics of independent, dependent and control variables per country for 2020

Variables	N	Mean	Median	SD	Min	Max	p25	p75
GER								
Dependent								
GPM	8	0.4475	0.4330	0.1139	0.3087	0.5859	0.3480	0.5618
Independent								
CCC (days)	8	145.7441	147.3063	40.8258	97.9447	199.9071	104.5556	182.1886
DIO (days)	8	125.9289	127.5013	38.9084	56.1443	177.1744	106.1234	153.4315
DSO (days)	8	68.1017	66.1955	17.3988	49.6567	103.6916	54.4503	75.0868
DPO (days)	8	48.6597	42.0726	25.2284	19.9234	93.2467	30.2262	65.7552
Control								
SIZE (in ln)	8	14.8741	14.8729	1.4329	12.4296	16.6231	13.9435	16.1537
AGE (in ln)	8	4.0132	4.0155	1.0566	2.6391	5.2933	3.0342	5.0368
GROW	8	0.0841	0.0673	0.1061	-0.0474	0.2249	-0.0050	0.1855
DEBT	8	0.5019	0.4908	0.1349	0.2795	0.6873	0.4153	0.6181
TANG	8	0.1922	0.1458	0.1371	0.0672	0.4975	0.1193	0.2212
GWIA	8	0.2346	0.2130	0.1449	0.0856	0.4525	0.1048	0.3517
CR	8	2.5391	2.0140	1.3293	1.1811	4.3818	1.4478	3.9130
USA								
Dependent								
GPM	13	0.5783	0.6203	0.1150	0.4050	0.7504	0.4967	0.6565
Independent								
CCC (days)	13	155.8276	145.2319	59.2880	93.5806	253.7476	106.7763	180.8038
DIO (days)	13	151.3613	141.9984	60.2271	71.7103	270.9971	104.9471	174.8510
DSO (days)	13	59.6773	60.0052	13.6478	40.9800	81.4843	51.1345	67.6465
DPO (days)	13	54.1239	53.7250	20.4133	19.8931	85.4616	38.2692	66.3729
Control								
SIZE (in ln)	13	15.4078	15.2876	1.2340	13.7150	17.2358	14.4713	16.4793
AGE (in ln)	13	3.6619	3.3322	0.7688	2.6391	4.8122	3.0445	4.3438
GROW	13	0.0632	0.0088	0.1198	-0.0312	0.3054	-0.0224	0.0848
DEBT	13	0.4730	0.5451	0.1716	0.1477	0.6777	0.3679	0.5743
TANG	13	0.1423	0.1245	0.0729	0.0620	0.2646	0.0802	0.1928
GWIA	13	0.3396	0.2442	0.2578	0.0366	0.7138	0.1190	0.5340
CR	13	3.2188	2.6340	1.6090	1.3952	5.5769	1.9256	4.7076

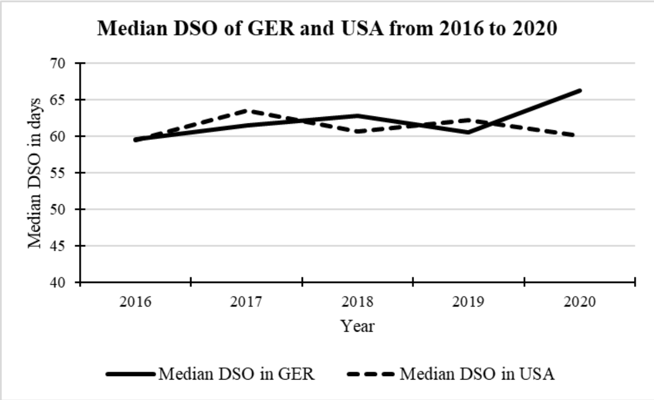
Note: SIZE (in ln) is size measured as natural logarithm of total sales. AGE (in ln) is age measured as natural logarithm of years since formation. N: number of obs.; Mean: mean; Median: median; SD: standard deviation; Min: minimum value of sample; Max: maximum value of sample; p25: 25th percentile; p75: 75th percentile.

Figure C1: Median *DIO* for GER and USA from 2016-2020



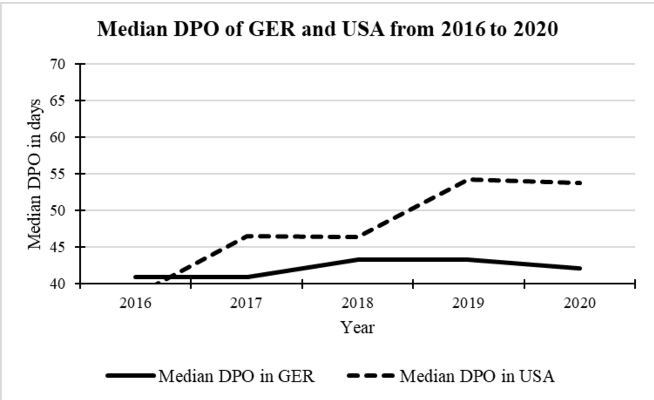
Note: Figure is based on Tables C6-C10.

Figure C2: Median *DSO* for GER and USA from 2016-2020



Note: Figure is based on Tables C6-C10.

Figure C3: Median *DPO* for GER and USA from 2016-2020



Note: Figure is based on Tables C6-C10.

Table C11: P-values for Wilcoxon rank-sum, non-parametric median and parametric mean tests for dependent and independent variables for 2016-2020

	Wilcoxon rank-sum test		Non-parametric median test		Parametric mean test	
Variable	**P-value**	**Exact p-value**	**Continuity corrected Pearson chi^2 p-value**	**Exact p-value**	**P-value**	**Divergence between parametric and non-parametric test**
DIO	0.5540	0.5557	0.327	0.327	0.7728	No
DSO	0.1731	0.1739	0.870	1.000	0.0780*	Yes
DPO	0.3096	0.3110	0.253	0.253	0.5993	No
CCC	0.1137	0.1141	0.414	0.414	0.6759	No
GPM	0.2888	0.2902	0.142	0.141	0.1141	No

*Note: If p-value is below 10%, then null hypothesis, which implies no statistical difference in the population distribution (Wilcoxon rank-sum test), median (non-parametric median test) or mean (two-sample t-test for mean) of the tested variable between the samples of GER and the USA, is rejected. P-value of Fisher´s exact test is used for Wilcoxon rank-sum and non-parametric median test since it is more reliable than the p-value of the Pearson chi-squared test statistic in samples with less than 200 obs. (Fisher 1935; Stata n.d.-b). The non-parametric median test was done with the Stata option "medianties(drop)", which drops values equal to the median from the analysis to run an unbiased analysis (Stata n.d.-b). The splitting option "medianties(split)" was not possible since mainly one value was equal to the median, making the split option (splitting the number of values between the group above and the group below the median) impossible. ***: p-value <0.01; **: p-value <0.05; *: p-value <0.1.*

Table C12: Spearman´s rank and Pearson correlation matrix of dependent, independent and control variables for GER for 2016-2020

	GPM	*DIO*	*DSO*	*DPO*	*CCC*	*SIZE*	*AGE*	*GROW*	*DEBT*	*TANG*	*GWIA*	*CR*	*LIST*	*IFRS*
GPM	1.0000	0.7669 (0.000)	-0.3025 (0.008)	0.2503 (0.030)	0.6069 (0.000)	-0.6412 (0.000)	0.3605 (0.002)	0.0465 (0.692)	-0.3507 (0.002)	0.0647 (0.582)	-0.5756 (0.000)	0.3777 (0.001)	-0.6718 (0.000)	-0.6429 (0.000)
DIO	0.7687 (0.000)	1.0000	-0.1971 (0.090)	0.2575 (0.026)	0.9058 (0.000)	-0.6242 (0.000)	0.3257 (0.004)	0.596 (0.611)	-0.2838 (0.014)	0.1281 (0.274)	-0.5289 (0.000)	0.3634 (0.001)	-0.5444 (0.000)	-0.4832 (0.000)
DSO	-0.4354 (0.000)	-0.2985 (0.009)	1.0000	0.2815 (0.014)	0.0718 (0.540)	0.1922 (0.099)	-0.2973 (0.010)	-0.0670 (0.568)	0.0854 (0.466)	-0.3240 (0.005)	0.2979 (0.009)	-0.2483 (0.032)	0.4370 (0.000)	0.4019 (0.000)
DPO	0.1964 (0.091)	0.1611 (0.167)	0.1549 (0.185)	1.0000	0.0325 (0.782)	0.0748 (0.523)	0.0784 (0.504)	-0.0343 (0.770)	0.1464 (0.210)	0.2045 (0.078)	-0.0216 (0.854)	-0.2902 (0.012)	0.1412 (0.227)	-0.0409 (0.728)
CCC	0.5768 (0.000)	0.8877 (0.000)	-0.0346 (0.768)	-0.0572 (0.626)	1.0000	-0.6291 (0.000)	0.2219 (0.056)	0.0645 (0.582)	-0.2863 (0.013)	-0.0391 (0.739)	-0.4449 (0.000)	0.3701 (0.001)	-0.4767 (0.000)	-0.3559 (0.002)
SIZE	-0.5849 (0.000)	-0.5598 (0.000)	0.2153 (0.064)	0.1274 (0.276)	-0.5744 (0.000)	1.0000	-0.1575 (0.177)	-0.2305 (0.047)	0.3156 (0.006)	0.1028 (0.380)	0.4048 (0.000)	-0.4603 (0.000)	0.4772 (0.000)	0.4543 (0.000)
AGE	0.3456 (0.002)	0.1713 (0.142)	-0.2852 (0.013)	0.1650 (0.157)	0.1111 (0.343)	-0.0224 (0.849)	1.0000	0.0428 (0.716)	0.0466 (0.691)	0.5222 (0.000)	-0.4850 (0.000)	-0.0344 (0.770)	-0.3093 (0.007)	-0.1539 (0.187)
GROW	0.0932 (0.426)	0.0349 (0.766)	-0.0676 (0.564)	-0.1962 (0.092)	0.0547 (0.641)	-0.1888 (0.105)	-0.0141 (0.905)	1.0000	0.1024 (0.382)	-0.1625 (0.164)	0.0554 (0.637)	0.0062 (0.958)	-0.0429 (0.715)	-0.0529 (0.652)
DEBT	-0.3873 (0.001)	-0.4245 (0.000)	0.1853 (0.111)	0.1010 (0.389)	-0.4039 (0.000)	0.3144 (0.006)	0.0746 (0.525)	-0.0044 (0.970)	1.0000	0.2196 (0.058)	0.2245 (0.053)	-0.5982 (0.000)	-0.0198 (0.866)	-0.0146 (0.901)
TANG	0.1614 (0.167)	0.1547 (0.185)	-0.3795 (0.001)	0.2900 (0.012)	0.0485 (0.679)	-0.0269 (0.819)	0.5150 (0.000)	-0.2239 (0.054)	0.1690 (0.147)	1.0000	-0.4557 (0.000)	-0.2264 (0.051)	-0.3629 (0.001)	-0.1399 (0.231)
GWIA	-0.4559 (0.000)	-0.4508 (0.000)	0.3872 (0.001)	-0.0397 (0.735)	-0.4024 (0.000)	0.2330 (0.044)	-0.3336 (0.003)	0.0722 (0.538)	0.2059 (0.076)	-0.5863 (0.000)	1.0000	-0.3784 (0.001)	0.5847 (0.000)	0.4272 (0.000)
CR	0.3999 (0.000)	0.4567 (0.000)	-0.2756 (0.017)	-0.2336 (0.044)	0.4467 (0.000)	-0.3971 (0.000)	-0.0632 (0.590)	0.0990 (0.398)	-0.6633 (0.000)	-0.1194 (0.308)	-0.3533 (0.002)	1.0000	-0.2623 (0.023)	-0.1838 (0.115)
LIST	-0.6711 (0.000)	-0.5527 (0.000)	0.4636 (0.000)	0.1197 (0.306)	-0.4757 (0.000)	0.4445 (0.000)	-0.2286 (0.049)	-0.0548 (0.641)	0.0025 (0.983)	-0.3719 (0.001)	0.5909 (0.000)	-0.2426 (0.036)	1.0000	0.6302 (0.000)
IFRS	-0.6299 (0.000)	-0.5017 (0.000)	0.4847 (0.000)	-0.0050 (0.966)	-0.3558 (0.002)	0.4350 (0.000)	-0.0849 (0.469)	-0.0666 (0.570)	0.0088 (0.940)	-0.2339 (0.043)	0.5382 (0.000)	-0.1653 (0.156)	0.6302 (0.000)	1.0000

