

A Work Project, presented as part of the requirements for the Award of a Master's degree in  
Finance from the Nova School of Business and Economics

HOW CAN COMPANIES INCREASE THEIR PROFITABILITY BY EFFECTIVELY  
MANAGING THEIR WORKING CAPITAL?

- EVIDENCE FROM THE AUTOMOBILE MANUFACTURING INDUSTRY -

OLIVER PRECKEL

Work project carried out under the supervision of

Professor Leonor Fernandes Ferreira

17<sup>th</sup> December 2021

**Abstract**

This paper investigates the relationship between working capital management and profitability in the automobile manufacturing industry. It was found that Cash Conversion Cycle (CCC) negatively impacts profitability. As lower CCC leads to higher profitability, this study provides information on which turnover ratios are the best levers to impact companies' CCC. Furthermore, there are significant differences in CCC and Return on Assets (RoA) within the automobile manufacturing industry between Asian and Non-Asian companies. Moreover, the automobile manufacturing industry and the automotive supplier industry (often grouped together as “automotive” industry) differ significantly in their CCC and RoA levels.

**Key words:** Cash Conversion Cycle, Working Capital Management, Profitability, Automobile Manufacturing Industry, Accounting Turnover Ratios

This work used infrastructure and resources funded by Fundação para a Ciência e a Tecnologia (UID/ECO/00124/2013, UID/ECO/00124/2019 and Social Sciences DataLab, Project 22209), POR Lisboa (LISBOA-01-0145-FEDER-007722 and Social Sciences DataLab, Project 22209) and POR Norte (Social Sciences DataLab, Project 22209)

## **1. Introduction**

Working capital management (WCM) is one of the most important pillars for corporate liquidity management. It is one of the most effective levers for releasing liquidity without external financing. The funds thus released can then be used for investments in profitable projects. A direct correlation between CCC - as a proxy for WCM - and profitability can thus be expected. As current assets account for almost half of total assets in the automobile manufacturing industry (Kumari and Anthuvan 2017, p. 6746), WCM is therefore particularly important. In one of the most central industries – expected total revenues of US\$ 1,589bn in 2021; growing by a CAGR of 7.33% (Statista.com 2021b) – with intense competition and high customer bargaining power, companies must find ways to maximize the efficiency of their existing assets to meet shareholder and stakeholder needs. As a result, optimised WCM can be an effective tool. Growing concerns about environmental sustainability, in which individuals' mobility and automobiles play an important role, are forcing automakers to invest in new green technologies while shareholders continue to demand returns on their invested capital. This core industry, in which most people can be considered stakeholders, is therefore undergoing an upheaval. Adding to this, the importance of WCM in the industry makes the study of the impact of WCM on profitability particularly relevant.

The purpose of this Work Project is to examine and understand the relationship between WCM and profitability in the automobile manufacturing industry. Based on this, an analysis is conducted on how managers can use this knowledge to manage working capital (WC) more effectively and thereby increase profitability.

Following this introduction, Section 2 introduces and discusses the key concepts: CCC, RoA and WCM. Section 3 reviews the literature, namely the most relevant papers on the relation of WCM and profitability, both generally and for the automotive and automobile manufacturing industry in particular. Section 4 presents the research questions based on the research model, then it introduces the statistical approach used in the research and describes

the sampling process. Section 5 provides answers to the research questions and presents their results. Section 6 concludes the results, identifies limitations in this work and gives recommendations for future research.

## **2. Industry Analysis**

In recent years, the automobile manufacturing industry was in radical change, as emerging environmental issues are also affecting individual transportation. Therefore, in all segments, a shift from internal combustion engines to more sustainable drive technologies is ongoing. However, besides exceptions like Tesla Inc., which experienced a strong rise with their new technologies, there are primarily the same companies dominating the market as 20 years ago. Nine of the top ten automobile manufacturers in 2000 by production volume were still in this list in 2017<sup>1</sup> (OICA 2001, 2018).

This already shows that competition takes place amongst the same few companies for years and indicates that the automobile manufacturing industry has very high barriers to market entry, requiring such enormous investments in production facilities and know-how that hardly any new market entrant can afford them. On the other hand, it is precisely these high investments that release economies of scale and thus help existing companies to strengthen their position. In fact, it was Henry Ford, founder of what is now still the 5<sup>th</sup> largest automobile manufacturer Ford Motor Company, who first introduced the assembly line production by strong investments into physical capital and thereby released these economies of scale (Raff 1991, p. 726).

However, new entrants to the electromobility market, such as Tesla or BYD, have shown that the automobile industry is changing and innovative companies with new technologies can enter the market. In both the premium (characterised through higher quality and pricing and market position) and mass (typified through high sales volumes and lower prices) segments,

---

<sup>1</sup> Or their successor companies

most companies have loyalty rates above 50 per cent, underscoring the difficulty of attracting new customers (J.D. Power 2021).

Competition in the automobile manufacturing market can be classified as intense with many large players, the largest of which (Toyota) has a market share of less than 10 per cent (Statista.com 2021a).

Although most suppliers focus on specific areas within the end product, the supplier industry is even more competitive than the Original Equipment Manufacturer (OEM) market, with the top 10 accounting for only 36% of the market volume of the top 100 suppliers (€331 bn out of €918 bn), indicating that suppliers' bargaining power might be very low (Berylls Strategy Advisors 2020).

Due to the broad spectrum of automobile manufacturers and comparable quality standards, potential buyers have high bargaining power towards the manufacturers. This is further reinforced by the fact that manufacturers have not created ecosystems that would make potential brand switching more difficult.

Finally, it is necessary to narrow down the term "automobile manufacturing" for the purposes of this study. When compiling the final sample, it is necessary to decide whether a broad or a narrow definition should be chosen. A broad definition includes a very large number of companies operating along the automotive value chain. This very large number of sample companies is associated with strong statistical power. On the other hand, a narrow definition - as used in this study - means that all sample companies serve the same stage within the value chain. Although the population is therefore smaller than for the broad definition, a narrow definition provides a high degree of comparability. Since the automotive industry might be very heterogeneous (this will be examined in RQ I.I), only automobile manufacturers are included in the sample of this study, which means that a different approach

is taken than in most existing literature. Thus, the concept is to obtain highly precise results that apply only to a very specific group of companies.

### 3. Key Concepts

#### 3.1 Cash Conversion Cycle

In this study, CCC is used as a key performance indicator (KPI) for WCM. CCC is calculated as:

$$CCC = DSO + DIO - DPO \quad [1]$$

Although there are other commonly used ratios such as the Current Ratio and the Acid Test Ratio<sup>2</sup>, CCC offers several advantages as a measure of WCM efficiency. First, it provides a dynamic perspective, as it does not just relate balance sheet items to each other (Richards and Laughlin 1980). CCC is the sum of its components, which in turn scale balance sheet items (point in time related) by income statement items (period related) and thereby creating a dynamic measure. Also, it is measured in days<sup>3</sup>, giving a feasible indication for managers on their WCM.

#### 3.2 Working Capital Management

In general, two types of WCM can be distinguished at this point: Aggressive and conservative WCM. On the one hand, an aggressive WCM style would aim for low investment levels in WC, resulting in WC reflecting only a small proportion of total assets, while on the other hand conservative WCM means being generous in terms of acceptable WC levels compared to total asset (Nazir and Afza 2009).

With regards to CCC and its components as a measure of WCM, DSO and DPO can directly be influenced by the average payment and collection terms in days. Therefore, aggressive WCM would mean enforcing strong bargaining power and negotiating long due dates for payables and short due dates for receivables in order to minimize the cash that is

---

<sup>2</sup> Current Ratio =  $\frac{\text{Current Assets}}{\text{Current Liabilities}}$ , Acid test ratio =  $\frac{\text{Cash \& Cash Equivalents} + \text{Accounts Receivables}}{\text{Current Liabilities}}$

<sup>3</sup> It is also possible to measure CCC in other time units, such as months.

being tied up in WC. However, this might come at cost of good relationships to suppliers and customers. A potential consequence of too aggressive WCM therefore might be that suppliers and clients stop business with this firm or that they get into financial distress (Petersen and Rajan 1997). Concerning inventory management, aggressive WCM is a strategy based on low inventory levels. This offers the advantage of very few capital being tied, however in case of unforeseen demand or production problems of suppliers, this leads to out-of-stock issues, meaning that less sales can be made which has direct negative financial impact (Deloof 2003).

On the other hand, a firm can conduct a conservative WCM style, meaning that this firm offers long accounts receivables and pays its payables quickly. Although this might help suppliers and customers in difficult times and is a measure to overcome agency cost by allowing customers to check quality before buying (Long et al. 1993), it comes at financial cost, as capital is tied up in WC that cannot be invested in profitable projects. The same holds for inventory management: Conservative inventory management allows to have reserves of inventories for strong demand or supply chain problems. However, this also means more tied up capital in inventories that cannot be invested into profitable projects.

Therefore, it can be said overall that WCM follows a risk-return trade-off, where a riskier approach (aggressive WCM) is associated with potentially higher benefits but also higher risks and vice versa. Thus, a clear recommendation on which of these WCM styles is superior cannot be given at this point.

### *3.3 Return on Assets*

RoA, calculated as  $\frac{\text{EBIT}}{\text{Total Assets}}$ <sup>4</sup> will be used as a proxy of profitability, as it offers several advantages over other profitability measures that are primarily related to capital structure, interest, currencies, and taxation (Leverage, tax shield, currency effects, different taxations<sup>5</sup>).

---

<sup>4</sup> Since total assets are comparatively stable over the periods, RoA calculation is simplified by taking the end of period values for total assets instead of the average total assets of the period.

<sup>5</sup> Due to Value Added Tax (VAT), this is still not a 100 per cent tax adjusted measure

Therefore, it is especially suitable for comparisons, as it best reflects the operating profit generating capacity.

By breaking down the RoA into its parts, it is possible to gain insights into the drivers of profitability:

$$\text{RoA} = \frac{\text{EBIT}}{\text{Total Assets}} = \frac{\text{EBIT}}{\text{Gross Profit}} \times \frac{\text{Gross Profit}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Total Assets}} \quad [2]$$

Thereby, RoA can be broken down into Operating Risk (OR), Gross Profit Margin (GPM) and Assets Turnover (AT). In the further course of this work, this breakdown will help to identify the levers for potential improvements.

