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Empirical Analysis of Working Capital Behavior: The Case of the Polish Food Manufacturing Industry

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Dorota Czerwińska-Kayzer[1], Joanna Florek[2]

Abstract:

Purpose: *The purpose of this paper was to present and compare the duration of the cash conversion cycle and its components in food manufacturing sector industries. In turn, the utilitarian objective was defined as specifying the intervals for average working capital cycles in these industries.*

Design/Methodology/Approach: *The proposition of how to determine the average time intervals of the cash conversion cycle and its components in food manufacturing sector industries was focused on identifying the time intervals needed for each working capital component to move from the expenditure stage to cash inflow. For every industry, the average values were determined based on their variation which, in turn, was calculated using their medians and quartile deviations recorded over the 15-year study period.*

Findings: *Irrespective of the situation they find themselves in, enterprise managers usually focus on managing their working capital. Adequate management of its components ensures financial stability for the enterprise because they have a direct impact on liquidity, profitability and solvability. This study confirmed that the duration of the cash conversion cycle, including its sub-cycles, differs significantly between enterprise groups covered by the analysis. It depends on the type of activity and is inherent to each industry. Knowing the days sales of inventory (DSI), days sales outstanding (DSO) and days payable outstanding (DPO) in enterprises with a similar business profile contributes to efficient management in these areas. Therefore, the average DSI, DSO and DPO values determined in this paper may serve as benchmarks in financial assessments.*

Practical implications: *Calculating the average values of indexes that account for industry differences provides a new, streamlined tool for assessing and managing each component of working capital. Monitoring the cash conversion cycle and its components and comparing them to average values will help control the business and quickly identify potential problems. In undesirable situations, this approach also provides a more efficient way to develop emergency plans and recovery measures.*

Originality/value: *The calculated intervals of the average cash conversion cycle and conversion cycles for each component of working capital (inventory, accounts receivable, and accounts payable) take into account the particularities of different branches in the food industry. Consequently, companies can use these intervals to benchmark their financial situation or when preparing plans for ongoing actions or corrective measures.*

[1]*Poznań University of Life Sciences, Poznań, Poland ORCID 0000-0003-4352-3074, e-mail: dorota.czerwinska@up.poznan.pl;*
[2]*Poznań University of Life Sciences, Poznań, Poland ORCID 0000-0002-2990-3348*

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Paper type: *Research study.*

1. Introduction

Enterprises must focus on managing their working capital, one of the key enablers of liquidity, whether facing economic uncertainty or enjoying relative stability (Przychocka *et al.*, 2024). This is because current assets are the quickest to convert to cash, and are therefore the main component used to meet short-term payables (Kontuš and Mihanović, 2019).

Hence, the question arises whether there is synchronization between the release of products from the inventory, the inflow of receivables and payment deadlines. To put it on other words, does the company finance its customers, or is it financed by its suppliers? (Bieniasz *et al.*, 2009). That question can be answered by the cash conversion cycle. The literature views it as one of the best metrics of working capital and liquidity management in an enterprise (Gołaś, 2020, Ryś-Jurek, 2021, Wanzala and Obokoh, 2024).

This is possible because, in accordance with the initial concept developed by Richardson and Laughlin (1980) in the 1980s, it links each component of working capital to the cash conversion cycle, converting the amounts into indexes for easier understanding. As emphasized by Gitman and Sachdeva (1982), the cash conversion cycle, together with its sub-cycles referring to inventories, receivables and payables, reflects the dynamics of liquidity, and therefore provides a better metric than static indexes, i.e., the current ratio or quick ratio.

Later on, that idea was also fostered by Jose *et al.* (1996), Deloof (2003), Eljelly (2004), García-Teruel and Martinez-Solano (2006), Lazaridis and Tryfonidis 2006, Preiβler (2008), Bolek (2013), Gołaś (2020), and Czerwińska-Kayzer *et al.* (2021).

According to the assumption made in the literature, the shorter the working capital cycle, the better the credit terms (Jagodzińska-Komar, 2023), and financial standing of the enterprise (Kontuš and Mihanović, 2019). In such situations, cash invested in current assets quickly flows back to the enterprise and can be reused thanks to sales transactions, thus bringing additional profits (Rezart *et al.*, 2022). In turn, the longer the cash conversion cycle, the greater the company's demand for external financing which contributes to increasing the ongoing operational costs (Kiymaz *et al.*, 2024).

If a business pays its invoices within a longer deadline, it can use its cash resources for a longer time (Czerwińska-Kayzer, 2022). The above means that knowing the duration of these cycles is highly useful is assessing the financial condition of enterprises and in managing their assets.

Unfortunately, the literature fails to clearly define the duration of the cash conversion cycle, as it considerably differs across industries (Czerwińska-Kayzer *et al.*, 2021).

However, the literatures strongly emphasize that it should be benchmarked against the industry's average levels (Sierpińska and Jachna 2007; Gołaś *et al.*, 2010). Such an approach certainly enables a more objective assessment as it takes account of differences that exist within the industry and are caused by business particularities, market links, production processes and, as a consequence, by different demand for working capital.

Despite the recommendation for financial assessments to be based on industry benchmarks, there is a dearth of papers providing a detailed picture of how the cash conversion cycle and its components differ between industries. Also, the literature fails to indicate the desired intervals for these ratios.

These are the very problems addressed in the paper whose primary purpose is to present and compare the duration of the cash conversion cycle and its components in food industry branches. The study also pursues an utilitarian goal, formulated as determining the intervals for average durations of the working capital cycle in each branch of the food industry. The paper verified the following hypotheses to attain the objectives set out above:

1. Average cash conversion cycles differ significantly between branches of the food industry.
2. The average sub-cycles of working capital, i.e. days sales of inventory, days sales outstanding and days payable outstanding, differ significantly across branches of the food industry.

