The Determinants of Trade Credit in the U.S. Total Manufacturing Sector

M. I. Nadiri

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This paper estimates a model specifying the determinants of trade credit in the United States total manufacturing sector for the postwar period. Trade credit is considered as a selling expense, like advertising outlays. Its determinants are derived from a profit maximization model in which the price, volume of output, and the selling costs are all variables to be jointly determined. The opportunity or user cost of accounts receivable and accounts payable are specified and the response of these accounts as well as net trade credit to changes in various monetary decision variables is examined.

I. INTRODUCTION

Trade credit has been a major and growing source of finance in all sectors of the United States economy since World War II. Its volume and widespread use have not been matched by any other kind of business financing. Yet trade credit, like other components of working capital, has received little attention in the literature. One reason for this neglect is that trade credit is buried in the distribution activity of the firm, and sorting out the complex institutional factors that influence its behavior is extremely difficult. The few available studies on the subject have been concerned primarily with assessing the response of trade credit to changes in monetary policy. Rarely has attention been given to developing an optimal model of trade credit based on the theory of the firm, to specifying the opportunity cost of extending or receiving trade credit, or to incorporating the influence of changes in the monetary policy instruments on the optimal level of trade credit.

In this paper we attempt to analyze these three problems. The brief discussion in Section 2 introduces the issues. The theoretical framework for the study is sketched in Section 3. In Section 3a, the concept of opportunity or “user” costs of accounts receivable and payable is developed. The relationship and response of these forms of trade credit to changes in monetary policy are discussed in Section 3b. The adjustment process is formulated in Section 3c. The empirical results of the model for accounts receivable, accounts payable, and net trade credit, i.e., the difference between accounts receivable and payable, are presented and analyzed in Section 4. The paper is concluded with a summary and an appendix describing the data sources and definitions of the variables used in the study.

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2. SETTING OF THE PROBLEM

Interbusiness trade credit is closely analogous to advertising.² Like advertising, trade credit affects the position and elasticity of the demand schedule of the firm. It is a way of expanding the market; it is also a selling cost arising in the context of the firm's joint pricing policy. The firm jointly provides goods and credit to its customers, just as it provides information, good will, and commodities when it advertises. Like advertising expenditure, trade credit is a capital investment that, by establishing permanent relations between lender and borrower, gives returns over time. Some other features of the behavior of trade credit in the United States economy are of interest: (i) The growth rate both of accounts receivable and accounts payable has been very high.³ (ii) There is considerable uniformity in the terms and methods of evaluating trade credit in each industry. Terms of trade credit are relatively stable, and the main criterion for extending credit is the creditor's selection of the customer—a type of non-price credit rationing.⁴ (iii) Trade credit is granted for a very short period. Thus its velocity is very high and could greatly influence the effectiveness of monetary policy. (iv) Both accounts receivable and accounts payable move closely with business activity. Accounts receivable seem to lag at the upper turning point of the business cycle and lead at the lower turning point, thus assisting in the recovery of business activity.

3. SPECIFICATION OF THE MODEL

As a selling expenditure, optimal trade credit policy can be analyzed in the context of a profit maximization model in which the price, quality, volume, and selling costs are all variables to be determined.⁵ Following Nerlove and Arrow [26], we postulate that the quantity (q) is a function of price (p), amount of trade credit (B), and a shift variable (z).⁶ Let z represent a monetary policy indicator. The demand function is:

\[ q = f(p, B, z). \]

² Movements in interbusiness trade credit are similar to movements of capital in international trade. Surplus countries, acting as vendors, accept the currency or IOU's of the deficit countries to enable the latter to postpone, temporarily, adjustment of their trade balances [20]. The aim of the creditor nations is to expand exports; the recipient countries attempt to meet their foreign exchange needs and perhaps finance their capital accumulation by accepting short term credit.

³ In total manufacturing, total receivables increased by $40 billion and accounts payable rose by $20 billion from 1947 to 1964. This development was accompanied by a substantial decrease in cash and short term securities, suggesting that manufacturing firms decreased their cash and government securities to finance accounts receivable. For further comments see [28] and [36].

⁴ There has been a general upward drift, with some fluctuations, in the collection period of trade credit in the manufacturing sector during the postwar period. This upward drift has been mainly due to the practices of the larger and more profitable firms. Over sixty per cent of the firms in this sector grant or receive trade credit on terms of a two per cent discount, ten days, and a net period of thirty days. See [8] and [28, p. 44–49].

⁵ To simplify, we assume that trade credit is the only selling expense, although the model can easily be extended to include other promotional and distribution costs. For various analyses of selling and promotion expenditures see [7, 13, 14, 17, 30, 34, and 35].