Note: Triangle below the diagonal are correlation coefficients of Spearman´s rank correlation matrix and above the diagonal are those of Pearson correlation matrix. P-values are inside brackets. Dark grey highlighted cells: p-value <0.01; medium grey highlighted cells: p-value <0.05; light grey highlighted cells: p-value <0.1.

Table C13: Spearman´s rank and Pearson correlation matrix of dependent, independent and control variables for USA for 2016-2020

	GPM	*DIO*	*DSO*	*DPO*	*CCC*	*SIZE*	*AGE*	*GROW*	*DEBT*	*TANG*	*GWIA*	*CR*
GPM	1.0000	0.4896 (0.000)	0.2646 (0.021)	0.0261 (0.823)	0.4763 (0.000)	-0.2210 (0.055)	-0.2654 (0.021)	0.2235 (0.052)	-0.0398 (0.733)	-0.2815 (0.014)	-0.2725 (0.017)	0.1040 (0.371)
DIO	0.4063 (0.000)	1.0000	-0.0297 (0.799)	-0.1485 (0.201)	0.9741 (0.000)	-0.2184 (0.058)	0.0071 (0.952)	-0.2158 (0.061)	0.1634 (0.159)	-0.1940 (0.093)	0.2004 (0.083)	0.0061 (0.958)
DSO	0.2883 (0.012)	-0.0881 (0.449)	1.0000	0.1657 (0.153)	0.0569 (0.625)	0.1110 (0.340)	-0.0255 (0.827)	0.1962 (0.089)	0.0675 (0.563)	-0.3053 (0.007)	0.0869 (0.456)	-0.2673 (0.020)
DPO	0.0089 (0.939)	-0.0208 (0.858)	0.2128 (0.065)	1.0000	-0.3158 (0.006)	0.3480 (0.002)	0.2059 (0.074)	0.0681 (0.559)	0.3423 (0.003)	-0.0045 (0.969)	0.0459 (0.694)	-0.2448 (0.033)
CCC	0.3768 (0.001)	0.9345 (0.000)	-0.0612 (0.599)	-0.2546 (0.027)	1.0000	-0.2433 (0.034)	-0.0208 (0.858)	-0.2188 (0.058)	0.0904 (0.438)	-0.2346 (0.041)	0.2120 (0.066)	0.0057 (0.961)
SIZE	-0.1941 (0.093)	-0.2527 (0.028)	0.1444 (0.213)	0.3463 (0.002)	-0.2912 (0.011)	1.0000	0.4851 (0.000)	-0.2132 (0.064)	0.2795 (0.015)	-0.3489 (0.002)	0.4446 (0.000)	-0.4870 (0.000)
AGE	-0.3216 (0.005)	0.0578 (0.620)	-0.0287 (0.806)	0.1827 (0.114)	-0.0349 (0.765)	0.4098 (0.000)	1.0000	-0.3071 (0.007)	0.3987 (0.000)	-0.0707 (0.544)	0.3562 (0.002)	-0.2934 (0.010)
GROW	0.2460 (0.032)	-0.1968 (0.088)	0.1285 (0.269)	-0.0212 (0.856)	-0.1936 (0.094)	-0.2152 (0.062)	-0.3496 (0.002)	1.0000	0.0632 (0.587)	-0.0012 (0.992)	-0.2118 (0.066)	0.0638 (0.584)
DEBT	-0.0914 (0.432)	0.1572 (0.175)	0.0740 (0.526)	0.3714 (0.001)	0.0429 (0.713)	0.2513 (0.029)	0.4015 (0.000)	0.0684 (0.557)	1.0000	-0.1993 (0.084)	0.5063 (0.000)	-0.3972 (0.000)
TANG	-0.1029 (0.376)	-0.1056 (0.364)	-0.3355 (0.003)	0.0100 (0.932)	-0.2040 (0.077)	-0.3339 (0.003)	-0.0420 (0.719)	-0.0345 (0.767)	-0.3001 (0.008)	1.0000	-0.5207 (0.000)	0.1743 (0.132)
GWIA	-0.2748 (0.016)	0.1611 (0.164)	0.0920 (0.430)	0.0243 (0.835)	0.1818 (0.116)	0.4277 (0.000)	0.3351 (0.003)	-0.1830 (0.114)	0.3779 (0.001)	-0.5625 (0.000)	1.0000	-0.680 (0.000)
CR	0.0276 (0.813)	0.1262 (0.277)	-0.3125 (0.006)	-0.3296 (0.004)	0.1794 (0.121)	-0.5612 (0.000)	-0.2910 (0.011)	0.0317 (0.786)	-0.2807 (0.014)	0.2792 (0.015)	-0.6519 (0.000)	1.0000

Note: Triangle below the diagonal are correlation coefficients of Spearman´s rank correlation matrix and above the diagonal are those of Pearson correlation matrix. P-values are inside brackets. Dark grey highlighted cells: p-value <0.01; medium grey highlighted cells: p-value <0.05; light grey highlighted cells: p-value <0.1.

Appendix D

The following applies for all regression analyses in Appendices D and E:

Pooled OLS regression is based on the Stata command "regress". The FE model is a linear regression model with the option to integrate multiple FE based on the Stata command "reghdfe" (Correia 2016). Moreover, it represents a generalized version of the "xtreg" Stata command for FE models, which is faster and more flexible than "xtreg" for a larger sample size or a higher number of fixed effects (Correia n.d., 2016). The command applies the Correia estimator, which is based on the estimators of Guimarães and Portugal (2010) and Gaure (2010). Company and year effects were fixed to be equivalent to FE models in past research. Clustered SDE were applied in both models with the option "vce(cluster)" to cluster by companies.

Model assumptions are linearity, normality of errors, homoskedasticity, and neither autocorrelation nor multicollinearity (Wooldridge 2012). Linearity was generally assumed based on an initial analysis with scatterplots. The other assumptions were exemplary tested for the OLS model with normal SDE. Test for normality of errors was done with Shapiro-Wilk test (Shapiro and Wilk 1965), test for heteroskedasticity with Breusch-Pagan test (Breusch and Pagan 1979), test for multicollinearity with variation inflation factor (Studenmund 2014) and test for autocorrelation with Wooldridge test (Wooldridge 2002). The null hypothesis of the Shapiro-Wilk test implies normality, the one of the Breusch-Pagan test homoskedasticity and the one of the Wooldridge test no first-order autocorrelation. For each test applies: If the p-value of the test is below 10%, the null hypothesis is rejected. A variance inflation factor above 5 indicates considerable multicollinearity (Studenmund 2014). For all regressions, errors are generally approximately normally distributed since sample sizes exceed 30 obs. (Wooldridge 2012). Furthermore, the partial violation of the assumption of no autocorrelation is not expected to influence the validity of the results of the regression models with normal SDE. Additional robustness is induced by regressions with clustered SDE, which yield findings robust for heteroskedasticity and autocorrelation (Rogers 1993; Correia n.d.; Stata n.d.-c).

The F-test is a joint test with the null hypothesis that the coefficient of each independent, control and dummy variable (except for constant) is equal to zero (Stata n.d.-d). R^2 measures the overall goodness of fit, meaning how much variation in *GPM* is explained by the independent and control variables (Wooldridge 2012). The adjusted R^2 is used to compare the goodness of fit between OLS and FE models (Wooldridge 2012). The within R^2 measures this goodness of fit for the within regression, which is the FE model (Stata n.d.-e). Singleton obs. (group with one observation), which may inflate statistical significance (Correia 2015), were dropped from the sample for the FE models. P-values are inside brackets. ***: p-value <0.01; **: p-value <0.05; *: p-value <0.1.