This paper bridges a gap in the literature related to working capital management by showing particular cash conversion cycles in different branches of the food industry. Also, the study adds value by specifying average time intervals for the cash conversion cycle and its sub-cycles in each class of food production businesses.

Thus, it bridges the knowledge gap in the field of working capital management. This paper includes the following sections, a literature review which discusses the importance of the cash conversion cycle in ongoing management activities and the structure of the food industry.

Next, the study presents the dataset and the research methodology by explaining the

structure of indexes used and the method for calculating the intervals. The results are shown and discussed in section 4. The paper finishes with conclusions and recommendations.

2. Literature Review

2.1 Cash Conversion Cycle and Its Components

Working capital management is among the key areas of operational management and of financial responsibilities at enterprise level (Motlíček and Polák, 2015; Ryś-Jurek, 2021). As emphasized by Wang *et al.* (2020), adequate management of working capital plays a crucial role in ensuring financial stability for enterprises because it has an impact on liquidity, profitability and solvability.

Working capital management is a complex process because of the complicated relationships between its four components, i.e., inventory, current receivables, short-term liabilities, and cash (Wang *et al.*, 2020; Kukeli *et al.*, 2025).

Inventory should be kept at a level which does not cause production downtime (Gołaś, 2020), whereas the receipt of payment for products sold should be synchronized with the repayment of short-term liabilities incurred to buy raw materials (Bolek, 2013). Maintaining inventory at an adequate level depends on multiple factors, e.g., inventory type (Kolias *et al.*, 2011), and business profile (Gołaś, 2020).

Excessive inventory may cause an increase in warehousing costs and can lead to exceeding the products' use-by date, which is of particular importance in the food industry (Kim and Chung, 1990). In turn, insufficient levels may result in running out of stock too early, which could disrupt the production cycle, and increase the risk of operational inefficiency.

As a consequence, the company may lose its customers (Wang *et al.*, 2020; Kukeli *et al.*, 2025). Efficient inventory management involves greater sales revenue and smaller transaction costs (Gołaś *et al.*, 2010). The second link of the working capital cycle is the days sales outstanding ratio (DSO) which indicates the number of days it takes a company to collect payment from customers after a sale of products (Gołaś, 2016).

If the company grants longer credit terms to its customers, this may help boosting sales and thus lead to an increase in profitability (Jaworski *et al.*, 2018). In turn, waiting too long for cash can increase the leverage ratio which, in turn, can lead to an additional financial burden (Wang *et al.*, 2020). The third link is the days payable outstanding (DPO), i.e., the time elapsed from purchasing raw materials to paying the supplier (Bieniasz and Czerwińska-Kayzer, 2007). DPO can be decisive for whether or not the company is viewed as credible.

Any delays in paying the liabilities can have adverse consequences for the seller (Gałecka and Pyra, 2016). As emphasized multiple times in the literature, rational management of the above-listed components has an effect on liquidity, profitability, goodwill, and financial risk (Knauer and Wöhrmann, 2013, Czerwińska-Kayzer *et al.*, 2021; Rezart *et al.*, 2022; Kukeli *et al.*, 2025).

Therefore, in a competitive economic environment, efficient management of working capital is necessary in order for companies—irrespective of their size and economic conditions they deal with—to attain the expected financial results and run a sustainable business (Florek *et al.*, 2015; Łuniewski and Gołębiewska, 2021; Hofmann *et al.*, 2022).

The combination of those components shows the time the company needs to covert cash outflows (cash spent on purchases) to cash inflows (cash collected from sales). Such a solution sheds light on how each component of the working capital cycle is related to the company's cash conversion (Richards and Laughlin, 1980), while also enhancing the analysis by taking into account the dynamic nature of liquidity (Gitman and Sachdeva, 1982).

In the literature, the combination of these three ratios—days sales of inventory, days sales outstanding and days payable outstanding—is referred to as the cash conversion cycle or the working capital cycle (Bieniasz and Czerwińska-Kayzer 2007; Gołaś *et al.*, 2010).

According to Chen *et al.* (2022), a shorter cash conversion cycle often means greater financial resilience, as it enables enterprises to more efficiently convert inventories and receivables into cash, thus reducing the need for external financing. As noted by Carnes *et al.* (2023), enterprises which employ optimum management procedures for the cash conversion cycle attain better financial performance in economic downturn periods because they maintain liquidity.

In turn, Hofmann *et al.* (2022) claim that the appropriate levels can differ as business conditions change. What they also observed is that companies which struggle with financial constraints report shorter cash conversion cycles than thriving businesses. However, they do not provide any specific time intervals. As emphasized by Oseifuah and Gyekye (2018), both during crises and in day-to-day operations, managers should focus on optimizing the length of the cash conversion cycle in order to survive limited liquidity periods and be ready for a sudden economic decline.

2.2 Manufacture of Food Products

The food industry is an industrial processing sector composed of economic operators that directly manufacture and process food, as well as participate in its distribution. This means that, on the one hand, they are specific in that they produce goods based

on soft, seasonal, highly perishable raw materials of agricultural origin with a relatively short shelf life. On the other hand, they engage in diversified economic activities using different technologies and production cycles (Czerwińska-Kayzer, 2022). That diversity is the reason why food enterprises need to be split into more fine-grained groups, so as to enable a more precise analysis and comparison of results.

