

The Cost of Trade Credit: A Net Present Value Perspective

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Abstract:

Trade credit represents a substantial portion of short-term credit for most firms. A trade credit decision is usually limited to a comparison of the effective cost of trade credit with the annual cost of borrowing. If the cost of not taking the cash discount exceeds the firm's borrowing cost, the decision is to take the cash discount. This article examines traditional trade credit analysis, and reveals its inconsistencies with shareholder wealth maximization. The cost of foregoing trade credit and the cost of changing suppliers offering different trade credit terms are modeled using a net present value (NPV) framework.

Article:

INTRODUCTION

Trade credit is a two-sided transaction. The selling firm records an account receivable, thereby creating short-term credit. The purchasing firm records an accounts payable, thereby increasing its short-term debt. Through collection, the selling firm converts accounts receivable to cash and reduces the implicit loan to its customer. The customer, in turn, must seek replacement funding for the credit lost. In essence, both firms are knowingly engaged in a zero-sum game.

Financial theories have explained the use of trade credit by differential borrowing costs and tax rates for buying and selling firms, by informational advantages to the seller of offering trade credit, and by sellers using trade credit as a substitute for instituting more costly measures such as changing the product or service price and/or changing the production queue.

Although trade credit is a large short-term liability for most firms, the literature on the management of trade credit is comparatively sparse. The traditional trade credit model specified in most finance textbooks offers a quick method to make a payables decision, however, as presented in this study, the decision rendered using this model is not always consistent with shareholder wealth maximization.

This study examines the cost of accounts payable from a net present value (NPV) perspective. The NPV models of a trade credit decision are developed for single- and multiple-period purchases, and for a comparison of competing supplier terms. Traditional trade credit analysis is also compared to the net present value approach assuming specific reinvestment rate assumptions. The NPV of trade credit is more flexible than the traditional approach, and most importantly, it is always consistent with shareholder wealth maximization.

THEORIES OF TRADE CREDIT

Financial models explaining the use of trade credit are often founded on imperfections in the capital markets. These imperfections include differential borrowing costs, taxes, and information costs.

Schwartz [12] suggests that suppliers with lower borrowing costs will offer trade credit to smaller, less financially secure customers, who would otherwise pay higher costs to financial intermediaries. In times of tight credit, such suppliers offer increasingly more trade credit to enhance their relation with their customers who have limited borrowing ability in the credit markets.

A differential taxation theory is proposed by Brick and Fung [2], who argue that suppliers who are in higher tax brackets than their customers gain by offering trade credit to buyers in lower tax brackets. The tax rate, in effect, partially determines the after-tax borrowing cost. Buyers that are able to borrow at a lower after-tax cost than the seller will prefer to pay the cash price.

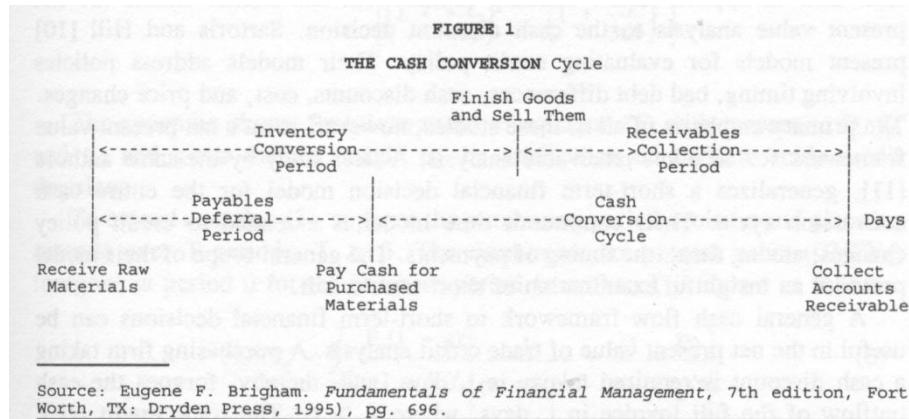
Emery [3] develops a model based upon information costs. Sellers are able to earn a higher return than on marketable securities. Buyers borrow at a rate lower than offered by intermediaries, because third-party lenders do not possess the direct credit information about the buying firm's ability to pay. Emery [4] also advances trade credit as an operational decision. When demand fluctuates, sellers would rather adjust the trade credit terms than the price or production queue. A change in the price increases the information search cost of buyers, while a change in production (inventory increases or delivery lags) increases the cost to the seller. Long et. al. [8] provide empirical support for the operational theory.

