

Is Cash-to-Cash Cycle Appropriate to Measure Supply Chain Performance?

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Abstract In this chapter, the cash-to-cash cycle time (C2C) and financial performance metrics of seven selected industries (integrator, apparel, electronics, automobile, airline, logistics, and retail) are investigated with data taken from their annual reports from 2008 to 2012. The purpose is to study C2C whether it is appropriate to measure supply chain performance or not. The C2C characteristics are identified industry by industry with a focus on supply chain management (SCM) and logistics. The relationship between C2C and financial performances is evaluated using measurements of gross, net profit rate, revenue growth, current ratio, and return on asset (ROA). It is found that C2C is very powerful metric to understand supply chain strategies, but it is not a predictor of financial performance.

Keywords SCM performance · C2C · Financial performance · ROA · Profitability

1 Introduction

During the last few decades, there have been enormous changes in the global business environment. The world has been changing quickly due to the development of technologies spread of the internet, globalization and increasing mobility of freight and person. From a business perspective, the environment has been rapidly changing as well, following the changes of customer needs and the innovation of industrial technologies. In order to stay competitive and continue to grow in this quickly changing business world, companies are trying to introduce and apply new and innovative management techniques.

Organizations began to realize that it is not enough to improve efficiencies within the organization, but that their whole supply chain has to be made competitive

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(Childerhouse and Towill 2002; Li et al. 2006). Supply chain management (SCM) has been defined to explicitly recognize the strategic nature of coordination between trading partners, and its purpose is to improve the performance of an individual organization and the whole supply chain. The organizations measure and evaluate the operational performance to compare it with other supply chains (Childerhouse and Towill 2002; Feldmann and Muller 2003; Li et al. 2006). 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.

Operational innovation has been central to some of the greatest success stories in recent business history, including Wal-Mart, Toyota, and Dell (Hammer 2004). Operation innovation can give high revenue growth, lower inventory using cross-docking and responsive purchase and distributed goods, lower prices, and high profits, but operational performance is difficult to realize (Hammer 2004). To improve the operational performance, a firm must to apply supply chain practices (Rice and Hoppe 2001; Hammer 2004; Li et al. 2006), change business culture (Hammer 2004), and introduce six sigma and lean. Supply chain practice could improve cash flows and reduce the cash-to-cash cycle time (C2C), which would help free up working capital to be invested in other products, better processes, and better financial performance (Rice and Hoppe 2001)—specifically growth, profitability, and capital utilization. Some studies have been done on the relationship between liquidity management and operating performance of a company. The concept of C2C leads to the premise that a reduction in the cash conversion cycle time will lead to a financial and operational improvement; however, the C2C concept assumes that a shortening of cycle time can be achieved without increasing costs and decreasing sales (Soenen 1993). However, to reduce C2C means reducing the terms of credit for the receiver and delaying payment to suppliers. This assumption would lead to a reduction of the product's attractiveness from the customer's perspective and an increase in the cost of goods supplied.

A number of researchers have analyzed the industry using C2C, such as shrimp suppliers in Thailand to a major retailer in the USA (Banomyong 2005), the relationship between C2C and return on asset (ROA), return on equity (ROE) in Japan and Taiwan (Wang 2002), and the relationship between corporate profitability and working capital in Greece (Lazaridis and Tryfonidis 2006). C2C is also used to measure the impact on profitability using ROA and ROE for manufacturing companies in Pakistan (Anser and Malik 2013), comparing C2C of merchandising and manufacturing industries in Turkey (Uyar 2009) and in Korea (Lee et al. 2010).

C2C is one of the liquidity ratios which measure a company's ability to meet cash needs (Fraser and Ormiston 2007). Traditional measures of corporate liquidity such as the current ratio, the quick ratio, and even net working capital are static in terms of what cash resources are ready for use at a given moment in time to satisfy the current obligations (Wang 2002). From this point of view, investors should focus their concern to cash flows from mobilizing inventory and receivable investments within the normal firm's operations. The operating cash flows are sensitive to declining sales and earnings (Richards and Laughlin 1980).

The previous research showed the results that reducing the C2C improved operating performance of a firm (Wang 2002); statistical significance between profitability and the C2C (Lazaridis and Tryfonidis 2006); and a strong negative relationship between variables of working capital management and profitability (Raheman and Nasr 2007). It suggested that companies could increase profits by correctly managing the C2C and keeping the components of C2C to an optimum level.