In 1991, having in mind the diversified production portfolio of the food industry, the Statistical Office of European Communities (Eurostat) introduced the European Classification of Economic Activities, which divided the food industry into nine sections. In 2007, in light of technological advancements and the subsequent diversification of production, the food industry underwent a restructuring, resulting in the delineation of three distinct divisions.

Among these divisions was the production of foodstuffs. It includes processors of products originating from agriculture, forestry and fisheries, as well as manufacturers of semi-finished products which are not direct food products. The structure of the food manufacturing branches, including its identified groups, classes and corresponding designations (as used later in this paper), is presented in Table 1.

Table 1. *Classification of the food industry as per the 2007 Polish Classification of Economic Activity; branches symbols used in the study.*

Section 10 Manufacture of food products		**Symbol***
Group	**Class**	
101 Processing and preserving of meat and production of meat products		
1011	Processing and preserving of meat, excluding poultry meat	1011
1012	Processing and preserving of poultry meat	1012
1013	Production of meat products, including poultry meat products	1013
102	Processing and preserving of fish, crustaceans and molluscs	1020
103	Processing and preserving of fruit and vegetable	
1031	Processing and preserving of potatoes	1031
1032	Manufacture of fruit and vegetable juice	1032
1039	Other processing and preserving of fruit and vegetables	1039
104	Manufacture of oils and fats of plant and animal	1040
1041	Manufacture of oils and other fluid fats	
1042	Manufacture of margarine and similar edible fats	
105	Manufacture of dairy products	
1051	Operation of dairies and cheese making	1051
1052	Manufacture of ice cream	1052
106	Manufacture of grain mill products, starches and starch products	
1061	Manufacture of grain mill products	1061
1062	Manufacture of starches and starch products	1062
107	Manufacture of bread goods and farinaceous products	
1071	Manufacture of bread; manufacture of fresh pastry goods and cakes	1071
1072	Manufacture of rusks and biscuits; manufacture of preserved	1072

	pastry goods and cakes	
1073	Manufacture of macaroni, noodles, couscous and similar farinaceous products	1073
108	Manufacture of other food products	
1081	Manufacture of sugar	1081
1082	Manufacture of cocoa, chocolate and sugar confectionery	1082
1083	Processing of tea and coffee	1083
1084	Manufacture of condiments and seasonings	1084
1085	Manufacture of prepared meals and dishes	1085
1086	Manufacture of homogenized food preparations and dietetic food	1086
1089	Manufacture of other food products not elsewhere classified	1089
109	Manufacture of prepared feeds and foods for animals	
1091	Manufacture of prepared feeds for farm animals	1091
1092	Manufacture of prepared pet foods	1092

Note: ** The symbol designates the number of the class or group covered by the study and the industry concerned.*
Source: *Own elaboration based on the Classification Structure (stat.gov.pl).*

3. Source Materials and Methodology

This paper relies on 2005–2020[3] financial data of Polish food manufacturers, as retrieved from yearly P&L accounts and balance sheets. The data was sourced from the unpublished statistical database of the Central Statistical Office in Poland. The study covered 24 industries which form part of the food manufacturing section as per the standard industry classification codes.

The operators covered by the study are compliant both with the PKD 2007 classification system of economic activity and with the system applicable in the European Union. Industry names and symbols used in the study are as specified in Table 1.

In this study, the cash conversion cycle was calculated as per the original formula (Richardson and Laughlin, 1980):

$$\text{Cash conversion cycle} = \text{Inventory cycle} + \text{Receivables cycle} - \text{Short} - \text{term liabilities cycle}$$

The above formula highlights the simplicity and homogeneous structure of the indicator. However, this may be misleading, because while the final equation and the names of its elements are unified and do not give rise to discussion, the structure of

[3]*This relatively long time interval saw several changes in the structure and scope of financial reports used as the basic data source. Therefore, for the sake of comparability, the data was recalculated and adjusted to the currently applicable structure of financial reports before proceeding to the analysis.*

sub-indexes is often modified and deviates from the original assumptions (Bieniasz *et al.*, 2009). Hence, this study calculated the sub-cycles in accordance with the following mathematical formulas in order to meet the fixed baseline principle which ensures that the rotation indexes carry the same information content (Bieniasz and Czerwińska-Kayzer, 2007; Czerwińska-Kayzer, 2022):

Inventory cycle (days sales of inventory, DSI):

$$Inventory\ cycle\ = \frac{Total\ inventories \times 365}{Revenue\ from\ sale}$$

Receivables cycle (collecting receivables, days sales outstanding, DSO):

$$Receivables\ cycle\ = \frac{Short-term\ receivables \times 365}{Revenue\ from\ sale}$$

Short-term liabilities cycle (time of meeting liabilities, days payable outstanding, DPO):

$$Short-term\ liabilities\ cycle = \frac{Short-term\ liabilities\ \times 365}{Revenue\ from\ sale}$$

The following descriptive statistics tools were used in an effort to show the differences in the cash conversion cycle and its sub-cycles: coefficient of variation, skewness, and measures of position (average, median, quartiles, minimum and maximum values).

In accordance with the utilitarian goal of the study, the average values for each industries were determined based on identified variation which, in turn, was calculated using their medians and quartile deviations recorded in the 15-year (2005–2020) study period.

The lower boundaries of the average intervals were calculated by subtracting the quartile deviation from the median, whereas the upper boundaries were determined by adding the quartile deviation to the median (Wawrzyniak, 2016) as per the formula below:

$$[Me - Q; Me + Q]$$

Where: *Me*: median (the middle value), *Q*: quartile deviation.

