CORRELATION BETWEEN SCM AND FINANCE PERFORMANCES: EVIDENCE FROM KOREAN COMPANIES

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Abstract

In this paper, the Cash-to-Cash cycle time and finance performance metrics of the three selected industries-car manufacturing industry, clothing manufacturing industry, and wholesale and retail trade industry-are investigated with data of sample companies listed on Korean stock market for a period from 2004 to 2008. The purpose of this paper is to identify the relationship between C2C cycle time and finance performance metrics. A positive correlation is detected between C2C cycle time and the metrics for car manufacturing and clothing manufacturing industries, while a negative correlation is investigated for wholesale and retail trade industry. Further study analyzes how each component of C2C cycle time affects on the performance metrics. For car manufacturing and clothing manufacturing industries, it is suggested to generate more sales and keep enough inventories, instead of decreasing the C2C cycle time. For wholesale and retail trade industry, it is advised to decrease inventory level and to ask faster collection, as well as to make later payment. It is noticeable that what is generally hypothesized for C2C cycle time, 'the shorter the C2C cycle time, the more profitable a company is,' could be only accepted for wholesale and retail trade industry. For car manufacturing and clothing manufacturing companies, it is more important to keep enough inventories and to increase sales revenue than cutting down the C2C cycle time with the purpose of improving liquidity.

1. INTRODUCTION

During the last decades, there have been enormous changes in global business environment. The world has been changing quickly due to development of technologies such as wide use of internet, and companies are trying to globalize their business. In the business perspective, the business environment has been rapidly changing following the changes of customer needs and the innovation of industrial technologies. In order to stay competitive and continue to grow its business in this quickly changing business world, companies are trying to introduce and apply new and innovative management techniques.

Small-and-medium companies, as well as large corporations, have realized that they need to adopt new management techniques to be flexible and to respond quickly to the changes. Therefore, some of supply chain management techniques have been developed and many companies are interested in introducing some of the strategic management techniques to maintain their positions in the business world by managing the whole supply chain of material, information, and financial flows integratedly. In addition, once introducing SCM techniques, measuring and evaluating the performance to compare it with other supply

chains or its own previous supply chains are necessary. Therefore, each company needs to set its own performance metrics and each metric requires data collection. SCM performance metrics can be differently created according to the company's own needs and requirements. However, to compare its performance inter-company or inter-industry, standards of using performance metrics are required.

For this purpose, SCOR model (Supply Chain Operations Reference model), provided by Supply-Chain Council (SCC), has been widely accepted. SCOR model provides five customer-facing metrics which covers reliability, responsiveness, and agility, and another five internal-facing metrics to cover costs and assets. This paper aims to focus on the SCOR model's internal-facing metrics, especially Cash-to-Cash cycle time, and three other finance performance metrics: operating profit rate, net profit rate, and return on assets. It is mainly due to the accessibility to the reliable data which can be obtained from companies' financial statements: income statement and balance sheet.

With the data of Korean companies in the three selected industries-car manufacturing, clothing manufacturing, and wholesale and retail trade-, a comparison of the C2C cycle time of each industry has been conducted. Then, the correlation analyses of C2C cycle time and each finance performance metrics are followed to see whether there is a positive or negative relationship between them. Lastly, the linear regression are carried out to identify how each component of C2C cycle time affects the performance and to provide a way to improve.

Overall, it is concluded that what is generally hypothesized for C2C cycle time, which is there is a negative correlation between the length of C2C and SCM performance, could be accepted only for wholesale and retail trade industry. According to Fawcett, Ellram and Ogden (2007), the goal of many companies has become to possess negative C2C cycle time, but from this paper, it would be suggested that car manufacturing and clothing manufacturing companies should rather not try to decrease C2C cycle time. Instead, it is more important to keep enough inventories in stock not to lose sales and customers, and to increase sales revenue for companies in those industries.

There have been several studies on the length of C2C cycle time for different industries on Korean companies. However, this paper differs from other studies in that the correlation between the C2C cycle time and other finance performance metrics were estimated to see and propose how to improve a company's SCM performance by industry. So, this paper is proposing Korean companies, either manufacturing or wholesale and retail trade, to know the relation of C2C cycle time, as well as each of three components, and SCM performance, and to revise or develop their SCM strategies according to the findings of this paper.

2. LITERATURE REVIEW

In short, there have been several previous studies on the introduction and execution of SCM, but not so many studies on SCM performance analysis have been conducted, especially for Korean companies.

Kim, Kwon and Baik (2003) empirically analyzed the SCM performance of Korean companies with SCOR metrics. With the data of 621 Korean companies from 1997 to 2001, they compared the performance by industry and by size of the company. The analysis presented that the SCM performance of Korean companies has been gradually improved during the five years. By industry, the distribution industry showed better performance than manufacturing industry, and by the company size, large corporations were better than

small-and-medium companies. They pointed out that the C2C cycle time of Korean companies was longer than the global leading companies in all the industries except for the communication, which meant that Korean companies needed to make an investment in and improve their SCM.

Kim and Kim (2004) made an exploratory study on developing SCM performance measurements especially for small-and-medium companies. To test the validity of the performance metrics presented by their research model, the case analyses were performed for the selected three companies who have introduced SCM. It resulted in providing the guidelines for small-and-medium companies to refer to when introducing or establishing SCM and the frame to measure the performance and to compare with competitors in the same industry afterwards. However, what could be pointed out is that the number of sample companies was only three.

As a critical performance measure, Christopher and Gattorna (2005) pointed out the C2C cycle time. They stated that detailed analysis of logistics pipeline emphasized the importance of the length of the C2C cycle time, and by mapping the supply chain, a company could identify opportunities for reducing inventory and cost. Fawcett, Ellram and Ogden (2007) also selected the Cash-to-Cash cycle time as the measure which had the greatest impact on supply chain practice as it showed the direct financial benefits of SCM. They said that supply chain practice could improve cash flows and reduce the Cash-to-Cash cycle time, which would help free up working capital to be invested in other products, better processes, etc. Farris, Hutchison, and Hasty (2005) as well identified the Cash-to-Cash cycle time as a measurement tool to be used to improve firm liquidity position and overall firm value, as it helps to recognize the greatest leverage points and opportunities for improvements by optimizing the entire supply chain.