#### 4. Literature Review

In previous literature, the relationship between CCC and profitability was subject to a broad range of studies:

In a study of ca. 1000 Belgian companies between 1992 and 1996, Deloof (2003) finds a negative relationship of all three constituents of CCC (DIO, DSO, DPO) and profitability (measured by Gross operating income margin<sup>6</sup>). While the negative relations of DIO and DSO with profitability follow the intuition that shorter tied up WC leads to higher profitability as this capital can be used productively, Deloof (2003) argues that the negative relationship of DPO and profitability might be because less profitable firms need more time to pay their accounts payables. However, he raises the general question that the causation of this negative relation might be inverse, meaning that higher profitability leads to lower CCC and not vice versa.

Lazaridis and Tryfonidis (2006) also find a negative impact of CCC on GPM in a study of 131 companies listed at Athens Stock Exchange between 2001 and 2004. Again, this is supported by negative relations of all individual components of CCC with profitability. In addition they find effects that moderate profitability: They observe that larger firms

---

<sup>6</sup> calculated as  $\frac{\text{Sales} - \text{COGS}}{\text{Total Assets} - \text{Financial Assets}}$

(measured by  $\ln(\text{sales})$ ) and firms with a higher share of fixed assets (of total assets) have higher GPM and companies with higher financial debt (Total Loans / Total Assets) reach lower GPM.

For a sample of listed Chinese manufacturing companies between 2010 and 2017, Ren et al. (2019) also found a negative impact of CCC on RoA, that is moderated by the type of ownership. They argue that, due to their close governmental connections, state-owned companies have better access to capital and this might influence the preference for aggressive WCM and the possibility to generate higher RoA.

Rizky and Mayasari (2018) also found a negative impact of CCC on RoA (proxied by Net Income/Total Assets) in a sample of Indonesian retail companies (2012-2015). The authors argue that lower levels of WC (reflected by lower CCCs) lead to more cash holdings and hence to less need of external financing that would have come at cost of profit.

Dalci et al. (2019) show the negative impact of CCC on RoA in a study based on a sample of 285 non-financial German firms between 2006-2013, however Dalci et al. (2019) observe that firm size moderates this effect, and argued that bigger firms are able to enforce stronger trade policies by higher bargaining power. This size effect is also in line with J.P.Morgan's (2019, p. 7) result, as they found in a sample of the S&P 1500 index (excluding Financial Services and Real Estate firms) that larger companies<sup>7</sup> have consistently lower average CCCs than the smaller ones between 2011 and 2018 (Large companies: Min: 52.0 days, Max: 56.3 days, Small companies: Min: 71.2 days, Max: 80.3 days).

There are also indications, that it might be value creating for companies not to enforce their entire bargaining power into aggressive trade policies. For instance, higher DSO might go along with higher sales as customers might be able to check product quality before paying and are hence more likely buy as agency costs decrease (Long et al. 1993). However, Long et al.

---

<sup>7</sup> "bigger" ("smaller") is defined as the 50% bigger (smaller) companies of an industry measured by revenue

(1993) find that this effect of overcoming agency cost is moderated by the variable “size” and the factor “uniqueness”, meaning that the smaller a company and the more unique their products are, the stronger the effect of overcoming agency cost becomes. Deloof and Jegers (1996) confirmed this findings with a Belgian Sample of industrial and wholesale companies between 1989 and 1991, indicating that companies can create value by more generous accounts receivables policies. Petersen and Rajan (1997) found similar results in 1,228 US small businesses between 1988 and 1989 arguing that more generous trade policies can create value as it can be a possibility to finance clients in financial distress situations and be therefore beneficial in the long run.

Although in previous literature, only very few explicit research on the impact of CCC on profitability within the global automobile manufacturing industry has been conducted, rather clear findings can be found within the related automotive industry (also includes suppliers) with an overemphasis in Southern Asia. Transferability to the global automobile manufacturers industry is therefore not fully given, as the automotive industry might be very heterogeneous both in its subgroups and across regions.

Based on a sample of 745 European automotive companies between 2010-2019, Zaher and Illescas (2020) found that the relationship between CCC and profitability is reflected in an inverted “U-shape” with an existing optimal level of CCC. Furthermore, they observe that companies with higher Cash holdings<sup>8</sup> have higher optimal CCC-levels, and vice versa. Zaher and Illescas (2020) argue that companies with high cash holdings are not dependent on low CCCs (as their investments and operations are backed by cash), thus they can adjust their CCC to an optimal level.

While Zaher and Illescas (2020) found a non-linear relationship between CCC and profitability, other authors observed a linear negative relationship of CCC and profitability in

---

<sup>8</sup> proxied by Cash holding ratio; Cash holding ratio =  $\frac{\text{Cash \& Cash Equivalents}}{\text{Current Liabilities}}$

this industry. This is the case, for example of Vijayakumar (2011) in the Indian automobile industry<sup>9</sup> for the periods 1996-2009, Ahmad and Sarwar (2016) in the Pakistani automotive<sup>10</sup> industry<sup>11</sup> between 2008-2013 and Shajar (2017) in the Indian automobiles industry in Southern Asia for the years 2006-2016. The latter also found this negative relationship to be moderated by a positive relationship between sales growth and RoA (Shajar (2017)).

Although there is already a substantial amount of research on the impact of CCC on RoA, yet no research was conducted on a global sample of companies that differentiate by regions and are serving the exact same step in the automobile value chain. Furthermore, there is also no study available giving concrete recommendations based on the relative impact of the three WC components (Inventories, Receivables, Payables). Therefore, this work project is answering both by examining the relationship of WCM and profitability based on a global sample with a narrow definition of sample companies and giving recommendations based on the most effective levers.

## **5. Methodology**

### *5.1 Research Questions*

In order to understand the structure of the automobile manufacturing industry, in a first step this study gives insights on mean differences of key variables (CCC, RoA) along the value chain and across regions.

*RQ I.I: Do key variables have differences in means in the automobile industry?*

*(a) Along the value chain? (b) Across regions?*

To answer RQ I.I, univariate analysis is conducted, namely comparison of means using independent sample t-tests.

---

<sup>9</sup> Subsuming commercial and multiutility vehicles, passenger cars and two and three wheelers.

<sup>10</sup> Although the author calls it “automobile” industry, their sample also include automotive suppliers.

<sup>11</sup> In this study, profitability was measured by Return on Capital employed (ROCE)

*RQI.II How do key variables for the relationship of WCM and profitability evolve in the automobile manufacturing industry?  
(a) RoA? (b) CCC?*

To further understand the automobile industry, univariate analysis will be continued by analysing the evolution of means of key variables (CCC, RoA), as well as their components.

In a next step, the impact of CCC on RoA (as a proxy for profitability) is examined:

*RQ II: How, and to what extent, does CCC impact RoA?*

An OLS regression model was chosen. Hereby, results are controlled for dummy variables to take into account the impact of region (REG\_ASIA), reporting standards (IFRS), and the year of reporting (YEAR). They are justified as follows.

i) Region (Asian, Non-Asian): Due to different business patterns around the world, a potential impact of a companies' origin might be expected. Asian/Non-Asian split was chosen, as comparable structures in Europe and the US were assumed;

ii) Reporting standard (IFRS, domestic reporting standard): As this work projects key variables are closely related to accounting policies and choices, it is important to consider whether the datapoints were created by applying an international, comparable accounting standard or a domestic reporting standard. Although we are aware that the impact of different accounting standards has complex effects on CCC and RoA, controlling with a dummy variable is the most feasible approach to capture potential effects;

iii) Year (2018, 2019, 2020): Due to cyclical effects of the business environment as well as external shocks over time (e.g. the Covid-19 pandemic), it is important to control time effects.

To gain meaningful insights into the management of inventories, customer credit, and supplier payments, the regression of CCC on the turnover ratios (inventory turnover, accounts receivable turnover, and accounts receivable turnover; see Appendix 3.1 for calculation)

provides a way to measure their marginal impact<sup>12</sup>. Thereby, insights into the relative importance of the three ratios are gained, which can be translated in the manager recommendations on which of the WC components is the smallest and largest lever to impact CCC.

*RQ III: Which turnover ratios are the most effective levers for companies to impact their CCC?*

Again, a OLS regression that is controlled for dummy variables will be run to examine the relationship.

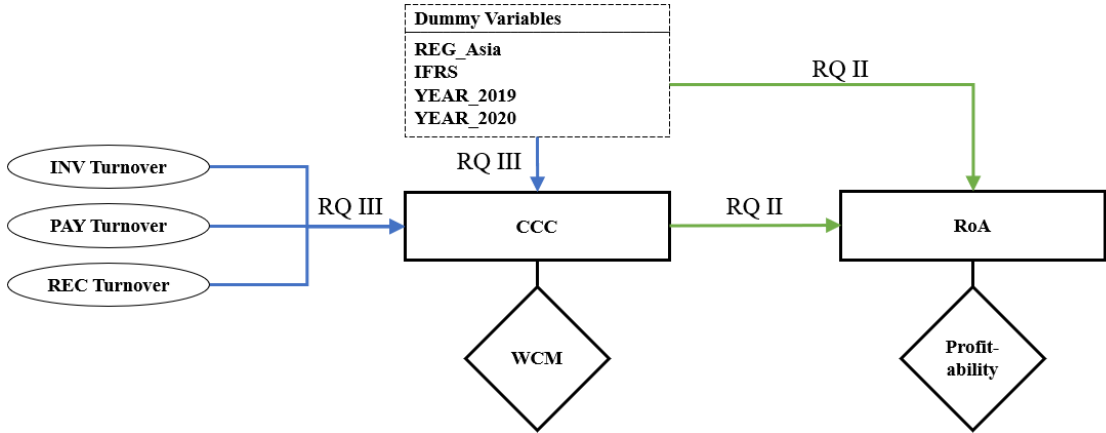


Figure 1: Regression model

5.2 Statistical Analysis

For statistical analysis, IBM SPSS 28 is used to conduct univariate, bivariate and multivariate analysis. For RQ I, univariate analysis and independent sample t-tests are used to describe and understand the underlying data. In case the Levene’s test for equality of variances is significant in a t-test, the p-values will be considered that are not assuming equal variances.