According to Wawrzyniak (2016), the above-described intervals can be used for financial benchmarks in various industries, including the food sector too.

4. Research Results and Discussion

4.1 Inventory Cycle

Working capital management depends on a number of factors, including days sales of inventory. As mentioned earlier, it is best to keep inventories on hand for the shortest amount of time possible. Keep in mind that the need to maintain stock levels depends on the technology and organization of the manufacturing processes of each business type.

As shown in Table 2, the variability in days sales of inventory among food manufacturers ranged from 3.2% to 38.5%. The industries with the greatest variability over the study period (38.5% and 31.5%, respectively) were the manufacture of oils and fats of plant and animal origin (1040) and the manufacture of prepared meals and dishes (1085). They reported inventory cycle ratios of 38 to 101 and 14 to 52, respectively.

Conversely, the smallest variability in days sales of inventory was witnessed in the following industries: other processing and preserving of fruit and vegetables (1039), production of meat products, including poultry meat products (1013), operation of dairies and cheese making (1051), processing and preserving of fish, crustaceans and molluscs (1020), and manufacture of bread; manufacture of fresh pastry goods and cakes (1071). The coefficient of variation was not above 10% in any of the aforementioned industries. This suggests that they rely on well-organized inventory management processes and limit their stock-keeping periods.

Figure 1 shows the average days in inventory for each industry. The following industries reported relatively short inventory cycle, according to analysis: manufacture of bread; manufacture of fresh pastry goods and cakes (1071) (9–13 days), processing and preserving of meat, excluding poultry meat (1011) (11–16 days), processing and preserving of poultry meat (1012) (11–16 days), production of meat products, including poultry meat products (1013) (13–16 days), operation of dairies and cheese making (1051) (17–22 days) manufacture of rusks and biscuits; manufacture of preserved pastry goods and cakes (1072) (18–24 days).

Table 2. *Values of selected descriptive statistics of inventory cycle by food industries (days)*

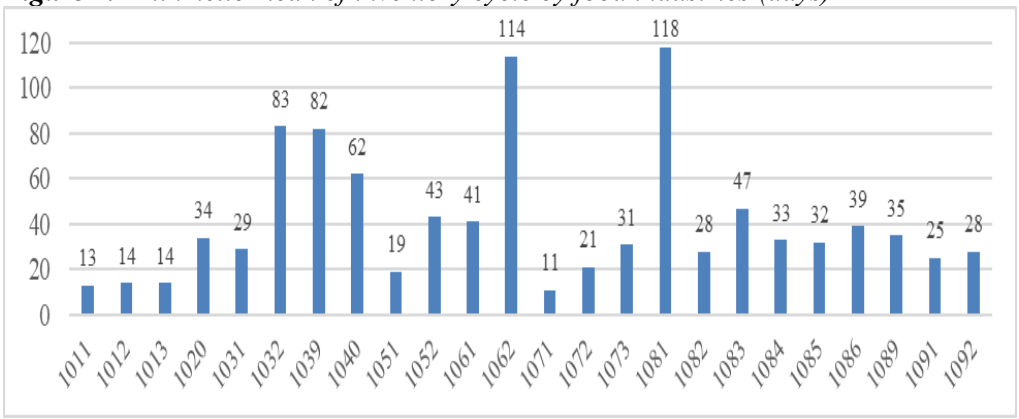
Branches	Minimum	Lower quartile	Median	Upper quartile	Maximum	Coefficient of variation (%)	Skewness
1011	11	12	13	15	16	11,8	0,38
1012	11	14	15	15	16	11,6	-0,87
1013	13	14	14	15	16	6,1	-0,49
1020	28	32	34	35	41	9,5	0,54
1031	24	26	29	32	36	13,7	0,34

1032	63	78	82	89	96	11,2	-0,6
1039	77	80	82	83	86	3,2	-0,09
1040	38	40	54	78	101	38,5	0,52
1051	17	18	19	20	22	7,4	0,51
1052	29	36	44	51	55	21,2	-0,36
1061	32	39	42	43	49	12,2	-0,28
1062	93	101	110	131	139	15,2	0,32
1071	9	10	11	11	13	9,6	0,25
1072	18	20	22	23	24	10,6	-0,12
1073	23	28	31	33	39	13,8	-0,18
1081	95	99	114	134	145	15,8	-0,02
1082	23	25	28	30	35	13,9	0,33
1083	34	44	48	50	52	10,2	-1,52
1084	29	30	31	35	39	10,5	0,7
1085	14	23	33	37	52	31,5	0,01
1086	31	33	37	47	49	17,7	0,38
1089	27	29	38	40	41	15,5	-0,53
1091	21	24	25	26	30	10,0	0,48
1092	22	25	28	29	40	18,7	1,24

Source: *Own calculation based on Central Statistical Office data (2005–2020).*

Conversely, industries with days sales of inventory ratio of over 2 months include: manufacture of sugar (1081), manufacture of starches and starch products (1062), manufacture of fruit and vegetable juice (1032), other processing and preserving of fruit and vegetables (1039) and manufacture of oils and fats of plant and animal (1040). Note that long inventory cycle were found in industries whose production cycle relies on plant raw materials that are collected seasonally, stored, and then transferred for further processing.