Some of the studies have been done on the relationship between liquidity management and operating performance of a company. Wang (2002) found out the relationship between the C2C cycle time and the return on assets (ROA), and the relationship between the C2C cycle time and the return on equity (ROE) are commonly negative and sensitive to industry factors, based on the companies in Japan and in Taiwan from 1985 to 1996. The study concluded that aggressive liquidity management or reducing the C2C cycle time improved operating performance of a firm.

In addition, Lazaridis and Tryfonidis (2006) investigated the relationship of corporate profitability and working capital management on 131 companies listed in the Athens Stock Exchange for a period of 2001 to 2004. The research presented statistical significance between profitability and the C2C cycle time. It suggested that companies could increase profits by managing correctly the C2C cycle time and keeping the components of C2C cycle time to an optimum level.

Raheman and Nasr (2007) also did a research on the effect of different variables of working capital management, such as the average collection period, inventory turnover in days, average payment period, C2C cycle time, etc. on the net operating profitability. A sample of 94 Pakistani firms was selected for a period from 1999 to 2004. The results found out a strong negative relationship between variables of working capital management and profitability, and a significant negative relationship between liquidity and profitability. In addition, a positive relationship between size of the firm and profitability, and a negative relationship between debt used by the firm and profitability were observed.

Similarly, Uyar (2009) conducted an empirical investigation of Turkish companies in 2007 to set industry benchmarks for the C2C cycle time of merchandising and manufacturing industries. The paper showed that retail and wholesale industry had shorter C2C cycle time than manufacturing industry. Especially the textile industry had the longest C2C cycle time, which might imply liquidity problems. Moreover, the finding indicated a significant negative correlation between the length of C2C cycle time and the firm size, in terms of net sales and total assets, and between the length of C2C cycle time and the profitability. It concluded that smaller companies have longer C2C cycle time, and the longer C2C cycle time, the less profitable they are.

3. METHODOLOGY AND DATA ANALYSIS ON THE CORRELATION BETWEEN CASH-TO-CASH CYCLE TIME AND FINANCE PERFORMANCE METRICS

3.1. Scope and methodology

The purpose of this paper is to see the differences of Cash-to-Cash cycle time of different industries and to know whether there is a positive or negative correlation between C2C cycle time and finance performance. Each component of C2C cycle time-Days sales outstanding (DSO), Inventory days of supply (DOI) and Days payable outstanding (DPO)-are closely studied to see how it affects the performance metrics, either positively or negatively.

3.1.1. Set-up of a model and data collection

To see the tendencies of different industries, three industries are selected: (1) Manufacture of motor vehicles, trailers and semitrailers (car manufacturing), (2) manufacture of wearing apparel, clothing accessories and fur articles (clothing manufacturing), and (3) wholesale and retail trade. The data used in this paper is acquired from Financial Supervisory Service (FSS) and websites of different companies. Sample firms for each industry are who are listed on Korean stock market, according to FSS, dated on October 26, 2009. Data for the recent five years, starting from 2004 to 2008, becomes the basis of calculations of this paper. The reason of choosing companies on Korean stock market based on FSS is primarily due to the reliability of the financial statements. The number of companies is 36 for car manufacturing industry, 20 for clothing manufacturing industry, and 48 for wholesale and retail trade. The total number of companies results to 104, but the total number of observations for the period from 2004 to 2008 became 489, due to lack of information for certain periods for several companies as some of them are recently established, after 2005.

As this paper is focused on C2C cycle time and finance performance metrics, three performance metrics are selected-Operating profit rate, Net profit rate, and Return on Assets (ROA)-as those metrics are what could be easily calculated with the data we could get from a company's financial statements: An income statement and a balance sheet.

In addition, to see if there is difference between large corporations and small-and-medium sized companies within one industry, the standard of classification of The Small & Medium Business Administration (SMBA) is considered. For the car manufacturing and clothing manufacturing industry, the standard of classification is 8 billion Korean won of Stockholder's equity. The wholesale and retail trade industry is classified by 20 billion Korean won of sales revenue.

3.1.2. Variables

This paper is to investigate whether the length of C2C cycle time has correlation with SCM performance metrics, such as Operating profit rate, Net profit rate, and ROA. All the variables stated below have been used to test the hypotheses of the paper:

- Cash-to-Cash cycle time (C2C) is measured to capture the effect of coordinating the three working capital: Accounts receivable, inventory, and accounts payable. According to Fraser and Ormiston (2007), it is one of liquidity ratios which measures a company's ability to meet cash needs. C2C is defined as the sum of the days sales outstanding (DSO), plus the inventory days of supply (DOI), minus the days payable outstanding (DPO), that is:

  C2C = DSO + DOI – DPO

- In turn, the components of C2C are given below:

  DSO = Accounts receivable / Revenue * 365

  DOI = Inventory / COGS *365

  DPO = Accounts payable / COGS * 365

- Profitability ratios represent a firm's ability to translate sales into profits. Fraser and Ormiston (2007) select operating profit rate and net profit rate as profitability ratios for comparing a company's management with industry competitors. Profitability ratios measure the overall performance of a company and the efficiency of its management of assets, liabilities, and equity.

  Operating profit rate is measured as one of the performance measures to see how efficiently a company is managed. Generally as a company grows, operating profit grows as well, and it is not surprising that larger companies have higher operating profit than smaller ones. However, it does not mean the company who has higher operating profit is more efficient than the one who has smaller operating profit. Therefore, operating profit as a percentage of revenue can express the company's profitability considering the size of a company.