Further, an Ordinary Least Squares (OLS) regression analysis is conducted to answer RQ II and RQ III. Before running the regressions, potential impact factors<sup>13</sup> will be tested for significant correlation. The regressions follow the following model in equation [3]:

$$Y_i = a + \beta_1 * X_{1i} + \beta_2 * X_{2i} + \beta_3 * X_{3i} + \epsilon_i \tag{3}$$

<sup>12</sup> Regressing CCC on its components DIO, DSO and DPO would be useless to get recommendations, as the regression would give coefficients for DIO and DSO of 1 and for DPO of -1 with zero errors per definition.

<sup>13</sup> Potential impact factors will be those for which in past literature significant impact was found

The OLS model to be tested in RQ II includes RoA as the dependent variable and CCC as an independent variable. For RQ III, CCC is the dependent variable and the three accounting turnover ratios are the independent variables. In both models the abovementioned dummy variables are assumed to take into account the respective effects. The accepted level of significance for all regressions will be  $p \leq 0.05$ .

To ensure the internal validity of the research, the regression models are tested for multicollinearity, autocorrelation and random distribution of errors.

No multicollinearity will be assumed if all Variance inflation factors (VIFs) are below the value 5 in accordance with Montgomery et al. (2012, p. 296). No autocorrelation will be assumed if the Durbin-Watson test statistic lies between the lower and upper bound of Savin and White (1977, p. 1992), that in turn depend on the sample size and the number of independent variables (Montgomery et al. 2012, p. 477). In line with Montgomery et al. (2012, pp. 136–138), this study will assume normality distribution of residuals, if the normal probability plot of the residuals follows a generally straight line that has no intercept/a intercept close to the origin.

### *5.3 Sample and Data*

The initial sample consists of 33 companies that are primarily active in the production and manufacturing of passenger cars. Those companies were selected based on the criteria of being part of the NASDAQ OMX Global Automobile index which represents the 33 “largest and most liquid companies engaged in the manufacturing of automobiles” (NASDAQ Inc 2021).

Data was retrieved from Bloomberg<sup>14</sup> for the years 2018 to 2020. The latter year is the most recent period for which data is available and the length of three years was chosen to avoid cyclical effects affecting the comparability of data, however in case of any effects

---

<sup>14</sup> Missing datapoints were excluded listwise from the regressions

related to the Covid-19 pandemic those will be reflected by the YEAR dummy. All financial data was retrieved in USD, thereby ensuring comparability and avoiding currency effects.

This research uses financial data from the annual consolidated financial statements and collected data for 99 initial datapoints.

Five companies were excluded from the initial sample based on the following criteria: (i) missing production of automobiles (one company); ii) too early stage leading to no active activity (three companies); (iii) automobile manufacturing not being the core activity (one company). The 30 companies in the final sample are presented in the Appendix 4.2.3.

When preparing the data for the analysis 12 individual datapoints were excluded as they were identified to be outliers<sup>15</sup>. For the individual outlier analysis, Hoaglin and Iglewicz (1987) approach was adapted<sup>16</sup>. For this, the key variables CCC (zero datapoints), RoA (three datapoints), Inventory Turnover (three datapoints), Receivables Turnover (six datapoints) and Payables Turnover (zero datapoint) were examined for outliers. After exclusion, the final sample includes 28 companies and 72 data points.

In order to answer RQ I.I (a), in particular, an analogue sample of automobile suppliers was selected. As there is no exclusive index for automobile suppliers, the worldwide top 50 suppliers by revenue 2019 were taken (according to Berylls Strategy Advisors 2020, p. 13). Of these 50 suppliers, six were excluded since sufficient data was missing as they are not listed, 13 as their core activity was not the manufacturing of car components and one as it had no active activity. No individual datapoints were excluded. Therefore, the final supplier sample consists of 30 companies and 90 datapoints.

## **6. Results**

### *6.1.1 (a) Differences along the value chain (RQ I.I)*

---

<sup>15</sup> See comprehensive list of outliers and exclusion reasons in Appendix 4.2.4

<sup>16</sup> According to this approach, a datapoint is considered an outlier, if a key analysis metric of the datapoint is bigger than the 0.75 Quartile + 2.2 \* Interquartile Range (IQR) or smaller than 0.25 Quartile – 2.2 \* IQR

It is not uncommon to consolidate automobile manufacturers and automobile suppliers as one group “automotive” (cf. J.P.Morgan 2019; Zaher and Illescas 2020; Ahmad and Sarwar 2016). However, this intrinsically assumes that both sub-industries are homogeneous with respect to the examined variables. This assumption must be true for the results to be valid. As mentioned, to test this assumption, a sample of the largest and most liquid automotive supplier companies was compiled in this study - analogous to the OMX Nasdaq Index. For the supplier sample, it is found an average CCC of 43 days (standard deviation 39.6) and a mean RoA of 5.0% (standard deviation 5.1%). Both KPIs are significantly deviating from the respective KPIs of the automobile manufacturers (CCC<sub>manufacturers</sub>: 85 days; p=0.000, RoA<sub>manufacturers</sub>: 3.2%; p=0.007). Automobile manufacturers and suppliers are therefore not a homogenous group with respect to WCM, so that analysis of these group should be differentiated. In fact, the weighted average (by number of datapoints) of CCC of both samples is with 61 days<sup>17</sup> in line with the average 56 days that J.P.Morgan (2019, p. 9) found<sup>18</sup>. At the same time, the supplier average CCC of 43 days is smaller than the 56 days CCC that Lind et al. (2012) observed for their automobile system supplier sample. However, updated 2018 to 2020 values for Lind et al. (2012) sample<sup>19</sup> show an average CCC of 38 days and a standard deviation of 25.62 (see Appendix 5.3.1), which are in line with the average 43 days CCC of automobile suppliers that were analysed above. Therefore, findings of this Work Project suggest that CCC for suppliers have decreased since Lind et al. (2012) conducted their study. This is also supported by the fact that Lind et al. (2012) already found a decrease of 4 days in CCC in automobile suppliers between 2006 and 2008.

Given these results, the study continues the analysis solely focusing on automobile manufacturers in order to maintain valid results.

---

<sup>17</sup>  $\frac{90 \text{ datapoints} \cdot 43 \text{ days} + 66 \text{ datapoints} \cdot 85 \text{ days}}{156 \text{ datapoints}} = 61 \text{ days}$

<sup>18</sup> As sum of the average CCC parts

<sup>19</sup> Lind et al. (2012) sample includes BorgWarner, Bosch, Continental, Denso, Magna, Mahle, Schaeffler Group, Valeo; update was conducted without Bosch and Mahle as they were not listed

### *6.1.2 (b) Differences across regions (RQ 11)*

When splitting the automobile manufacturing sample into Asian and Non-Asian (consolidating European and US companies), significant differences in CCC ( $p=0.000$ ) are found. While Asian companies show a mean CCC of 57 days, Non-Asian companies show much longer CCC amounting to an average of 151 days. For Asian companies, all three components of CCC are on average leading to lower CCC compared to Non-Asian companies, however only DIO shows to be significantly different between regions ( $p=0.040$ ). Regarding DIO, it takes less time for Asian companies to convert inventories into sales than for Non-Asian ones, and less time to convert accounts receivables into cash as well. On the other hand, Asian companies are able to pay their accounts payables later than their Non-Asian peers. However, the main driver of the difference in CCC length between Asian and Non-Asian companies lays in DSO, with the former collecting quicker ( $DSO_{Asian}: 100$  days,  $DSO_{Non-Asian}: 147$  days). This difference might be due to more disciplined business patterns in Asia. Furthermore, stronger interenterprise connections might be more common in Asia which might lead to the fact that they are incentivised to pay payables sooner to their suppliers. On the other hand, longer DSO in Non-Asian companies could mean that customers of Non-Asian companies have more financial distress.

Average DIO of Asian companies are also lower than among Non-Asian companies, suggesting that Asian companies are more efficient in inventory management than Non-Asian ones. One reason for this might be they are regionally closer to the raw materials and thus, with better ability to react to changes in demand quicker. Furthermore, it might be the case that Asian companies have adopted lean<sup>20</sup> management more efficiently. Toyota developed

---

<sup>20</sup> Definition Lean: “Lean production is an integrated socio-technical system whose main objective is to eliminate waste by concurrently reducing or minimizing supplier, customer, and internal variability.” Shah and Ward 2007.

this system and due to cultural similarities, this system may be more widespread in Asian than in Non-Asian countries (Teich and Faddoul 2013).

Regarding profitability, Asian companies present significantly higher RoA levels than to Non-Asian ones ( $RoA_{Asian}$  3.7% vs.  $RoA_{Non-Asian}$  1.8%,  $p=0.006$ ). RoA and its drivers will be analysed detail in the next section.

#### *6.2.1 (a) Return on Assets and its drivers (RQ I.II)*

The average RoA in the sample is 3.2% over the 2018-2020 period. Although there are significant differences in RoA levels in Asian and Non-Asian companies, in both regions they decreased steadily over time ( $RoA_{Asia}$ : 4.4% in 2018 to 2.7% in 2020;  $RoA_{Non-Asian}$ : 3.0% in 2018 to 0.9% in 2020).

Breaking down RoA into its drivers, that is Gross Profit Margin (GPM), Asset Turnover (AT) and Operating Risk (OR) gives even more meaningful insights: While GPM and Operating Risk are in both regions on a comparable level ( $GPM_{Asia}$ : 18.9%  $GPM_{Non-Asian}$ : 19.6%,  $OR_{Asia}$ : 16.3%  $OR_{Non-Asian}$ : 15.5%), the significant difference in RoA is derived from significantly ( $p=0.000$ ) lower Asset Turnover in Non-Asian ( $AT_{Non-Asian}$  48.6%) compared to Asian companies ( $AT_{Asian}$  74.8%), meaning that Asian companies are able to use their assets more efficiently to generate sales than their Non-Asian counterparts. The importance of operating efficiency in the automobile industry will be taken up again within RQ III, which examines how companies can impact their CCC by focussing on WCM on the basis of accounting turnover ratios.

