Average Collection Period Versus Day Sales Outstanding

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ABSTRACT

Corporate finance textbooks use various terms—Average Collection Period, Days Sales Outstanding, and Days Sales in Receivables, among others—to describe the speed with which the firm converts its sales to cash. Several textbooks go on to say these terms are synonymous, and yet different texts provide different formulas. Specifically, some calculate this metric as $\frac{Accounts\ Receivable}{Daily\ Credit\ Sales}$*, while others use* $\frac{Accounts\ Receivable}{Daily\ Sales}$*. We have not found a textbook that points out different definitions exist.*

We show that these are not two alternative ways of defining the same thing, but instead are really two distinct metrics with two completely different purposes. The most common use of either measure is as an input to estimate cash cycle, the average number of days between the time a firm disburses a dollar for its product's inputs and the time it gets that dollar back. As such, cash cycle = average age of inventory + average number of days customers take to pay – average time accounts payable are outstanding. Another potential benefit, although most textbooks do not focus on it, is to use this metric as a signal of the likelihood of an increase in customer defaults.

We show that the first metric, $\frac{Accounts\ Receivable}{Daily\ Credit\ Sales}$*, is an incorrect input for determining cash cycle. While it does provide a reasonable estimate of the amount of time a bill is outstanding given the customer bought on credit, it ignores cash purchases; ceteris paribus, cash purchases shorten the time the firm must wait for its money. However,* $\frac{Accounts\ Receivable}{Daily\ Credit\ Sales}$ *is the better choice when this metric is used for the purpose of estimating whether the rate of defaults is more likely to increase or decrease in the coming periods.*

INTRODUCTION

There are two common ratios used to estimate the speed with which a firm collects the proceeds from its sales. The first, $\frac{Accounts\ Receivable}{Daily\ Sales}$, measures the unconditional time it takes for a customer to pay. The other, $\frac{Accounts\ Receivable}{Daily\ Credit\ Sales}$, measures how long a customer takes to pay *conditional on his not paying in cash*. Unfortunately, there does not seem to be widespread appreciation for the fact that conceptually these are two different metrics that are measuring two completely different things. Moreover, textbooks use a number of terms to describe one of these two measures—Average Collection Period, Days Sales Outstanding, and Day Sales in Receivables, among others—and assert the terms are synonymous.

For the remainder of the paper, we use the following expressions to distinguish between these two measures. We define

$$Average\ Collection\ Period = ACP = \frac{Accounts\ Receivable}{Daily\ Credit\ Sales} \qquad [1]$$

and

$$Days\ Sales\ Outstanding = DSO = \frac{Accounts\ Receivable}{Daily\ Sales}. \qquad [2]$$

As indicated in Table 1, this is roughly consistent with the main labels textbook authors use, although a number of these authors suggest one or more of these terms are synonymous.

We emphasize that at this point it is not a matter of one measure's being "right" and the other "wrong." Instead, these are two different metrics with two different purposes. Which one is the correct one to use depends on context. We show that ACP is useful for estimating the likelihood of changes in customer default rates; while DSO can be used for this purpose, it is a noisier measure. On the other hand, DSO is an unbiased metric for estimating cash cycle, while ACP is completely inappropriate for this purpose.

The two measures are different only because of cash sales. If we know the proportion of sales, p_0, that are paid in cash,[1] then

$$\text{Daily Credit Sales} = (1 - p_0)(\text{Daily Sales}).$$

Thus, we can convert either metric to the other by the relationship

$$Average\ Collection\ Period = \frac{Accounts\ Receivable}{(1-p_0)Daily\ Sales} = \frac{Days\ Sales\ Outstanding}{1-p_0}.$$

Because $0 \leq p_0 < 1$, Average Collection Period $\geq$ Days Sales Outstanding, and the difference between the two is greater for larger values of p_0.

WHICH IS THE BETTER METRIC FOR PREDICTING DEFAULT RATES?

The differences between the two metrics can best be seen by example. Suppose that non-defaulting customers who buy on credit make their payments on the 30th day, on average. Because it exceeds 30 days, an ACP of 35 days would imply either that currently the accounts of those who will eventually pay are not representative of the population of customers who buy on credit, or that accounts receivable currently includes some customers who will default. If ACP increases from 35 to 40 days, then either the accounts have become less representative or the proportion of future defaulters has increased. Thus Bayes' Theorem implies that an increase in ACP means an increase in the likelihood of greater default rates in the future.