⁶ Unless specifically mentioned, B refers to either accounts receivable or payable throughout this paper.
The cost function of the firm consists of two elements, the production cost, \( c(q) \), and the selling expense, \( D \):

\[
(2) \quad c = c(q) + D.
\]

\( D \) is the sum of trade credit newly advanced (\( \dot{B} \)) and replacement of trade credit lost because of bad debts, delinquencies, etc. Suppose that the replacement component of \( D \) is \( \delta B \) where \( \delta \) is the rate of depreciation of trade credit. \(^7\)

The problem facing the firm is to select the optimal price (\( \hat{p} \)) and the optimal trade credit (\( \dot{B} \)) so that its net profit is maximized. This is done by first maximizing with respect to \( p \):

\[
(3) \quad \phi(p, B, z) = \int_0^\infty e^{-rt}[pf(p, B, z) - c(q) - D] \, dt,
\]

subject to the constraint

\[
(4) \quad D = \dot{B} + \delta B.
\]

Obtaining the optimal price (\( \hat{p} \)), we then maximize

\[
(5) \quad \phi_1(B, z) = \int_0^\infty e^{-rt}[\hat{pf}(B, z) - (r + \delta)B] \, dt
\]

for the optimal value of \( B \). Nerlove and Arrow [26] have shown that the solution for (5) is

\[
(6) \quad \frac{\dot{B}}{pq} = \frac{v}{\eta(r + \delta)},
\]

where \( v \) and \( \eta \) are the elasticities of demand with respect to trade credit and price, respectively, while \( r \) is the discount rate. In general, we can write

\[
(7) \quad \dot{B}_t = g(pq, \mu, z)
\]

where \( \mu = r + \delta \) is the opportunity or user cost of trade credit extended or received. \(^8\) The terms \( v, pq, \mu, \) and possibly \( \eta \), may be a function of the shift variable \( z \); \( v, \mu, \) and \( pq \) may increase with \( z \), but the direction of the effect of changes in \( z \) on the price elasticity of demand (\( \eta \)) is difficult to specify. We can postulate, however, the following reasonable hypotheses:

\[
(8a) \quad \frac{\partial \dot{B}}{\partial pq} > 0,
\]

\[
(8b) \quad \frac{\partial \dot{B}}{\partial \mu} < 0,
\]

\(^7\) \( \delta \) need not be a constant; it may vary with the profitability of the credit recipient and general business conditions. Delinquencies and bad debts do not capture all the costs associated with the deterioration of credit quality but serve as good signalling devices for subsequent bankruptcies, repossessions, etc. (see [10]).

\(^8\) The scale and user cost variables for accounts receivable and payable are conceptually somewhat different. See p. 414 of text.
and

\[ \frac{\partial B}{\partial z} \geq 0. \]

Hypothesis (8a) suggests that trade credit, as a condition of sales, is positively related to the level of sales; (8b) suggests that the amount of trade credit is inversely related to its opportunity cost, \( \mu \). According to (8c) the effect of changes in monetary policy on trade credit cannot be specified a priori; it all depends on how the demand and supply functions for trade credit shift in response to changes in the monetary policy.

3a. The Opportunity Cost of Credit

A complex set of factors influences the opportunity or user cost of trade credit. At best, we can provide only an approximation to the true user cost of trade credit. This discussion is in terms of the user cost of accounts receivable but is equally pertinent, with slight reinterpretation, to that of accounts payable.

Three types of costs are involved in the user cost of accounts receivable: the carrying cost, the depreciation cost, and the credit standards of the lender. The carrying cost of trade credit is the real income foregone by tying up funds in receivables. It consists of the interest rate on bills (\( r \)) adjusted for capital gains (losses), \( \hat{p}_h/p_h \), and changes in the general price level, \( \hat{p}/p \). We can write the carrying cost (\( s_1 \)) as

\[ s_1 = r + (\hat{p}_h/p_h) + (\hat{p}/p). \]

The relevant measure for \( r \) is the rediscount rate on accounts receivable at commercial banks. This rate is usually the prime commercial rate. The carrying cost of receivables is also influenced by the discount period (\( t \)) and the net period of the credit (\( T \)). By giving its customers discounts for a specified period, the creditor encourages them to pay earlier. By restricting the repayment of receivables to a net period \( T \), the creditors reduce their own carrying cost. The adjusted carrying cost of receivables is

\[ s = \left(1 - \frac{t}{T}\right)s_1. \]

Thus, if the customers pay during the discount period \( t \), or if the creditors reduce the net period of the loans by increasing \( T \), the carrying cost of receivables will decline.