Some researchers tried to find the different C2C characteristics industry by industry. Retail and wholesale industry was found to have had a shorter C2C than manufacturing industry. The textile industry had the longest C2C, which might imply liquidity problems (Uyar 2009). Moreover, the findings indicated a significant negative correlation between the length of C2C and the firm's size in terms of net sales and total assets, and between the length of C2C and profitability. It concluded that smaller companies have longer C2Cs, and the longer the C2C, the less profitable they are (Raheman and Nasr 2007; Uyar 2009).

This paper focuses on C2C and four other finance performance metrics: revenue change rate (%), profit margin (%), net and gross), ROA (%), and current ratio. With the data from the selected industries, a comparison of the C2C of each industry has been conducted. This was then the correlation analysis of the C2C and finance performance metrics to see whether there is a positive or negative relationship between them.

2 C2C and SCM Performance

One important factor in business is ongoing performance measurement. Measuring supply chain performance is not a new practice. The problem is not a lack of possible metrics, but an overwhelming abundance of choices (Hofman 2004). A survey found that organizations that are best at SCM hold a 40–65 % advantage in their C2C over average organizations, while the top organizations carry 50–85 % less inventory than competitors (Sheridan 1998). C2C is measured using accounts receivable, inventory, and accounts payable data. C2C is defined as the sum of the days sales outstanding (DSO), plus the days of inventory (DOI), minus the days payable outstanding (DPO), that is $C2C = DSO + DOI - DPO$. DSO typically grows as revenue increases, and it shrinks as revenue decreases (Wojcik 2009). 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.

The goal of many companies has been to shorten C2C, but in this paper, the relationship between C2C and financial performances is tested industry by industry (Fawcett et al. 2007). The C2C is a critical performance measure and was also selected as the measure which has the greatest impact on supply chain practice as it showed the direct financial benefits of SCM (Banomyong 2005; Christopher and Gattorna 2005; Farris et al. 2005; Fawcett et al. 2007).

Gartner has measured the top 25 firms in terms of supply chain performance since 2003 using peer opinion, return on assets, inventory turns, and revenue growth. The ranking gives which firms demonstrate operational and innovation excellence based on health of their value chains. To measure the overall operational excellence, Gartner identified key metrics with perfect order rates and total supply chain costs. Gartner also recommended the more detailed functional metrics that must be aligned with end-to-end supply chain goals to achieve the overall goal of operational excellence. C2C is a metric to assess the perfect order and SCM cost. The C2C metric is an important measure as it bridges across inbound material activities with suppliers, through manufacturing operations and outbound sales activities with customers (Farris and Hutchison 2002). C2C offers increased visibility of more decision variables; increases optimization of decisions in the supply chain; reduces suboptimization of financial decision within firms; and aids supplier decision making by eliminating the uncertainty of customer actions (Farris et al. 2005).

Gartner's measurement is based on Hofman's suggestions of the hierarchy of supply chain metrics (Gartner 2013; Hofman 2004). Hofman clarifies three levels of metrics for measuring supply chain performance. The top tier includes demand forecast, perfect order, and SCM cost, mid-level includes C2C to access cash flow and customer versus supplier balance, while bottom level to comprehend operational effectiveness includes supplier quality and raw material inventory purchasing costs. Hofman's top tier focuses on demand visibility based on push strategies such as demand visibility. C2C is not the sole metric to cover the end to end of supply chain, but it gives a certain diagnostic view based on inventory, accounts receivable, and accounts payable.

3 Research Methodology

The purpose of this paper is to see whether or not the C2C metrics could be used to measure SCM performance of a company. The second objective is to know the differences in C2C industry by industry and to know whether there is a positive or negative correlation between C2C and financial performance in eleven industries. These factors are closely studied to see how they affect the performance metrics, either positively or negatively, and the differences among industries. To see the tendencies of different industries, eleven industries are selected: the apparel industry (8 companies with 46 data from 2008 to 2014); the airline industry (27 companies with 138 data from 2007 to 2013); integrators (4 companies with 21 data from 2008 to 2013); the automobile industry (12 companies with 59 data from 2006 to 2013); the electronics industry (17 companies with 77 data from 2009 to 2013); the retail industry (8 companies with 40 data from 2006 to 2014); the logistics industry (9 companies with 45 data from 2008 to 2013); consumer packaged goods (CPG) industry (8 companies with 32 data from 2010 to 2013); the beverage and food industry (5 companies with 20 data from 2010 to 2013); the equipment and