The same is true for DSO, but here the metric is noisier because increases in DSO may also be due to some customers who ordinarily pay cash instead choosing to buy on credit (but eventually paying their bills). For example, an increase in DSO from 35 to 40 days might be due to a non-representative sample, or to increased pending defaults, or to customers who ordinarily pay cash choosing to buy on credit (while the frequency of defaults remains constant). Both measures are noisy because accounts receivable may not be representative, but DSO is additionally noisy because it includes customers who ordinarily pay in cash and switch to credit but do not default. Because it is less noisy, ACP is a better metric for signaling changes in future default rates than is DSO.

Data from the years leading to W.T. Grant's bankruptcy in 1975 provides evidence of this. Grant had adopted a strategy of loose credit that it hoped would lead to greater market share, but which instead led to massive bad-debt losses. Table 2 shows that these bad-debt losses were signaled more emphatically by ACP, which increased 58.1 days (from 467.8 days to 525.9 days) between 1970 and 1971. By contrast, DSO increased by only 4.0 days (from 111.1 days to 115.1 days) during that same time, and by no more than 15.1 days in any of the eight years preceding Grant's bankruptcy (and that in 1974, the year immediately preceding bankruptcy).

This can also be seen in a more formal setting. Consider a firm with total annual sales S and three types of customers: (1) those who pay cash, (2) those who buy on credit, but will eventually pay their accounts on some day N, and (3) those who will default. At some point, those in group (3) will be classified as bad debts and dropped from Accounts Receivable; we assume this occurs on day M, M > max(N). We also represent by p_i the proportion of total sales that are made to customers whose obligation will be satisfied[2] at time i. Thus p_0 represents the total proportion of sales that are paid in cash, p_i the proportion that are paid on day i, $1 \leq i \leq N$, and p_M the proportion of sales that end in default on day M. If the probability that a customer pays on any given day is independent of the size of the transaction, then these values of p_i can be thought of as the probability a customer is of type i. At the time of sale, the firm can estimate but does not know with certainty the value of any p_i (except, of course, p_0).

If we count sales as transactions that are satisfied immediately, we find the average number of days until an obligation is satisfied is $\frac{\sum_{i=0}^{M} p_i i}{\sum_{i=0}^{M} p_i} = \sum_{i=0}^{M} p_i i$ because $\sum_{i=0}^{M} p_i = 1$. Similarly, if we omit cash sales from consideration, the average number of days until an obligation is satisfied is $\frac{\sum_{i=1}^{M} p_i i}{\sum_{i=1}^{M} p_i} = \frac{\sum_{i=1}^{M} p_i i}{1-p_0}$. These are the two values that DSO and ACP are designed to approximate.

Without loss of generality, we make several assumptions regarding total sales and the various types of customers. First we assume sales are uniformly distributed throughout the year. Also, we assume that all sales on any given day are distributed by the vector $\vec{p_i}$ of values of p_i described in the last paragraph. Violations of this assumption leave the standard metrics for DSO and ACP unbiased (because they appear only in the numerator of these metrics and so Jensen's Inequality does not create a bias), but would make DSO and ACP random variables and so would require us to express everything in terms of expected values. Finally, we assume that the DSO and ACP metrics have reached a "steady state," i.e., at least M days have transpired since the firm's origination. Once M days have passed, the other assumptions imply DSO and ACP will remain constant provided the components of $\vec{p_i}$ remain constant.

Given our assumptions, DSO = $\frac{Accounts\ Receivable}{Daily\ Sales} = \sum_{i=0}^{M} p_i i$ and ACP = $\frac{Accounts\ Receivable}{Daily\ Credit\ Sales} = \frac{\sum_{i=1}^{M} p_i i}{1-p_0}$. If either of these measures changes, then we can infer that the proportions p_i have changed. For example, suppose the average number of days non-defaulting credit customers take to pay, $\frac{\sum_{i=1}^{N} p_i i}{\sum_{i=1}^{N} p_i}$, remains constant, and yet ACP has increased. It must be the case that p_M has increased. Thus ACP is a useful metric for forecasting default rates because pending increases in the default rate, p_M, will cause increases in ACP first. Of course, in practice it is also possible that ACP has increased because $\frac{\sum_{i=1}^{N} p_i i}{\sum_{i=1}^{N} p_i}$ has increased; for example, customers who used to pay in 30 days have started paying in 40 days. As Ross, Westerfield, and Jordan [2013, p. 673] point out, "[when ACP increases] either customers in general are taking longer to pay, or some percentage of accounts receivable are seriously overdue." Nevertheless, if ACP has increased, Bayes' Theorem implies the likelihood of increased defaults has also increased, even though increased defaults are not guaranteed.