Both the substantial upside potential for Non-Asian companies and the comparatively high standard deviation within the Asian subsample (28.7%) can recommend to managers in both regions that improving turnover of current asset items might be an effective tool to lever profitability.

### 6.2.2 (b) Cash Conversion Cycle and its components (RQ I.II)

The average CCC of automobile companies in the sample is 85 days and is composed by average values of 52 days for DIO, 113 days for DSO and 66 days for DPO<sup>21</sup>. These lengths are below the values found by Lind et al. (2012) in for the period 2006-2008, thus suggesting a better efficiency in the sample and period 2018-2020 analysed of this work project: In their study, which consist out of a subsample<sup>22</sup> of this study, the average CCC was 106 days. While Lind et al. (2012) found lower levels of DIO (46 days) and DSO (102 days), the higher CCC in their study is primarily driven by a lower level of DPO (41 days). However, the difference in CCC of Lind et al. (2012) sample and this studies' sample can most likely be derived by the composition of the sample, as the updated 2018-2020 average CCC of Lind et al. (2012) sample is 152 days (see Appendix 5.3.2).

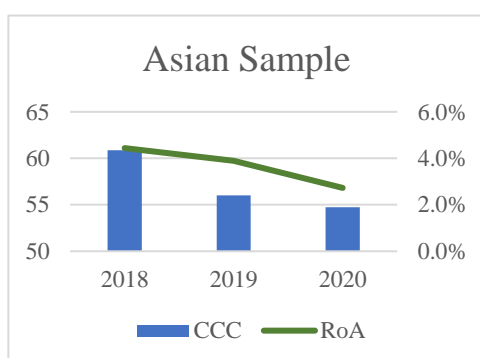


Figure 2: CCC and RoA of Asian sample

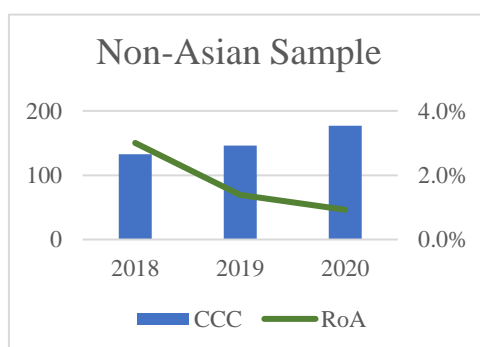


Figure 3: CCC and RoA of Non-Asian sample

In Asian companies, CCC decreased by six days, from 61 days in 2018 to 55 days in 2020, while in Non-Asian companies it increased by 44 days in the same period, from 133 days to 177 days. For the latter, this change was primarily driven by the loss of efficiency in collecting from sales, thus increased DSO (129 days in 2018 to 176 days in 2020). These results are deviating from what J.P.Morgan (2019, p. 16) find in the study for “Auto & Auto Parts” companies between 2011-2018, in which such companies had average CCC of 56 days<sup>23</sup>. However, this deviation may be related to

<sup>21</sup> Sums of average CCC components values are not adding up to average CCC as 6 values for DPO and CCC are not available

<sup>22</sup> Subsample: BMW, Daimler, Geely, Honda, Hyundai, Nissan, Renault, Toyota, Volkswagen

<sup>23</sup> Calculated according to avg. Values of DSO, DIO and DPO; Base index is 100% concentrated on the US, while in this study US companies underrepresented

the definition of the sample, as J.P.Morgan (2019) chose in contrast to this study a broad definition that also includes suppliers, which are not comparable as the results from RQ I.I indicate.

### 6.3 Impact of CCC on RoA (RQII)

The equation of the estimated model of the impact of CCC on RoA is the following:

$$ROA = 4.40 - 0.01 * CCC + 1.01 * REG\_ASIA + 0.34 * IFRS - 1.12 * YEAR\_2019 - [4] \\ 1.99 * YEAR\_2020$$

The  $R^2$  of this regression model is 0.194 and significant ( $F=2.881$ ).

The dummies  $REG\_ASIA$  ( $p=0.335$ ),  $IFRS$  ( $p=0.686$ ),  $YEAR\_2019$  ( $p=0.252$ ) and  $YEAR\_2020$  ( $p=0.051$ ) show not to be significant at  $p \leq 0.05$ , however for  $YEAR\_2020$  this is only very slightly. This means that there are strong indications that the mere impact of the year 2020 results in a RoA that is ceteris paribus lower by 1.99%-points compared to the base year 2018.

The main driver of this is likely to be the impact of the Covid 19 pandemic, with consumers becoming cautious about making major investments due to uncertainty about the course of the economic recovery. This is underscored by the 11% drop in the intent to buy a new car between pre-crisis levels and September 2020 (McKinsey & Company 2021, Exhibit 01).

The regression constant shows to be significant ( $p=0.002$ ), meaning that if all tested variables would be zero, there would be a positive RoA of 4.40%. This shows that also other factors are impacting RoA that are not explicitly tested, which are all reflected in the constant. At the same time, the explicit variables in the regression are able to explain the variation of RoA by 19.4%.

The results show that there is a significant negative impact of CCC on RoA. This is in line with past literature generally, but also for the automotive industry in particular (Vijayakumar

2011, Ahmad Naveed 2016, Shajar 2017). However, moderating effects of Cash holdings (Zaher and Illescas 2020), firm size (Dalci et al. 2019; Lazaridis and Tryfonidis 2006) and fixed assets ratio (Lazaridis and Tryfonidis 2006) could not be confirmed, as the corresponding variables were not significantly correlating with RoA in the correlation analysis (see appendix 5.4). As the D/A ratio was significantly correlating with both CCC and RoA, this variable was also not included into the regression analysis to avoid multicollinearity.

Finally, the negative impact of CCC on RoA indicates that managers in the automobile manufacturing industry can increase profitability through decisions that decrease their companies' CCC. This result follows a logic that is particularly pronounced in an investment- and WC-intensive industry such as automotive manufacturing. Lower CCCs mean less tied up WC. This released liquidity has positive profitability effects on two levels: On the one hand, there is less need for additional external financing (cf. Rizky and Mayasari 2018). On the other hand, this capital that was previously tied up with no return, can then be invested into profitable projects.

Which of potential measures would particularly be effective will be empirically examined and discussed in the next section.

As the descriptive analysis shows, the biggest lever for increasing profitability is improving operating efficiency and thus optimizing asset turnover ratios. Due to the substantial improvement potential in Non-Asian companies and the high standard deviation of Asian companies, this is particularly important for the sample companies. With respect to WCM, asset turnover can be increased by improving Receivables Turnover, Inventory Turnover and Payables Turnover.

#### *6.4 Impact of Turnover ratios on CCC (RQ III)*

$$CCC = 206.62 - 9.08 * INV - 5.99 * REC + 4.79 * PAY - 42.92 * REG\_ASIA - 15.06 * [5]$$

$$IFRS + 1.82 * YEAR_{2019} + 13.36 * YEAR_{2020}$$

The regression model is significant and shows a  $R^2$  of 0.581 (F-Statistics is 11.31). The variables PAY (p=0.137), IFRS (p=0.361), YEAR\_2019 (p=0.917) and YEAR\_2020 (p=0.451) show not to be significant at  $p \leq 0.05$

In line with expectation, the estimated model shows negative coefficients for Inventories Turnover (p-value: 0.001) and Receivables Turnover (p-value: 0.000) and a positive one for Payables Turnover. This means that if managers want to decrease CCC, one more turnover of inventories would *ceteris paribus* lead to a decrease in CCC by nine days while one additional turnover of receivables will shorten CCC by six days. However, a unitary change in Payables Turnover (although not significant) would in turn lead to a change in CCC of circa five days.

Therefore, the biggest lever *ceteris paribus* is to turn over inventories one more time. As inventory turnover is calculated by Sales divided by average inventory, companies could either increase sales while keeping the average inventory constant or lowering the average inventory while keeping sales constant. For both alternatives however, less average inventory per unit of sales is needed. Therefore, one effective way to reach this is to adapt just in time production, which offers the possibility to tie minimum levels of WC. As just in time production bears a substantial out-of-stock risk which has direct negative financial impact, at the same time proper forecasting with high care and safety buffers should be conducted.

Further, increasing receivables turnover would be the second but biggest lever of these three factors. To do this, managers could adapt shorter due dates for customers. Although this might be very effective from a mere financial perspective, managers should take care not to deteriorate relations to customers, which might lead to termination of contracts and therefore have negative financial impact in the future.

Finally, the smallest lever for managers is to decrease their payables turnover. One possible measure would be to achieve longer payment terms through effective negotiations, which seems feasible given the low bargaining power of suppliers identified in the industry

analysis. By that, the company has on average more available liquidity over the year (resulting from the payables acting as short-term financing), leading to lower CCC. Again, companies should take care to maintain good business relations with their suppliers to not harm long term success. Also, managers should be aware of the negative signalling that increasing DPO (as a result of lower payables turnover) are causing, as these might also be associated with financial trouble. However, the impact of payables turnover needs to be seen with caution, as the coefficient is not significant, meaning that the sample cannot tell with 95% certainty that the coefficient is different from 0.

Again, the constant shows to be significant, meaning that there are additional, non-explicitly tested variables that are impacting CCC.

On top of that, the regression also shows the dummy variable REG\_ASIA – the impact of the origin in Asia – to be significant and confirms the findings from the univariate regression, meaning that CCC for Asian companies are significantly deviating from the remaining sample. Therefore, the regression is repeated with the same variables for the Asian subsample to understand more deeply the patterns and impact factors of CCC in this region:

$$CCC_{Asian} = 128.16 - 7.60 * INV - 5.06 * REC + 8.90 * PAY - 37.66 * IFRS + 2.24 * [6] \\ YEAR_{2019} + 10.09 * YEAR_{2020}$$

The regression has a  $R^2$  of 0.55 and is statistically significant (F Statistics 7.71). The variables YEAR\_2019 and YEAR\_2020 are statistically not significant at  $p \leq 0.05\%$ .