machine industry (4 companies with 12 data from 2010 to 2013); and finally the restaurant industry (2 companies with 8 data from 2010 to 2013). The data used in this paper were predominantly collected from www.investing.businessweek.com operated by Bloomberg, finance.yahoo.com, investing.money.msn.com, and companies' annual report. The total number of companies is 103 and 509 sample data from 2006 to 2014.

3.1 Data Collection and Descriptive Statistics

Tables 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, and 13 give the descriptive statistics of the variables including weighted revenue change (%), weighted gross profit margin (GPM) (%), net profit margin (%), return on assets (%), current ratio, C2C, DSO, days in inventory (DII), and DPO. Table 1 presents the total descriptive statistics of all surveyed companies and shows moderate fluctuations on revenue change (the coefficient of variable (CV) is 1.43). But it is highest among the variables from -31.16 to 53.42 % with a weighted average change of 8.71 %. The variation of (GPM) (0.82) is less than net profit margin (1.21). In this context, presumably, we could assume that the cost of goods sold is less varied than expenses even revenue change is high. Table 2 shows average financial and operational performance including current ratio (CR) of all surveyed industries. Table 3 presents integrators including DHL, FedEx, TNT, and UPS, while the average C2C varies from 2.25 to 35.62 days with an average of 22.03 days and median of 26.79 days. DII (2.74 days) and DPO (26.07 days) show the lowest levels, followed by the retail industry (5.43 days) for DII and the restaurant industry (26.23 days) for DPO.

Table 4 shows the descriptive statistics of the selected apparel industry companies. The (GPM) is the biggest with 48.38 %, followed by the restaurant industry with 48.20 %. Inventory level is also the highest number of days with 127.27 that varied from 63.56 to 338.75 days, followed by the food and beverage industry with 11.39 days. Table 5 shows the electronics industry as having very high revenue

Table 1 Descriptive statistics of total surveyed, 2006–2014

	<i>N</i>	Min	Max	GM	Median	CV
Revenue change (%)	391	-31.16	53.42	8.71	5.93	1.43
Gross profit margin (%)	495	1.08	111.28	23.51	22.50	0.82
Net profit margin (%)	495	-6.90	34.20	6.47	4.27	1.21
ROA (%)	495	-6.64	27.46	5.57	5.19	0.82
Current ratio	495	0.33	4.78	1.31	1.15	0.52
C2C	495	2.25	35.62	22.03	26.79	0.55
DSO	495	0.05	150.34	34.69	28.28	0.71
DII	495	0.01	334.32	44.81	33.75	1.17
DPO	495	2.53	168.30	55.73	45.71	0.62

Table 2 Average of financial variables industry by industry

	REV.	GPM	NPM	ROA	CR	C2C	DII
Integrator	3.0	14.6	2.5	3.7	1.45	21.45	2.80
Apparel	10.8	58.1	11.8	13.0	2.19	84.06	128.65
Electronics	2.9	34.4	8.8	7.3	1.8	23.18	39.76
Automobile	11.1	18.1	4.7	3.8	1.22	29.70	46.83
Retail	12.2	20.0	2.4	4.5	1.02	-3.15	45.53
Airlines	16.0	17.3	3.5	1.4	0.91	-2.17	11.49
Logistics	2.6	14.9	2.5	4.9	1.24	15.46	5.44
CPG	3.2	35.8	13.1	11.0	1.23	26.63	73.75
Restaurant	7.9	47.4	12.9	12.7	1.21	24.24	35.14
Food and beverage	4.2	21.7	15.7	8.8	0.96	46.27	112.64
Equipment	6.4	35.2	7.5	6.7	1.88	92.21	101.60