  Operating profit rate = Operating profit / Revenue

- Net profit rate is also measured as another performance measure. While operating profit includes all revenue from ongoing operations minus production, sales, and administrative costs, net profit is operating profit minus interest, taxes, and depreciation. The objective of a company is to generate high profit, and net profit is the one which shows the company's competitive power. Therefore, in order to take a company's performance and profitability into consideration, net profit rate is also reviewed as sometimes a company shows positive operating profit rate with negative net profit rate. It also indicates whether the business is making enough sales volume in order to cover the fixed costs and still generate an acceptable profit.

  Net profit rate = Net profit / Revenue

- Return on Assets (ROA) is measured as another indicator of a company's profitability. ROA shows how efficiently a company manages its assets to generate profits, or how effectively a company allocates its resources, debt and equity, to convert them into profits.

  ROA = Net profit / Total assets

3.2. Testable hypotheses

Since the objective of this paper is to examine the relationship between C2C cycle time and SCM performance metrics of Korean companies, below three testable hypotheses are developed. The null hypothesis is represented by a symbol H_0, while the alternative hypothesis is symbolized as H_1.

Hypothesis A

The first hypothesis of this paper tries to investigate the relationship of C2C cycle time and operating profit rate. It tests for a negative relationship between C2C cycle time and operating profit rate. That is:

H_{0A}: There is no relationship between C2C cycle time and operating profit rate of Korean companies.

H_{1A}: There is a possible negative relationship between C2C and operating profit rate of Korean companies. The shorter C2C cycle time results in the higher operating profit rate and vice versa.

Hypothesis B

The second hypothesis examines the relationship of C2C cycle time and net profit rate to see how changes of the length of C2C cycle time affects net profit rate. It requires the C2C cycle time to be negatively related to the net profit rate. That is:

H_{0B}: There is no relationship between C2C cycle time and net profit rate of Korean companies.

H_{1B}: There may exist a possible negative relationship between C2C and net profit rate of Korean companies. Companies with a shorter C2C cycle time are expected to achieve a higher net profit rate and vice versa.

Hypothesis C

The last hypothesis investigates the relationship of C2C cycle time and Return on Assets within the sample of Korean companies. It allows a negative relationship between the length of C2C cycle time and ROA. That is:

H_{0C}: There is no relationship between C2C cycle time and ROA of Korean companies.

H_{1C}: It is a possible negative relationship between C2C cycle time and ROA of Korean companies. Companies with a shorter C2C cycle time may have higher ROA and vice versa.

3.3. Data analysis and results

In this paper, two types of data analyses have been provided: descriptive and quantitative. Descriptive statistics is the first step in the analysis and it has been conducted with Excel 2007, and for quantitative analysis, two methods are applied using SPSS 15.0. Firstly, the correlation model is used, specifically Pearson correlation coefficient to measure the relation between C2C cycle time and each of the three performance metrics, operating profit rate, net profit rate, and ROA. Secondly, multiple linear regression analysis is carried out in order to estimate the positive or negative impact of each component of C2C cycle time, either DSO, DOI or DPO, on the performance metrics more in detail.

3.3.1. Descriptive statistics

Descriptive statistics shows the minimum, maximum, mean value, median, and standard deviation of the different variables in the paper. Table 1 gives the descriptive statistics of the variables for Korean car manufacturing companies for a period of five years from 2004 to

2008 from a total of 174 observations. It is observed that firms receive payment against sales after an average of 63.83 days. Companies wait for an average 64.77 days to pay their purchases, and inventory takes on average 32.13 days to be sold. Overall the average C2C cycle time ranges at 31.19 days.

Table 1 also presents the descriptive statistics by classifying the data into large corporations and small-and-medium companies. While the average C2C cycle time of large corporations is 34.59 days, small-and-medium companies show 20.53 days. It is because the small-and-medium companies possess around seven days less inventory, and the DPO is seven days longer than large corporations.

Table 1. Descriptive statistics of Korean car manufacturing companies, 2004-2008

Descriptive Statistics						
Korean car manufacturing companies, 2004-2008, 174 observations						
	N	Minimum	Maximum	Mean	Median	Std. Dev.
Operating profit rate	174	-0.15	0.14	0.03	0.03	0.04
Net profit rate	174	-0.81	0.31	0.03	0.03	0.09
ROA	174	-0.68	0.16	0.03	0.04	0.08
C2C	174	-59.28	173.24	31.19	28.55	44.61
DSO	174	8.19	149.95	63.83	63.93	26.82
DOI	174	0.79	104.99	32.13	23.83	23.57
DPO	174	11.38	178.19	64.77	61.55	29.81
Korean car manufacturing companies (Large corporations), 2004-2008, 132 observations						
	N	Minimum	Maximum	Mean	Median	Std. Dev.
Operating profit rate	132	-0.09	0.14	0.03	0.03	0.04
Net profit rate	132	-0.81	0.21	0.03	0.03	0.10
ROA	132	-0.68	0.16	0.03	0.04	0.09
C2C	132	-59.28	173.24	34.59	28.55	46.34
DSO	132	8.19	149.95	63.66	62.69	29.35
DOI	132	0.79	104.99	33.99	26.23	24.42
DPO	132	13.92	178.19	63.06	60.67	28.22
Korean car manufacturing companies (small-and-medium companies), 2004-2008, 42 observations						
	N	Minimum	Maximum	Mean	Median	Std. Dev.
Operating profit rate	42	-0.15	0.14	0.04	0.04	0.05
Net profit rate	42	-0.16	0.31	0.06	0.04	0.08
ROA	42	-0.14	0.13	0.05	0.05	0.05
C2C	42	-53.53	84.01	20.53	28.69	37.16
DSO	42	35.89	100.69	64.38	68.18	16.79
DOI	42	6.33	78.02	26.30	17.14	19.82
DPO	42	11.38	160.92	70.15	72.13	34.15

Similarly, Table 2 shows the descriptive statistics of Korean clothing manufacturing companies for a total of 87 observations. The C2C cycle time for Korean clothing manufacturing industry is 179.27 days, about 148 days longer than car manufacturing industry. The DSO on average is 48.40 days, and the average DPO is 72.88 days. The average DOI is 203.75 days, about 172 days longer than car manufacturing industry, which is huge.