Smith [13] develops a model based on asymmetric information. For the buyer, trade credit helps establish a reputation for product quality while it provides information about the buyer's credit worthiness. Also, the use of trade credit reduces the large initial marketing cost of establishing an initial sale, and helps the seller develop a continual on-going relationship with the buyer.

Long et. al. [8] suggest that since World War I, credit terms appear to be based on the frequency of purchase and the uniqueness of product. In essence, industry-specific terms emerged, which he notes "... is difficult to explain in a financial context, but is consistent with verifying product quality for relatively unknown unique, goods." [8, p. 119]. Long et. al cite early work Ettinger and Goleib [5], who note the direct relation between product quality guarantees and the availability of substitute goods. In the highly competitive agricultural goods market, Long et. al. argue, goods have always been sold for cash than on a credit basis.

TRADE CREDIT AND THE CASH CONVERSION CYCLE

Trade credit is beneficial to a purchasing firm's cash flow because it lengthens the time interval between purchase and cash payment for materials. (See Figure 1). In terms of the cash conversion cycle, the longer the payables deferral period, the shorter a firm's cash conversion cycle. A firm that reduces its cash conversion cycle increases its liquidity. It is also in a position to rely on less discretionary short-term borrowing. The purchasing firm has the incentive to stretch the payment as much as possible. How long to stretch involves ethical, legal, and economic considerations; these topics are beyond the scope of this study.



Sellers try to shorten their own cash conversion cycle and to counteract the purchasers "stretch incentive." They encourage earlier payment than the net date by offering a cash discount. The cash discount represents a direct reduction from the purchase price for payment within a specified period. For example, a selling firm with terms of 2/10, net 30, is offering its customer the opportunity to pay only 98% of the invoice price if payment is made within 10 days but requires 100 percent of the invoice by day 30.

TRADITIONAL TRADE CREDIT ANALYSIS

The cost of trade credit is typically determined by annualizing a cash discount. If t_d is the cash discount period, t_n is the net period, and D is the discount expressed as a decimal, the effective annual rate (EAR) on accounts payable, i_p , is found as follows:

$$i_p = \left(1 + \frac{D}{1 - D} \right)^{\frac{365}{t_n - t_d}} - 1 \quad (1)$$

If the cost of trade credit in equation (1) exceeds short-term borrowing rate, a firm should take the discount even if doing so requires the firm to borrow short-term.¹ A more extensive analysis is deemed unnecessary. Although this approach offers simplicity, it is an implicit internal rate of return derivation. Therefore, it is not always consistent with shareholder wealth maximization.

NET PRESENT VALUE AND TRADE CREDIT

Little research of accounts payable policy has been undertaken. In contrast, researchers have conducted an extensive analysis of accounts receivables policy. Atkins and Kim [1], Sartoris and Hill [10,11], Hill and Riener [6], and others have conducted research on the use of net present value (NPV) analysis for short-term credit decisions. Atkins and Kim propose the use of discounted net cash flow as applied to net working capital. Hill and Riener extend the net present value analysis to the cash discount decision. Sartoris and Hill [10] present models for evaluating credit policy. Their models address policies involving timing, bad debt differences, cash discounts, cost, and price changes. The primary emphasis of all of these studies, however, is on a net present value framework for accounts receivable analysis. A later study by the same authors [11], generalizes a short-term financial decision model for the entire cash conversion cycle. Their continuous time model is extended to credit policy changes, among them, the timing of

payments. The general scope of their model provides an insightful examination of short-term credit.

A general cash flow framework to short-term financial decisions can be useful in the net present value of trade credit analysis. A purchasing firm taking a cash discount is required to pay in t_d days, and, thereby, forgoes the cash outflow of the full invoice in t_d days, where $t_n > t_d$. The trade credit NPV decision can be conceptualized as the present value of $P_0(1 - D)$ at time t_d minus the present value of P_0 at time t_n , where P_0 is gross purchases invoiced at time 0 and D is the cash discount. Time value of money discounting occurs at k_d , the per day (risk-free) borrowing rate. The net present value foregone by *not* taking the cash discount is shown in equation (2):

$$NPV_0 = [-P_0(1 - D)(1 + k_d)^{-t_d}] - [-P_0(1 + k_d)^{-t_n}] \quad (2)$$

When the net present value of equation (2) equals zero, the solution to lc , is the per day internal rate of return, or the per day cost of trade credit.