The depreciation rate (\( \delta \)) of accounts receivable consists of two parts: percentage of bad debts (\( \beta \)) and delinquency rate (\( \alpha \)) on accounts outstanding. A certain fraction of the total receivables is lost each period due to bad debts; they are completely written off the books. Another part is not paid on time necessitating collection efforts, which are made at substantial costs. The depreciation rate of accounts receivable reflects the deterioration in the quality of credit which increases with the amount of credit extended.\(^9\) This rate, \( \delta = \beta + \alpha \), is similar to the depreciation cost of capital equipment, which results from technological change, utilization of capital equipment, etc.

\(^9\) Marginal firms with weak financial conditions become the recipients of trade credit during business expansion, thus increasing the possibility of defaults and losses in recessions.
The ability of the lender to finance receivables without jeopardizing its own financial and liquidity position is another component of the user cost of accounts receivable. The component, basically a qualitative and nonprice phenomenon, can be approximated by the liquidity position of the lender. If its liquidity position is favorable, it may extend more trade credit, even to marginal customers, to advance sales. By so doing, the lender lowers its credit standard and assumes greater risks of default. On the other hand, if the firm's own need for working capital is high, it may refrain from further extension of credit by making its credit standards more stringent.\(^{10}\) The liquidity position of the firm can be approximated, albeit imprecisely, by any one or a combination of the familiar financial ratios—quick ratio, working capital, debt-equity ratio, etc. [19, 29].

The user cost of accounts receivable is the sum of the three cost factors mentioned above, which can be written

\[
\mu = s + \delta + \psi, \tag{10a}
\]

where \(\psi\) is the previous quarter's quick ratio serving as an index of the liquidity position of the lender.

With slight reinterpretation \(\mu\) is also the user cost of accounts payable. The carrying cost of accounts payable consists of two parts: the interest rate on bank loans and the length of the period between the discount and net periods \((T - t)\).\(^{11}\) Since the terms of trade credit remain fairly stable, it is cheaper for the borrower to increase the volume or stretch the payment period of its accounts payable when the bank loan rate rises. By not paying on time or by imposing bad debts on its creditors, the borrower increases its future cost of credit. The lenders may refrain from extending further credit, may ask for higher interest payments, or may impose other stringent conditions. Thus, the lower the frequency of bad debts and delinquencies in the history of the borrower, the lower its cost of accounts payable.

This cost will be lower if the borrowing firm has a strong debt-repayment capacity. If the firm's liquidity is adequate, the probability of default is low; its creditor will be more lenient in extending credit or lengthening the maturity period of a loan. Thus \(\psi\) enters the user cost of accounts payable with a negative sign, i.e.,

\[
-\mu = s + \delta + \psi. \tag{10b}
\]

\(^{10}\) Meltzer states that firms, in their response to a tight monetary policy, finance their trade credit from their liquid assets. He uses the quick-ratio as the measure of liquidity. Unfortunately, Meltzer does not precisely spell out the mechanism through which changes in a firm's liquidity position influence its trade credit policy (see [21, 22]).

\(^{11}\) The borrower receives goods and services as well as credit at the time of transaction. It has a choice of paying immediately, at the end of the discount period \((t)\), or not paying until the end of the net period \((T)\). For the first choice, it of course receives a price reduction in the form of the discount. No matter which option it exercises, the opportunity cost of the trade credit is the cheaper alternative of raising funds from outside sources. We are assuming that the customer can always borrow from banks at the prevailing interest rate, or at some monotonically increasing function of such cost. The argument that some firms take trade credit solely because they cannot obtain funds from banks is not a real objection to the above statement. The customer can always mortgage its assets or pay very high interest to obtain the necessary funds; otherwise, it will soon be bankrupt.
We would expect \( \partial B/\partial \mu > 0 \); that is, the signs of the coefficients of \( s \), \( \delta \), and \( \psi \) in the accounts payable regressions should be positive.\(^{12}\)

3b. Monetary Policy Indicators

One issue extensively discussed in the literature is the response of trade credit to changes in monetary policy. Often the interest rate or some weighted measure of it is used as an indicator of changes in monetary policy \([2, 3, 16, 21, 22]\). Interest rates are not, in general, good indicators of monetary policy because they reflect forces other than the decisions taken by the monetary authorities. Changes in the rate of capital accumulation and in the stock of interest-bearing government securities affect interest rates irrespective of the actions of the monetary authorities (see \([4]\) for further comments).

Recently other indicators of monetary policy have been suggested. Karaken-Solow \([18]\) use the maximum earnings of the banking system as a measure of changes in monetary policy. Wood \([38]\) suggests using changes in the amount of government securities held by the Federal Reserve as a measure of “optimal policy” of the monetary authorities. Brunner and Meltzer \([4]\) compare different indices of monetary policy instruments in terms of their “optimal” monetary policy indicator and conclude that “money stock is the best approximation to the true indicator: it is the least misleading and least dangerous single guide to the position of monetary policy” \([4, p. 24]\).