Table D1: Regression analysis of *DIO*, *DPO* and *DSO* (Models 5.A and 5.B) for total sample for 2016-2020

Variables	Pooled OLS with normal SDE (Model 5.A)	Pooled OLS with clustered SDE (Model 5.A)	FE model with normal SDE (Model 5.B)	FE model with clustered SDE (Model 5.B)
Constant β_0	0.766070*** (0.000)	0.766070*** (0.000)	0.629582** (0.042)	0.629582* (0.088)
Independent variables				
DIO α_1	0.000899*** (0.000)	0.000899*** (0.000)	0.000251** (0.021)	0.000251** (0.024)
DSO α_2	-0.000624 (0.166)	0.000624 (0.381)	-0.000614** (0.013)	-0.000614* (0.062)
DPO α_3	0.001686*** (0.000)	0.001686*** (0.005)	0.000280 (0.191)	0.000280 (0.168)
Control variables				
SIZE β_1	-0.003900 (0.525)	-0.003900 (0.705)	-0.007141 (0.736)	-0.007141 (0.789)
AGE β_2	0.008519 (0.294)	0.008519 (0.369)	0.029409 (0.585)	0.029409 (0.698)
GROW β_3	0.146351** (0.044)	0.146351 (0.147)	0.057356*** (0.009)	0.057356** (0.048)
DEBT β_4	-0.139192*** (0.002)	-0.139192* (0.057)	-0.052386 (0.185)	-0.052386 (0.235)
TANG β_5	-0.571893*** (0.000)	-0.571893*** (0.000)	-0.285012*** (0.000)	-0.285012* (0.051)
GWIA β_6	-0.291431*** (0.000)	-0.291431*** (0.001)	-0.032515 (0.247)	-0.032515 (0.286)
CR β_7	-0.021482*** (0.001)	-0.021482*** (0.050)	0.001086 (0.675)	0.001086 (0.676)
Dummy variables				
COUNTRY β_8	0.122459*** (0.000)	0.122459** (0.022)		
LIST β_9	-0.120946*** (0.000)	-0.120946*** (0.003)		
IFRS β_{10}	-0.027188 (0.241)	-0.027188 (0.478)		
YEAR2017 β_{11}	-0.002345 (0.894)	-0.002345 (0.800)		
YEAR2018 β_{12}	-0.015960 (0.361)	-0.015960* (0.091)		
YEAR2019 β_{13}	-0.024838 (0.153)	-0.024838** (0.019)		
YEAR2020 β_{14}	-0.042423** (0.043)	-0.042423*** (0.003)		
Obs.	151	151	150	150
F-test p-value	0.0000	0.0000	0.0000	0.0220
R^2	0.7573	0.7573	0.9902	0.9902
Adjusted R^2	0.7263	0.7263	0.9854	0.9852
Within R^2			0.3291	0.3291
Shapiro-Wilk test p-value	0.02099			
Breusch-Pagan test p-value	0.2787			
Variance inflation factor below 5	No (Highest VIF 7.10)			
Wooldridge test p-value	0.0066			

Note: Despite the variation inflation factor is slightly above 5 for a variable, no multicollinearity can be still assumed. Also, the total sample is only initially analysed before a detailed analysis of the country sample follows, on which the main hypotheses of the Work Project are based.

Table D2: Regression analysis of *CCC* (Models 6.A and 6.B) for total sample for 2016-2020

Variables	Pooled OLS with normal SDE (Model 6.A)	Pooled OLS with clustered SDE (Model 6.A)	FE model with normal SDE (Model 6.B)	FE model with clustered SDE (Model 6.B)
Constant β_0	0.731616*** (0.000)	0.731616*** (0.001)	0.508846 (0.111)	0.508846 (0.159)
Dependent variable				
***CCC* α_4**	0.000742*** (0.000)	0.000742*** (0.000)	0.000096 (0.367)	0.000096 (0.374)
Control variables				
***SIZE* β_1**	-0.002966 (0.686)	-0.002966 (0.836)	0.002614 (0.903)	0.002614 (0.923)
***AGE* β_2**	0.017803* (0.063)	0.017803 (0.264)	0.022363 (0.696)	0.022363 (0.778)
***GROW* β_3**	0.171164** (0.049)	0.171164* (0.096)	0.062755*** (0.007)	0.062755** (0.047)
***DEBT* β_4**	-0.113239** (0.032)	-0.113239 (0.159)	-0.070475* (0.090)	-0.070475 (0.206)
***TANG* β_5**	-0.459900*** (0.000)	-0.459900** (0.013)	-0.241143*** (0.002)	-0.241143* (0.078)
***GWIA* β_6**	-0.289347*** (0.000)	-0.289347*** (0.005)	-0.027509 (0.354)	-0.027509 (0.455)
***CR* β_7**	-0.021491*** (0.004)	-0.021491* (0.054)	0.001797 (0.503)	0.001797 (0.574)
Dummy variables				
***COUNTRY* β_8**	0.100870*** (0.006)	0.100870 (0.134)		
***LIST* β_9**	-0.100568*** (0.001)	-0.100568* (0.088)		
***IFRS* β_{10}**	-0.074028*** (0.005)	-0.074028 (0.128)		
***YEAR2017* β_{11}**	0.008406 (0.690)	0.008406 (0.274)		
***YEAR2018* β_{12}**	-0.002195 (0.916)	-0.002195 (0.812)		
***YEAR2019* β_{13}**	-0.001354 (0.947)	-0.001354 (0.894)		
***YEAR2020* β_{14}**	-0.014498 (0.553)	-0.014498 (0.240)		
Obs.	151	151	150	150
F-test p-value	0.0000	0.0000	0.0005	0.2602
R^2	0.6473	0.6473	0.9888	0.9888
Adjusted R^2	0.6081	0.6081	0.9836	0.9835
Within R^2			0.2331	0.2331
Shapiro-Wilk test p-value	0.02930			
Breusch-Pagan test p-value	0.1503			
Variance inflation factor below 5	No (Highest VIF 7.01)			
Wooldridge test p-value	0.0037			

Note: Despite the variation inflation factor is slightly above 5 for a variable, no multicollinearity can be still assumed. Also, the total sample is only initially analysed before a detailed analysis of the country sample follows, on which the main hypotheses of the Work Project are based.

Table D3: Regression analysis of *DIO*, *DSO* and *DPO* (Models 5.A and 5.B) for GER for 2016-2020

Variables	Pooled OLS with normal SDE (Model 5.A)	Pooled OLS with clustered SDE (Model 5.A)	FE model with normal SDE (Model 5.B)	FE model with clustered SDE (Model 5.B)
Constant β_0	0.813975*** (0.000)	0.813975*** (0.000)	-1.344768** (0.032)	-1.344768 (0.136)
Independent variables				
DIO α_1	0.000132 (0.417)	0.000132 (0.665)	0.000432*** (0.001)	0.000432** (0.019)
DSO α_2	-0.000893** (0.015)	-0.000893*** (0.004)	-0.000225 (0.284)	-0.000225 (0.160)
DPO α_3	0.003041*** (0.000)	0.003041*** (0.000)	0.000311 (0.240)	0.000311 (0.127)
Control variables				
SIZE β_1	-0.011653* (0.053)	-0.011653 (0.410)	0.097288** (0.015)	0.097288 (0.104)
AGE β_2	0.041410*** (0.000)	0.041410*** (0.000)	0.118992** (0.040)	0.118992* (0.076)
GROW β_3	-0.111384 (0.247)	-0.111384 (0.225)	0.072896* (0.058)	0.072896 (0.145)
DEBT β_4	-0.254446*** (0.000)	-0.254446*** (0.000)	0.017176 (0.733)	0.017176 (0.645)
TANG β_5	-0.505742*** (0.000)	-0.505742*** (0.002)	-0.164620* (0.075)	-0.164620* (0.063)
GWIA β_6	-0.092975 (0.126)	-0.092975 (0.332)	0.104951** (0.016)	0.104951* (0.079)
CR β_7	-0.006934 (0.245)	-0.006934 (0.320)	0.001800 (0.503)	0.001800 (0.460)
Dummy variables				
LIST β_8	-0.160586*** (0.000)	-0.160586*** (0.000)		
IFRS β_9	-0.041922** (0.012)	-0.041922 (0.221)		
YEAR2017 β_{10}	-0.013562 (0.411)	-0.013562 (0.208)		
YEAR2018 β_{11}	-0.025577 (0.122)	-0.025577** (0.018)		
YEAR2019 β_{12}	-0.014337 (0.394)	-0.014337 (0.251)		
YEAR2020 β_{13}	-0.026993 (0.217)	-0.026993 (0.142)		
Obs.	75	75	74	74
F-test p-value	0.0000	0.0000	0.0000	0.0000
R^2	0.9205	0.9205	0.9971	0.9970
Adjusted R^2	0.8986	0.8986	0.9949	0.9947
Within R^2			0.7295	0.7295
Shapiro-Wilk test p-value	0.45217			
Breusch-Pagan test p-value	0.2807			
Variance inflation factor below 5	Yes			
Wooldridge test p-value	0.0001			

Table D4: Regression analysis of *CCC* (Models 6.A and 6.B) for GER for 2016-2020

Variables	Pooled OLS with normal SDE (Model 6.A)	Pooled OLS with clustered SDE (Model 6.A)	FE model with normal SDE (Model 6.B)	FE model with clustered SDE (Model 6.B)
Constant β_0	0.895347*** (0.000)	0.895347** (0.016)	-1.694571** (0.016)	-1.694571** (0.037)
Independent variable				
CCC α_4	0.000246 (0.286)	0.000246 (0.534)	0.000266* (0.058)	0.000266** (0.042)
Control variables				
SIZE β_1	-0.014959 (0.133)	-0.014959 (0.587)	0.123516*** (0.008)	0.123516** (0.019)
AGE β_2	0.041484*** (0.004)	0.041484 (0.131)	0.116172* (0.078)	0.116172* (0.085)
GROW β_3	-0.091788 (0.564)	-0.091788 (0.623)	0.091558** (0.036)	0.091558** (0.028)
DEBT β_4	-0.257097*** (0.001)	-0.257097** (0.017)	0.005136 (0.931)	0.005136 (0.925)
TANG β_5	-0.296839** (0.013)	-0.296839 (0.258)	-0.070535 (0.488)	-0.070535 (0.376)
GWIA β_6	-0.110127 (0.268)	-0.110127 (0.606)	0.101752** (0.043)	0.101752 (0.154)
CR β_7	-0.014656 (0.124)	-0.014656 (0.241)	0.003098 (0.323)	0.003098 (0.311)
Dummy variables				
LIST β_8	-0.107624*** (0.001)	-0.107624 (0.105)		
IFRS β_9	-0.086465*** (0.001)	-0.086465** (0.046)		
YEAR2017 β_{10}	0.000565 (0.983)	0.000565 (0.949)		
YEAR2018 β_{11}	-0.005669 (0.834)	-0.005669 (0.768)		
YEAR2019 β_{12}	0.004407 (0.874)	0.004407 (0.735)		
YEAR2020 β_{13}	-0.003570 (0.920)	-0.003570 (0.827)		
Obs.	75	75	74	74
F-test p-value	0.0000	0.0000	0.0000	0.0008
R^2	0.7713	0.7713	0.9958	0.9958
Adjusted R^2	0.7180	0.7180	0.9931	0.9929
Within R^2			0.6165	0.6165
Shapiro-Wilk test p-value	0.02257			
Breusch-Pagan test p-value	0.6319			
Variance inflation factor below 5	Yes			
Wooldridge test p-value	0.0001			