Table 3 Descriptive statistics of integrators companies, 2008–2013

DPW, FedEx, TNT, UPS							
	<i>N</i>	Min	Max	GM	Median	CV	GM (1)
Revenue change (%)	16	-15.13	13.61	2.35	2.78	3.41	2.56
Gross profit margin (%)	21	6.95	25.52	15.99	13.77	0.46	16.26
Net profit margin (%)	21	-3.75	7.89	2.22	2.19	1.44	2.37
ROA (%)	21	-5.74	12.07	3.32	3.03	1.37	3.55
Current ratio	21	0.66	2.13	1.45	1.56	0.29	1.46
C2C	21	2.25	35.62	22.43	26.47	0.50	21.93
DSO	21	34.87	56.58	45.81	43.26	0.14	45.38
DII	21	0.60	5.47	2.69	2.35	0.63	2.78
DPO	21	15.57	47.32	26.07	21.40	0.38	26.23

Table 4 Descriptive statistics of apparel industry companies, 2008–2014

Benetton, Inditex, H & M, GAP, Ralph Lauren, LVMH, Adidas, Nike							
	<i>N</i>	Min	Max	GM	Median	CV	GM(1)
Revenue change (%)	28	-2.63	25.65	8.62	8.50	0.83	9.27
Gross profit margin (%)	36	7.56	65.80	48.38	57.09	0.28	45.90
Net profit margin (%)	36	3.53	17.22	10.26	10.29	0.36	10.87
ROA (%)	36	2.36	31.57	13.39	13.80	0.57	11.71
Current ratio	36	1.21	3.47	2.18	1.98	0.31	1.91
C2C	36	-42.17	252.10	80.85	85.73	0.98	88.82
DSO	36	3.86	56.94	24.09	25.78	0.69	40.10
DII	36	63.56	338.75	127.21	93.41	0.65	120.65
DPO	36	19.22	140.96	71.37	45.42	0.59	71.75

Table 5 Descriptive statistics of electronics industry, 2009–2013

Sony, Toshiba, Apple, Dell, RIMM, Samsung, LG, Nokia, and 9 others							
	<i>N</i>	Min	Max	GM	Median	CV	GM(1)
Revenue change (%)	60	−57.88	65.96	3.89	1.22	5.14	2.93
Gross profit margin (%)	77	10.78	80.16	33.72	32.79	0.52	34.37
Net profit margin (%)	77	−10.51	33.10	8.73	5.37	1.26	8.79
ROA (%)	77	−11.63	26.49	7.21	6.83	1.14	6.81
Current ratio	77	0.83	9.37	1.71	1.44	0.64	1.80
C2C	77	−78.54	133.33	21.38	21.79	2.34	23.18
DSO	77	18.10	122.68	53.91	49.76	0.45	53.87
DII	77	3.29	90.62	39.66	37.97	0.56	39.76
DPO	77	17.53	144.87	72.19	63.29	0.46	70.45

Table 6 Descriptive statistics of automobile industry, 2006–2013

Renault, Hyundai, Peugeot, Toyota, Honda, Nissan, GM, and 5 others							
	<i>N</i>	Min	Max	GM	Median	CV	GM(1)
Revenue change (%)	47	−26.76	25.59	4.95	5.67	2.24	11.07
GPM (%)	59	1.53	27.50	18.38	18.44	0.28	18.38
Net profit margin (%)	59	−9.27	14.83	4.15	4.55	1.04	4.72
ROA (%)	59	−7.73	12.87	3.29	3.07	1.12	3.79
Current ratio	59	0.50	1.81	1.17	1.16	0.25	1.18
C2C	59	−18.73	173.12	28.65	23.72	1.35	25.31
DSO	59	10.12	182.73	23.03	21.55	1.44	20.09
DII	59	19.00	85.86	47.45	49.74	0.31	43.68
DPO	59	18.10	85.82	51.80	47.06	0.34	46.39

change fluctuations with CV 5.14 from minimum level −57.88 % (Nokia in 2013) to 65.96 % (Apple in 2011). Table 6 displays data of the automobile industry. The industry's DSO varied greatly compared to other industry from 10.12 days (Renault in 2012) to 182.73 days (Nissan in 2013). Table 7 presents 8 retail industry companies from 2006 to 2014. Retailers' C2C fluctuates from −49.70 (Amazon in 2010) to 54.07 (Home Depot in 2011) with a high value of CV (−3.03).