To compare the C2C cycle time of large corporations and small-and-medium companies of Korean clothing manufacturing industry does not show a big difference, as small-and-medium companies have only 6.73 longer days than large corporations. DSO, DOI, or DPO does not show a big difference, either.

Table 2. Descriptive statistics of Korean clothing manufacturing companies, 2004-2008

Descriptive Statistics						
Korean clothing manufacturing companies, 2004-2008, 87 observations						
	N	Minimum	Maximum	Mean	Median	Std. Dev.
Operating profit rate	87	-0.92	0.20	0.03	0.06	0.15
Net profit rate	87	-1.21	0.23	0.01	0.05	0.19
ROA	87	-0.41	0.20	0.03	0.04	0.10
C2C	87	-16.13	665.87	179.27	170.08	119.83
DSO	87	12.39	143.69	48.40	46.40	23.84
DOI	87	39.60	867.56	203.75	167.00	132.11
DPO	87	10.36	345.38	72.88	44.08	63.24
Korean clothing manufacturing companies (Large corporations), 2004-2008, 48 observations						
	N	Minimum	Maximum	Mean	Median	Std. Dev.
Operating profit rate	48	-0.55	0.20	0.04	0.05	0.12
Net profit rate	48	-0.84	0.23	0.02	0.04	0.16
ROA	48	-0.38	0.20	0.03	0.03	0.10
C2C	48	-16.13	665.87	176.25	178.89	137.06
DSO	48	12.39	143.69	46.50	45.39	24.74
DOI	48	39.60	867.56	208.47	175.10	150.77
DPO	48	12.15	345.38	78.72	43.86	73.30
Korean clothing manufacturing companies (small-and-medium companies), 2004-2008, 39 observations						
	N	Minimum	Maximum	Mean	Median	Std. Dev.
Operating profit rate	39	-0.92	0.17	0.02	0.08	0.19
Net profit rate	39	-1.21	0.15	0.00	0.06	0.23
ROA	39	-0.41	0.16	0.04	0.05	0.10
C2C	39	74.72	508.43	182.98	155.40	96.10
DSO	39	21.14	125.42	50.74	46.40	22.79
DOI	39	52.21	505.21	197.94	156.53	106.41
DPO	39	10.36	163.16	65.71	48.78	48.05

Table 3 is the descriptive statistics of Korean wholesale and retail trade companies for a total of 228 observations. The net profit rate shows mean of -3%, which is the only one that has negative profitability among the three industries. The average C2C cycle time is 16.33 days, which is around 183 days less than clothing manufacturing industry. However, what is noticeable is the minimum C2C cycle time is -838.23 days, while the maximum is 558.26 days. Also, the gaps between the minimum and the maximum of DSO, DOI, and DPO are huge. Firms receive payment after an average of 56.41 days and wait for an average 92.41 days to pay the purchases with DOI of 52.33 days.

Moreover, while the average C2C cycle time of large corporations is -3.77 days, the average C2C cycle time of small-and-medium companies is 179.50 days. The reason why small-and-medium companies of wholesale and retail trade industry have longer C2C cycle time than large corporation is about 105 days longer DSO and 70 days longer DOI. In addition, the small-and-medium companies show large negative profitability, -38% of the operating profit rate, -53% of the net profit rate, and -25% of ROA.

Table 3. Descriptive statistics of Korean wholesale and retail trade companies, 2004-2008

Descriptive Statistics						
Korean wholesale and retail trade companies, 2004-2008, 228 observations						
	N	Minimum	Maximum	Mean	Median	Std. Dev.
Operating profit rate	228	-1.38	0.26	0.01	0.03	0.20
Net profit rate	228	-1.93	0.68	-0.03	0.03	0.32
ROA	228	-2.22	0.23	0.00	0.04	0.22
C2C	228	-838.23	558.26	16.33	31.40	183.47
DSO	228	0.00	811.95	56.41	37.64	70.45
DOI	228	0.00	489.34	52.33	32.79	60.74
DPO	228	4.42	898.81	92.41	37.13	164.68
Korean wholesale and retail trade companies (Large corporations), 2004-2008, 203 observations						
	N	Minimum	Maximum	Mean	Median	Std. Dev.
Operating profit rate	203	-0.17	0.26	0.06	0.04	0.07
Net profit rate	203	-1.24	0.47	0.04	0.03	0.12
ROA	203	-1.67	0.23	0.03	0.04	0.13
C2C	203	-838.23	285.52	-3.77	26.39	176.88
DSO	203	2.25	199.43	44.93	33.57	38.53
DOI	203	0.00	251.21	44.74	28.81	43.64
DPO	203	4.42	898.81	93.43	36.75	169.94
Korean wholesale and retail trade companies (small-and-medium companies), 2004-2008, 25 observations						
	N	Minimum	Maximum	Mean	Median	Std. Dev.
Operating profit rate	25	-1.38	0.14	-0.38	-0.33	0.40
Net profit rate	25	-1.93	0.68	-0.53	-0.44	0.74
ROA	25	-2.22	0.20	-0.25	-0.12	0.47
C2C	25	-33.11	558.26	179.50	136.90	154.60
DSO	25	0.00	811.95	149.61	119.30	155.86
DOI	25	0.00	489.34	114.03	77.08	120.04
DPO	25	7.97	539.24	84.14	49.23	115.58

3.3.2. Pearson correlation coefficient analysis

Pearson correlation analysis is used to see the relationship between C2C cycle time and the variables, such as operating profit rate, net profit rate, and ROA. According to the hypotheses set in the previous section, it is expected to have negative correlation between operating profit rate and C2C cycle time, between net profit rate and C2C cycle time, and between ROA and C2C cycle time. Table 4 presents pearson correlation coefficients for all variables considered for Korean car manufacturing industry. Table 5 is the result for clothing manufacturing industry, and Table 6 is for wholesale and retail trade industry.