Table D5: Interpretation of regression coefficients of control and dummy variables for GER

For all models	Interpretation of the regression coefficients considers the ceteris paribus effect of the particular variable. Since focus lies on the impact of WCM on *GPM*, the detailed analysis of the significance (1%, 5% or 10% level) was left out for control variables. The mentioned research examples used different profitability proxies and regression methods. The reference to them only considers the similarity in results (significance and sign of coefficients). In case of consistent findings for pooled OLS and FE models, indication is clear. For primary consistent results in terms of coefficient sign and significance for pooled OLS and FE models, indication is based on the main outcome. For inconsistent results between pooled OLS and FE models, indication is based on the model with the significant results, showing a potential tendency. In the following, the coefficients of the control variables *SIZE*, *AGE*, *GROW*, *DEBT*, *TANG*, *GWIA* and *CR* and of the dummy variables *LIST*, *IFRS*, *YEAR2017*, *YEAR2018*, *YEAR2019* and *YEAR2020* are analysed.
SIZE	*SIZE* is significantly positively associated with *GPM* in models 5.B and 6.B and mainly insignificantly negatively for the other models except for model 5.A with normal SDE, where the negative effect is weakly significant. Findings for models 5.B and 6.B are in line with the initial assumption and Hoegerle et al. (2020). On the contrary, the insignificantly influence was discovered by Gill et al. (2010) and the significantly negative one by Lin and Wang (2021). Despite the inconsistent results, there is indication, that larger MD firms in GER exhibit higher profitability, which could be induced by e.g., their market power and scalability in production.
AGE	In all models (except for model 6.A with clustered SDE) higher *AGE* significantly increases *GPM*, which is consistent with Afrifa and Padachi (2016) and expectations. As a result, there is strong evidence that more aged German MD firms are more profitable than younger ones. Reasons could be the longer time in market as well as for R&D opportunities, earlier issues of patents and more established reputation.
GROW	*GROW* was only found to have a significantly positive impact in models 5.B and 6.B (except for model 5.B with clustered SDE), which was also confirmed by Deloof (2003). In contrast, an insignificantly negative effect was measured in models 5.A and 6.A, being consistent with results of Hoegerle et al. (2020). Although there is inconsistency among the models, findings show that there may be a positive relationship implying that German MD companies with more growth opportunities tend to have higher profitability, because they e.g., secure future demand of customers and innovation power for new products.
DEBT	As expected, and in line with Hoegerle et al. (2020), a higher *DEBT* level leads to a significant reduction in *GPM*. However, this finding was only evident in models 5.A and 6.A since in models 5.B and 6.B *DEBT* is insignificantly positively associated with *GPM* (in line with Padachi 2006). Hence, there is indication for the negative impact of *DEBT*, but it was not confirmed in all models. The negative effect may result from the pattern that a firm borrows more external capital if it does not have enough retained earnings, indicating lower prior innovation power and less available growth opportunities, which may be also reflected in the current profitability.

(to be continued)

Table D5 *(continued).*

TANG	Initial assumption of a negative effect of *TANG* was confirmed in all models except for model 6.B and model 6.A with clustered SDE, where the impact was not significant. Significant results, also found by Afrifa and Padachi (2016), suggest lower profitability for firms with higher asset tangibility since they may face substantially higher maintenance, depreciation, and impairment costs, which may outweigh benefits (sales from produced goods) established with the fixed assets.
GWIA	*GWIA* shows (in line with expectations) a significantly positive impact in model 5.B, which is only confirmed in model 6.B with normal SDE. In model 2.B with clustered SDE, the positive impact is insignificant. In models 5.A and 6.A, higher *GWIA* is contrary to assumptions associated with insignificantly lower *GPM*. Despite the contrary results, there is partial indication that German MD firms with higher *GWIA* may have increased *GPM* due to higher competitive advantage and innovation power, resulting from more valuable patents, trademarks, goodwill, and intangible assets from R&D processes and ensuring consistent demand for MD. Generally, there is a limitation for the results for *TANG* and *GWIA* because the recognition and measurement of these variables may differ between German firms applying either *IFRS* or HGB.
CR	In line with Raheman et al. (2010) and in contrast to initial expectation, *CR* exhibits insignificant and inconsistent coefficients. As a result, higher potential liquidity may be less relevant for profitability of MD firms since it is more influenced by factors as *TANG* or *AGE*, which are more closely related to the MD development and production process.
LIST* and *IFRS	The status of being listed has a significantly negative impact on *GPM* in model 5.A with normal and clustered SDE and in model 6.A with normal SDE. Against expectation of outweighing benefits from more financing and investment opportunities for listed firms, costs from agency problems and potentially inflexibility due to stricter disclosure and reporting requirements tend to be larger and may lead to the negative effect on profitability (Jensen 1989; Brav 2009; Doidge et al. 2017). The potential negative influence is also reasonable because listed firms in GER apply *IFRS* as financial reporting standards and *IFRS* is significantly negatively associated with *GPM* for German MD firms (except for model 5.A with clustered SDE). The negative effect might emerge from e.g., different inventory valuation rules and accounting choice between *IFRS* and HGB, that will be indirectly reflected in cost of goods sold, *DIO*, *DPO* and *GPM*.
Year dummies	Year dummies are insignificantly and mainly negatively related to *GPM*, except for *YEAR2018* in model 5.A with clustered SDE. However, the insignificant effect of *YEAR2018* on *GPM* generally outweighs due to insignificant coefficients in model 5.A with normal SDE and in model 6.A with normal and clustered SDE.

Table D6: Regression analysis of *DIO*, *DSO* and *DPO* (Models 5.A and 5.B) for USA for 2016-2020

Variables	Pooled OLS with normal SDE (Model 5.A)	Pooled OLS with clustered SDE (Model 5.A)	FE model with normal SDE (Model 5.B)	FE model with clustered SDE (Model 5.B)
Constant β_0	1.032384*** (0.000)	1.032384*** (0.000)	1.102298** (0.026)	1.102298** (0.015)
Independent variables				
DIO α_1	0.000908*** (0.000)	0.000908*** (0.000)	0.000203 (0.224)	0.000203 (0.151)
DSO α_2	0.000284 (0.741)	0.000284 (0.781)	0.000277 (0.727)	0.000277 (0.627)
DPO α_3	0.000505 (0.353)	0.000505 (0.553)	0.000130 (0.690)	0.000130 (0.711)
Control variables				
SIZE β_1	-0.008979 (0.356)	-0.008979 (0.509)	-0.042068 (0.267)	-0.042068 (0.160)
AGE β_2	-0.011827 (0.354)	-0.011827 (0.582)	0.050503 (0.587)	0.050503 (0.576)
GROW β_3	0.071013 (0.451)	0.071013 (0.522)	0.028279 (0.400)	0.028279 (0.410)
DEBT β_4	0.077520 (0.264)	0.077520 (0.557)	-0.088420 (0.145)	-0.088420 (0.101)
TANG β_5	-1.023439*** (0.000)	-1.023439*** (0.000)	-0.210718* (0.064)	-0.210718 (0.312)
GWIA β_6	-0.483320*** (0.000)	-0.483320*** (0.000)	-0.072515* (0.057)	-0.072515* (0.060)
CR β_7	-0.044728*** (0.000)	-0.044728** (0.010)	-0.001102 (0.814)	-0.001102 (0.702)
Dummy variables				
YEAR2017 β_8	-0.012578 (0.611)	-0.012578 (0.571)		
YEAR2018 β_9	-0.012740 (0.597)	-0.012740 (0.492)		
YEAR2019 β_{10}	-0.026297 (0.280)	-0.026297 (0.197)		
YEAR2020 β_{11}	-0.041615 (0.132)	-0.041615 (0.139)		
Obs.	76	76	76	76
F-test p-value	0.0000	0.0000	0.0477	0.0279
R^2	0.7542	0.7542	0.9865	0.9865
Adjusted R^2	0.6978	0.6978	0.9769	0.9764
Within R^2			0.3205	0.3205
Shapiro-Wilk test p-value	0.47004			
Breusch-Pagan test p-value	0.6074			
Variance inflation factor below 5	Yes			
Wooldridge test p-value	0.1244			

Table D7: Regression analysis of *CCC* (Models 6.A and 6.B) for USA for 2016-2020

Variables	Pooled OLS with normal SDE (Model 6.A)	Pooled OLS with clustered SDE (Model 6.A)	FE model with normal SDE (Model 6.B)	FE model with clustered SDE (Model 6.B)
Constant β_0	1.002451*** (0.000)	1.002451*** (0.000)	1.043175** (0.028)	1.043175** (0.008)
Independent variable				
CCC α_4	0.000799*** (0.000)	0.000799*** (0.000)	0.000142 (0.355)	0.000142 (0.357)
Control variables				
SIZE β_1	-0.005859 (0.557)	-0.005859 (0.700)	-0.034358 (0.340)	-0.034358 (0.226)
AGE β_2	-0.011971 (0.367)	-0.011971 (0.666)	0.042397 (0.641)	0.042397 (0.647)
GROW β_3	0.086328 (0.377)	0.086328 (0.451)	0.028865 (0.368)	0.028865 (0.420)
DEBT β_4	0.139901** (0.043)	0.139901 (0.232)	-0.082467 (0.141)	-0.082467 (0.118)
TANG β_5	-1.005117*** (0.000)	-1.005117*** (0.000)	-0.217885** (0.033)	-0.217885 (0.286)
GWIA β_6	-0.503218*** (0.000)	-0.503218*** (0.000)	-0.069470* (0.063)	-0.069470* (0.058)
CR β_7	-0.045825*** (0.000)	-0.045825*** (0.005)	-0.001715 (0.696)	-0.001715 (0.550)
Dummy variables				
YEAR2017 β_8	-0.005604 (0.825)	-0.005604 (0.795)		
YEAR2018 β_9	-0.006706 (0.789)	-0.006706 (0.714)		
YEAR2019 β_{10}	-0.011975 (0.622)	-0.011975 (0.577)		
YEAR2020 β_{11}	-0.024807 (0.369)	-0.024807 (0.341)		
Obs.	76	76	76	76
F-test p-value	0.0000	0.0000	0.0283	0.0152
R^2	0.7235	0.7235	0.9860	0.9860
Adjusted R^2	0.6708	0.6708	0.9772	0.9766
Within R^2			0.2964	0.2964
Shapiro-Wilk test p-value	0.20107			
Breusch-Pagan test p-value	0.2709			
Variance inflation factor below 5	Yes			
Wooldridge test p-value	0.1762			