DSO also has the property that increases in the metric will be associated with increases in default rates. However, here the relationship is significantly weaker because there is also the possibility that p_0 has decreased while p_M has remained unchanged, with the decrease in p_0 going to increases in p_i for one or more i satisfying $1 \leq i \leq N$. Thus, even if $\frac{\sum_{i=1}^{N} p_i i}{\sum_{i=1}^{N} p_i}$ remains constant, an increase in DSO may just be due to more customers switching from cash to credit, but eventually paying. Therefore DSO is a noisier measure of pending defaults than is ACP.

WHICH IS THE BETTER METRIC FOR ESTIMATING CASH CYCLE?

The purpose of estimating cash cycle is to ascertain how fast investments in net working capital are converted back to cash. This information is useful not only to a firm that is choosing credit terms (either for a loan or an account payable) or has cash earmarked for another purpose that it can use if it is returned in time, but also to the firm's creditors who will want to assess the likelihood they will receive their money at the specified time. Certainly the greater the proportion of customers who pay in cash, the sooner the firm gets back its money. However, Average Collection Period considers only credit customers and is invariant to the proportion of customers who pay in cash. For an extreme example, if 90% of a firm's customers pay in cash, and the remaining 10% pay on the 60th day, then the relevant input for cash cycle should be the six days DSO produces, not the 60-day value that ACP suggests.

This is not a trivial distinction. Restaurants, supermarkets, service stations, and in fact most retailers have primarily cash or bank credit-card sales (which are generally booked as cash, e.g., see Wiley [2007]). Thus the issue of cash sales is not an unusual exception, but rather the rule in many industries. Despite W.T. Grant's problems shown in Table 2, for example, the fact remains that on average about 75% of their sales were cash sales, and use of ACP rather than DSO greatly overstates the average period of time between the sale and the receipt of cash.

That DSO is a more accurate metric than ACP for the purpose of estimating cash cycle can also be demonstrated more formally. The average day that cash is received from the sale of inventory is $\sum_{i=0}^{M} p_i i$, which is DSO.[3] Given this, ACP = $\frac{Days\ Sales\ Outstanding}{1-p_0}$ is biased upwards, with the bias being severe for firms that have a large proportion of cash sales.

Some might object that inclusion of cash sales will delude the user into believing accounts receivable will be collected sooner than they actually will be received. For example, if a quarter of the firm's sales are cash and the other three-quarters are collected on the 40th day, then Days Sales Outstanding = 30 days, yet only a quarter of the sales proceeds have been collected by this 30th day. This is a red herring, as the objection applies equally well to any pattern of receipts that is not a degenerate distribution with all sales collected after the same number of days. For example, suppose all sales are credit sales and that a fourth of the customers pay on the 10th day, while the remainder pay on the 50th day. The average collection period will be 40 days, but this does not mean that half the entire accounts receivable balance will be collected in 40 days; in fact, by construction, only a quarter of it will be collected in that timeframe.

A second objection to using Days Sales Outstanding as we have defined it above might be that using Average Collection Period leads to a more conservative estimate. In general, however, unbiasedness is preferable to conservatism. For example, conservatism would suggest a CFO might require a significantly higher return than a weighted cost of capital suggests, but this will lead him to reject positive-NPV projects and thus fail to maximize shareholder wealth. Shareholders would be better served if the CFO uses an unbiased estimate.

While our focus is on textbook treatment of cash cycle, some academic research also seems to have used Average Collection Period and Days Sales Outstanding interchangeably. For example, while Richards and Laughlin (1980) do not formally define the "Receivables Conversion Period" they use to find cash cycle, their examples make it clear they are using daily sales and thus what we define as Days Sales Outstanding. However, in a refinement that Gentry et al (1990) state "is based on the traditional concepts of the cash operating cycle (OC) and cash conversion cycle (CCC) shown in Richards and Laughlin," they use daily credit sales, not daily sales, thus biasing their estimate of cash cycle upwards.