Table 4. Pearson Correlation Coefficients – Korean car manufacturing industry

Pearson Correlation Coefficients					
Korean car manufacturing companies, 2004-2008, 174 observations					
		C2C	Operating profit rate	Net profit rate	ROA
C2C	Pearson Correlation	1	.388**	.230**	.213**
	Sig. (2-tailed)		.000	.002	.005
	N	174	174	174	174
Operating profit rate	Pearson Correlation	.388**	1	.621**	.672**
	Sig. (2-tailed)	.000		.000	.000
	N	174	174	174	174
Net profit rate	Pearson Correlation	.230**	.621**	1	.933**
	Sig. (2-tailed)	.002	.000		.000
	N	174	174	174	174
ROA	Pearson Correlation	.213**	.672**	.933**	1
	Sig. (2-tailed)	.005	.000	.000	
	N	174	174	174	174
Korean car manufacturing companies (Large corporations), 2004-2008, 132 observations					
		C2C	Operating profit rate	Net profit rate	ROA
C2C	Pearson Correlation	1	.426**	.288**	.254**
	Sig. (2-tailed)		.000	.001	.003
	N	132	132	132	132
Operating profit rate	Pearson Correlation	.426**	1	.626**	.691**
	Sig. (2-tailed)	.000		.000	.000
	N	132	132	132	132
Net profit rate	Pearson Correlation	.288**	.626**	1	.965**
	Sig. (2-tailed)	.001	.000		.000
	N	132	132	132	132
ROA	Pearson Correlation	.254**	.691**	.965**	1
	Sig. (2-tailed)	.003	.000	.000	
	N	132	132	132	132
Korean car manufacturing companies (small-and-medium companies), 2004-2008, 42 observations					
		C2C	Operating profit rate	Net profit rate	ROA
C2C	Pearson Correlation	1	.323*	.077	.052
	Sig. (2-tailed)		.037	.627	.744
	N	42	42	42	42
Operating profit rate	Pearson Correlation	.323*	1	.630**	.742**
	Sig. (2-tailed)	.037		.000	.000
	N	42	42	42	42
Net profit rate	Pearson Correlation	.077	.630**	1	.765**
	Sig. (2-tailed)	.627	.000		.000
	N	42	42	42	42
ROA	Pearson Correlation	.052	.742**	.765**	1
	Sig. (2-tailed)	.744	.000	.000	
	N	42	42	42	42

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

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

Table 5: Pearson Correlation Coefficients – Korean clothing manufacturing industry

Pearson Correlation Coefficients					
Korean clothing manufacturing companies, 2004-2008, 87 observations					
		C2C	Operating profit rate	Net profit rate	ROA
C2C	Pearson Correlation	1	.262*	.227*	.134
	Sig. (2-tailed)		.014	.034	.215
	N	87	87	87	87
Operating profit rate	Pearson Correlation	.262*	1	.936**	.841**
	Sig. (2-tailed)	.014		.000	.000
	N	87	87	87	87
Net profit rate	Pearson Correlation	.227*	.936**	1	.909**
	Sig. (2-tailed)	.034	.000		.000
	N	87	87	87	87
ROA	Pearson Correlation	.134	.841**	.909**	1
	Sig. (2-tailed)	.215	.000	.000	
	N	87	87	87	87
Korean clothing manufacturing companies (Large corporations), 2004-2008, 48 observations					
		C2C	Operating profit rate	Net profit rate	ROA
C2C	Pearson Correlation	1	.312*	.259	.112
	Sig. (2-tailed)		.031	.076	.448
	N	48	48	48	48
Operating profit rate	Pearson Correlation	.312*	1	.883**	.762**
	Sig. (2-tailed)	.031		.000	.000
	N	48	48	48	48
Net profit rate	Pearson Correlation	.259	.883**	1	.920**
	Sig. (2-tailed)	.076	.000		.000
	N	48	48	48	48
ROA	Pearson Correlation	.112	.762**	.920**	1
	Sig. (2-tailed)	.448	.000	.000	
	N	48	48	48	48
Korean clothing manufacturing companies (small-and-medium companies), 2004-2008, 39 observations					
		C2C	Operating profit rate	Net profit rate	ROA
C2C	Pearson Correlation	1	.257	.220	.177
	Sig. (2-tailed)		.114	.178	.282
	N	39	39	39	39
Operating profit rate	Pearson Correlation	.257	1	.969**	.945**
	Sig. (2-tailed)	.114		.000	.000
	N	39	39	39	39
Net profit rate	Pearson Correlation	.220	.969**	1	.926**
	Sig. (2-tailed)	.178	.000		.000
	N	39	39	39	39
ROA	Pearson Correlation	.177	.945**	.926**	1
	Sig. (2-tailed)	.282	.000	.000	
	N	39	39	39	39

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

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

Table 6: Pearson Correlation Coefficients – Korean wholesale and retail trade industry

Pearson Correlation Coefficients					
Korean wholesale and retail trade companies, 2004-2008, 228 observations					
		C2C	Operating profit rate	Net profit rate	ROA
C2C	Pearson Correlation	1	-.366**	-.241**	-.143*
	Sig. (2-tailed)		.000	.000	.031
	N	228	228	228	228
Operating profit rate	Pearson Correlation	-.366**	1	.835**	.479**
	Sig. (2-tailed)	.000		.000	.000
	N	228	228	228	228
Net profit rate	Pearson Correlation	-.241**	.835**	1	.681**
	Sig. (2-tailed)	.000	.000		.000
	N	228	228	228	228
ROA	Pearson Correlation	-.143*	.479**	.681**	1
	Sig. (2-tailed)	.031	.000	.000	
	N	228	228	228	228
Korean wholesale and retail trade companies (Large corporations), 2004-2008, 203 observations					
		C2C	Operating profit rate	Net profit rate	ROA
C2C	Pearson Correlation	1	-.619**	-.325**	-.152*
	Sig. (2-tailed)		.000	.000	.030
	N	203	203	203	203
Operating profit rate	Pearson Correlation	-.619**	1	.639**	.377**
	Sig. (2-tailed)	.000		.000	.000
	N	203	203	203	203
Net profit rate	Pearson Correlation	-.325**	.639**	1	.894**
	Sig. (2-tailed)	.000	.000		.000
	N	203	203	203	203
ROA	Pearson Correlation	-.152*	.377**	.894**	1
	Sig. (2-tailed)	.030	.000	.000	
	N	203	203	203	203
Korean wholesale and retail trade companies (small-and-medium companies), 2004-2008, 25 observations					
		C2C	Operating profit rate	Net profit rate	ROA
C2C	Pearson Correlation	1	.171	.181	.320
	Sig. (2-tailed)		.415	.387	.119
	N	25	25	25	25
Operating profit rate	Pearson Correlation	.171	1	.777**	.288
	Sig. (2-tailed)	.415		.000	.163
	N	25	25	25	25
Net profit rate	Pearson Correlation	.181	.777**	1	.513**
	Sig. (2-tailed)	.387	.000		.009
	N	25	25	25	25
ROA	Pearson Correlation	.320	.288	.513**	1
	Sig. (2-tailed)	.119	.163	.009	
	N	25	25	25	25