For the Asian subsample, similar trends are observable as for the total sample: Although the constant for this sub-sample is circa 40% lower, the impact of the turnover ratios on CCC slightly shifted. The impact of inventory and receivables turnover is lower for Asian companies while the ceteris paribus impact of payables turnover almost doubled compared to the overall sample. Therefore, managers of Asian companies should first focus on decreasing payables turnover to decrease CCC, followed by inventory turnover and receivables turnover.

The measures mentioned above for managing turnover ratios apply analogously here, but it needs to be taken into account that business structures within Asia might be heterogeneous, as for instance, governmental ownership and regulations have an impact for Chinese companies. (Ren et al. 2019).

Additionally, also the IFRS dummy is significant, meaning that Asian companies that adopt IAS/IFRS have *ceteris paribus* a lower CCC of circa 38 days. This could be because of the differing accounting practices: For example, US GAAP adapting companies can choose between FIFO and LIFO approach for inventory accounting, while under IFRS LIFO is forbidden. Thus, two companies having the same business might have different values in inventories and therefore differing CCC.

## **7. Conclusion**

The purpose of this study was to examine the impact of WCM on profitability and thereby deriving recommendations for managers.

This work confirms the evidence and prevailing hypothesis of previous literature that there is a negative impact of CCC on profitability proven based on the automobile manufacturing industry. On this topic, this study finds four key insights: 1) The automobile manufacturing industry shows significant differences in CCC and RoA with regards to their region of origin, here in particular Asian and Non-Asian companies. While Asian companies have significantly lower levels of CCC, they reach higher levels of RoA. The differences in RoA can almost entirely derived by differences in Asset Turnover, which indicates that improvements in operating efficiency might be an effective lever to increase profitability. 2) The automotive industry should be differentiated when it comes to WCM as indications are found that the automotive supply chain is heterogenous. Therefore, analysis should distinguish between manufacturers and suppliers due to significant differences in CCC and RoA. These could explain deviating descriptive statistics in industry reports compared to our findings. 3) There is a negative impact of CCC on RoA, showing that managers should decrease CCC to

increase profitability, no matter of geography. Therefore, the underlying data suggest that companies should try to enforce a more aggressive WCM, as the returns in this trade-off more than compensate for the associated risks. Moderating effects that were found in earlier research as size, cash holdings and fixed assets ratio could not be confirmed in this study. 4) In order to improve profitability by decreasing CCC, this study suggests that improving Inventory Turnover is the biggest and Payables Turnover is the smallest lever of the three accounting turnovers ratios for the overall sample. For the Asian subsample, the order of effectiveness is a little changed, showing that decreasing payables turnover has the biggest impact and increasing Receivables Turnover has the smallest effect.

## **8. Limitations and future research**

The results of RQ I indicate that improving current Asset Turnover is an effective lever to increase RoA. However, this study only focused on part of the total asset turnover ratio, as it does not consider the fixed assets turnover ratio. Neither the employee efficiency (sales per employee) was analysed. Whether, or which of these last two ratios mentioned could improve the RoA is outside the scope of this study.

The interpretation of DPO should be treated with caution. This research found that a lower CCC is beneficial for profitability, and higher DPO leads to a lower CCC. On the other hand, a high DPO could be an indicator of a company having difficulty to pay its payables (Deloof 2003).

The impacts of differences in local accounting policies in the respective regions was not covered by this study. By adding a dummy with the intention of adopting either IFRS or local accounting standards, this research attempted to give some idea of this impact. However, there are policies beyond the scope of this project, for instance the LIFO inventory measurement permitted by the US GAAP, but forbidden under IFRS, or presenting the interest expense above or below the EBIT in the income statement, which is an option in the

IFRS but not in the US GAAP, might have direct implications for this study. Again, this topic might be subject for future research.

This study finds significant differences between Asian and Non-Asian companies. However, it implicitly assumes that these two groups are internally homogeneous. In particular, this assumption may be questioned with regard to Chinese and Japanese/Korean companies, as the respective economic systems differ greatly in terms of regulation. With regard to the influence of state ownership, Ren et al. (2019) have already found an impact that could also be present here. Therefore, to make the findings of this study more robust, macroeconomics variables could be added as explanatory variables.

On top of that, this study used only direct financially reported variables but neglected the impact of non-financial factors. For instance, ESG related factors like ecological sustainability and employer rights might explain variation of profitability. Thus, it might be insightful to include a proxy for these in the regression as it may be that higher profits in Asia occur at the cost of working conditions, whereas automobile manufacturing companies in the EU and US typically have strong unions<sup>24</sup>, which means that such conditions will affect profitability.

Finally, the question of reverse causality raised by Deloof (2003) has not yet been definitively resolved. Even with the results of this study, it remains questionable whether lower CCC causes higher profitability or whether it is easier for more profitable companies to decrease their CCC.

---

<sup>24</sup> E.g. the UAW in North America with more than 400,000 members (UAW 2021) and the IG Metall in Germany with more than 2.2 m members (UAW 2021; IG Metall 2021). Note that neither is solely focused on the automotive industry.

## References

- Ahmad, Naveed; Sarwar, Naila (2016): Cash Conversion Cycle Management in Auto Mobile Industry: Relationship with Firm Performance, Leverage, Liquidity and Capital Employed. In *Industrial Engineering Letters* 6, pp. 33–39.
- Berylls Strategy Advisors (2020): The world's 100 biggest automotive suppliers in 2019. Berylls Study on the Global Automotive Supplier Industry. Available online at [https://www.berylls.com/wp-content/uploads/2020/07/202007\\_BERYLLS\\_Study\\_Top\\_100\\_supplier-2019\\_EN.pdf](https://www.berylls.com/wp-content/uploads/2020/07/202007_BERYLLS_Study_Top_100_supplier-2019_EN.pdf), checked on 10/24/2021.
- Dalci, Ilhan; Tanova, Cem; Ozyapici, Hasan; Bein, Murad A. (2019): The Moderating Impact of Firm Size on the Relationship between Working Capital Management and Profitability. In *Prague Economic Papers* 28 (3), pp. 296–312. DOI: 10.18267/j.pep.681.
- Deloof, Marc (2003): Does Working Capital Management Affect Profitability of Belgian Firms? In *J Bus Fin & Acc* 30 (3-4), pp. 573–588. DOI: 10.1111/1468-5957.00008.
- Deloof, Marc; Jegers, Marc (1996): Trade Credit, Product Quality, and Intragroup Trade: Some European Evidence. In *Financial Management* 25 (3), pp. 33–43. DOI: 10.2307/3665806.
- EU (2019): Regulation (EU) 2019/631 of the European Parliament and of the Council of 17 April 2019 setting CO2 emission performance standards for new passenger cars and for new light commercial vehicles, and repealing Regulations (EC) No 443/2009 and (EU) No 510/2011. Available online at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02019R0631-20210301&from=EN>, checked on 24 October.
- Hoaglin, David C.; Iglewicz, Boris (1987): Fine-Tuning Some Resistant Rules for Outlier Labeling. In *Journal of the American Statistical Association* 82 (400), p. 1147. DOI: 10.2307/2289392.
- IG Metall (2021): IG Metall - A strong community. Available online at <https://www.igmetall.de/ueber-uns/ig-metall--a-strong-community>, checked on 10/24/2021.
- J.D. Power (2021): Effects of Lockdown Keeps Vehicle Owners Locked in on Their Current Brand, J.D. Power Finds. Available online at <https://www.jdpower.com/business/press-releases/2021-us-automotive-brand-loyalty-study>, checked on 10/24/2021.
- J.P.Morgan (2019): J.P. Morgan Working Capital Index. Helping companies benchmark for success. Available online at <https://www.jpmorgan.com/content/dam/jpm/cib/complex/content/treasury-services/benchmarking-working-capital/pdf-1.pdf>, checked on 11/2/2021.
- Kumari, Navena; Anthuvan, Victor (2017): A Study On The Impact Of The Working Capital Management On The Profitability Of The Leading Listed Automobile Companies In India (2006-2012) 5 (8), pp. 6744–6757.
- Lazaridis, Ioannis; Tryfonidis, Dimitrios (2006): Relationship between working capital management and profitability of listed companies in the Athens stock exchange. In *Journal of financial management and analysis* 19 (1), pp. 26–35.
- Lind, Lotta; Pirttilä, Miia; Viskari, Sari; Schupp, Florian; Kärri, Timo (2012): Working capital management in the automotive industry: Financial value chain analysis. In *Journal of Purchasing and Supply Management* 18 (2), pp. 92–100. DOI: 10.1016/j.pursup.2012.04.003.
- Long, Michael S.; Malitz, Ileen B.; Ravid, S. Abraham (1993): Trade Credit, Quality Guarantees, and Product Marketability. In *Financial Management* 22 (4), p. 117. DOI: 10.2307/3665582.

McKinsey & Company (2021): Car buying is on again, and mobility is picking up. Edited by Thomas Furcher, Daniel Holland-Letz, Felix Rupalla, Andreas Tschiesner. Available online at <https://www.mckinsey.com/business-functions/marketing-and-sales/our-insights/how-consumers-behavior-in-car-buying-and-mobility-changes-amid-covid-19>, checked on 12/2/2021.

Montgomery, Douglas C.; Peck, Elizabeth A.; Vining, G. Geoffrey (2012): Introduction to linear regression analysis. 5th ed. Hoboken, NJ: Wiley (Wiley series in probability and statistics, 821).

NASDAQ Inc (2021): NASDAQ OMX Global Automobile. Index Description. Available online at <https://indexes.nasdaqomx.com/Index/Overview/QAUTO#products>, checked on 11/22/2021.

Nazir, Mian Sajid; Afza, Talat (2009): Impact of Aggressive Working Capital Management Policy on Firms' Profitability. In *The IUP Journal of Applied Finance* 15 (8), pp. 19–30.

OICA (2001): World motor vehicle production by manufacturer. World ranking 2000. Available online at <https://www.oica.net/wp-content/uploads/2007/06/worldranking2000.pdf>, checked on 24 October.

OICA (2018): WORLD MOTOR VEHICLE PRODUCTION. OICA correspondents survey. Available online at <https://www.oica.net/wp-content/uploads/World-Ranking-of-Manufacturers-1.pdf>, checked on 24 October.