CONCLUSIONS

Textbooks often suggest such terms as Average Collection Period, Days Sales Outstanding, and Days Sales in Receivables are synonyms, yet they provide different definitions. Some texts define these in terms of sales, while others use credit sales.

We show that these are actually two different metrics that conceptually measure two completely different things. The metric using sales (which we designate Days Sales Outstanding, or DSO) is useful for estimating the firm's cash cycle, while the metric using credit sales (which we designate Average Collection Period, or ACP) is a poor choice for this purpose. While it is not emphasized in most textbooks, both DSO and ACP can also be used as signals of future default rates by customers. Here ACP is the better measure because cash-paying customers, by definition, cannot default, and so focusing on customers who purchase on credit provides a more accurate input.

TABLE 1—TEXTBOOKS' LABELS AND DEFINITIONS FOR AVERAGE COLLECTION PERIOD OR DAYS SALES OUTSTANDING

	Labels as "Average Collection Period"	Labels as "Days Sales Outstanding"	Other Labels
Uses Total Sales	Bodie, Kane, and Marcus (9th Ed)	Brigham and Ehrhardt (13th Ed)[4] Brealey, Myers, and Allen (11th Ed)	Berk, DeMarzo, and Harford[5] Welch[6]
Uses Credit Sales	Block, Hirt, and Danielson (14th Ed) Cornett, Adair, and Nofsinger (3rd Ed) Titman, Keown, and Martin (11th Ed)		Ross, Westerfield, and Jaffe (10th Ed)[7] Ross, Westerfield, and Jordan 10th Ed)[7]

TABLE 2—W.T. GRANT'S ACP AND DSO IN THE YEARS LEADING TO ITS 1975 BANKRUPTCY

	Total Sales	Credit Sales	Accounts Receivable	DSO	ACP
1967	$979,500	$215,500	$237,100	88.4 days	401.6 days
1968	$1,091,700	$235,400	$282,600	94.5 days	438.2 days
1969	$1,210,900	$262,800	$324,400	97.8 days	450.6 days
1970	$1,254,100	$297,900	$381,800	111.1 days	467.8 days
1971	$1,374,800	$301,000	$433,700	115.1 days	525.9 days
1972	$1,644,700	$342,300	$493,900	109.6 days	526.7 days
1973	$1,849,800	$406,300	$556,100	109.7 days	499.6 days
1974	$1,762,000	$451,400	$602,300	124.8 days	487.0 days

The data in this table were obtained from Tranchin (1977). While DSO (= $\frac{Accounts\ Receivable}{Daily\ Sales}$) provided some warning that Grant was facing credit default problems, even stronger warning was provided by the more rapid rise in ACP (= $\frac{Accounts\ Receivable}{Daily\ Credit\ Sales}$). Specifically, while the largest increase in DSO was 15 days (from 1973 to 1974), this was dwarfed by the largest increase in ACP, 58.1 days between 1970's 467.8 days and 1971's 525.9 days.

ENDNOTES

[1] We assume $p_0 < 1$ because, if $p_0 = 1$, then all sales are for cash and none on credit, and so ACP would be undefined.

[2] By "satisfied" we mean "not (or no longer) a component of Accounts Receivable." Cash transactions are satisfied immediately, because those amounts never become an account receivable. Defaults are not "satisfied" in the traditional meaning of the word, but at date M they are removed from Accounts Receivable. All other transactions are satisfied on the date the customer's obligation is paid.

[3] While bad debts are "satisfied" when they are written off on day M, this metric treats them as actually *collected* on that day. In the context of estimating cash cycle, then, a more accurate treatment would be to account for bad debt loss as uncollected by estimating p_M and calculating $\frac{\sum_{i=1}^{M} p_i i}{1-p_M}$. Because bad debt losses are presumably a small proportion of sales, the bias is fairly small. Nevertheless, we have not seen any text that makes this point at all.

[4] Specifies "Average Collection Period" as synonymous.

[5] Actually labels as "Accounts Receivable Days," but specifies "Average Collection Period" and "Days Sales Outstanding" are synonymous.

[6] "Days Receivables Outstanding," but specifies "Days Sales Outstanding" and "Average Collection Period" are synonymous.

[7] Both Ross and Westerfield books say "Days Sales in Receivables" and calculate the ratio using sales, but both state in a footnote that "We have implicitly assumed that all sales are credit sales. If they were not, then we would simply use total credit sales in these calculations, not total sales."

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