Table 8 shows the descriptive statistics of airline industry companies. The net profit margin, ROA, and (CR) are the lowest with 1.34, 0.10, and 0.90 %. But the C2C level is also the shortest with −6.55 days. The level of fluctuation of ROA is 148.36 from −27.48 (United Airlines in 2008) to 20.17 (Delta in 2013). It is also important to note that 10 of 27 airlines have been recording negative average weighted ROA through recent 7–4 years. Even though airlines have the best weighted average C2C, their financial performance is the worst.

Table 9 shows the logistics industry, in which the revenue change fluctuates greatly with CV 7.35 from minimum level −84.77 % (Li and Fung in 2010 and

Table 7 Descriptive statistics of retail industry companies, 2006–2014

Carrefour, Wal-Mart, Costco, Metro, Tesco, Target, Home Depot, Amazon							
	<i>N</i>	Min	Max	GM	Median	CV	GM(1)
Revenue change (%)	36	−7.46	40.56	3.68	4.16	2.59	2.59
Gross profit margin (%)	45	7.07	34.57	20.30	21.25	0.37	20.99
Net profit margin (%)	45	−0.15	6.17	2.31	1.88	0.75	2.58
ROA (%)	45	−0.33	11.04	4.32	4.50	0.71	4.72
Current ratio	45	0.65	1.71	0.95	0.88	0.30	1.03
C2C	45	−49.70	54.07	−9.70	−14.77	−3.03	−0.04
DSO	45	0.47	38.90	13.95	5.57	0.86	9.50
DII	45	19.08	86.77	46.66	44.85	0.35	46.97
DPO	45	31.92	110.64	70.31	52.62	0.42	56.51

Table 8 Descriptive statistics of airline industry companies, 2007–2013

Companies name refer to Table 1							
	<i>N</i>	Min	Max	GM	Median	CV	GM(1)
Revenue change (%)	111	−41.05	84.87	8.84	8.41	2.27	15.96
GPM (%)	138	−11.32	56.47	19.70	20.09	1.27	19.65
Net profit margin (%)	138	−39.31	162.15	1.34	1.65	55.21	3.49
ROA (%)	138	−27.48	20.17	0.10	1.07	148.36	1.42
Current ratio	138	0.19	2.28	0.90	0.81	0.53	0.80
C2C	138	−131.23	82.85	−6.55	−2.93	−5.41	−2.17
DSO	138	4.19	99.59	21.92	21.04	0.59	22.90
DII	138	0.21	55.35	11.39	9.94	0.84	11.07
DPO	138	1.80	214.85	39.64	28.43	0.92	36.09

Table 9 Descriptive statistics of logistics companies, 2008–2013

Con-Way, Ryder Sys., ND, Yamato Holdings, Li & Fung, and 4 others							
	<i>N</i>	Min	Max	GM	Median	CV	GM(1)
Revenue change (%)	16	−84.77	25.98	−2.4	2.65	−7.35	2.6
Gross profit margin (%)	22	3.82	45.48	17.2	18.15	0.55	16.6
Net profit margin (%)	22	−2.52	5.23	2.3	2.72	0.63	2.5
ROA (%)	22	−3.72	21.18	4.3	2.97	1.27	4.9
Current ratio	22	0.14	1.87	1.21	1.24	0.32	1.24
C2C	22	5.88	28.81	15.81	16.26	0.34	15.46
DSO	22	36.53	76.89	51.65	51.27	0.21	51.65
DII	22	0.11	22.18	5.43	1.79	1.02	4.23
DPO	22	21.32	58.64	39.70	42.74	0.28	40.43

−18.53 % for Ryders in 2009) to 25.98 % (Norbert Dentressangle in 2011). Tables 10 and 11 show data of the CPG and restaurant industries. The industries' parameters are stable within $CV = 1$ except C2C 1.51 (CPG) and 1.28 (restaurant). Table 12 shows the descriptive data of the beverage and food industry with revenue change 1.88 from −4.82 % (Nestlé in 2011) to 32.53 % (Coca-Cola in 2011) and C2C 2.58 from −107.42 days (Anheuser Busch in 2013) to 322.18 days (Diageo in 2013) in terms of CV. Table 13 presents four companies in the equipment and machine industry. Its revenue changes vary from −15.51 % (Caterpillar in 2013) to 41.21 % (Caterpillar in 2011) with a CV of 1.69.