Petersen, Mitchell A.; Rajan, Raghuram G. (1997): Trade Credit: Theories and Evidence. In *Rev. Financ. Stud.* 10 (3), pp. 661–691. DOI: 10.1093/rfs/10.3.661.

Raff, Daniel M. G. (1991): Making Cars and Making Money in the Interwar Automobile Industry: Economies of Scale and Scope and the Manufacturing behind the Marketing. In *Bus. Hist. Rev.* 65 (4), pp. 721–753. DOI: 10.2307/3117263.

Ren, Ting; Liu, Nan; Yang, Hongyan; Xiao, Youzhi; Hu, Yijun (2019): Working capital management and firm performance in China. In *ARA* 27 (4), pp. 546–562. DOI: 10.1108/ARA-04-2018-0099.

Richards, Verlyn D.; Laughlin, Eugene J. (1980): A Cash Conversion Cycle Approach to Liquidity Analysis. In *Financial Management* 9 (1), p. 32. DOI: 10.2307/3665310.

Rizky, Ade; Mayasari, Mega (2018): The Impact Of Cash Conversion Cycle On Firm Profitability Of Retail Companies. DOI: 10.5281/zenodo.1305161.

Savin, N. E.; White, Kenneth J. (1977): The Durbin-Watson Test for Serial Correlation with Extreme Sample Sizes or Many Regressors. In *Econometrica* 45 (8), p. 1989. DOI: 10.2307/1914122.

Shah, Rachna; Ward, Peter T. (2007): Defining and developing measures of lean production. In *Journal of Operations Management* 25 (4), pp. 785–805. DOI: 10.1016/j.jom.2007.01.019.

Shajar, Syed Noorul (2017): Relationship between Working Capital Management and Profitability of Automobile Companies in India: A Paradigm Shift towards Economic Strengthening. In *International Journal of Trade, Economics and Finance* 8 (4), pp. 210–216.

Statista.com (2021a): Global automotive market share in 2020, by brand. Available online at <https://www.statista.com/statistics/316786/global-market-share-of-the-leading-automakers/>, checked on 10/24/2021.

Statista.com (2021b): Passenger Cars - Worldwide. Available online at <https://www-statista-com.eu1.proxy.openathens.net/outlook/mmo/passenger-cars/worldwide>, checked on 24 October.

Teich, Sorin T.; Faddoul, Fady F. (2013): Lean management-the journey from toyota to healthcare. In *Rambam Maimonides medical journal* 4 (2), e0007. DOI: 10.5041/RMMJ.10107.

UAW (2021): About: Who we are. Available online at <https://uaw.org/about/>, checked on 24 October.

Vijayakumar, A. (2011): Cash Conversion Cycle and Corporate Profitability - An Empirical Enquiry in Indian Automobile Firms. In *International Journal of Research in Commerce, IT & Management* 1 (2), pp. 84–91.

Zaher, Heba; Illescas, Gilberto Marquez (2020): The Moderating Effect of Firms' Cash Holding on the Relation Between Cash Conversion Cycle and Firm Performance. In Laszlo Komlosi, Peter Kelle, Damira Djukec (Ed.): *Economic and Social Development*. 58th International Scientific Conference on Economic and Social Development.

# Table of Contents

1. General.....	30
1.1 Abbreviations and Acronyms .....	30
2. Industry Analysis .....	31
2.1 PESTLE Analysis .....	31
2.2 Porters' Five Forces Analysis.....	32
3. Key Concepts.....	33
3.1 Definition of Key Variables.....	33
4. Methodology .....	33
4.1 Statistical tools for research questions.....	33
4.2 Sampling.....	34
4.2.1 Initial Sample .....	34
4.2.2 Excluded Companies .....	35
4.2.3 Final Sample.....	35
4.2.4 Outliers .....	36
4.2.5 Suppliers: Initial Sample .....	37
4.2.6 Suppliers: Excluded Companies.....	38
5. Results.....	38
5.1 Overview on conducted t-tests.....	38
5.2 Descriptive Analysis.....	39
5.2.1 RoA and CCC across regions.....	39
5.2.2 RoA components across regions .....	39
5.2.3 RoA and CCC across regions over time.....	39
5.2.4 CCC components across regions over time.....	40
5.2.5 Turnover ratios across regions .....	40
5.2.6 Dummy variables split.....	40
5.3 Updated 2018-2020 values for Lind et al. (2012) sample .....	41
5.3.1 Updated supplier values for Lind et al. (2012) sample .....	41
5.3.2 Updated manufacturers values for Lind et al. (2012) sample .....	41
5.4 Correlation overview .....	41
5.5 Regressions.....	42
5.5.1 Regression equation variables .....	42
5.5.2 Regression results.....	42
5.5.3 P-P plots for regressions.....	43

## Appendix 1 General

### Appendix 1.1 – Abbreviations and Acronyms

<b>Abbreviation</b>	<b>Meaning</b>
AT	Asset Turnover
Bn	Billion
Ca.	Circa
CAGR	Compound annual growth rate
CCC	Cash Conversion Cycle
CO2	Carbon dioxide
DIO	Days Inventory Outstanding
DPO	Days Payables Outstanding
DSO	Days Sales Outstanding
EBIT	Earnings before interest and taxes
ESG	Environmental, Social and Governance
EU	European Union
FIFO	First in first out
LIFO	Last in first out
GAAP	Generally Accepted Accounting Principles
GPM	Gross Profit Margin
IAS	International Accounting Standards
IFRS	International Financial Reporting Standard
KPI	Key Performance Indicator
LT	Long term
MSCI	Morgan Stanley Capital International
NASDAQ	National Association of Securities Dealers Automated Quotations
OEM	Original Equipment Manufacturer
OLS	Ordinary least squares
OR	Operating Risk
p.	Page
PESTLE	Political, Economic, Social, Technological, Legal and Environmental
R&D	Research & Development
RoA	Return on Assets
ROCE	Return on Capital Employed
RQ	Research Question
S&P	Standard & Poors
US	United States
VIF	Variance Inflation Factor
WC	Working Capital
WCM	Working Capital Management

## 2 Industry Analysis

### Appendix 2.1 – PESTLE Analysis

<b>Dimension</b>	<b>Key Impacts</b>
<b>Political</b>	<ul style="list-style-type: none"> <li>- Environmental regulations: Ban of certain drive technologies, carbon emission limits (e.g. EU Regulation 2019/631, requiring new passenger cars to limit less than 95g CO2/km) (EU 2019)</li> <li>- Trade tariffs</li> </ul>
<b>Economic</b>	<ul style="list-style-type: none"> <li>- Rising global prosperity leading to more people being able to afford a car (McKinsey &amp; Company 2016)</li> </ul>
<b>Social</b>	<ul style="list-style-type: none"> <li>- Strong workers councils and unions which lead to high wages and consequently cost pressure (e.g. UAW in North America with more than 400,000 members or IG Metall in Germany with more than 2.2m members; both are not only focused on automotive industry)</li> </ul>
<b>Technological</b>	<ul style="list-style-type: none"> <li>- Improving technologies like artificial intelligent offer new business models and have the potential to disrupt the industry by enabling the possibility of self-driving cars</li> </ul>
<b>Legal</b>	<ul style="list-style-type: none"> <li>- Trademark and copyright concerns</li> <li>- Recalls</li> <li>- Sues for falsifying emission figures</li> </ul>
<b>Environmental</b>	<ul style="list-style-type: none"> <li>- Emerging climate issues lead to the societal and political expectation for the industry to reduce carbon emissions, forcing companies to find alternative drive technologies</li> <li>- Not yet clear which technology will prevail</li> </ul>

## Appendix 2.2 – Porters’ Five Forces Analysis

<b>Force</b>	<b>Intensity</b>	<b>Drivers</b>
<b>Threats of new entrants</b>	<b>Low</b>	<ul style="list-style-type: none"> <li>- immense capital expenditure and human capital required to enter the market</li> <li>- Current participants profiting from strong economies of scale</li> <li>- Disruption in the industry has made it possible for new entrants like Tesla Inc. to enter the market</li> </ul>
<b>Competition</b>	<b>High</b>	<ul style="list-style-type: none"> <li>- Brand loyalty is low (J.D. Power 2021)</li> <li>- Many large player, the largest of which (Toyota) only having a market share of less than 10 per cent (Statista.com 2021a)</li> </ul>
<b>Bargaining power of suppliers</b>	<b>Low</b>	<ul style="list-style-type: none"> <li>- Competition in the supplier market is even more intense with the top 10 suppliers having only 36% of the market volume of the top 100 suppliers (€331 bn out of €918 bn) (Berylls Strategy Advisors 2020)</li> </ul>
<b>Bargaining power of customers</b>	<b>High</b>	<ul style="list-style-type: none"> <li>- Broad spectrum of automobile manufacturers comparable quality standards gives customers high bargaining power towards the manufacturers</li> <li>- Automobile manufacturers have not created ecosystems that would make potential brand switching more difficult</li> </ul>
<b>Threats of substitution</b>	<b>Low</b>	<ul style="list-style-type: none"> <li>- Emerging trends of shared mobility could lead to less people customers buying a car, however the cars that are used for shared mobility need to be replaced more often so that this effect might be offset</li> <li>- Ecological concerns could lead to customers preferring public transport and bicycles over using an own car, however as the manufacturers are producing more efficient and environmental friendly cars this effect might not be strong</li> </ul>

### 3 Key Concepts

#### Appendix 3.1 – Definition of Key Variables

Key Variable	Formular	Meaning
Cash Conversion Cycle (CCC)	$CCC = DSO + DIO - DPO$	Days it takes for investment into inventory to turnover into cash from sales
Receivables Turnover	$\frac{\text{Sales}}{\text{Avg. Accounts Receivables}}$	Number of times accounts receivables are turned over in the period
Inventory Turnover	$\frac{\text{COGS}}{\text{Avg. Inventories}}$	Number of times inventory are turned over in the period
Payables Turnover	$\frac{\text{End. Inv.} + \text{COGS} - \text{Beg. Inv.}}{\text{Avg. Accounts Payables}}$	Number of times accounts payables are turned over in the period
Return on Assets (RoA)	$\frac{\text{EBIT}}{\text{Total Assets}}$	Comparable measure of profitability that is not biased by capital structure
DSO (in days)	$\frac{365}{\text{Receivables Turnover}}$	Average number of days it takes to recover accounts receivables
DIO (in days)	$\frac{365}{\text{Inventory Turnover}}$	Average number of days it takes until inventory is sold
DPO (in days)	$\frac{365}{\text{Payables Turnover}}$	Average number of days it takes until payables are paid