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

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

According to the correlation analysis, the results do not show significant correlation in case of small-and-medium companies except for the one between C2C and operating profit rate for car manufacturing industry, with coefficient of 0.323 and p-value of 0.037. Therefore, there is no need to group large corporations and small-and-medium companies differently, and further analyses are carried out only for the total sample firms of each industry.

Table 7 summarizes the pearson correlation coefficients analyses. When the coefficient is not significant there is generally no point in reporting its value, and from this analysis, it is

noticed only the correlation of C2C and ROA of clothing manufacturing industry is not significant. All the other correlations are significant at the level of either 1% or 5%.

Table 7. Summary of pearson correlation coefficients

Pearson Correlation Coefficients with C2C	Operating Profit Rate	Net Profit Rate	ROA
Car Manufacturing	**+ 0.388****	**+ 0.230****	**+ 0.213****
Clothing Manufacturing	**+ 0.262***	**+ 0.227***	**+ 0.134**
Wholesale and Retail Trade	**- 0.366****	**- 0.241****	**- 0.143***

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

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

For car manufacturing industry, the result of correlation analysis of C2C and operating profit rate shows a positive coefficient of 0.388, with p-value of 0.000. There is also a positive relationship between C2C and net profit rate (pearson correlation coefficient of 0.230, with p-value of 0.002), as well as between C2C and ROA (pearson correlation coefficient of 0.213, with p-value of 0.005). The p-values show significance of the tests, however, the result of correlation coefficient indicate positive relations between the variables, contrary to the alternative hypotheses of H_{1A}, H_{1B} and H_{1C}. It can be concluded that if a car manufacturing company has longer C2C cycle time, then its operating profit rate, net profit rate, and ROA increases.

In case of clothing manufacturing industry, the correlation analysis was quite the same as car manufacturing industry. It shows a positive coefficient of 0.262 for C2C and operating profit rate, and a positive coefficient of 0.227 for C2C and net profit rate, both at the 0.05 level of significance. It implies that although the results show significance of the tests, contrary to the alternative hypotheses of H_{1A} and H_{1B}, there are positive relations between the variables, according to the positive signs of correlation coefficients. However, even though the correlation coefficient between C2C and ROA was positive as 0.134, the p-value was 0.215 which is not significant at the significance level of 0.05. So, the null hypothesis H_{0C} is accepted for clothing manufacturing industry.

On the other hand, for wholesale and retail trade industry, the three alternative hypotheses are all accepted. The correlation analysis of C2C and operating profit rate states a negative coefficient of -0.366, with p-value of 0.000. There are also negative relations between C2C and net profit rate (pearson correlation coefficient of -0.241, with p-value of 0.000), and between C2C and ROA (pearson correlation coefficient of -0.143, with p-value of 0.031). In conclusion, as hypothesized in H_{1A}, H_{1B} and H_{1C}, there are negative relations between C2C cycle time and operating profit rate, between C2C and net profit, and between C2C and ROA. That is, as a wholesale and retail trade company has shorter C2C cycle time, the operating profit rate, net profit rate, and ROA grow.

To conclude, the positive correlation between C2C cycle time and SCM performance metrics, which are represented by operating profit rate, net profit rate, and ROA, is examined for car manufacturing industry and clothing manufacturing. On the contrary, the negative correlation is found between C2C cycle time and the selected performance metrics for wholesale and retail trade industry.

3.3.3. Multiple linear regression analysis

In order to investigate more on how C2C cycle time affects on each of the performance metrics, and to know the roles the components of C2C cycle time play, multiple linear regression analysis has been followed. The independent variables are the components of C2C cycle time-DSO (Days sales outstanding), DOI (Inventory days of supply), and DPO (Days payable outstanding)-and the dependent variables are the performance metrics-operating profit rate, net profit rate, and ROA.

Table 8 presents the linear regression coefficients for each dependent variable with the three independent variables for Korean car manufacturing industry. Table 9 is the analysis results for clothing manufacturing industry, and Table 10 is for wholesale and retail trade industry.

Table 8: Linear Regression Coefficients – Korean car manufacturing industry

Linear Regression Coefficients					
Korean car manufacturing companies, 2004-2008, 174 observations					
Dependent Variable: Operating profit rate	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
	B	Std. Error	Beta	B	Std. Error
(Cosnstant)	.029	.010		3.000	.003
DSO	.000	.000	.210	2.813	.005
DOI	.000	.000	.191	2.634	.009
DPO	.000	.000	-.303	-4.153	.000
Dependent Variable: Net profit rate	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
	B	Std. Error	Beta	B	Std. Error
(Cosnstant)	.004	.022		.173	.862
DSO	.001	.000	.260	3.321	.001
DOI	5.71E-005	.000	.014	.189	.850
DPO	.000	.000	-.155	-2.027	.044
Dependent Variable: ROA	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
	B	Std. Error	Beta	B	Std. Error
(Cosnstant)	.011	.020		.541	.590
DSO	.001	.000	.263	3.367	.001
DOI	-4.95E-005	.000	-.014	-.180	.857
DPO	.000	.000	-.153	-2.004	.047