Companies' data were taken 2–7 years from their financial statements weighted more on recent year. When the author takes four years data for a company, the weighted data was calculated by years of the first year (y_i) by 40 % plus the second year (y_{i-1}) by 30 % plus the third year (y_{i-2}) by 15 % plus the fourth year (y_{i-3}) by 5 % (F2).

Table 10 Descriptive statistics of CPG companies, 2010–2013

Unilever, P&G, J&J, Kimberly-Clark, Colgate-Palmolive, and 2 others							
	N	Min	Max	GM	Median	CV	GM(1)
Revenue change (%)	24	−2.98	12.21	3.94	3.39	0.95	3.24
Gross profit margin (%)	32	12.42	114.01	43.2	42.49	0.75	43.3
Net profit margin (%)	32	7.41	21.65	13.2	14.31	0.30	13.1
ROA (%)	32	6.28	19.72	11.1	10.37	0.31	11.0
Current ratio	32	0.46	2.38	1.24	1.14	0.46	1.11
C2C	32	−146.86	97.85	30.93	29.63	1.51	26.63
DSO	32	19.86	61.40	41.53	42.25	0.28	41.86
DII	32	52.74	128.70	74.07	67.08	0.27	73.75
DPO	32	38.21	261.16	84.87	76.15	0.47	88.24

Table 11 Descriptive statistics of restaurant companies, 2010–2013

Starbucks, Mcdonald's							
	N	Min	Max	GM	Median	CV	GM(1)
Revenue change (%)	6	1.95	13.67	8.4	10.62	0.62	7.9
Gross profit margin (%)	8	38.89	58.75	48.20	48.16	0.20	47.9
Net profit margin (%)	8	0.06	20.55	13.6	15.24	0.55	12.9
ROA (%)	8	0.07	16.92	13.8	15.46	0.41	12.7
Current ratio	8	0.24	1.90	1.34	1.47	0.39	1.21
C2C	8	−4.02	66.29	22.46	15.51	1.28	24.24
DSO	8	10.32	18.21	15.09	15.45	0.21	15.33
DII	8	2.61	77.95	33.60	23.84	1.02	35.14
DPO	8	21.50	40.10	26.23	24.37	0.23	26.23

Table 12 Descriptive statistics of beverage and food industry, 2010–2013

Coca-Cola, Pepsico, Nestle, Anheuser-Busch, Diageo							
	<i>N</i>	Min	Max	GM	Median	CV	GM(1)
Revenue change (%)	15	−4.82	32.53	4.84	2.72	1.88	4.18
Gross profit margin (%)	20	9.65	64.64	25.1	17.29	0.73	25.1
Net profit margin (%)	20	9.42	38.89	16.5	15.83	0.47	15.7
ROA (%)	20	3.52	30.66	9.5	8.69	0.59	8.8
Current ratio	20	0.34	1.76	0.97	0.98	0.43	0.96
C2C	20	−107.42	322.18	52.38	19.83	2.58	46.27
DSO	20	24.14	65.66	39.13	36.96	0.30	39.16
DII	20	39.83	346.80	111.39	63.06	0.99	112.64
DPO	20	37.72	189.58	98.14	91.70	0.49	105.54

Table 13 Descriptive statistics of equip. and machine ind., 2010–2013

Caterpillar, Cummins, Deere & Co, Komatsu							
	<i>N</i>	Min	Max	GM	Median	CV	GM(1)
Revenue change (%)	12	−15.51	41.21	10.4	8.53	1.69	6.4
Gross profit margin (%)	16	11.28	72.87	41.1	46.72	0.54	40.2
Net profit margin (%)	16	0.67	10.24	7.4	8.31	0.34	7.5
ROA (%)	16	0.50	15.84	6.7	6.01	0.59	6.7
Current ratio	16	1.34	2.57	1.85	1.87	0.21	1.88
C2C	16	−19.51	225.46	90.08	96.49	0.85	92.21
DSO	16	36.75	117.52	66.50	55.19	0.42	65.20
DII	16	58.06	167.90	99.84	94.35	0.36	101.60
DPO	16	38.19	133.16	76.26	68.48	0.44	74.59

$$P_i = [(0.5y_i) + (0.3y_{i-1}) + (0.2y_{i-2})] \quad (F1)$$

$$P_i = [(0.4y_i) + (0.3y_{i-1}) + (0.15y_{i-2}) + (0.05y_{i-3})] \quad (F2)$$

$$P_i = [(0.4y_i) + (0.3y_{i-1}) + (0.15y_{i-2}) + (0.1y_{i-3}) + (0.05y_{i-4})] \quad (F3)$$