To expand equation (2) for purchases at any day t , let purchases grow according to the growth function $p(t) = (1 + g)^t$, where $p(t)$ is the pattern of purchases denoted by the function of purchases according to the per period growth rate (g) for (t) time periods. Accordingly, purchases at day t are $P_t = P_0p(t)$. Therefore, rewriting equation (2), the net present value foregone at day t (NPV_t) is:

$$NPV_t = P_t[(1 + k_d)^{-t_n} - (1 - D)(1 + k_d)^{-t_d}] \quad (3)$$

If the effective annual discount interest rate is i_p , assuming daily compounding of interest, the net present value as shown in equation (4) is:

$$NPV_t = P_t \left[\frac{1}{(1 + i_p)^{t_n/365}} - \frac{(1 - D)}{(1 + i_p)^{t_d/365}} \right] \quad (4)$$

Note that the internal rate of return in equation (4) should be conceptually the same as the effective annual cost of trade credit shown in equation (1). As a further extension, if k_p denotes the nominal annual interest rate, $k_p = 365[(1 + 01)^{1/365} - 1]$. Therefore, equation (4) can be rewritten:

$$NPV_t = P_t \left[\frac{1}{\left(1 + \frac{k_p}{365}\right)^{t_n}} - \frac{(1 - D)}{\left(1 + \frac{k_p}{365}\right)^{t_d}} \right] \quad (5)$$

The appendix shows first derivatives of equation (5) with respect to D , t_d , and t_n , and gives further insight to the application of NPV to trade credit decisions.

To extend equation (3), suppose the purchasing period decision and planning extends over T periods, $T \geq 0$. The cumulative net present value ($CNPV_0$) foregone at period 0 for the purchase period from 0 to T is shown as follows:

$$\text{CNPV}_0 = \sum_{t=0}^T \frac{P_0(1+g)^t}{(1+k_d)^t} \left[\frac{1}{(1+k_d)^{t_d}} - \frac{(1-D)}{(1+k_d)^{t_n}} \right] \quad (6)$$

In equation (6), purchases of P_0 occur on day 0, and purchases are assumed to have a daily constant growth rate of g for the next t days; these purchases are discounted at the firm's daily borrowing interest rate k_d for the same number of days. The net present value for a single day's purchases is captured in the second term of equation (6). The purchase terms call for payment of $P_0(1+g)^t(1-D)$ in t_d days of day t or $P_0(1+g)^t$ in t_n days of day t .

Now suppose a purchasing firm presently takes the cash discount and makes purchases of P , on day t . As before, the current supplier has terms of a cash discount D for payment in t_d days or net payment in t_n days. The purchasing firm is considering changing to a new supplier whose terms are a discount of D' for payment within t'_d days, or a net period of t'_n days. New purchases are P'_t , where $P_t = P_0 \hat{p}'(t)$. Therefore, assuming the cash discount is taken with either the current or new supplier, the incremental net present value of cash discounts from changing suppliers at time 0 is:

$$\Delta \text{NPV}_0 = P_0(1-D)(1+k_d)^{-t_d} - P'_0(1-D')(1+k_d)^{-t'_d} \quad (7)$$

For any day t , assuming purchases of $P_t = P_0(1+g)^t$ and $P = P''_0(1+g)$ for the current and new suppliers, respectively, the incremental net present value

is:

$$\Delta \text{NPV}_t = \frac{P_t(1-D)}{(1+i_p)^{t/365}} - \frac{P'_t(1-D')}{(1+i_p)^{t'/365}} \quad (8)$$

As before, k_p denotes the nominal annual interest rate and $Is = 365[(1+i_p)^{1/365} - 1]$. Therefore, equation (8) can be rewritten using the nominal annual discount rate as follows:

$$\Delta \text{NPV}_t = P_t(1-D) \left[\frac{1}{\left(1 + \frac{k_p}{365}\right)^{t_d}} \right] - P'_t(1-D') \left[\frac{1}{\left(1 + \frac{k_p}{365}\right)^{t'_d}} \right] \quad (9)$$

Summing the change in net present values in equation (7) over T periods, the cumulative change in net present value (ΔCNPV_0) at period 0, $T \geq 0$, is as shown:

$$\Delta \text{CNPV}_0 = \sum_{t=0}^T \frac{1}{(1+k_d)^t} \left[\frac{P_t(1-D)}{(1+k_d)^{t_d}} - \frac{P'_t(1-D')}{(1+k_d)^{t'_d}} \right] \quad (10)$$

The new supplier's terms should be accepted if ΔCNPV_0 . If the initial

gross purchases and purchasing growth function is unaffected by the choice of supplier, then the NPV decision to change suppliers should be based entirely on the length of the free trade credit periods and the cash discount percentages.