Figure 1. *Arithmetic mean of inventory cycle by food industries (days)*



Source: *Own calculation based on Central Statistical Office data (2005-2020).*

These results corroborate hypothesis #2, which states that days sales of inventory ratio varies by industry and is directly related to the products manufactured. The

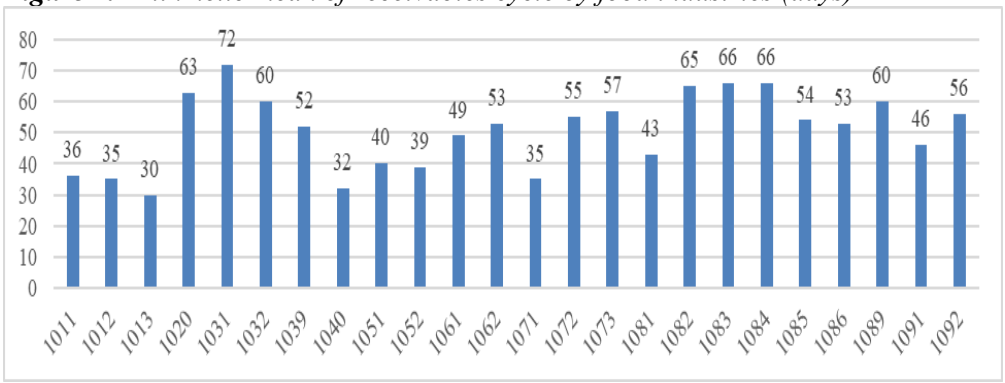
above relationship is also confirmed by the research of Bieniasz *et al.* (2009), who found that the inventory cycle is closely related to the production cycle and varies depending on the type of industrial business.

4.2 Receivables Cycle

The second element of the operating cycle is the time spent waiting for receivables. It specifies the number of days between when an invoice is issued and when payment is received (Bieniasz and Czerwińska-Kayzer, 2007). There are no standard values for that ratio indicated in the literature. The general assumption for Polish industrial enterprises is that payments take approximately 60 days to be received (Sierpińska and Jachna, 2009).

According to a study by Bieniasz *et al.* (2009), food and beverage producers had relatively short days sales outstanding. From 2005 to 2007, the range varied from 43 days in 2007 to 45 days in 2008 among food producers. According to this study, food producers spent an average of between 30 and 72 days waiting for receivables (Figure 2).

Figure 2. *Arithmetic mean of receivables cycle by food industries (days)*



Source: *Own calculation based on Central Statistical Office data (2005-2020).*

There is relatively low variability in DSO between industries. During the study period, the coefficient of variation did not exceed 30% for all industries.

Table 3. *Values of selected descriptive statistics of receivables cycle by food industries (days)*

Branches	Minimum	Lower quartile	Median	Upper quartile	Maximum	Coefficient of variation (%)	Skewness
1011	29	32	34	39	43	13,9	0,33
1012	31	34	35	37	38	7	-0,29
1013	26	28	29	34	35	11,1	0,31

1020	53	55	61	70	80	13,2	0,38
1031	50	65	70	80	87	16	-0,33
1032	47	55	62	65	78	13,6	0,43
1039	45	52	52	53	56	4,7	-1,34
1040	22	27	32	35	44	21,3	0,43
1051	37	39	40	41	43	4,8	-0,42
1052	26	31	40	45	50	21,1	-0,14
1061	36	48	51	51	56	10,2	-1,77
1062	46	50	51	58	63	11,5	0,6
1071	32	33	35	36	40	7,9	0,68
1072	46	52	56	59	63	9,6	-0,4
1073	43	49	60	64	68	15,9	-0,41
1081	37	40	43	45	53	9,8	0,67
1082	52	58	67	70	82	13,3	0,13
1083	55	63	66	69	76	9,1	0
1084	56	63	66	68	75	7,5	0,09
1085	29	46	51	62	83	21,1	0,34
1086	43	45	48	63	65	17,3	0,38
1089	53	57	60	63	71	8,7	0,7
1091	43	44	45	47	52	5,8	1,26
1092	32	48	51	66	79	27,3	-0,09

Source: *Own calculation based on Central Statistical Office data (2005-2020).*

According to observations, the following industries reported relatively short days sales outstanding: production of meat products, including poultry meat products (1013) (26-35 days), manufacture of oils and fats of plant and animal origin (1040) (22-44 days), processing and preserving of poultry meat (1012) (31-38 days), manufacture of bread; manufacture of fresh pastry goods and cakes (1071) (32-40 days), and processing and preserving of meat, excluding poultry meat (1011) (29-43 days) (Table 3).

It is also worth noting that liquid fat and oil producers had shorter waiting times for receivables in the manufacture of oils and fats of plant and animal origin (1040).

Conversely, the DSO was longer in the following industries: processing and preserving of potatoes (1031) (50-87 days), processing of tea and coffee (1083) (55-76 days), manufacture of condiments and seasonings (1084) (56-75 days), manufacture of cocoa, chocolate and sugar confectionery (1082) (52-82 days) and processing and preserving of fish, crustaceans and molluscs (1020) (53-80 days).

Between 2005 and 2007, Bieniasz *et al.* (2009) conducted a study on the duration of the receivables cycle. They indicated that manufacturers of feed and pet food waited longer to collect their receivables (48-54 days). However, they were not included in the long-DSO group in this study since they reported a waiting time of less than 60

days.
It should also be noted that Bieniasz *et al.* (2009) considered feed and pet food manufacturing as a single category, whereas this study divides it into two categories, manufacture of prepared feeds for farm animals (1091) and manufacture of prepared pet foods (1092).

They had a significant difference in the amount of time they spent waiting for receivables. Namely, it was shorter in manufacturers of prepared feeds for farm animals. The average and maximum values were 46 and 52 days, respectively. In turn, as regards manufacturers of prepared pet foods, the average days sales outstanding was 56 days.