Table D8: Interpretation of regression coefficients of control and dummy variables for USA

For all models	Interpretation of the regression coefficients considers the ceteris paribus effect of the particular variable. Since focus lies on the impact of WCM on *GPM*, the detailed analysis of the significance (1%, 5% or 10% level) was left out for control variables. The mentioned research examples used different profitability proxies and regression methods. The reference to them only considers the similarity in results (significance and sign of coefficients). In case of consistent findings for pooled OLS and FE models, indication is clear. For primary consistent results in terms of coefficient sign and significance for pooled OLS and FE models, indication is based on the main outcome. For inconsistent results between pooled OLS and FE models, indication is based on the model with the significant results, showing a potential tendency. In the following, the coefficients of the control variables *SIZE*, *AGE*, *GROW*, *DEBT*, *TANG*, *GWIA* and *CR* and of the year dummies (*YEAR2017*, *YEAR2018*, *YEAR2019* and *YEAR2020*) are analysed.
SIZE	Despite the larger *SIZE* of U.S. MD firms relative to German ones, *SIZE* has an insignificantly negative effect on *GPM*, which contrasts the initial assumption, but it is aligned with Gill et al. (2010). The result is also partially contrary to GER, where *SIZE* behaves significantly positively with *GPM* in models 5.A and 6.A. Generally, market power and scalability in production from higher *SIZE* may not be relevant for profitability of U.S. MD firms.
AGE	Although, U.S. MD companies are younger than German ones, *AGE* and related factors, such as time in market and longer used patents, do not play a significant role for *GPM*, being contrary to expectations, outcomes for GER and findings of Usman, Shaikh, and Khan (2017). Moreover, the signs of the coefficients in models 5.A and 6.A differ from those in models 5.B and 6.B.
GROW	Despite the higher *GROW* among U.S. MD firms, *GROW* seems to be positively related to *GPM* as priorly assumed, but the effect is insignificant in all models, like outcomes of Sharma and Kumar (2011), but not like those for GER. As a result, more growth opportunities and the related higher innovation power may not lead to higher profitability, because product innovations probably need longer time to be reflected in significantly higher demand of customers.
DEBT	*DEBT* mainly exhibits an insignificant effect on *GPM*. Moreover, the effect is not consistent between the models: Models 5.A and 6.A show a positive effect with a significant influence for model 6.A with normal SDE and models 5.B and 6.B a negative one. The insignificant effect, which is partially in contrast to results for German MD firms, was also analysed by Padachi (2006), but not initially expected. In conclusion, U.S. firms with higher financial leverage do not necessarily have lower profitability because they e.g., use leverage to finance their continuing innovation activity with which they secure future demand, sales growth, and products´ life. Additionally, U.S. firms may have more favourably debt conditions due to country factors (e.g., higher investor protection) or company factors (e.g., higher negotiation power due to larger *SIZE*) relative to German firms, weakening the effect of *DEBT* on profitability.

(to be continued)

Table D8 *(continued).*

TANG	In line with initial expectation, Afrifa and Padachi (2016) and with GER, *TANG* is mainly negatively associated with *GPM* (except for an insignificantly negative impact in models 6.A and 6.B with clustered SDE). As a result, U.S. MD firms face as their German competitors outweighing maintenance, depreciation, and impairment costs of fixed assets for increased asset tangibility. Also, there may not be a substantial influence of financial reporting standards on the effect of *TANG* on *GPM* between GER and the USA. Hence, the subsequent valuation of fixed assets with either fair value or initial cost, both less accumulated depreciation, may not lead to a distraction in the *TANG* impact between GER and the USA.
GWIA	Contrary to assumptions, higher *GWIA* levels induce significantly lower *GPM* levels in the U.S. MD industry. Thus, U.S. MD firms with more valuable patents, goodwill, brands, trademarks, and intangible assets from R&D (overall higher innovation power) processes do not necessarily have higher profitability since they might also face e.g., higher production, maintenance or amortization costs that may outweigh benefits from competitive advantage and innovation power, reducing operating profitability. Also, innovation power might need more time to be trigger customer demand and thus, to be reflected in profitability. Apart from this, the analysed relationship is mainly different from that discovered for GER, which results probably from deviating financial reporting standards.
CR	*CR*´s negative impact was proved to be significant only in models 5.A and 6.A, being consistent with initial assumption and Raheman and Nasr (2007) but primary contrary to GER. In contrast to German MD firms, U.S. firms with higher potential liquidity levels may have lower profitability, because holding too much liquidity is costly and does not lead to profitable investments.
Year dummies	In addition, all year dummies have an insignificant and negative influence on *GPM*, indicating no major year events affecting *GPM*.
In conclusion, there are several divergences regarding the relevance of the control variables for *GPM* between GER and USA, indicating diversity in the MD industry itself and probably occurring due to substantial differences in the size of the control variables between German and U.S. MD companies. The deviations in the size of the control variables may result from the outlined differences between GER and the USA in the MD market (market size, growth and MD portfolio), the healthcare system, the investor protection law and other country factors (e.g., *GPDG* or interest and tax rate).	

Appendix E

The robustness test was used as general check of the findings in the Work Project. Thus, difference testing for dependent and independent variables does not include Wilcoxon test. Also, only the relevant correlation coefficients for the hypotheses are listed below.

Table E1: Non-parametric median and parametric mean tests for dependent and independent variables for 2016-2019

			Non-parametric median test		Parametric mean test	
Variables	**Normality GER**	**Normality USA**	**Fisher´s exact p-value**	**Statistically different median**	**P-value**	**Statistically different mean**
DIO	0.47475	0.00005***	0.292	No	0.9452	No
DSO	0.00630***	0.41859	1.000	No	0.1616	No
DPO	0.00451***	0.38585	0.292	No	0.8535	No
CCC	0.01080**	0.00000***	0.483	No	0.6607	No
GPM	0.00230***	0.00019***	0.160	No	0.2902	No

*Note: Procedure similar to Table C11 (except for the exclusion of the year 2020 and the population distribution test). Normality and statistical indifference are fulfilled if p-values are above 10%. The non-parametric median test was done with the Stata option "medianties(drop)" and with "medianties(split)" (Stata n.d.-b). Both options yielded the same p-values. For the median test, p-value of Fisher´s exact test is used since it is more reliable than that of Pearson chi-squared test in samples with less than 200 obs. (Fisher 1935; Stata n.d.-b). In case of divergent results for median and mean tests, result of mean test will be focused for a normally distributed variable in both countries and that of the median test for divergent findings for the normality of the variable between both countries. ***: p-value <0.01; **: p-value <0.05; *: p-value <0.1.*

Table E2: Correlation coefficients of independent variables with *GPM* in GER and USA for Spearman´s rank and Pearson correlation matrix for 2016-2019

Varia-bles	**GER - Spearman**	**USA – Spearman**	**GER – Pearson**	**USA – Pearson**	**Consistency of results for GER**	**Consistency of results for USA**	**Consistency of results overall**
DIO	0.7531*** (0.0000)	0.4125*** (0.0008)	0.7656*** (0.0000)	0.4964*** (0.0000)	Yes	Yes	Yes
DSO	-0.4768*** (0.0000)	0.3213** (0.0102)	-0.3210*** (0.0081)	0.2905** (0.0209)	Yes	Yes	No
DPO	0.1704 (0.1679)	-0.0594 (0.6437)	0.2554** (0.0370)	-0.0337 (0.7932)	No	Yes	No
CCC	0.5718*** (0.0000)	0.3865*** (0.0018)	0.6031*** (0.0000)	0.4852*** (0.0001)	Yes	Yes	Yes

*Note: Procedure similar as in Tables C12-C13 (except for the exclusion of the year 2020). P-values are inside brackets. ***: p-value <0.01; **: p-value <0.05; *: p-value <0.1.*

Table E3: Regression analysis of *DIO*, *DSO* and *DPO* (Models 5.A and 5.B) for GER for 2016-2019

Variables	Pooled OLS with normal SDE (Model 5.A)	Pooled OLS with clustered SDE (Model 5.A)	FE model with normal SDE (Model 5.B)	FE model with clustered SDE (Model 5.B)
Constant β_0	0.807641*** (0.000)	0.807641*** (0.000)	-2.150651*** (0.008)	-2.150651** (0.027)
Independent variables				
DIO α_1	0.000123 (0.444)	0.000123 (0.650)	0.000447*** (0.001)	0.000447*** (0.007)
DSO α_2	-0.000698* (0.059)	-0.000698** (0.012)	-0.000032 (0.891)	-0.000032 (0.823)
DPO α_3	0.003188*** (0.000)	0.003188*** (0.000)	0.000276 (0.338)	0.000276 (0.242)
Control variables				
SIZE β_1	-0.012588** (0.043)	-0.012588 (0.381)	0.156048*** (0.003)	0.156048** (0.013)
AGE β_2	0.039504*** (0.000)	0.039504*** (0.001)	0.119075 (0.127)	0.119075 (0.247)
GROW β_3	-0.136046 (0.224)	-0.136046 (0.234)	0.080033* (0.056)	0.080033 (0.130)
DEBT β_4	-0.265776*** (0.000)	-0.265776*** (0.000)	0.042525 (0.498)	0.042525 (0.317)
TANG β_5	-0.463634*** (0.000)	-0.463634*** (0.003)	-0.138494 (0.157)	-0.138494 (0.161)
GWIA β_6	-0.040219 (0.524)	-0.040219 (0.675)	0.081198 (0.116)	0.081198 (0.220)
CR β_7	-0.005777 (0.333)	-0.005777 (0.410)	0.000690 (0.807)	0.000690 (0.801)
Dummy variables				
LIST β_8	-0.173011*** (0.000)	-0.173011*** (0.000)		
IFRS β_9	-0.044365*** (0.008)	-0.044365 (0.188)		
YEAR2017 β_{10}	-0.012730 (0.433)	-0.012730 (0.228)		
YEAR2018 β_{11}	-0.025711 (0.117)	-0.025711** (0.032)		
YEAR2019 β_{12}	-0.011277 (0.500)	-0.011277 (0.351)		
Obs.	67	67	66	66
F-test p-value	0.0000	0.0000	0.0000	0.0000
R^2	0.9218	0.9218	0.9972	0.9972
Adjusted R^2	0.8988	0.8988	0.9948	0.9946
Within R^2			0.7399	0.7399
Shapiro-Wilk test p-value	0.35548			
Breusch-Pagan test p-value	0.2220			
Variance inflation factor below 5	Yes			
Wooldridge test p-value	0.0001			

Note: Procedure is similar as in Table D3 (except for the exclusion of the year 2020). Focus lies on the robustness of the impact of independent variables on GPM. Hence, interpretation of coefficients of control and dummy variables was not done.