TRADE CREDIT DECISION USING NPV: AN EXAMPLE

Using equation (1), if the terms of credit are 2/10, net 30, the effective cost of trade credit is approximately 44.5853% as shown in (11)²

$$i_p = \left(1 + \frac{0.02}{1 - 0.02}\right)^{\frac{365}{30 - 10}} \quad (11)$$

$$= 44.5853\%$$

The equivalence of equation (11) with the NPV approach shown in equation (4) can be illustrated assuming purchases of \$12,000,000 on terms of 2/10, net 30. Using equation (4) and solving for the effective annual interest rate (i_p) that provides a net present value equal to zero, the internal rate of return (effective annual cost of trade credit) is approximately 44.5853% as before:

$$NPV_0 = \$12,000,000 \left[\frac{1}{(1 + 0.445853)^{30/365}} - \frac{(1 - 0.02)}{(1 + 0.445853)^{10/365}} \right] \quad (12)$$

$$\approx 0$$

Likewise, substituting $k_p \approx 36.8886\%$ into equation (4) results in a $NPV \approx 0$.³ When the discount rate exceeds 36.89%, the net present value will be negative. For example, at $k_p = 40\%$, the $NPV = -\$19,793.42$.

Suppose, however, that a firm can only invest the net payment delayed from t_d to t_N at $k_p = 10\%$, the firm's cost of borrowing rather than at 36.89%. At $k_p = 10\%$, the net present value is \$173,958.17 as presented in equation (13):

$$NPV_0 = \$12,000,000 \left[\frac{1}{\left(1 + \frac{0.10}{365}\right)^{30}} - \frac{(1 - 0.02)}{\left(1 + \frac{0.10}{365}\right)^{10}} \right] \quad (13)$$

$$= \$12,000,000(0.991815624 - 0.977319110)$$

$$= \$11,901,787.49 - \$11,727,829.32$$

$$= \$173,958.17$$

Therefore, a purchasing firm that does not take the discount and instead pays its supplier at day t_n forgoes a $NPV = \$173,958.17$, assuming the firm can invest the cash flow of $P(1 - D)$, otherwise paid at time t_d , at only $k_p = 10\%$. From another perspective, if the \$11,760,000 were not paid at day 10, and received periodic interest of $k_d = 10\%/365$ for 20 days (until day 30), the accumulated balance would be \$11,824,606.35. Therefore, the balance of the delayed payment with interest would fall short of the \$12,000,000 needed on day 30 by \$175,393.65. The present value of this shortfall at $k_d = 10\%/365$ per day for 30 days is \$173,958.17.

If the investment of the net cash flow from day t_d to t_n occurs at $k_p = 10\%$, a modified IRR calculation shows the true compounded rate of return on trade credit which is less than 44.58%. The modified IRR is found by equating the present value of the cash outflow less the discount (\$11,727,829.32) with the future value of the foregone cash outlay (\$12,000,000) at day t_n . This is done in equation (14) which shows the modified IRR to be approximately 32.20 % :

$$i_p = \left[\left(\frac{\$12,000,000}{\$11,727,829.32} \right)^{\frac{1}{30}} \right]^{365} - 1 \quad (14)$$

$$= 32.1997\%$$

Therefore, purchasers achieve a 44.58 % effective rate only if the cash outflow delayed from day t_d to t_n is invested at the effective rate (implicit in) 2/10, net 30 terms.