In our empirical estimation, four indicators are used as proxies for \( z \) in equation (7). These are: changes in the money supply defined as the sum of demand and time deposits plus currency, the adjusted required reserve ratio, the maximum earnings of the banking system, and the high-powered money series (see the Appendix, p. 422). These measures are not ideal but are generally better and more direct indicators of monetary policy changes than are interest rates.\(^{13}\) The interest rate effect on trade credit is reflected in our model through the user cost, \( \mu \).

3c. Adjustment Process

Actual levels of receivables and payables may not always equal their desired levels. There are several reasons why such discrepancies should exist: the firm cannot always estimate its sales accurately and with certainty; most firms do not accurately anticipate changes in monetary policy or in the rates of default and bad debts on their trade credit; the discovery and collection of delinquent accounts take time and involve costs which may be distributed over time; the discrepancy may reflect disequilibrium in other assets of the firm, such as capital goods or

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\(^{12}\) Conceptually \( \delta \) and \( \psi \) in (10a) and (10b) are different. In (10a) they refer to the percentage of bad debts and the rate of delinquency of other sectors on manufacturing receivables. In (10b) they refer to bad debts and defaults of the manufacturing sector to other sectors of the economy. However, the same measures of \( \delta \) and \( \psi \) are used in the accounts receivable and accounts payable regressions. In the manufacturing sector, \( \delta \) and \( \psi \) have similar values for granting and receiving trade credit. See \([28]\).

\(^{13}\) The use of these indicators circumvents the time lag between Federal Reserve action and changes in the interest rate, thus reflecting more accurately the response of trade credit to changes in monetary policy decisions.
inventories, for disequilibrium in one item of the balance sheet affects the adjustment of other accounts;\textsuperscript{14} or it may be due to aggregation since an individual firm may instantaneously adjust its trade credit position but the adjustment of the whole sector may not be that quick.

We shall assume that the adjustment process of the actual to the desired levels of accounts receivable and accounts payable differs but both are geometrically declining. That is,

\begin{align}
[AR_t/AR_{t-1}] & = [AR_t^*/AR_{t-1}^*]^{\lambda}, \\
[AP_t/AP_{t-1}] & = [AP_t^*/AP_{t-1}^*]^{\gamma},
\end{align}

where $\lambda$ and $\gamma$ are the coefficients of adjustments, $AR_t$ is accounts receivable, and $AP_t$ is accounts payable. The desired values of $AR_t$ and $AP_t$ in terms of equation (7) can be written as

\begin{align}
AR_t^* & = g_1(pq, \mu, z), \\
AP_t^* & = g_2(pq, \mu, z).
\end{align}

Substituting in equations (11) and (12) for $AR_t^*$ and $AP_t^*$ and taking logs, we obtain the basic estimating equations:

\begin{align}
\ln AR_t & = a_0 + a_1 \ln X_{1t} + a_2 \ln \mu_t + a_3 d \ln z_t + a_4 \ln AR_{t-1}, \\
\ln AP_t & = b_0 + b_1 \ln X_{2t} + b_2 \ln \mu_t + b_3 d \ln z_t + b_4 \ln AP_{t-1},
\end{align}

where $X_{1t}$ is total sales, $X_{2t}$ is total purchases, $a_4 = 1 - \lambda$, and $b_4 = 1 - \gamma$.

4. EMPIRICAL RESULTS

Equations (15) and (16) were fitted to quarterly data for the United States total manufacturing sector for the period 1949-I to 1964-IV. The emphasis of the analysis is on the behavior of accounts receivable and accounts payable, but results are also reported for net trade credit in order to compare and relate our findings with those reported by other investigators (see [2, 3, 16, 21, 22, and 37]). The results are summarized in Tables I and II. In the Statistical Appendix, the data and specification of the variables are described.

Experiments with different forms of the regression equation for both $AR_t$ and $AP_t$ suggested the appropriateness of the logarithmic form.\textsuperscript{15} The results in Columns I and $I'$ of Table I are encouraging according to the conventional statistical criteria—high adjusted $R^2$, low standard error of estimate $S_y$, and statistically "significant" coefficients with expected signs.\textsuperscript{16} There is, however,

\textsuperscript{14} See, for example, [1] for further comments on this issue.

\textsuperscript{15} Regressions with linear, semi-log, and log linear forms were also fitted for $AR_t$ and $AP_t$ as well as net trade credit ($N_t$). On the whole the log linear form gave better results in terms of the usual statistical criteria. Note that the search for the appropriate form of the regression biases the statistical significance of the variables of the model.