The above example confirms the differences between industries in how long they wait for receivables. Additionally, it underscores the importance of considering this phenomenon in financial assessments and demonstrates the significance of determining average DSO values.

4.3 Short-Term Liabilities Cycle

Another sub-cycle of cash conversion, short-term liabilities cycle, specifies the number of days it takes for the company to pay its current liabilities (Sierpińska and Jachna, 2009). A review of the extant literature on the subject reveals a paucity of clear boundaries for that ratio (Czerwińska-Kayzer, 2022).

As emphasized by Bieniasz and Czerwińska-Kayzer (2007), it should be synchronized with the operating cycle. Conversely, Dobija (2008) asserts that a DPO of approximately 55 days is conducive to optimal outcomes.

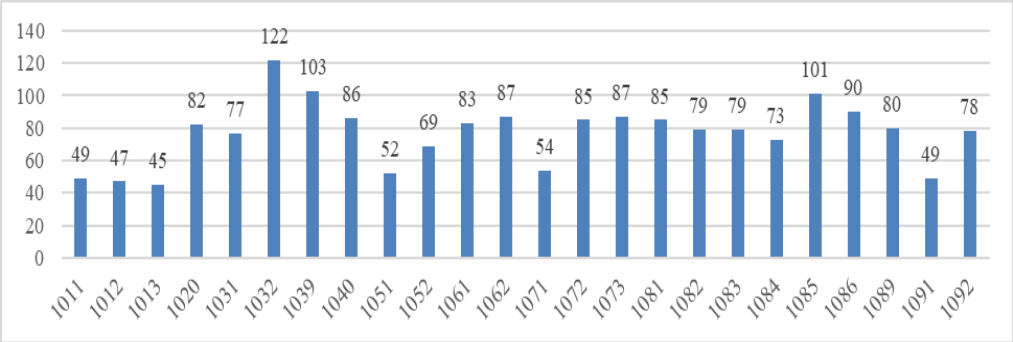
As shown in Table 4, there was relatively low variability in days payable outstanding across the food industry. The greatest variability was witnessed in the following industries: manufacture of oils and fats of plant and animal origin (1040), manufacture of sugar (1081) and manufacture of prepared meals and dishes (1085), each with a coefficient of variation of over 25%.

Conversely, the smallest variability in DPO was recorded in the following industries: processing and preserving of fish, crustaceans and molluscs (1020) and operation of dairies and cheese making (1051), with a coefficient of variation of 4.7% and 5.2%, respectively. It is noteworthy that the distribution of values observed in half of the industries under consideration exhibited slight right-side skewness.

According to the analysis of DPO across the industries, the shortest were found in: production of meat products, including poultry meat products (1013) (37-51 days), processing and preserving of poultry meat (1012) (40-52 days), processing and preserving of meat, excluding poultry meat (1011) (44-55 days), manufacture of prepared feeds for farm animals (1091) (42-55 days), operation of dairies and cheese

making (1051) (49-58 days) and manufacture of bread; manufacture of fresh pastry goods and cakes (1071) (45-59 days).

Figure 3. *Arithmetic mean short-term liabilities cycle by food industries (days)*



Source: *Own calculation based on Central Statistical Office data (2005-2020).*

In turn, the DPOs recorded in the following industries were much longer: manufacture of fruit and vegetable juice (1032), other processing and preserving of fruit and vegetables (1039) and manufacture of prepared meals and dishes (1085), with average values of 122, 103 and 101 days, respectively (Figure 3).

Table 4. *Values of selected descriptive statistics of short-term liabilities cycle by food industries (days)*

Branches	Minimum	Lower quartile	Median	Upper quartile	Maximum	Coefficient of variation (%)	Skewness
1011	44	46	48	51	55	6,9	0,32
1012	40	45	48	50	52	8,2	-0,52
1013	37	43	43	47	51	9,0	0,23
1020	76	80	82	84	93	4,7	1,16
1031	52	72	79	83	94	14,5	-0,66
1032	98	111	116	132	164	13,9	1,01
1039	90	97	102	107	121	8,7	0,61
1040	37	48	93	119	127	40,4	-0,30
1051	49	50	52	54	58	5,2	0,73
1052	53	66	68	76	80	11,6	-0,45
1061	63	83	85	87	90	9,1	-2,19
1062	67	81	85	95	106	12,8	-0,06
1071	45	52	56	57	59	8,6	-1,01
1072	75	80	87	90	97	8,3	0,23
1073	61	78	90	99	111	17,4	-0,34
1081	60	69	74	90	142	29,1	1,32
1082	66	75	77	84	101	10,7	1,23
1083	60	66	73	92	116	22,7	0,93
1084	61	67	75	79	86	10,8	-0,07
1085	59	84	96	114	166	25,2	1,02

1086	73	85	88	93	113	12,9	0,75
1089	59	77	81	84	101	14,0	-0,17
1091	42	45	51	52	55	8,7	-0,38
1092	55	68	78	91	96	19,1	-0,38

Source: *Own calculation based on Central Statistical Office data (2005-2020).*

As demonstrated in the study conducted by Bieniasz *et al.* (2009), a discrepancy was identified in the days payable outstanding ratio among industrial processing businesses, too. Between 2005 and 2007, they reported an average value of 57 to 68 days. Food and beverage manufacturers were among the sectors with relatively short DPO.

4.4 Cash Conversion Cycle

As shown in Table 5, the cash conversion cycle varied considerably among food manufacturers, ranging from 49 to 112 days. More than half of the considered industries exhibited high coefficients of variation, confirming the difference in cash conversion duration across the food industry.