Table E4: Regression analysis of *CCC* (Models 6.A and 6.B) for GER for 2016-2019

Variables	Pooled OLS with normal SDE (Model 6.A)	Pooled OLS with clustered SDE (Model 6.A)	FE model with normal SDE (Model 6.B)	FE model with clustered SDE (Model 6.B)
Constant β_0	0.892796*** (0.000)	0.892796** (0.020)	-2.469520*** (0.005)	-2.469520*** (0.003)
Independent variable				
***CCC* α_4**	0.000262 (0.260)	0.000262 (0.476)	0.000332** (0.022)	0.000332** (0.015)
Control variables				
***SIZE* β_1**	-0.017681* (0.089)	-0.017681 (0.539)	0.190258*** (0.001)	0.190258*** (0.000)
***AGE* β_2**	0.040249*** (0.006)	0.040249 (0.131)	0.083473 (0.324)	0.083473 (0.330)
***GROW* β_3**	-0.085554 (0.647)	-0.085554 (0.730)	0.086534* (0.058)	0.086534* (0.070)
***DEBT* β_4**	-0.239644*** (0.002)	-0.239644** (0.015)	0.031598 (0.652)	0.031598 (0.504)
***TANG* β_5**	-0.228128* (0.064)	-0.228128 (0.372)	-0.041442 (0.682)	-0.041442 (0.607)
***GWIA* β_6**	-0.059913 (0.566)	-0.059913 (0.786)	0.087739 (0.121)	0.087739 (0.272)
***CR* β_7**	-0.011305 (0.246)	-0.011305 (0.357)	0.001550 (0.618)	0.001550 (0.559)
Dummy variables				
***LIST* β_8**	-0.112961*** (0.001)	-0.112961 (0.117)		
***IFRS* β_9**	-0.081851*** (0.002)	-0.081851** (0.048)		
***YEAR2017* β_{10}**	0.000979 (0.971)	0.000979 (0.907)		
***YEAR2018* β_{11}**	-0.004542 (0.866)	-0.004542 (0.811)		
***YEAR2019* β_{12}**	0.005246 (0.850)	0.005246 (0.666)		
Obs.	67	67	66	66
F-test p-value	0.0000	0.0000	0.0000	0.0000
R^2	0.7692	0.7692	0.9964	0.9964
Adjusted R^2	0.7126	0.7126	0.9937	0.9935
Within R^2			0.6670	0.6670
Shapiro-Wilk test p-value	0.00658			
Breusch-Pagan test p-value	0.2566			
Variance inflation factor below 5	Yes			
Wooldridge test p-value	0.0002			

Note: Procedure is similar as in Table D4 (except for the exclusion of the year 2020). Focus lies on the robustness of the impact of independent variables on GPM. Hence, interpretation of coefficients of control and dummy variables was not done.

Table E5: Regression analysis of *DIO*, *DSO* and *DPO* (Models 5.A and 5.B) for USA for 2016-2019

Variables	Pooled OLS with normal SDE (Model 5.A)	Pooled OLS with clustered SDE (Model 5.A)	FE model with normal SDE (Model 5.B)	FE model with clustered SDE (Model 5.B)
Constant β_0	0.976167*** (0.000)	0.976167*** (0.001)	1.512317*** (0.005)	1.512317*** (0.008)
Independent variables				
DIO α_1	0.000863*** (0.000)	0.000863*** (0.000)	0.000088 (0.565)	0.000088 (0.562)
DSO α_2	0.001181 (0.230)	0.001181 (0.262)	-0.000340 (0.644)	-0.000340 (0.362)
DPO α_3	0.000557 (0.377)	0.000557 (0.515)	-0.000211 (0.508)	-0.000211 (0.452)
Control variables				
SIZE β_1	-0.009463 (0.407)	-0.009463 (0.535)	-0.057753 (0.122)	-0.057753 (0.112)
AGE β_2	-0.009958 (0.464)	-0.009958 (0.649)	0.009941 (0.912)	0.009941 (0.887)
GROW β_3	0.070208 (0.522)	0.070208 (0.598)	-0.036072 (0.319)	-0.036072* (0.082)
DEBT β_4	0.102509 (0.183)	0.102509 (0.435)	-0.018433 (0.735)	-0.018433 (0.733)
TANG β_5	-1.017631*** (0.000)	-1.017631*** (0.000)	-0.212807* (0.076)	-0.212807 (0.281)
GWIA β_6	-0.487111*** (0.000)	-0.487111*** (0.000)	-0.009323 (0.782)	-0.009323 (0.765)
CR β_7	-0.045256*** (0.000)	-0.045256** (0.014)	-0.001845 (0.665)	-0.001845 (0.340)
Dummy variables				
YEAR2017 β_8	-0.018930 (0.448)	-0.018930 (0.420)		
YEAR2018 β_9	-0.013348 (0.581)	-0.013348 (0.513)		
YEAR2019 β_{10}	-0.028520 (0.250)	-0.028520 (0.208)		
Obs.	63	63	62	62
F-test p-value	0.0000	0.0000	0.0183	0.0009
R^2	0.7638	0.7638	0.9923	0.9923
Adjusted R^2	0.7012	0.7012	0.9853	0.9848
Within R^2			0.4513	0.4513
Shapiro-Wilk test p-value	0.32309			
Breusch-Pagan test p-value	0.5523			
Variance inflation factor below 5	Yes			
Wooldridge test p-value	0.0137			

Note: Procedure is similar as in Table D6 (except for the exclusion of the year 2020). Focus lies on the robustness of the impact of independent variables on GPM. Hence, interpretation of coefficients of control and dummy variables was not done.

Table E6: Regression analysis of *CCC* (Models 6.A and 6.B) for USA for 2016-2019

Variables	Pooled OLS with normal SDE (Model 6.A)	Pooled OLS with clustered SDE (Model 6.A)	FE model with normal SDE (Model 6.B)	FE model with clustered SDE (Model 6.B)
Constant β_0	1.052078*** (0.000)	1.052078*** (0.001)	1.512751*** (0.004)	1.512751*** (0.008)
Independent variable				
***CCC* α_4**	0.000754*** (0.000)	0.000754*** (0.000)	0.000107 (0.415)	0.000107 (0.348)
Control variables				
***SIZE* β_1**	-0.008078 (0.490)	-0.008078 (0.623)	-0.060074* (0.096)	-0.060074* (0.094)
***AGE* β_2**	-0.009693 (0.493)	-0.009693 (0.723)	0.011566 (0.895)	0.011566 (0.852)
***GROW* β_3**	0.088256 (0.434)	0.088256 (0.527)	-0.037289 (0.291)	-0.037289* (0.095)
***DEBT* β_4**	0.153536** (0.048)	0.153536 (0.180)	-0.034699 (0.475)	-0.034699 (0.405)
***TANG* β_5**	-1.051495*** (0.000)	-1.051495*** (0.000)	-0.190525* (0.076)	-0.190525 (0.339)
***GWIA* β_6**	-0.512669*** (0.000)	-0.512669*** (0.000)	-0.012171 (0.706)	-0.012171 (0.650)
***CR* β_7**	-0.050244*** (0.000)	-0.050244** (0.010)	-0.001687 (0.667)	-0.001687 (0.468)
Dummy variables				
***YEAR2017* β_8**	-0.007599 (0.763)	-0.007599 (0.751)		
***YEAR2018* β_9**	-0.007305 (0.770)	-0.007305 (0.727)		
***YEAR2019* β_{10}**	-0.012011 (0.620)	-0.012011 (0.598)		
Obs.	63	63	62	62
	0.0000	0.0000	0.0067	0.0637
R^2	0.7334	0.7334	0.9921	0.9921
Adjusted R^2	0.6759	0.6759	0.9858	0.9854
Within R^2			0.4376	0.4376
Shapiro-Wilk test p-value	0.06930			
Breusch-Pagan test p-value	0.1922			
Variance inflation factor below 5	Yes			
Wooldridge test p-value	0.0071			

Note: Procedure is similar as in Table D7 (except for the exclusion of the year 2020). Focus lies on the robustness of the impact of independent variables on GPM. Hence, interpretation of coefficients of control and dummy variables was not done.

Appendix F

Below is the Stata code for the analysis of the Work Project. Rows starting with "*" are no commands but indicate what the subsequent command will do. The code does not include the robustness test. For the robustness test, observations from 2020 were excluded from the dataset. Then, the summary statistics for 2020 and the dummy *YEAR2020* were excluded from the code. Afterwards, the code was run again.