$$P_i = [(0.4y_i) + (0.3y_{i-1}) + (0.15y_{i-2}) + (0.075y_{i-3}) + (0.04y_{i-4}) + (0.035y_{i-5})] \quad (F4)$$

$$P_i = [(0.4y_i) + (0.3y_{i-1}) + (0.15y_{i-2}) + (0.075y_{i-3}) + (0.04y_{i-4}) + (0.025y_{i-5}) + (0.01y_{i-6})] \quad (F5)$$

$$P_i = [(0.4y_i) + (0.3y_{i-1}) + (0.15y_{i-2}) + (0.07y_{i-3}) + (0.04y_{i-4}) + (0.275y_{i-5}) + (0.0075y_{i-6}) + (0.005y_{i-7})] \quad (F6)$$

P_i Weighted financial or operational performance variables.

3.2 Variables and Hypothesis

SCM Performance: The short-term objectives of SCM are primarily to increase productivity and reduce inventory and cycle time, while the long-term objectives are to increase market share and profit for all members of the supply chain (Tan et al. 1998). Some of the inventory strategies can be used for improving the variable of the inventory days of supply, real-time inventory tracking for example, using advanced technology such as RFID provides real-time inventory information throughout the supply chain, CPFR (Collaborative Planning, Forecasting, and Replenishment), and synchronizing supply/demand planning (Farris et al. 2005). Excellent supply chain performance leads to strong financial performance such as earnings per share, ROA, and net profit margin (Hofman 2004).

Hypothesis 1: The organizations with a low level of C2C will have a high level of financial performance (gross, net profit rate, and revenue growth).

Organizational performance refers to how well an organization achieves its market-oriented goals as well as its financial goals (Yamin et al. 1999). Financial metrics have served as a tool for comparing organizations and evaluating an organization's behavior over time (Holmberg 2000). A number of prior studies have measured organizational performance using both financial and market criteria, including return on investment (ROI), market share, profit margin on sales, the growth of sales, the growth of market share, and overall competitive position (Vickery et al. 1999; Stock et al. 2000). Gross profit and net profit rate are used to as profitability ratios for comparing a company's management with industry competitors (Fraser and Ormiston 2007). Gross profit rate is measured as one of the performance measures to see at first how efficiently a company is managed. Generally, as a company grows, gross profit grows as well. However, it does not mean that a company which has higher gross profits is more efficient than one which has smaller gross profits. Net profit rate is also another performance measure. The objective of generating high 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 a positive operating profit rate with a negative net profit rate. It also indicates whether the business has enough sales volume in order to cover the fixed costs and still generate an acceptable profit.

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.

Hypothesis 2: The organizations with a low level of C2C will have a high level of liquidity (CR) and ROA.

Hypothesis 3: The companies within the same industry category will have homogeneity characteristics and heterogeneity characteristics in comparison with the other industries.

Although organizations have understood the importance of implementing good SCM, they often do not know exactly how to realize the goal, due to a lack of understanding of what constitutes a comprehensive set of SCM practices and strategy. By matching SCM metrics and financial performance, this study provides SCM managers with a useful tool for evaluating their SCM activities.

4 Results and Analysis

C2C and financial performance (H1): The results of the analysis in Tables 14 and 15 show that C2C has a relationship with gross profit, not with revenue growth rate nor net profit margin. The relationship between C2C and financial performance, such as revenue growth rate and net profit margin, is not statistically significant, but significant with the GPM. But the higher GPM will make longer the C2C (0.00109). It means the bigger the C2C, the bigger the profits. C2C presents the length of the payment of purchases to the supplier and remittance from the customers. Previous literature has concluded that companies can increase their profitability by shortening the C2C (Lazaridis and Tryfonidis 2006; Raheman and Nasr 2007; Shin and Soenen 1998). This study shows the negative relationship between C2C and revenue growth, as well as net profit margin, but this was not significant. So, the author found it difficult to prove the hypothesis. Gartner has published the top 25 companies in terms of supply chain using peer opinion, ROA, inventory turns, and revenue growth (Gartner 2013). Table 16 shows the differences between top 25 companies and the other unranked companies. No significant difference was found for C2C and revenue growth rate between the top 25 and other unranked companies.