Table 9: Linear Regression Coefficients – Korean clothing manufacturing industry

Linear Regression Coefficients					
Korean clothing manufacturing companies, 2004-2008, 87 observations					
Dependent Variable: Operating profit rate	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
	B	Std. Error	Beta	B	Std. Error
(Cosnstant)	-.032	.040		-.798	.427
DSO	.000	.001	-.022	-.177	.860
DOI	.000	.000	.295	2.424	.018
DPO	-4.90E-006	.000	-.002	-.015	.988
Dependent Variable: Net profit rate	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
	B	Std. Error	Beta	B	Std. Error
(Cosnstant)	-.051	.050		-1.024	.309
DSO	.000	.001	-.056	-.438	.662
DOI	.000	.000	.262	2.143	.035
DPO	.000	.000	.033	.240	.811
Dependent Variable: ROA	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
	B	Std. Error	Beta	B	Std. Error
(Cosnstant)	.011	.027		.420	.676
DSO	.000	.001	-.057	-.441	.660
DOI	.000	.000	.157	1.254	.213
DPO	.000	.000	.067	.478	.634

Table 10: Linear Regression Coefficients – Korean wholesale and retail trade industry

Linear Regression Coefficients					
Korean wholesale and retail trade companies, 2004-2008, 228 observations					
Dependent Variable: Operating profit rate	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
	B	Std. Error	Beta	B	Std. Error
(Cosnstant)	.031	.019		1.664	.098
DSO	-.001	.000	-.340	-5.013	.000
DOI	-2.78E-005	.000	-.008	-.129	.898
DPO	.000	.000	-.346	5.358	.000
Dependent Variable: Net profit rate	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
	B	Std. Error	Beta	B	Std. Error
(Cosnstant)	.017	.031		.560	.576
DSO	-.001	.000	-.200	-2.794	.006
DOI	.000	.000	-.083	-1.194	.234
DPO	.000	.000	.191	2.797	.006
Dependent Variable: ROA	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
	B	Std. Error	Beta	B	Std. Error
(Cosnstant)	.043	.016		2.779	.006
DSO	.000	.000	-.171	-2.382	.018
DOI	.000	.000	-.145	-2.097	.037
DPO	.000	.000	.116	1.694	.092

Table 11 summarizes the result of linear regression analyses for all three industries. To sum up by industry, DSO has a positive impact on operating profit rate, net profit rate, and ROA, firstly for car manufacturing industry, at the significance level of 1%. It is also noted that DOI impacts positively on operating profit rate at the 1% of significance level, and DPO negatively makes an impact on operating profit rate, net profit rate, and ROA either at 1% or at 5% of significance level.

That is, as DPO decreases while DSO increases, a car manufacturing company can be more profitable. Therefore as a car manufacturing company, it seems the relationship with suppliers and customers plays a big role. As a company gives a longer payment term to customers, they might purchase more from the company, which increases profitability. According to Wojcik (2009), DSO typically grows as revenue increases and it shrinks as revenue decreases. On the other hand, it is important to pay the suppliers earlier to be more profitable, as it might bring discount terms from the suppliers for early payment, which decreases the total costs.

In addition, as DOI positively impacts the SCM performance, it could be suggested for a car manufacturing company to keep inventory in stock not to lose sales and not to cause customer dissatisfaction from lack of inventory. It also prevents additional costs for urgent orders. As sales increase improves profitability, it is important to increase sales with enough inventories. However it does not mean that a company should maintain as big amount of inventory as possible. The optimum inventory level could be maintained by regularly evaluating the Reorder Points (ROP) and Economic Order Quantity (EOQ).

Overall, to have better supply chain performance in car manufacturing industry, it is more important to increase sales than to reduce Cash-to-Cash cycle time. It is suggested to pay earlier to have discounts, to give long payment terms to promote sales, and to keep inventory stock not to lose customers.

Secondly, DOI was the only variable which impacts performance in clothing manufacturing industry. Like in the case of car manufacturing industry, DOI positively impacts on SCM performance, especially on operating profit rate and net profit rate, which show statistical significance at the 5% level. As DOI positively impacts on SCM performance, it is proposed to keep enough inventory stock for clothing manufacturing companies as well, for smooth flow of business and not to lose customers and sales. As seen in Table 2, the average DOI of clothing manufacturing industry is 204 days, while car manufacturing has 32 days and wholesale and retail trade shows 52 days of inventory. Some of the inventory strategies can be used for improving the variable of the inventory days of supply: Real-time inventory tracking-for example, by advanced technology such as RFID-to provide real-time inventory information throughout the supply chain, Collaborative Planning, Forecasting, and Replenishment (CPFR), and synchronizing supply/demand planning (Farris, Hutchison, and Hasty, 2005).

Lastly, in wholesale and retail trade industry, DSO negatively impacts operating profit rate and net profit rate at the 1% of statistical significance level. DSO and DOI show negative impact on ROA at the significance level of 5%. DPO has positive impact on operating profit rate and net profit rate at the significance level of 1%.

That is, unlike car manufacturing or clothing manufacturing companies, it is suggested for wholesale and retail trade companies to have shorter DSO, shorter DOI, and longer DPO in order to have better SCM performance. Like what was hypothesized at the beginning, it is

found that in wholesale and retail trade industry, as DSO and DOI are shorter, and as DPO is longer, the C2C cycle time becomes shorter and brings better SCM performance.

As a wholesale and retail trade company, it does not need to keep high inventory stock. It should decrease inventory level by increasing inventory turns or by introducing some advanced technologies or strategies, such as RFID or CPFR. A wholesale and retail trade company also needs to try to have shorter DSO and longer DPO, while taking the trade practices of the industry into consideration. As a supplier and a customer, a company should consider the cost of the burden of the other members of the supply chain. In general, large corporations have shorter DSO than small-and-medium companies. As seen in Table 3, the average DSO of large corporations is 45 days while small-and-medium companies have 150 days, which is more than 100 days longer. So, it is advised to find out a way to decrease DSO especially for small-and-medium companies. For example, in order to encourage faster payments and to improve accounts receivable collection, the selling firm could offer discount terms for early payment, or for the delinquent customers, the firm could require Cash On Delivery (COD) payments. Moreover, it can be suggested to require full payment at time of order or a deposit for the payment. With the development of the technology, the acceptance of electronic payments could also help faster collection of accounts receivable by eliminating float time (Farris et al., 2005).