\textsuperscript{16} Since the $R^2$ for the regressions are very high, about .98, and their $S_y$ are similar, these statistics are not reported in Tables I and II.
### TABLE I


<table>
<thead>
<tr>
<th>Variables</th>
<th>Accounts Receivable (AR&lt;sub&gt;t&lt;/sub&gt;)</th>
<th>Accounts Payable (AP&lt;sub&gt;t&lt;/sub&gt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Constant</td>
<td>-1.4091</td>
<td>-3.3512</td>
</tr>
<tr>
<td>ln X&lt;sub&gt;1&lt;/sub&gt;</td>
<td>0.6566</td>
<td>1.5484</td>
</tr>
<tr>
<td></td>
<td>(0.0928)</td>
<td>(0.0223)</td>
</tr>
<tr>
<td>ln X&lt;sub&gt;2&lt;/sub&gt;</td>
<td>0.0426</td>
<td>-1.1396</td>
</tr>
<tr>
<td>ln µ&lt;sub&gt;t&lt;/sub&gt;</td>
<td>(0.0164)</td>
<td>(0.0212)</td>
</tr>
<tr>
<td>ln ψ&lt;sub&gt;t&lt;/sub&gt;</td>
<td>0.0290</td>
<td>0.1100</td>
</tr>
<tr>
<td>d ln z&lt;sub&gt;t&lt;/sub&gt;</td>
<td>0.8962</td>
<td>1.2452</td>
</tr>
<tr>
<td></td>
<td>(0.4843)</td>
<td>(0.7848)</td>
</tr>
<tr>
<td>ln AR&lt;sub&gt;t−1&lt;/sub&gt;</td>
<td>0.5679</td>
<td>0.5916</td>
</tr>
<tr>
<td></td>
<td>(0.0584)</td>
<td>(0.0596)</td>
</tr>
<tr>
<td>ln AP&lt;sub&gt;t−1&lt;/sub&gt;</td>
<td>1.1811</td>
<td>0.8779</td>
</tr>
<tr>
<td></td>
<td>(0.3157)</td>
<td>(0.3157)</td>
</tr>
</tbody>
</table>

*The figures in parentheses are standard errors of the regression coefficients.*
some evidence of serial correlation in the residuals of the equations, especially in the $AR_t$ regression [27].

The elasticities of $AR_t$ and $AP_t$ with respect to the scale factors, $X_{1t}$ and $X_{2t}$, are substantially different. The sales elasticity of $AR_t$ is about twice the elasticity of $AP_t$ with respect to total purchases, $X_{2t}$. A unit increase in manufacturing sales to other sectors seems to generate more trade credit than a unit increase in sales of other sectors to the manufacturing sector. Similarly, the coefficient of $\ln \mu_t$ in the $AR_t$ regression is negative: it is much larger and also more significant than the positive coefficient of $\ln \mu_t$ in the $AP_t$ equation. When the cost of credit goes up, the manufacturing firms seem to reduce or at least to postpone extending receivables and attempt to increase their payables from other sectors of the economy.\(^{17}\)

The signs of $\ln \mu_t$ in both equations are as expected and are mainly due to the stability of the terms of advancing or receiving trade credit. When the interest rate goes up and/or the need for working capital increases, the lenders do not usually change the terms of credit. Instead of charging higher interest for unpaid bills or increasing prices for goods sold by shortening the period or lowering the amount of the discount, they simply reduce the amount of credit to new and marginal firms. The borrowers, on the other hand, attempt to stretch the period of payment or acquire more credit from their suppliers when the cost of bank loans increases.

In both equations (15) and (16) the dominant influence of the user cost is due to the liquidity factor $\psi$. When the user cost ($\mu$) is decomposed into two components, $\bar{\mu} = s + \delta$ and $\psi$, and the equations are re-estimated, the coefficients of $\psi$ in both equations are statistically significant and much larger than the coefficients of $\bar{\mu}$, (see Columns 3 and 3′ of Table I). In the $AR_t$ regression even the sign of $\bar{\mu}$ becomes positive. The sign of $\psi$ in this equation suggests that the internal need for working capital is an important determinant of extending credit. The lender’s credit standard becomes stringent when it needs liquid assets for its own operation. As a borrower, the firm’s ability to acquire more trade credit is enhanced when its liquidity position, i.e., its debt-repayment capacity, is improved. Other effects of this decomposition are a lowering of all the coefficients except that of $\ln AR_{t-1}$ in the $AR_t$ equation and an increasing of all the coefficients except that of $\ln X_{2t}$ in the $AP_t$ regression (Columns 3 and 3′ of Table I). When $\psi$ is assumed to be zero, the coefficients of $\bar{\mu}$ in both equations have the expected signs, but the value of the coefficients changes substantially from those in Columns 1 and 1′ of Table I (Columns 4 and 4′).\(^{18}\)

When the user cost $\mu$ is excluded from the regression equations, the coefficients of $\ln X_{1t}$ and $\ln AR_{t-1}$ change; only slight changes occur in the remaining coefficients (see Columns 6 and 6′ of Table I).