C2C with liquidity and ROA (H2): Tables 17 and 18 showed the relationship of C2C with liquidity and ROA. Current ratio (CR) is used to measure a company's ability to meet payment obligations pay in the short term using current assets over

Table 14 Pearson's coefficient of correlation

	GPM	NPM	C2C	Rev. growth
Gross profit margin (GPM)	1	0.525**	0.313**	-0.046
Net profit margin (NPM)		1	0.127	-0.008
C2C			1	-0.162
Revenue growth rate				1

* $p < 0.05$

Table 15 Regression analysis with C2C

Independent variables	Rev. growth rate	GPM	NPM
Coefficient	-0.00036	0.00109	-0.00017
Constant	0.101	0.263	0.064
Sig.	0.101	0.001	0.200
R ²	0.026	0.098	0.016

Table 16 Independent *t*-test between SCM top 25 and other companies

Independent variables	<i>N</i>	Average	Sig.
Gross profit margin	78	26.66 %	0.052
	25	36.13 %	
Return on asset	78	3.91 %	0.000***
	25	11.42 %	
Inventory turns	74	71.77	0.016**
	25	16.15	
Net profit margin	78	4.84 %	0.000***
	25	12.68 %	
Current ratio	78	1.18	0.016**
	25	1.70	
Revenue growth rate	78	9.37 %	0.996
	25	9.36 %	
C2C	78	21.22	0.629
	25	27.46	

*** $p < 0.01$, ** $p < 0.05$ **Table 17** Pearson's coefficient of correlation

	ROA	C2C	Current ratio
ROA	1	0.151	0.455***
C2C		1	0.343***
Current ratio			1

*** $p < 0.01$ **Table 18** Regression analysis with C2C

Independent variables	ROA	Current ratio
Coefficient	-0.00016	0.00422
Constant	0.541	1.212
Sig.	0.127	0.000***
R ²	0.013	0.118

*** $p < 0.01$

current liabilities. The results of study showed the significant relationship between C2C and CR, but not between C2C and ROA, profitability on assets.

Comparing C2C industry by industry (H3): Table 19 presented the result of ANOVA (analysis of variance) among industries with financial performance along with C2C and Scheffe test comparing industry by industry. According to the ANOVA, each industry has its own characteristics of financial performance and C2C. Table 2 shows the differences. The retail and airline industries have negative C2Cs with the highest revenue growth rate compared to the other 9 industries; the equipment and apparel industries have longer C2Cs with higher average revenue growth rates. There exist differences between industries based on the Scheffe test. The GPM of apparel industry is much higher than that of integrator, automobile, retail, airline, and logistics industries.

Table 19 ANOVA and Scheffe test for industry by industry

	ANOVA	Scheffe test			
		Ind. A	Ind. B	Diff. (A – B) (%)	Sig.
Gross profit margin	0.000	Integrator	Apparel	–42.73	0.041
		Apparel	Automobile	40.40	0.002
		Apparel	Retail	36.93	0.024
		Apparel	Airline	38.88	0.000
		Apparel	Logistics	41.88	0.003
Return on asset	0.000	Apparel	Airline	11.73	0.002
		Airline	CPG	–9.57	0.020
Net profit margin	0.001	No significant differences			
Current ratio	0.000	Apparel	Airline	1.27	0.008
		Electronics	Airline	0.88	0.017
Revenue growth rate	0.020	No significant differences			
C2C	0.011	No significant differences			

5 Conclusion

The result of this study is that it is very difficult to prove the relationship between C2C and financial performance. The C2C has homogeneity characteristics within industry and different characteristic compared to other industries, but no significances statistically when pairwise compared between industries (Table 19). Shortening the payments to supplier creates liquidity pressures to other companies of the supply chain. Within the supply chain, a leading player, likely located downstream, could take initiative to shorten C2C significantly (Losbichler et al. 2008). A strong player in the supply chain could finance weak suppliers and customers. If the strong player tries to reduce C2C with a value chain perspective instead of a company and focus more on reducing inventory in place of shortening payable and receivable, the supply chain could achieve a durable competitive advantage. This study focuses only on company-wide performance rather than on supply chain performance of companies. Even with a focus on the company, shorten C2C would not contribute to financial nor operational performance.

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