Stata code

```
* 1) Clearing of previous analysis settings
clear all
set more off

* 2) Opening of dataset (Selection of destination)
import excel "SELECT YOUR OWN DESTINATION", sheet("DATA") firstrow

* 3) Managing outliers and checking normality of variables
* Shapiro-Wilk Test for normal distribution of variables before winsorization
bys COUNTRY: swilk GPM DIO DSO DPO CCC SIZE AGE GROW DEBT TANG GWIA CR
* Skewness and kurtosis test for normal distribution of variables before winsorization
sktest GPM DIO DSO DPO CCC SIZE AGE GROW DEBT TANG GWIA CR if COUNTRY==0
sktest GPM DIO DSO DPO CCC SIZE AGE GROW DEBT TANG GWIA CR if COUNTRY==1
* Winsorizing independent, dependent and control variables at 5th and 95th percentile
winsor2 GPM, replace cuts(5 95) by (COUNTRY)
winsor2 DIO, replace cuts(5 95) by (COUNTRY)
winsor2 DSO, replace cuts(5 95) by (COUNTRY)
winsor2 DPO, replace cuts(5 95) by (COUNTRY)
winsor2 CCC, replace cuts(5 95) by (COUNTRY)
winsor2 SIZE, replace cuts(5 95) by (COUNTRY)
winsor2 AGE, replace cuts(5 95) by (COUNTRY)
winsor2 AGE_ABS, replace cuts(5 95) by (COUNTRY)
winsor2 GROW, replace cuts(5 95) by (COUNTRY)
winsor2 DEBT, replace cuts(5 95) by (COUNTRY)
winsor2 TANG, replace cuts(5 95) by (COUNTRY)
winsor2 GWIA, replace cuts(5 95) by (COUNTRY)
winsor2 CR, replace cuts(5 95) by (COUNTRY)
* Shapiro-Wilk Test for normal distribution of variables after winsorization
bys COUNTRY: swilk GPM DIO DSO DPO CCC SIZE AGE GROW DEBT TANG GWIA CR
* Skewness and kurtosis test for normal distribution of variables after winsorization
sktest GPM DIO DSO DPO CCC SIZE AGE GROW DEBT TANG GWIA CR if COUNTRY==0
sktest GPM DIO DSO DPO CCC SIZE AGE GROW DEBT TANG GWIA CR if COUNTRY==1

* 4) Analysing sample data
* Number of listed firms per country and year
bys COUNTRY: tab LIST YEAR
* Number of firms with IFRS per country and year
bys COUNTRY: tab IFRS YEAR
* Number of firms per SIC code per country and year
bys COUNTRY: tab SICCODE YEAR

* 5) Summary statistics of dependent, independent and control variables
* Summary statistics of dependent, independent and control variables per country for all years
bys COUNTRY: tabstat GPM CCC DIO DSO DPO SIZE AGE AGE_ABS GROW DEBT TANG GWIA CR, statistics(N mean median sd
min max p25 p75)
* Summary statistics of dependent, independent and control variables in 2016 per country
bys COUNTRY: tabstat GPM CCC DIO DSO DPO SIZE AGE GROW DEBT TANG GWIA CR if YEAR==2016, statistics(N mean
median sd min max p25 p75)
* Summary statistics of dependent, independent and control variables in 2017 per country
bys COUNTRY: tabstat GPM CCC DIO DSO DPO SIZE AGE GROW DEBT TANG GWIA CR if YEAR==2017, statistics(N mean
median sd min max p25 p75)
* Summary statistics of dependent, independent and control variables in 2018 per country
bys COUNTRY: tabstat GPM CCC DIO DSO DPO SIZE AGE GROW DEBT TANG GWIA CR if YEAR==2018, statistics(N mean
median sd min max p25 p75)
* Summary statistics of dependent, independent and control variables in 2019 per country
bys COUNTRY: tabstat GPM CCC DIO DSO DPO SIZE AGE GROW DEBT TANG GWIA CR if YEAR==2019, statistics(N mean
median sd min max p25 p75)
* Summary statistics of dependent, independent and control variables in 2020 per country
bys COUNTRY: tabstat GPM CCC DIO DSO DPO SIZE AGE GROW DEBT TANG GWIA CR if YEAR==2020, statistics(N mean
median sd min max p25 p75)
```

**** 6) Managing outliers of other variables***
*** Winsorizing other variables**
winsor2 INV, replace cuts(5 95) by (COUNTRY)
winsor2 RECEIV, replace cuts(5 95) by (COUNTRY)
winsor2 CASHR, replace cuts(5 95) by (COUNTRY)
winsor2 CASH, replace cuts(5 95) by (COUNTRY)
winsor2 QR, replace cuts(5 95) by (COUNTRY)
winsor2 CARAT, replace cuts(5 95) by (COUNTRY)
winsor2 PAY, replace cuts(5 95) by (COUNTRY)
winsor2 CLRAT, replace cuts(5 95) by (COUNTRY)
winsor2 COGS, replace cuts(5 95) by (COUNTRY)
winsor2 OPM, replace cuts(5 95) by (COUNTRY)
winsor2 DA, replace cuts(5 95) by (COUNTRY)
winsor2 EBIT, replace cuts(5 95) by (COUNTRY)
winsor2 INTEREST, replace cuts(5 95) by (COUNTRY)
winsor2 NI, replace cuts(5 95) by (COUNTRY)
winsor2 GDPG, replace cuts(5 95) by (COUNTRY)

**** 7) Generating of OPEX variable***
generate OPEX=GPM-OPM

**** 8) Summary statistics of other variables per country for all years***
bys COUNTRY: tabstat INV RECEIV CASH CASHR QR CARAT PAY CLRAT NWC COGS OPEX OPM DA EBIT INTEREST NI GDPG, statistics(N mean median sd min max p25 p75)

**** 9) Checking normality of other variables***
**** Shapiro-Wilk Test for normal distribution of variables***
bys COUNTRY: swilk INV RECEIV CASH CASHR QR CARAT PAY CLRAT NWC COGS OPEX OPM DA EBIT INTEREST NI GDPG

**** 10) Non-parametric median (1) and parametric mean (2) testing for control and other variables***
*** SIZE**
median SIZE, by(COUNTRY) exact medianties(drop)
ttest SIZE, by(COUNTRY)
*** AGE**
median AGE, by(COUNTRY) exact medianties(drop)
ttest AGE, by(COUNTRY)
*** GROW**
median GROW, by(COUNTRY) exact medianties(drop)
ttest GROW, by(COUNTRY)
*** INV**
median INV, by(COUNTRY) exact medianties(drop)
ttest INV, by(COUNTRY)
*** RECEIV**
median RECEIV, by(COUNTRY) exact medianties(drop)
ttest RECEIV, by(COUNTRY)
*** TANG**
median TANG, by(COUNTRY) exact medianties(drop)
ttest TANG, by(COUNTRY)
*** GWIA**
median GWIA, by(COUNTRY) exact medianties(drop)
ttest GWIA, by(COUNTRY)
*** CASHR**
median CASHR, by(COUNTRY) exact medianties(drop)
ttest CASHR, by(COUNTRY)
*** CASH**
median CASH, by(COUNTRY) exact medianties(drop)
ttest CASH, by(COUNTRY)
*** QR**
median QR, by(COUNTRY) exact medianties(drop)
ttest QR, by(COUNTRY)
*** CR**
median CR, by(COUNTRY) exact medianties(drop)
ttest CR, by(COUNTRY)
*** CARAT**
median CARAT, by(COUNTRY) exact medianties(drop)
ttest CARAT, by(COUNTRY)
*** DEBT**
median DEBT, by(COUNTRY) exact medianties(drop)
ttest DEBT, by(COUNTRY)
*** PAY**
median PAY, by(COUNTRY) exact medianties(drop)
ttest PAY, by(COUNTRY)
*** CLRAT**
median CLRAT, by(COUNTRY) exact medianties(drop)
ttest CLRAT, by(COUNTRY)

*** NWC**
median NWC, by(COUNTRY) exact medianties(drop)
ttest NWC, by(COUNTRY)
*** COGS**
median COGS, by(COUNTRY) exact medianties(drop)
ttest COGS, by(COUNTRY)
*** OPEX**
median OPEX, by(COUNTRY) exact medianties(drop)
ttest OPEX, by(COUNTRY)
*** OPM**
median OPM, by(COUNTRY) exact medianties(drop)
ttest OPM, by(COUNTRY)
*** DA**
median DA, by(COUNTRY) exact medianties(drop)
ttest DA, by(COUNTRY)
*** EBIT**
median EBIT, by(COUNTRY) exact medianties(drop)
ttest EBIT, by(COUNTRY)
*** INTEREST**
median INTEREST, by(COUNTRY) exact medianties(drop)
ttest INTEREST, by(COUNTRY)
*** NI**
median NI, by(COUNTRY) exact medianties(drop)
ttest NI, by(COUNTRY)
*** GDPG**
median GDPG, by(COUNTRY) exact medianties(drop)
ttest GDPG, by(COUNTRY)

**** 11) Graph of median evolution of DIO, DSO, DPO, CCC and GPM per country and year***
*** DIO**
* Generating median DIO per year for GER
bys YEAR: egen mdDIO_GER= median(DIO) if COUNTRY==0
* Generating variable name
label variable mdDIO_GER "Median DIO in GER"
* Generating median DIO per year for USA
bys YEAR: egen mdDIO_USA= median(DIO) if COUNTRY==1
* Generating variable name
label variable mdDIO_USA "Median DIO in USA"
* Generating graph
line mdDIO_GER mdDIO_USA YEAR, sort
*** DSO**
* Generating median DSO per year for GER
bys YEAR: egen mdDSO_GER= median(DSO) if COUNTRY==0
* Generating variable name
label variable mdDSO_GER "Median DSO in GER"
* Generating median DSO per year for USA
bys YEAR: egen mdDSO_USA= median(DSO) if COUNTRY==1
* Generating variable name
label variable mdDSO_USA "Median DSO in USA"
* Generating graph
line mdDSO_GER mdDSO_USA YEAR, sort
*** DPO**
* Generating median DPO per year for GER
bys YEAR: egen mdDPO_GER= median(DPO) if COUNTRY==0
* Generating variable name
label variable mdDPO_GER "Median DPO in GER"
* Generating median DPO per year for USA
bys YEAR: egen mdDPO_USA= median(DPO) if COUNTRY==1
* Generating variable name
label variable mdDPO_USA "Median DPO in USA"
* Generating
line mdDPO_GER mdDPO_USA YEAR, sort
*** CCC**
* Generating median CCC per year for GER
bys YEAR: egen mdCCC_GER= median(CCC) if COUNTRY==0
* Generating variable name
label variable mdCCC_GER "Median CCC in GER"
* Generating median CCC per year for USA
bys YEAR: egen mdCCC_USA= median(CCC) if COUNTRY==1
* Generating variable name
label variable mdCCC_USA "Median CCC in USA"
* Generating graph
line mdCCC_GER mdCCC_USA YEAR, sort

```
* GPM
* Generating median GPM per year for GER
bys YEAR: egen mdGPM_GER= median(GPM) if COUNTRY==0
* Generating variable name
label variable mdGPM_GER "Median GPM in GER"
* Generating median GPM per year for USA
bys YEAR: egen mdGPM_USA= median(GPM) if COUNTRY==1
* Generating variable name
label variable mdGPM_USA "Median GPM in USA"
* Generating graph
line mdGPM_GER mdGPM_USA YEAR, sort

* 12) Testing statistical difference in population distribution, median and mean for DIO, DSO, DPO, CCC and GPM
* DIO
* Non-parametric method
* Test for equal population distribution
ranksum DIO, by(COUNTRY) exact
* Test for equal median
median DIO, by(COUNTRY) exact medianties(drop)
* Parametric method
* Test for equal mean
ttest DIO, by(COUNTRY)
* DSO
* Non-parametric method
* Test for equal population distribution
ranksum DSO, by(COUNTRY) exact
* Test for equal median
median DSO, by(COUNTRY) exact medianties(drop)
* Parametric method
* Test for equal mean
ttest DSO, by(COUNTRY)
* DPO
* Non-parametric method
* Test for equal population distribution
ranksum DPO, by(COUNTRY) exact
* Test for equal median
median DPO, by(COUNTRY) exact medianties(drop)
* Parametric method
* Test for equal mean
ttest DPO, by(COUNTRY)
* CCC
* Non-parametric method
* Test for equal population distribution
ranksum CCC, by(COUNTRY) exact
* Test for equal median
median CCC, by(COUNTRY) exact medianties(drop)
* Parametric method
* Test for equal mean
ttest CCC, by(COUNTRY)
* GPM
* Non-parametric method
* Test for equal population distribution
ranksum GPM, by(COUNTRY) exact
* Test for equal median
median GPM, by(COUNTRY) exact medianties(drop)
* Parametric method
* Test for equal mean
ttest GPM, by(COUNTRY)

* 13) Constructing correlation matrices
* Nonparametric correlation matrix - Spearman
* GER
spearman GPM DIO DSO DPO CCC SIZE AGE GROW DEBT TANG GWIA CR LIST IFRS if COUNTRY==0, stats(rho p)
* USA
spearman GPM DIO DSO DPO CCC SIZE AGE GROW DEBT TANG GWIA CR if COUNTRY==1, stats(rho p)
* Parametric correlation matrix - Pearson
* GER
pwcorr GPM DIO DSO DPO CCC SIZE AGE GROW DEBT TANG GWIA CR LIST IFRS if COUNTRY==0, sig
* USA
pwcorr GPM DIO DSO DPO CCC SIZE AGE GROW DEBT TANG GWIA CR if COUNTRY==1, sig
```