\(^{17}\) These statements hold if we assume that the manufacturing sector extends or receives all or a given part of its receivables and payables to or from other sectors of the economy. The FTC-SEC data on accounts receivable and payable used in this study include consumer credit and credit transfers among manufacturing firms.

\(^{18}\) One reason for the instability of the sign of $\ln \mu$ in the $AR_t$ equation could be the extremely large fluctuations in the quick-ratio series. Other measures of liquidity such as current ratio, debt-total assets ratio, or a combination of several liquidity indices could be used as proxies for $\psi$. For further suggestions on this subject see [29].
Various measures of monetary policy instruments mentioned on page 413 were used as proxies for $d \ln z$, in equations (15) and (16). The results were generally similar; however, the supply of money defined as the sum of currency, demand, and time deposits seemed to perform better. The coefficient of this variable in both equations is positive, statistically significant, and highly stable. The stability of the coefficient of $d \ln z$, is affected substantially by whether or not the coefficient of $\psi$ is constrained to zero (see Columns 4 and 4' of Table I). The coefficients of $d \ln z$, in each equation decrease by about fifty per cent when $\psi$ is excluded from the regression equations. This suggests that the main effect of changes in monetary policy is probably transmitted through the liquidity position of the firm.\textsuperscript{19} The magnitudes of the responses of both $AR_t$ and $AP_t$ to changes in monetary policy seem to be relatively high and equal, which suggests that the difference between $AR_t$ and $AP_t$ may not be affected by $d \ln z$. We shall see later that this is the case. This finding contrasts with the conclusions of Brechling-Lipsey [2] and Meltzer [22].

4a. The Adjustment Process

The adjustment coefficients of equations (15) and (16) differ from each other. The lagged dependent variables in these equations reduce the serial correlation of the residuals [27]. When $\ln AR_{t-1}$ and $\ln AP_{t-1}$ are excluded from the regression equations, the coefficients of most of the variables retain their sign and "significance" but the serial correlations of the residuals increase with no change in the $R^2$ of the equations (see Columns 2 and 2' of Table I). The adjustment coefficient in the $AR_t$ equation $\lambda$ is about .55 while $\gamma$ in the $AP_t$ equation is about .70, implying an average lag of 1.3 quarters and 2.4 quarters, respectively, for the actual values of these accounts to adjust to their desired levels.\textsuperscript{20} The faster adjustment of $AR_t$ may reflect the better control of the lender over its receivables rather than the ability of the borrower to adjust its accounts payable. Moreover, when the

\textsuperscript{19} For a similar suggestion see [21].

\textsuperscript{20} The average and variance of the adjustment lags of equations 1 and 1' of Table I are calculated by the formulae:

(1) average lag:

$$E\Theta_{AR_t} = \frac{\lambda}{1 - \lambda} = \frac{.5679}{1 - .5679} = 1.3143,$$

$$E\Theta_{AP_t} = \frac{\gamma}{1 - \gamma} = \frac{.7066}{1 - .7066} = 2.4083,$$

(2) variance of the lag:

$$V_{AR_t} = \frac{\lambda}{(1 - \lambda)^2} = \frac{.5679}{(.4321)^2} = 3.0418,$$

$$V_{AP_t} = \frac{\gamma}{(1 - \gamma)^2} = \frac{.7066}{(.2934)^2} = 8.2067.$$
distributions of the adjustment lag for $AR_t$ and $AP_t$ are compared with those of other assets such as real cash balances, labor, and capital stock services. We find that the more liquid an asset the faster and less variable is its adjustment path. Thus, the accounting procedure of constructing balance sheets can be rationalized in terms of the adjustment process underlying different assets and liabilities of the firm.

4b. Comparison with Other Models

Relatively few empirical studies of trade credit are available in the literature. The main contributors are Meltzer [21], Brechling and Lipsey [2], and Junk [16]. Meltzer argues that when monetary policy is tightened, firms increase their trade credit by running down their liquid assets such as cash and government securities. Brechling and Lipsey reach a similar conclusion in their interesting study of interfirm trade transfers among British companies during the period 1952 to 1958. Their main conclusions are: trade credit, both granted and received, rises in times of tight money and falls in times of easy money; net trade credit had a relatively strong inflationary impact on the English economy during this period. Junk, using quarterly interest rates as an indicator of monetary policy and a simple correlation technique, reports that net trade credit is insensitive to changes in monetary policy.

To compare the results reported by these writers with our findings, we recast our model in terms of net trade credit ($N_t$). Several approaches can be followed.

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21 For estimates of average and variance of the adjustment lag of real cash balances, labor, and capital services based on the same sample as this study, see [15, 23, 24, and 25].