COMPARING SUPPLIER CREDIT TERMS USING NPV: AN EXAMPLE

When comparing supplier terms with different cash discounts and free trade credit periods of unequal lengths, the net present value and traditional cost of trade credit methods will produce conflicting selections. Suppose a purchasing firm currently uses a supplier with terms of 2/5, net 30, and is considering changing suppliers to one offering terms of 1.5/25, net 45. Using equation (1), the effective interest rate for the current supplier's terms is 34.31% versus 31.76% for the new supplier's. Therefore, on the basis of trade credit terms, the decision maker would choose to stay with the current supplier. However, using net present value and applying equation (9), equation (15) presents the numerical solution that changing suppliers produces incremental net present value by \$4,574.91, again using \$12,000,000 of purchases:

$$\Delta NPV_0 = \$12,000,000(1 - 0.02) \left[\frac{1}{\left(1 + \frac{0.10}{365}\right)^5} \right]$$

$$- \$12,000,000(1 - 0.015) \left[\frac{1}{\left(1 + \frac{0.10}{365}\right)^{25}} \right] \quad (15)$$

$$= \$4,574.91$$

To understand the incremental net present value from another perspective, find the present value of 98% of \$12,000,000 invested for the 20 days between day 5 and day 25, and subtract the present value of the \$60,000 difference in the net purchase price. The \$60,000 difference is attributable to the 0.5% difference in the discount. The net present value calculation is then as shown in equation (16):

$$\begin{aligned} \Delta NPV_0 &= \$12,000,000(1 - 0.02) \left[\left(1 + \frac{0.10}{365} \right)^{20} - 1 \right] \left[\frac{1}{\left(1 + \frac{0.10}{365} \right)^{25}} \right] \\ &\quad - \$12,000,000(0.02 - 0.015) \left[\frac{1}{\left(1 + \frac{0.10}{365} \right)^{25}} \right] \quad (16) \\ &= \$4,574.91 \end{aligned}$$

Without a NPV analysis, the decision maker would probably not change suppliers and would forego the credit terms with the higher NPV. If the new supplier had offered terms of 1.5/20, net 45 instead of 1.5/25, net 45, the effective interest cost would be 24.70% and the incremental NPV would be -\$11,515.18. In that case, both methods render the same decision.

The use of net present value techniques in trade credit decisions has other advantages. First, suppliers normally have different prices for their product. Net present value equations include the valuation effects of different purchases in addition to different trade credit terms. The NPV method also adheres to the value additivity property, unlike the effective cost of trade credit approach. Because NPVs are additive, a firm facing capital rationing restrictions can combine the NPVs of trade credit for many products and find the combination of products and credit terms that maximize shareholder wealth. The effective cost of trade credit method has many shortcomings that are remedied with the use of net present value.

CONCLUSION

Trade credit represents an important source of short-term financing. Using a traditional cost of trade credit analysis, however, can sometimes lead to incorrect trade credit decisions. The actual effective interest rate earned might be considerably less than suggested by a traditional cost of trade credit calculation. When a trade credit decision involves suppliers with different credit terms, a traditional analysis can fail to provide decisions consistent with shareholder wealth maximization. A decision criterion based on net present value avoids both problems. In addition, the NPV method explicitly shows the contribution of the cash discount on shareholder wealth.

NOTES

1. The effective rate in equation (1) can be conceptualized using dollar purchases of P_t at time t . This alternative approach for finding i_p is shown in equation (17):

$$i_p = \left[\left(\frac{P}{P(1 - D)} \right)^{\frac{1}{t_n - t_d}} \right]^{365} - 1 \quad (17)$$

The term inside the parenthesis of equation (17) equals one plus the interest rate earned for t_n minus t_d , periods. The calculation inside the brackets is daily interest rate plus one. The annualization and subtraction of one occur outside the brackets of equation (17). In many textbooks, the cost of trade credit is shown without the effects of compounding of interest as: Cost of Trade Credit = $D/(1 - D) \times (365/t_n - t_d)$.

2. The effective rate is easily verified from an accounting standpoint. Note that the periodic interest rate for 20 days is 2.0408% ($0.02/0.98$). The total cash discount for payment in 10 days is

$\$240,000 = \$12,000,000(0.02)$, which is \$657.53 per day ($\$240,000/365$). The net payment is \$11,760,000 ($\$12,000,000 - \$240,000$). Therefore, net daily payables are \$32,219.18 ($\$11,760,000/365$). The daily return for net receivables is $2.0408\% = \$657.53/\$32,219.18$. Using equation (1), $i_p = 44.58\%$.