According to the asymmetry analysis, there is slight right-side skewness. This indicates that the majority of industries had below-average cycle durations during the study period. As demonstrated by Kukeli *et al.* (2025), the average cash conversion cycle is 90 days and ranges from 85 days during economically stable times to 92 days during crises. However, this study does not corroborate the above findings.

The following industries had the longest cash conversion cycles, which are positive and suggest the need for additional financing, manufacture of starches and starch products (1062) and manufacture of sugar (1081).

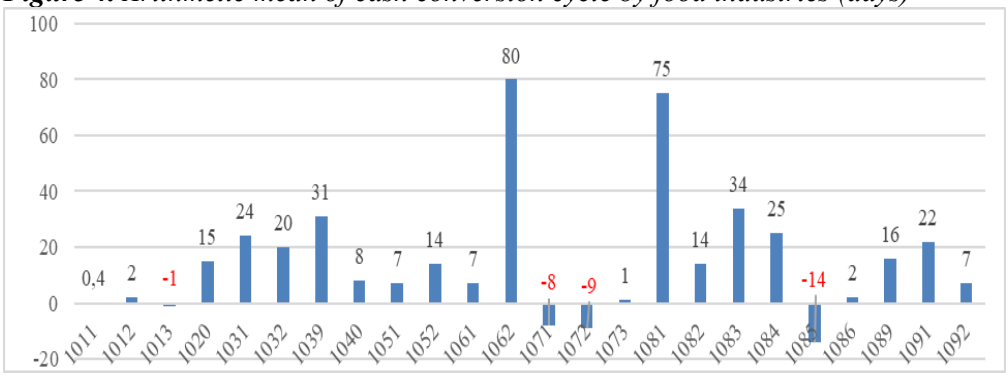
In both industries, the average time between when the company spends money and receives cash was above two months (Figure 4), and the coefficients of variation indicated minimal differences among businesses. As regards manufacture of starches and starch products and manufacture of sugar, the cycle took 54-111 days and 41-112 days, respectively.

The literature views a negative cash conversion cycle as desirable because it means the company is financed by its suppliers (Sierpińska and Jachna, 2009). While this is normal in trading operations (Czerwińska-Kayzer, 2022), prolonged periods of negative cash conversion cycles are considered disadvantageous in other types of business (Bieniasz *et al.*, 2009).

During the study period, more than half of the industries in the Polish food industry exhibited negative cash conversion cycles. The following industries had a negative average cash conversion cycle: manufacture of prepared meals and dishes (1085),

manufacture of rusks and biscuits; manufacture of preserved pastry goods and cakes (1072), manufacture of bread; manufacture of fresh pastry goods and cakes (1071) and production of meat products, including poultry meat products (1013).

Figure 4. *Arithmetic mean of cash conversion cycle by food industries (days)*



Source: *Own calculation based on Central Statistical Office data (2005-2020).*

In the baking and sugar industries, it took 50% of businesses no less than eight days to pay their short-term liabilities. In turn, in the production of prepared meals, dishes, and beverages, current liabilities took 17 days or more to settle in 50% of cases. Conversely, the median for that ratio was -1 day for manufacturers of meat products, including poultry meat products, and other food products not elsewhere classified (Table 5).

The negative cash conversion cycle discovered in industries listed above, especially in the manufacture of bread, fresh pastry goods and cakes, rusks and biscuits, preserved pastry goods and cakes, and prepared meals and dishes, can be considered normal and is explained by the short production cycle of these foods.

Table 5. *Values of selected descriptive statistics of cash conversion cycle by food industries (days)*

Branches	Minimum	Lower quartile	Median	Upper quartile	Maximum	Coefficient of variation (%)	Skewness
1011	-6	-4	1	4	6	115,4	-0,21
1012	-4	-3	3	5	6	220,1	-0,47
1013	-8	-5	-1	5	6	-500,1	-0,04
1020	8	11	15	20	24	34,3	0,05
1031	9	20	23	28	34	29,4	-0,36
1032	-6	7	16	32	57	88,7	0,63
1039	16	24	31	37	40	24	-0,33
1040	-33	2	15	22	27	232,5	-1,17
1051	3	6	7	9	10	26,7	-0,39
1052	1	7	10	19	34	73,2	1,05
1061	3	6	7	9	12	36	-0,02

1062	54	67	73	94	111	24,9	-0,54
1071	-13	-10	-8	-7	-3	-35,7	0
1072	-22	-14	-10	-4	3	-83,4	0,09
1073	-18	-5	1	4	25	1201	0,56
1081	41	66	73	87	112	24,8	0,04
1082	-12	7	15	26	33	93,9	-0,47
1083	-19	29	35	45	57	54,6	-1,6
1084	9	22	25	30	35	28	-0,73
1085	-49	-24	-17	-3	15	-133,3	-0,1
1086	-16	-7	-1	8	25	701,3	0,65
1089	-5	8	17	24	31	66,6	-0,34
1091	14	18	23	26	27	20,8	-0,44
1092	-7	2	7	11	18	110	-0,32

Source: *Own calculation based on Central Statistical Office data (2005-2020).*

The following industries recorded a positive cycle cash conversion cycle, with an average of one week: manufacture of oils and fats of plant and animal origin (1040), operation of dairies and cheese making (1051), manufacture of grain mill products (1061) and manufacture of prepared pet foods (1092).

The most advantageous alignment of the cash conversion cycle (i.e., a value close to zero) was observed in the following industries: manufacture of bread, fresh pastry goods and cakes, manufacture of rusks and biscuits, and manufacture of preserved pastry goods and cakes, with the longest values being -3 days and +3 days, respectively. A similar beneficial situation was observed in three meat industries. These industries required no more than six days of external financing and credited their contractors for up to eight days (Table 5).