**** 14) Running multivariate analysis***
*** Preparation**
*** Generation of firm ID**
egen ID=group(COMPANY)
*** Declaration of time and cross section dimensions**
xtset ID YEAR, yearly
*** Woolridge test (xtserial) installation for autocorrelation**
net from http://www.stata-journal.com/software/sj3-2/
net describe st0039
net install st0039
*** Installation reghdfe command for FE regression**
ssc install reghdfe
ssc install ftools

*** Regressions**
*** Total sample**
*** Model 5.A with normal SDE**
reg GPM DIO DSO DPO SIZE AGE GROW DEBT TANG GWIA CR COUNTRY LIST IFRS YEAR2017 YEAR2018 YEAR2019 YEAR2020
*** Prediction of residuals**
predict residual, resid
*** Shapiro Wilk test for normality of errors**
swilk(residual)
*** Homoskedasticity test**
estat hettest
*** Multicollinearity test**
vif
*** Drop of residuals**
drop residual
*** Autocorrelation test**
xtserial GPM DIO DSO DPO SIZE AGE GROW DEBT TANG GWIA CR COUNTRY LIST IFRS YEAR2017 YEAR2018 YEAR2019 YEAR2020
*** Model 5.A with clustered SE**
reg GPM DIO DSO DPO SIZE AGE GROW DEBT TANG GWIA CR COUNTRY LIST IFRS YEAR2017 YEAR2018 YEAR2019 YEAR2020, vce(cl ID)
*** Model 5.B with normal SDE**
reghdfe GPM DIO DSO DPO SIZE AGE GROW DEBT TANG GWIA CR, abs(YEAR ID)
*** Model 5.B with clustered SDE**
reghdfe GPM DIO DSO DPO SIZE AGE GROW DEBT TANG GWIA CR, abs(YEAR ID) vce(cl ID)

*** Model 6.A with normal SDE**
reg GPM CCC SIZE AGE GROW DEBT TANG GWIA CR COUNTRY LIST IFRS YEAR2017 YEAR2018 YEAR2019 YEAR2020
*** Prediction of residuals**
predict residual, resid
*** Shapiro Wilk test for normality of errors**
swilk(residual)
*** Homoskedasticity test**
estat hettest
*** Multicollinearity test**
vif
*** Drop of residuals**
drop residual
*** Autocorrelation test**
xtserial GPM CCC SIZE AGE GROW DEBT TANG GWIA CR COUNTRY LIST IFRS YEAR2017 YEAR2018 YEAR2019 YEAR2020
*** Model 6.A with clustered SDE**
reg GPM CCC SIZE AGE GROW DEBT TANG GWIA CR COUNTRY LIST IFRS YEAR2017 YEAR2018 YEAR2019 YEAR2020, vce(cl ID)
*** Model 6.B with normal SDE**
reghdfe GPM CCC SIZE AGE GROW DEBT TANG GWIA CR, abs(YEAR ID)
*** Model 6.B with clustered SDE**
reghdfe GPM CCC SIZE AGE GROW DEBT TANG GWIA CR, abs(YEAR ID) vce(cl ID)

*** GER**
*** * Model 5.A with normal SDE**
reg GPM DIO DSO DPO SIZE AGE GROW DEBT TANG GWIA CR LIST IFRS YEAR2017 YEAR2018 YEAR2019 YEAR2020 if COUNTRY==0
*** Prediction of residuals**
predict residual, resid
*** Shapiro Wilk test for normality of errors**
swilk(residual) if COUNTRY==0
*** Homoskedasticity test**
estat hettest
*** Multicollinearity test**
vif
*** Drop of residuals**
drop residual
*** Autocorrelation test**
xtserial GPM DIO DSO DPO SIZE AGE GROW DEBT TANG GWIA CR LIST IFRS YEAR2017 YEAR2018 YEAR2019 YEAR2020 if COUNTRY==0
*** Model 5.A with clustered SDE**
reg GPM DIO DSO DPO SIZE AGE GROW DEBT TANG GWIA CR LIST IFRS YEAR2017 YEAR2018 YEAR2019 YEAR2020 if COUNTRY==0, vce(cl ID)
*** Model 5.B with normal SDE**
reghdfe GPM DIO DSO DPO SIZE AGE GROW DEBT TANG GWIA CR if COUNTRY==0, abs(YEAR ID)
*** Model 5.B with clustered SDE**
reghdfe GPM DIO DSO DPO SIZE AGE GROW DEBT TANG GWIA CR if COUNTRY==0, abs(YEAR ID) vce(cl ID)

*** Model 6.A with normal SDE**
reg GPM CCC SIZE AGE GROW DEBT TANG GWIA CR LIST IFRS YEAR2017 YEAR2018 YEAR2019 YEAR2020 if COUNTRY==0
*** Prediction of residuals**
predict residual, resid
*** Shapiro Wilk test for normality of errors**
swilk(residual) if COUNTRY==0
*** Homoskedasticity test**
estat hettest
*** Multicollinearity test**
vif
*** Drop of residuals**
drop residual
*** Autocorrelation test**
xtserial GPM CCC SIZE AGE GROW DEBT TANG GWIA CR LIST IFRS YEAR2017 YEAR2018 YEAR2019 YEAR2020 if COUNTRY==0
*** Model 6.A with clustered SDE**
reg GPM CCC SIZE AGE GROW DEBT TANG GWIA CR LIST IFRS YEAR2017 YEAR2018 YEAR2019 YEAR2020 if COUNTRY==0, vce(cl ID)
*** Model 6.B with normal SDE**
reghdfe GPM CCC SIZE AGE GROW DEBT TANG GWIA CR if COUNTRY==0, abs(YEAR ID)
*** Model 6.B with clustered SDE**
reghdfe GPM CCC SIZE AGE GROW DEBT TANG GWIA CR if COUNTRY==0, abs(YEAR ID) vce(cl ID)

*** USA**
*** Model 5.A with normal SDE**
reg GPM DIO DSO DPO SIZE AGE GROW DEBT TANG GWIA CR YEAR2017 YEAR2018 YEAR2019 YEAR2020 if COUNTRY==1
*** Prediction of residuals**
predict residual, resid
*** Shapiro Wilk test for normality of errors**
swilk(residual) if COUNTRY==1
*** Homoskedasticity test**
estat hettest
*** Multicollinearity test**
vif
*** Drop of residuals**
drop residual
*** Autocorrelation test**
xtserial GPM DIO DSO DPO SIZE AGE GROW DEBT TANG GWIA CR YEAR2017 YEAR2018 YEAR2019 YEAR2020 if COUNTRY==1
*** Model 5.A with clustered SDE**
reg GPM DIO DSO DPO SIZE AGE GROW DEBT TANG GWIA CR YEAR2017 YEAR2018 YEAR2019 YEAR2020 if COUNTRY==1, vce(cl ID)
*** Model 5.B with normal SDE**
reghdfe GPM DIO DSO DPO SIZE AGE GROW DEBT TANG GWIA CR if COUNTRY==1, abs(YEAR ID)
*** Model 5.B with clustered SDE**
reghdfe GPM DIO DSO DPO SIZE AGE GROW DEBT TANG GWIA CR if COUNTRY==1, abs(YEAR ID) vce(cl ID)

*** Model 6.A with normal SDE**
reg GPM CCC SIZE AGE GROW DEBT TANG GWIA CR YEAR2017 YEAR2018 YEAR2019 YEAR2020 if COUNTRY==1
*** Prediction of residuals**
predict residual, resid
*** Shapiro Wilk test for normality of errors**
swilk(residual) if COUNTRY==1
*** Homoskedasticity test**
estat hettest
*** Multicollinearity test**
vif
*** Drop of residuals**
drop residual
*** Autocorrelation test**
xtserial GPM CCC SIZE AGE GROW DEBT TANG GWIA CR YEAR2017 YEAR2018 YEAR2019 YEAR2020 if COUNTRY==1
*** Model 6.A with clustered SDE**
reg GPM CCC SIZE AGE GROW DEBT TANG GWIA CR YEAR2017 YEAR2018 YEAR2019 YEAR2020 if COUNTRY==1, vce(cl ID)
*** Model 6.B with normal SDE**
reghdfe GPM CCC SIZE AGE GROW DEBT TANG GWIA CR if COUNTRY==1, abs(YEAR ID)
* Model 6.B with clustered SDE
reghdfe GPM CCC SIZE AGE GROW DEBT TANG GWIA CR if COUNTRY==1, abs(YEAR ID) vce(cl ID)