3. Equations (12) and (13) are compatible with pre-programmed functions on a financial calculator or an electronic spreadsheet. To find k_p on a financial calculator, use the uneven cash flow function. Enter $CF_0 = CF_1 = \dots = CF_9 = 0$, $CF_{10} = -\$11,760,000$, $CF_{11} = CF_{12} = \dots = CF_{29} = 0$, and $CF_{30} = \$12,000,000$. The resulting IRR is 0.101064572%, which when multiplied by 365 days is 36.8886%. Similarly, the net present value of \$173,958.17 is found by entering the same cash flows, entering $k_p = 10\%/365$ as the interest rate, and using the net present value function. When using an electronic spreadsheet, enter the first thirty cash flows in consecutive cells down the worksheet. Use a daily interest rate of $k_d = 10\%/365$. In another cell, use the built-in @IRR or @NPV financial functions.

REFERENCES

1. Atkins, Joseph C. and Yong H. Kim. "Comment and Correction: Opportunity Cost in the Evaluation of Investment in Accounts Receivable," *Financial Management*, Winter, 1977, pp. 71-74.
2. Brick, I.E. and W.K. Fung. "Taxes and the Theory of Trade Credit," *Journal of Finance*, September, 1984, pp. 1169-1176.
3. Emery, Gary W. "A Pure Financial Explanation for Trade Credit," *Journal of Financial and Quantitative Analysis*, September, 1984, pp. 271-285.
4. Emery, Gary W. "An Optimal Financial Response to Variable Demand," *Journal of Financial and Quantitative Analysis*, June, 1987, pp. 209-225.
5. Ettinger, Richard P. and David E. Goleib. *Credit and Collections*, New York, Prentice-Hall, revised edition, 1938.
6. Hill, Ned C. and Kenneth D. Riener. "Determining the Cash Discount in the Firm's Credit Policy," *Financial Management*, Spring, 1979, pp. 68-73.
7. Hill, Ned C. and William L. Sartoris. *Short-Term Financial Management*, New York, Macmillan Publishing, 1988.
8. Long, Michael S., Ileen B. Malitz, and S. Abraham Ravid. "Trade Credit, Quality Guarantees, and Product Marketability," *Financial Management*, Winter, 1991, pp. 117-127.
9. Mian, Shehzad L. and Clifford W. Smith, Jr. "Accounts Receivable Management Policy: Theory and Evidence," *Journal of Finance*, March, 1992, pp. 169-200.
10. Sartoris, William L. and Ned C. Hill. "Evaluating Credit Policy Alternatives: A Present Value Framework," *Journal of Financial Research*, Spring, 1981, pp. 81-89.
11. . "A Generalized Cash Flow Approach to Short-Term Financial Decisions," *Journal of Finance*, May, 1983, pp. 349-360.
12. Schwartz, R.A. "An Economic Model of Trade Credit," *Journal of Financial and Quantitative Analysis*, September, 1974, pp. 643-657.
13. Smith, Janet K. "Trade Credit and Informational Asymmetry," *Journal of Finance*, September, 1987, pp. 863-869.
14. Weston, J. Fred and Pham D. Tuan "Comment on Analysis of Credit Policy Changes," *Financial Management*, Winter, 1980, pp. 59-63.

APPENDIX

By differentiating equation (5) with respect to D , t_d , and t_n separately, a more insightful examination of net present value of trade credit foregone is possible. For equations (18), (19), and (20), it is assumed that $0 \leq D < 1$, $P_t > 0$, and $k_p \geq 0$. The first derivative of NPV with respect to D indicates NPV is an increasing function of the cash discount as shown:

$$\frac{dNPV_t}{dD} = \frac{P_t}{\left(1 + \frac{k_p}{365}\right)^{t_d}} > 0 \quad (18)$$

The cash discount period (free trade credit period) also affects the NPV positively. As t_d becomes larger, the NPV increases, as shown in equation (19):

$$\frac{dNPV_t}{dt_d} = \frac{-P_t(D-1)\ln\left(1 + \frac{k_p}{365}\right)}{\left(1 + \frac{k_p}{365}\right)^{t_d}} > 0 \quad (19)$$

An increase in the net period, however, has a negative effect on the net present value. The first derivative of t_n with respect to NPV indicates that a longer net period decreases the NPV of trade credit as shown in equation (20):

$$\frac{dNPV_t}{dt_n} = \frac{-P_t \ln\left(1 + \frac{k_p}{365}\right)}{\left(1 + \frac{k_p}{365}\right)^{t_n}} < 0 \quad (20)$$