Extending DPO would involve a risk of accepting additional implicit cost of opportunity cost or risk cost from the selling company, which could cause increase of total purchasing cost, or receiving lower quality products. As a way to extend DPO while not endangering the business of a company, it could be suggested to make scheduled partial payments instead of making one full payment or to pay with credit cards or electronic payments to make the payment at the optimum time, as it can lengthen the time that the money goes out from the hands of a company.

Table 11. Summary of linear regression analysis

Standardized Coefficients		Operating Profit Rate	Net Profit Rate	ROA
Car Manufacturing	DSO	**+ 0.210****	**+ 0.260****	**+ 0.263****
	DOI	**+ 0.191****	**+ 0.014**	**- 0.014**
	DPO	**- 0.303****	**- 0.155***	**- 0.153***
Clothing Manufacturing	DSO	**- 0.022**	**- 0.056**	**- 0.057**
	DOI	**+ 0.295***	**+ 0.262***	**+ 0.157**
	DPO	**- 0.002**	**+ 0.033**	**+ 0.067**
Wholesale and Retail Trade	DSO	**- 0.340****	**- 0.200****	**- 0.171***
	DOI	**- 0.008**	**- 0.083**	**- 0.145***
	DPO	**+ 0.346****	**+ 0.191****	**+ 0.116**

** Denotes statistical significance at the 1% level of a two-tailed test.

* Denotes statistical significance at the 5% level of a two-tailed test.

4. CONCLUSION AND FUTURE STUDIES

When measuring a company's management performance, not everyone would say that the Cash-to-Cash cycle time can be useful by itself. However, it can be agreed that the Cash-to-Cash cycle time can be valuable when it is combined with a company's profit data, showing the relation between the cash flow and the benefit to the company. The reason why people put a high value on the cash flow is because it is a relatively objective metric comparing with other metrics. It means that it is not easy for the assessors to exercise their own discretion when evaluating the performance in case of the cash flow.

After the latter half of 2008, the importance of cash flow has been thrown up under the circumstances of global economic depression and financial crisis. Insolvency has been triggered as it is difficult to receive financial support from banking facilities. Therefore, the cash flow metrics, such as the Cash-to-Cash cycle time, are becoming as important as the sales revenue. So, it is required to present an empirical analysis to prove the usefulness of measuring the cash flow metrics. This paper has conducted an empirical study on Korean car manufacturing industry, clothing manufacturing industry, and wholesale and retail trade industry for the year from 2004 to 2008.

First of all, a descriptive analysis was done to see the differences of C2C cycle time and its three components among the three selected industries. It is found that the average C2C cycle time of car manufacturing industry is 31.19 days, which is about 148 days shorter than clothing manufacturing industry. In addition, the average C2C cycle time of wholesale and retail trade industry ranges at 16.33 days, which is the shortest of the three, as expected. For wholesale and retail trade industry, while the average C2C cycle time of large corporations is -3.77 days, small-and-medium companies have 179.50 days, which might have generated large negative profitability: -38% of the operating profit rate, -53% of the net profit rate, and -25% of ROA.

In order to see the correlation between C2C cycle time and finance performance, three hypotheses have been developed. The hypotheses expect there are negative correlations between C2C cycle time and 1) operating profit rate, 2) net profit rate, and 3) ROA. Pearson correlation analysis has been used to estimate the relationships of the variables. For car manufacturing and clothing manufacturing industries, there are positive relations between C2C cycle time and the selected performance metrics, while wholesale and retail trade industry has negative correlation between the variables, as hypothesized.

Lastly, through multiple linear regression analysis, investigation on how components of C2C cycle time affect on the SCM performance has been followed. According to the analysis results, as DSO and DOI increase while DPO decreases, a car manufacturing may result in better performance. So, it is proposed to generate bigger sales revenue and keep enough inventories rather than trying to decrease C2C cycle time. For clothing manufacturing as well, it is suggested to keep enough inventories for smooth flow of business and not to lose customers and sales. On the contrary for wholesale and retail trade industry, it is advised to have shorter DSO, shorter DOI, and longer DPO, as it causes to have shorter C2C cycle time and better SCM performance. Therefore, as a way to decrease C2C cycle time, it is advised to decrease inventory level with advanced technologies and to ask a deposit of payment or electronic payment for faster collection, as well as to make scheduled partial payments or to pay with credit cards or electronic payment for later payment.

In conclusion, what is generally hypothesized regarding C2C cycle time, of pursuing for shorter C2C cycle time to generate higher profitability, could be accepted only when it comes to wholesale and retail trade industry. Contrary to the general hypothesis, from this paper, it is suggested for car manufacturing and clothing manufacturing companies not to concentrate on decreasing C2C cycle time. For car manufacturing and clothing manufacturing companies, it is more crucial to keep enough inventory stocks not to lose sales and customers, and to generate higher sales revenue.

Even if several studies have been done previously to see the length of C2C cycle time for different industries on Korean companies, this paper is distinct from other studies in that it estimates the correlation between the C2C cycle time and other SCM performance metrics and provides ways to improve a company's performance depending on the industry. This paper is proposing Korean companies a guideline to revise or develop their SCM strategies according to the analysis results of this paper.

The paper possesses a limitation due to the availability of data collection and only what is available from financial statements of Korean companies has been analyzed. Therefore, it is suggested for further studies to include other perspectives of SCM performance metrics, such as reliability, responsiveness, or flexibility. In addition, as this paper has been done only for the three selected industries, it is proposed to expand the scope of the study into other industries of chemicals, pharmaceutical or food.

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