### 4 Methodology

#### Appendix 4.1 – Statistical tools for research questions

# RQ	Type of analysis	Statistical tools
RQ I.I	Univariate	t-test
RQ I.II	Univariate	Descriptive Analysis: Mean, Standard Deviation
RQ II	Multivariate	OLS regression
RQ III	Multivariate	OLS regression

## 4.2 Sampling

### Appendix 4.2.1 – Initial Sample

#	Company Name	Country of Origin	Region
1	Aston Martin Lagonda Global	Britain	Non-Asia
2	Baic Motor Corp Ltd-H	China	Asia
3	Bayerische Motoren Werke Ag	Germany	Non-Asia
4	Byd Co Ltd-H	China	Asia
5	Canoo Inc	United States	Non-Asia
6	China Motor Corp	Taiwan	Asia
7	Chongqing Changan Automobi-B	China	Asia
8	Daimler Ag-Registered Shares	Germany	Non-Asia
9	Dongfeng Motor Grp Co Ltd-H	China	Asia
10	Fisker Inc	United States	Non-Asia
11	Ford Motor Co	United States	Non-Asia
12	Geely Automobile Holdings Lt	Hong Kong	Asia
13	General Motors Co	United States	Non-Asia
14	Great Wall Motor Company-H	China	Asia
15	Guangzhou Automobile Group-H	China	Asia
16	Honda Motor Co Ltd	Japan	Asia
17	Hyundai Motor Co	South Korea	Asia
18	Jardine Cycle & Carriage Ltd	Singapore	Asia
19	Kia Corp	South Korea	Asia
20	Lordstown Motors Corp-CI A	United States	Non-Asia
21	Mazda Motor Corp	Japan	Asia
22	Mitsubishi Motors Corp	Japan	Asia
23	Nissan Motor Co Ltd	Japan	Asia
24	Nissan Shatai Co Ltd	Japan	Asia
25	Porsche Automobil Hldg-Prf	Germany	Non-Asia
26	Renault Sa	France	Non-Asia
27	Subaru Corp	Japan	Asia
28	Suzuki Motor Corp	Japan	Asia
29	Tesla Inc	United States	Non-Asia
30	Toyota Motor Corp	Japan	Asia
31	Volkswagen Ag-Pref	Germany	Non-Asia
32	Yadea Group Holdings Ltd	China	Asia
33	Yulon Motor Company	Taiwan	Asia

#### Appendix 4.2.2 – Excluded Companies

<b>Company</b>	<b>Reason</b>
Canoo Inc.	Too early stage/no active production yet
Fisker Inc.	Too early stage/no active production yet
Jardine Cycle & Carriage Ltd	No automobile production
Lordstown Motors Corp-Cl A	Too early stage/no active production yet
Porsche Automobil Hldg-Prf	Car production is not core activity

#### Appendix 4.2.3 – Final Sample

<b>#</b>	<b>Company Name</b>	<b>Country of Origin</b>	<b>Region</b>
1	Aston Martin Lagonda Global	Britain	Non-Asia
2	Baic Motor Corp Ltd-H	China	Asia
3	Bayerische Motoren Werke Ag	Germany	Non-Asia
4	Byd Co Ltd-H	China	Asia
5	China Motor Corp	Taiwan	Asia
6	Chongqing Changan Automobi-B	China	Asia
7	Daimler Ag-Registered Shares	Germany	Non-Asia
8	Dongfeng Motor Grp Co Ltd-H	China	Asia
9	Ford Motor Co	United States	Non-Asia
10	Geely Automobile Holdings Lt	Hong Kong	Asia
11	General Motors Co	United States	Non-Asia
12	Great Wall Motor Company-H	China	Asia
13	Guangzhou Automobile Group-H	China	Asia
14	Honda Motor Co Ltd	Japan	Asia
15	Hyundai Motor Co	South Korea	Asia
16	Kia Corp	South Korea	Asia
17	Mazda Motor Corp	Japan	Asia
18	Mitsubishi Motors Corp	Japan	Asia
19	Nissan Motor Co Ltd	Japan	Asia
20	Nissan Shatai Co Ltd	Japan	Asia
21	Renault Sa	France	Non-Asia
22	Subaru Corp	Japan	Asia
23	Suzuki Motor Corp	Japan	Asia
24	Tesla Inc	United States	Non-Asia
25	Toyota Motor Corp	Japan	Asia
26	Volkswagen Ag-Pref	Germany	Non-Asia
27	Yadea Group Holdings Ltd	China	Asia
28	Yulon Motor Company	Taiwan	Asia

#### Appendix 4.2.4 – Outliers

<b>Company</b>	<b>Year</b>	<b>Reason</b>
Nissan Shatai Co Ltd	2018	Inventory Turnover is larger than $2.2 \times \text{IQR} + 0.75 \text{ Quartil}$
Nissan Shatai Co Ltd	2019	Inventory Turnover is larger than $2.2 \times \text{IQR} + 0.75 \text{ Quartil}$
Nissan Shatai Co Ltd	2020	Inventory Turnover is larger than $2.2 \times \text{IQR} + 0.75 \text{ Quartil}$
Yadea Group Holdings Ltd	2018	Receivables Turnover is larger than $2.2 \times \text{IQR} + 0.75 \text{ Quartil}$
Yadea Group Holdings Ltd	2019	Receivables Turnover is larger than $2.2 \times \text{IQR} + 0.75 \text{ Quartil}$
Yadea Group Holdings Ltd	2020	Receivables Turnover is larger than $2.2 \times \text{IQR} + 0.75 \text{ Quartil}$
Tesla Inc	2018	Receivables Turnover is larger than $0.25 \text{ Quartil} + 2.2 \times \text{IQR}$
Tesla Inc	2019	Receivables Turnover is larger than $0.25 \text{ Quartil} + 2.2 \times \text{IQR}$
Tesla Inc	2020	Receivables Turnover is larger than $0.25 \text{ Quartil} + 2.2 \times \text{IQR}$
Aston Martin Lagonda Global	2020	RoA is lower than $0.25 \text{ Quartil} - 2.2 \times \text{IQR}$
Geely Automobile Holdings Lt	2018	RoA is larger than $0.75 \text{ Quartil} + 2.2 \times \text{IQR}$
Yulon Motor Co	2019	RoA is lower than $0.25 \text{ Quartil} - 2.2 \times \text{IQR}$

#### Appendix 4.2.5 – Suppliers: Initial Sample

#	Supplier name	Country of Origin
1	Continental Ag	Germany
2	Denso Corp	Japan
3	Magna International Inc	Canada
4	Aisin Corp	Japan
5	Hyundai Mobis Co Ltd	South Korea
6	Bridgestone Corp	Japan
7	Michelin (Cgde)	France
8	Valeo	France
9	Faurecia	France
10	Lear Corp	US
11	Cummins Inc	US
12	Tenneco Inc-Class A	US
13	Magneti Marelli-Old	Italy
14	Adient Plc	US
15	Sumitomo Electric Industries	Japan
16	Yazaki Corp	Japan
17	Weichai Power Co Ltd-A	Japan
18	Goodyear Tire & Rubber Co	US
19	Aptiv Plc	US
20	Panasonic Corp	Japan
21	Toyota Boshoku Corp	Japan
22	Schaeffler Ag – Pref	Germany
23	Hitachi Ltd	Japan
24	Borgwarner Inc	US
25	Gestamp Automocion Sa	Spain
26	Yanfeng Automotive Trim Syst	China
27	Plastic Omnium	France
28	Jtekt Corp	Japan
29	Hwashin Bhap Chongqing Autom	China
30	Flex-N-Gate Corp	US
31	Ningbo Joyson Electronic -A	China
32	Dana Inc	US
33	Gkn Ltd	UK
34	Autoliv Inc-Swed Dep Receipt	US
35	Te Connectivity Ltd	Switzerland
36	Clarios International Inc	US
37	Toyoda Gosei Co Ltd	Japan
38	Koito Manufacturing Co Ltd	Japan
39	Samvardhana Motherson Group	India
40	Hella Gmbh & Co Kgaa	Germany
41	Sumitomo Rubber Industries	Japan
42	Brose Fahrzeugteile Se & Co	Germany
43	Contemporary Amperex Techn-A	China
44	American Axle & Mfg Holdings	US
45	Hanon Systems	South Korea
46	Bosch	Germany
47	Zf Friedrichshafen	Germany
48	Mahle	Germany
49	Thyssenkrupp Automotive	Germany
50	Benteler	Germany

## Appendix 4.2.6 – Suppliers: Excluded Companies

#	Supplier name	Reason
1	Benteler	Not listed
2	Bosch	Not listed
3	Brose Fahrzeugteile Se & Co	Not listed
4	Clarios International Inc	Not classified as Auto Components
5	Cummins Inc	Not classified as Auto Components
6	Flex-N-Gate Corp	Not classified as Auto Components
7	Gkn Ltd	No active activity
8	Hitachi Ltd	Not classified as Auto Components
9	Hwashin Bhap Chongqing Autom	Not classified as Auto Components
10	Magneti Marelli-Old	Not classified as Auto Components
11	Mahle	Not listed
12	TE Connectivity	Not classified as Auto Components
13	Panasonic Corp	Not classified as Auto Components
14	Samvardhana Motherson Group	Not classified as Auto Components
15	Te Connectivity Ltd	Not classified as Auto Components
16	Thyssenkrupp Automotive	Not listed
17	Weichai Power Co Ltd-A	Not classified as Auto Components
18	Yanfeng Automotive Trim Syst	Not classified as Auto Components
19	Yazaki Corp	Not classified as Auto Components
20	ZF Friedrichshafen	Not listed