22 Meltzer uses the model

$$L = f(M), \quad f' < 0,$$

and

$$\frac{R}{S} = g(S, M), \quad g'_1 > 0, g'_2 > 0,$$

where $L$ is the liquidity position of the firm defined as cash plus government securities divided by total current liabilities; $M$ is an index of strength of monetary policy measured by multiplying seasonally adjusted quarterly short term interest rates by the rates of free reserves in central city and reserve city banks at the end of each quarter; $S$ is net sales; and $R$ is net trade defined as the difference between accounts receivable and accounts payable.

Meltzer's model is a special case of ours. Equation (7) on page 410 combines equations (11a) and (11b). Our results substantiate Meltzer's conclusion that manufacturing firms reduce their cash and short term securities to finance accounts receivable and net trade credit only when the firms have excess liquidity. Otherwise, when their own need for liquidity increases they may reduce the $AR_t$ and $N_t$. In the case of accounts payable the firms will increase their demand for credit when their liquidity position is improved. This may be a reflection of the lower cost of accounts payable due to the improved debt-repayment capacity of the firms. Contrary to Meltzer's finding, we found a positive but insignificant relationship between $d \ln z_t$ and net trade credit $\ln N_t$. The coefficient of $d \ln z_t$ is positive and statistically "significant" in both $AR_t$ and $AP_t$ equations.

23 Their method was to compare the residuals from the regressions of accounts receivable and accounts payable on sales with different indicators of monetary policy. They use bill rates, velocity of circulation of bank advances, consol, yield, and velocity of circulation of money as indicators of monetary policy. They justify their procedure on the ground that a good measure of the strength of monetary policy for a ten year period was not available to them. Moreover, they wanted to allow for the response of various firms to variation in monetary policy.
We may redefine the dependent variable as \( \ln N_t = \ln (AR_t - AP_t) \) or \( \ln N_t = \ln (AR_t/AP_t) \) and estimate:

\[
(17) \quad \ln N_t = a_0 + a_1 \ln X_{1t} + a_2 \ln \mu_t + a_3 \ln z_t + a_4 \ln N_{t-1}. 
\]

Another approach is to subtract algebraically regression equation (16) from equation (15). The results are the same no matter which one of these approaches is adopted.\\(^24\\) The coefficient of the scale variable is positive and statistically "significant"; the user cost has a negative and statistically "significant" coefficient. The sign of the coefficient of \( d \ln z_t \) is unstable and is always statistically insignificant (see Table II, Columns 1–3). It is better to estimate the behavior of net trade

| TABLE II |
| DETERMINANTS OF NET TRADE CREDIT IN THE U.S. TOTAL MANUFACTURING SECTOR FOR THE PERIOD 1949-I–1964-IV* |

<table>
<thead>
<tr>
<th>Variables</th>
<th>( \ln N_t ) (^b)</th>
<th>( \ln (AR/AP)_t ) (^a)</th>
<th>( \ln (AR/AP)_t ) (^c)</th>
<th>( \ln N_t ) (^d)</th>
<th>( \ln N_t ) (^e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-1.0785</td>
<td>-.1722</td>
<td>-.6562</td>
<td>-.5994</td>
<td>-.6713</td>
</tr>
<tr>
<td>( \ln X_{1t} )</td>
<td>.3138</td>
<td>.3001</td>
<td>.2348</td>
<td>.1734</td>
<td>.2819</td>
</tr>
<tr>
<td>( \ln \mu_t )</td>
<td>(.1085)</td>
<td>(.1221)</td>
<td>(.1308)</td>
<td>(.0886)</td>
<td>(-)</td>
</tr>
<tr>
<td>( \ln \psi_t )</td>
<td>-.0641</td>
<td>-.0351</td>
<td>(.0333)</td>
<td>(.0110)</td>
<td>(-)</td>
</tr>
<tr>
<td>( d \ln z_t )</td>
<td>.2604</td>
<td>-.3788</td>
<td>.2013</td>
<td>(.0023)</td>
<td>(.0282)</td>
</tr>
<tr>
<td>( \ln r_t )</td>
<td>(.0023)</td>
<td>(.3693)</td>
<td>(.9948)</td>
<td>(.9948)</td>
<td>(-)</td>
</tr>
<tr>
<td>( \ln N_{t-1} )</td>
<td>.8263</td>
<td>.8285</td>
<td>.8929</td>
<td>(.0588)</td>
<td>(.0237)</td>
</tr>
<tr>
<td>( \ln (AR/AP)_{t-1} )</td>
<td>.9090</td>
<td>(.0609)</td>
<td>(.0479)</td>
<td>(.0479)</td>
<td>(.0584)</td>
</tr>
<tr>
<td>( D-W )</td>
<td>1.9919</td>
<td>2.3722</td>
<td>2.1024</td>
<td>2.1146</td>
<td>(-)</td>
</tr>
</tbody>
</table>

* The \( R^2 \) and \( S_x \) of the equations are not reported; they are quite similar from one equation to the other.