4.5 Average Duration of the Cash Conversion Cycle and Its Components

To achieve the study's practical goal, this section presents the average duration of the working capital cycle and its sub-cycles for the 24 industries of the food industry.

According to the collected data, the intervals of the cash conversion cycle vary by industry and are not always close to zero. The average duration was estimated to range between -7 and +7 days in the following industries, and it can be assumed to fluctuate around zero, processing and preserving of meat, excluding poultry meat; processing and preserving of poultry meat; production of meat products, including poultry meat products, and manufacture of macaroni, noodles, couscous and similar farinaceous products. Conversely, short positive cycles of no more than eight days are observed in the operation of dairies and cheese making and manufacture of grain mill products.

Negative cycles (from -4 to -15 days) were estimated in the following industries (this reflects a situation in which operations are financed with cash from suppliers),

manufacture of fresh pastry goods and cakes; manufacture of rusks and biscuits; and manufacture of preserved pastry goods and cakes.

The average intervals of the cash conversion cycle were estimated at 59–87 days for the manufacture of starches and starch products (1062), and 63–83 days for the manufacture of sugar (1081). As mentioned earlier, the relatively long cycle length is due to the long storage period (Table 6).

Table 6. *Values of average duration of the cash conversion cycle and its components by food industries (days)*

Branches	Cash conversion cycle		Inventory cycle		Receivables cycle		Short-term liabilities cycle	
	Lower limit	Upper limit	Lower limit	Upper limit	Lower limit	Upper limit	Lower limit	Upper limit
1011	-3	5	12	14	30	38	46	51
1012	-1	6	14	15	33	37	45	50
1013	-6	4	14	15	26	32	42	45
1020	11	20	32	35	54	69	81	84
1031	18	27	26	32	62	77	73	84
1032	3	28	77	88	57	67	105	127
1039	25	37	80	83	52	53	98	107
1040	5	25	35	73	28	35	57	128
1051	6	8	18	20	39	41	50	54
1052	4	16	36	52	34	47	62	72
1061	5	8	39	44	49	52	83	87
1062	59	87	95	124	47	55	78	92
1071	-10	-6	10	11	33	37	53	58
1072	-15	-4	20	23	52	59	82	92
1073	-4	5	29	34	52	67	79	101
1081	63	83	100	135	40	45	64	85
1082	6	25	25	30	61	73	72	82
1083	27	43	46	51	63	69	60	85
1084	21	29	29	34	63	67	69	82
1085	-27	-6	26	39	43	59	81	111
1086	-8	6	30	44	39	57	83	92
1089	8	26	33	43	56	63	77	84
1091	19	27	24	26	43	47	47	54
1092	3	12	26	30	42	60	65	89

Source: *Own calculation based on Central Statistical Office data (2005-2020).*

Long inventory cycles with an estimated average duration of 77–88 days were recorded in the production of fruit and vegetable juice (1032), as well as in the processing and preservation of other fruits and vegetables (1039). Note that, although the cycles are long, the range is narrow, 10 and 3 days, respectively (Table 6).

In addition to the inventory cycle, the other components of the cash conversion cycle are days sales outstanding and days payable outstanding. Table 5 shows the calculated average intervals for these ratios. Regarding days sales outstanding, it was noted that the time spent waiting for cash was distributed evenly, ranging from 30 to 60 days. This is consistent with what the literature states.

A greater variation was found in the average days payable outstanding. Relatively short periods and narrow intervals were estimated in the following industries: processing and preserving of meat, excluding poultry meat (1011); processing and preserving of poultry meat (1012); production of meat products, including poultry meat products (1013); operation of dairies and cheese making (1051); and manufacture of prepared feeds for farm animals (1091). The average intervals of days payable outstanding in these industries were as follows: 30-38, 33-37, 26-32, 39-41 and 43-47 days.

Conversely, relatively longer periods were estimated in the manufacture of fruit and vegetable juice (1032) (105-127 days), other processing and preserving of fruit and vegetables (1039) (98-107 days) and manufacture of prepared meals and dishes (1085) (81-111 days). A long and broad interval of days payable outstanding was found in the manufacture of oils and fats of plant and animal origin (1040) (with 57-128 days).

Note that, in this case, the width of the interval can be explained by the approach adopted in this study. Due to a lack of data, two business groups—manufacturers of oils and other liquid fats, and manufacturers of margarine and similar edible fats—were placed in a single industry.

5. Conclusions, Proposals, Recommendations

The cash conversion cycle is believed to be one of the best liquidity metrics thanks to its structure. It links each component of working capital to the cash conversion cycle, converting the amounts into indexes for easier understanding.

The study established that the cash conversion cycle varies significantly by industry and depends on the type of business. The results confirmed that the duration of working capital sub-cycles, i.e., days sales of inventory, days sales outstanding and days payables outstanding, also differs significantly across industries. Thus, the study corroborated the research hypotheses presented in this paper and demonstrated the necessity of determining the average duration intervals of the cash conversion cycle and its sub-cycles on a per- industries basis.

The average duration of working capital cycles may be useful for financial benchmarking of enterprises in a specific industry. Therefore, it can be a valuable tool for managers, investors, financial analysts, and controllers to assess liquidity. However, note that the time intervals presented in this paper do not represent a

reference value. Instead, they can serve as guidelines for analytical benchmarks, control, and planning because they are estimated using multiyear real-world data. Given the above considerations, the duration of working capital cycles in other industries and sectors remains an open question.

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