## 5 Results

### Appendix 5.1 – Overview on conducted t-tests

KPI	Sample	N	Mean	Std. Deviation	p-value	Significant differences
CCC	Manufacturers	66	85	83	0.000	yes
	Suppliers	90	43	39		
RoA	Manufacturers	72	3.15%	0.0336	0.007	yes
	Suppliers	90	4.97%	0.0506		
CCC	Asian	46	57	70	0.000	yes
	Non-Asian	20	151	74		
DIO	Asian	52	48	16	0.040	yes
	Non-Asian	20	60	23		
DSO	Asian	52	100	128	0.127	no
	Non-Asian	20	147	80		
DPO	Asian	46	70	30	0.073	no
	Non-Asian	20	57	18		
RoA	Asian	52	3.67%	0.0367	0.006	yes
	Non-Asian	20	1.81%	0.0185		
AT	Asian	52	74.79%	0.2873	0.000	yes
	Non-Asian	20	48.56%	0.0784		

## Appendix 5.2 – Descriptive Analysis

### Appendix 5.2.1 – RoA and CCC across regions

Sample	Total Sample		Asian		Non-Asian	
	CCC	RoA	CCC	RoA	CCC	RoA
<b>N</b>	66	72	46	52	20	20
<b>Mean</b>	85	3.2%	57	3.7%	151	1.8%
<b>Median</b>	62	3.0%	37	3.2%	154	2.0%
<b>Std. Dev</b>	83	3.4%	70	3.7%	74	1.9%

### Appendix 5.2.2 – RoA components across regions

Sample	Total Sample				Asian				Non-Asian			
	RoA	GPM	AT	OR	RoA	GPM	AT	OR	RoA	GPM	AT	OR
<b>N</b>	72	72	72	72	52	52	52	52	20	20	20	20
<b>Mean</b>	3.2%	19.1%	67.5%	16.1%	3.7%	18.9%	74.8%	16.3%	1.8%	19.6%	48.6%	15.5%
<b>Median</b>	3.0%	18.6%	58.4%	22.0%	3.2%	18.1%	68.4%	22.0%	2.0%	19.8%	48.2%	23.0%
<b>Std. Dev.</b>	3.4%	5.9%	27.4%	36.3%	3.7%	5.1%	28.7%	39.3%	1.9%	7.8%	7.8%	27.7%

### Appendix 5.2.3 – RoA and CCC across regions over time

	Total Sample					
	2018		2019		2020	
	CCC	RoA	CCC	RoA	CCC	RoA
<b>N</b>	22	24	23	24	21	24
<b>Mean</b>	84	4.0%	83	3.2%	90	2.3%
<b>Median</b>	64	3.4%	51	3.1%	63	2.0%
<b>Std. Dev</b>	75	3.6%	80	3.3%	96	3.1%

	Asian					
	2018		2019		2020	
	CCC	RoA	CCC	RoA	CCC	RoA
<b>N</b>	15	17	16	17	15	18
<b>Mean</b>	61	4.4%	56	3.9%	55	2.7%
<b>Median</b>	41	3.7%	30	3.6%	38	3.1%
<b>Std. Dev</b>	69	4.1%	70	3.6%	75	3.3%

	Non-Asian					
	2018		2019		2020	
	CCC	RoA	CCC	RoA	CCC	RoA
<b>N</b>	7	7	7	7	6	6
<b>Mean</b>	133	3.0%	146	1.4%	177	0.9%
<b>Median</b>	147	3.1%	149	1.7%	173	2.0%
<b>Std. Dev</b>	67	1.1%	69	1.9%	91	2.0%

## Appendix 5.2.4 – CCC components across regions over time

DIO	Total Sample				Asian				Non-Asian			
	2018	2019	2020	Total	2018	2019	2020	Total	2018	2019	2020	Total
N	24	24	24	72	17	17	18	52	7	7	6	20
Mean	51	51	53	52	48	46	50	48	59	62	61	60
Median	47	48	53	49	47	47	50	48	63	64	62	63
Std. Dev.	18	21	18	19	15	16	17	16	23	28	23	23

DSO	Total Sample				Asian				Non-Asian			
	2018	2019	2020	Total	2018	2019	2020	Total	2018	2019	2020	Total
N	24	24	24	72	17	17	18	52	7	7	6	20
Mean	113	95	131	113	107	77	116	100	129	141	176	147
Median	91	80	105	95	63	62	65	63	119	128	145	133
Std. Dev.	116	72	153	118	131	64	167	128	71	75	99	80

DPO	Total Sample				Asian				Non-Asian			
	2018	2019	2020	Total	2018	2019	2020	Total	2018	2019	2020	Total
N	22	23	21	66	15	16	15	46	7	7	6	20
Mean	64	66	69	66	68	70	72	70	55	57	59	57
Median	61	61	63	61	68	68	63	65	56	54	55	55
Std. Dev.	24	26	32	27	27	28	35	30	16	20	22	18

## Appendix 5.2.5 – Turnover ratios across regions

Sample	Total Sample			Asian			Non-Asian		
	INV	REC	PAY	INV	REC	PAY	INV	REC	PAY
N	72	72	65	52	52	45	20	20	20
Mean	8.1	7.8	6.5	8.5	9.6	6.3	7.2	3.1	7.0
Median	7.5	3.9	6.0	7.6	5.8	5.8	5.8	2.8	6.7
Std. Dev.	3.3	8.3	2.6	3.3	9.1	2.8	3.2	1.6	2.2

## Appendix 5.2.6 – Dummy variables split

Region of Origin	Total Sample	
	Asian	Non-Asian
N	52	20
%	72%	28%

Reporting Standard	Total Sample		Asian		Non-Asian	
	IFRS	Domestic	IFRS	Domestic	IFRS	Domestic
N	42	30	28	24	14	6
%	58%	42%	54%	46%	70%	30%

## Appendix 5.3 – Updated 2018-2020 values for Lind et al. (2012) sample

### Appendix 5.3.1 – Updated supplier values for Lind et al. (2012) sample

*Sample Companies: BorgWarner, Continental, Denso, Magna, Schaeffler, Valeo*

Lind et al. (2012) sample update		
	CCC	RoA
N	18	18
Mean	38	5.68%
Median	40	5.93%
Std. Deviation	25.62	4.98%

### Appendix 5.3.2 – Updated manufacturers values for Lind et al. (2012) sample

*Sample Companies: BMW, Daimler, Geely, Honda, Hyundai, Nissan, Renault, Volkswagen*

Lind et al. (2012) sample update		
	CCC	RoA
N	26	26
Mean	152	2.81%
Median	154	2.96%
Std. Deviation	85.86	1.86%

## Appendix 5.4 Correlation Overview

	RoA	CCC	CASH RATIO	FIXED ASSETS RATIO	D/A	LN(SALES)
<b>RoA</b>	1	0.362 (0.003)**	0.174 (0.144)	-0.082 (0.495)	-0.433 (0.000)**	0.072 (0.546)
<b>CCC</b>	0.362 (0.003)**	1	-0.604 (0.000)**	-0.068 (0.588)	0.795 (0.000)**	0.497 (0.000)**
<b>CASH RATIO</b>	0.174 (0.144)	-0.604 (0.000)**	1	0.076 (0.527)	-0.610 (0.000)**	-0.377 (0.001)**
<b>FIXED ASSETS RATIO</b>	-0.082 (0.495)	-0.068 (0.588)	0.076 (0.527)	1	0.102 (0.393)	0.192 (0.106)
<b>D/A</b>	-0.433 (0.000)**	0.795 (0.000)**	-0.610 (0.000)**	0.102 (0.393)	1	0.475 (0.000)**
<b>LN (SALES)</b>	0.072 (0.546)	0.497 (0.000)**	-0.377 (0.001)**	0.192 (0.106)	0.475 (0.000)**	1

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

## Appendix 5.5 Regressions

### Appendix 5.5.1 – Regression equation variables

Abbreviation	Type	Variable	Meaning
ROA	Numerical	Return on Assets	See above
CCC	Numerical	CCC	See above
INV	Numerical	Inventory Turnover	See above
REC	Numerical	Receivables Turnover	See above
PAY	Numerical	Payables Turnover	See above
REG_ASIA	Dummy	Dummy for region	1 if region of origin is Asia, 0 if Europe or US
IFRS	Dummy	Dummy for Reporting Standard	1 if reporting standard is IAS/IFRS, 0 if domestic reporting standard
YEAR_2019	Dummy	Dummy for year	1 if year is 2019, 0 if not 2019
YEAR_2020	Dummy	Dummy for year	1 if year is 2020, 0 if not 2020

### Appendix 5.5.2 – Regression results

	[4]	[5]	[6]
<b>R</b>	0.194	0.581	0.549
<b>F</b>	2.881	11.307	7.711
<b>n</b>	60	60	38
<b>k</b>	5	7	6
<b>Durbin Watson<sub>Lower Bound</sub></b>	1.249	1.179	0.966
<b>Durbin Watson<sub>Upper Bound</sub></b>	1.598	1.682	1.658
<b>Durbin Watson Statistic</b>	1.518	1.560	1.503
<b>Max. VIF</b>	1.429	1.626	1.516
<b>Dep.Var</b>	ROA	CCC	CCC <sub>Asia</sub>
<b>Constant</b>	4.40 (0.002)**	206.62 (0.000)**	128.16 (0.005)**
<b>CCC</b>	-0.012 (0.037)*	-	-
<b>INV</b>		-9.08 (0.001)**	-7.60 (0.011)*
<b>REC</b>		-5.99 (0.000)**	-5.06 (0.000)**
<b>PAY</b>		4.79 (0.137)	8.90 (0.009)**
<b>REG_ASIA</b>	1.01 (0.335)	-42.92 (0.020)*	-
<b>IFRS</b>	0.34 (0.686)	-15.06 (0.361)	-37.66 (0.030)*
<b>YEAR_2019</b>	-1.12 (0.252)	1.82 (0.917)	2.24 (0.905)
<b>YEAR_2020</b>	-1.99 (0.051)	13.36 (0.451)	10.09 (0.595)

\*\* is significant at the 0.01 level.

\* is significant at the 0.05 level.

Appendix 5.5.3 – P-P Plots for regressions