\\(^b\) The dependent variable is defined as \( N_t = (AR_t - AP_t) \).

\\(^a\) The values in this column are obtained by algebraic subtraction of equation \( 1' \) from \( 1 \) of Table I.

\\(^c\) This is the value of the coefficient of \( \ln (AR/\mu) \) of equation \( 1 \) in Table I.

\\(^d\) This is the value of the coefficient of \( \ln AP_t \) of equation \( 1 \) in Table I.

\\(^e\) There is a mechanical relationship between the regressions of \( N_t \), \( AR_t \), and \( AP_t \). Since the explanatory variables are the same in each regression, the coefficients of the \( N_t \) regression are the difference between the corresponding \( AR_t \) and \( AP_t \) regression coefficients; what happens to the standard error of estimate of the \( N_t \) regression depends upon whether the residuals of \( AR_t \) and \( AP_t \) regressions are independently distributed or not. The standard errors of the coefficients in the \( N_t \) regression depend on whether the effect of the relevant explanatory variable in \( AR_t \) and \( AP_t \) equations offset each other. I am indebted to the referee of this paper for this clarification.
credit by subtracting algebraically the regression equations for \( AR_i \) and \( AP_i \).\(^{25}\) The reasons are that the response patterns of the components of net trade credit to the independent variables are quite dissimilar and the adjustment lag suggested by equation (17) is very long and unrealistic (see Columns I and 2 of Table II).

Generally, net trade credit \( N_t \) has a lower elasticity for sales and a higher and negative partial correlation for the user cost of trade credit, not reported in Table II, than either of its components, \( AR_i \) or \( AP_i \). There is no strong evidence to support the hypothesis that the tightening of monetary policy will lead to an increase in net trade credit; this is true even if we eliminate the user cost from the regressions for \( N_t \).

This result is in contrast to the findings of Meltzer and of Brechling and Lipsey. To test the hypothesis of these writers directly we replace both \( d \ln z_t \) and \( \ln \mu_t \) by \( \ln r^*_t \) in equation (17). As indicated in Column 4 of Table II, the coefficient of \( \ln r^*_t \) is small, positive, and statistically insignificant.\(^{26}\) The short term sales elasticity of \( N_t \) declines substantially—almost by half when \( \ln r^*_t \) is introduced in the equation to depict the influence of monetary policy. Again the adjustment lag of \( N_t \) to its desired level is very long. To test the Brechling-Lipsey "hypothesis," the equation

\[
\ln N_t = b_0 + b_1 \ln X_{1t} 
\]

was estimated and its residuals and \( \ln r^*_t \) were plotted. The comparison indicated that except for the period 1955-I to 1957-III these two series moved in opposite directions. During most of this period, if we accept the procedure suggested by Brechling-Lipsey, tightening of monetary policy tended to contract the flow of net trade credit in the U.S. manufacturing sector.

5. SUMMARY AND CONCLUSIONS

These conclusions follow from the preceding analysis:

(i) Trade credit can be treated as a selling expenditure, like advertising outlays or expenditures on capital goods. Its behavior, like other assets of the firm, can be analyzed in the context of the neoclassical theory of the firm.

\(^{25}\) Since we do not have estimates of the standard error of the coefficients of the explanatory variables after the algebraic transformation, we cannot say anything about the significance of these variables in determining the behavior of net trade credit. The following equation, however, is an approximation to equation 5 in Table II:

\[
\ln (AR/AP)_t = .3634 + .1168 \ln X_{1t} - .0434 \ln \mu_t - .3645 d \ln z_t 
\]

\[
+.8638 \ln AR_{t-1} + .9202 \ln AP_{t-1}, \quad D-W = 2.3572. 
\]

\[
\begin{array}{cc}
(0.0695) & (0.0127) \\
(0.3675) & \quad (0.0421)
\end{array}
\]

The coefficient of \( d \ln z_t \) is statistically insignificant, suggesting that net trade credit is insensitive to changes in monetary policy changes. This conclusion, noted also in the text, is reached by Junk \([15]\) and contradicts the conclusions of Meltzer and Brechling-Lipsey.

\(^{26}\) When \( \ln r^*_t \) was used in the \( AR_i \) and \( AP_i \) equations, it had negative coefficients in each equation but was statistically significant only in the \( AP_i \) equation.
(ii) Accounts receivable, accounts payable, and net trade credit all respond to changes in their user costs. These costs are conceptually similar and consist of three elements: the carrying cost, the depreciation cost, and the lender’s credit standard or the borrower’s debt-repayment capacity. The manufacturing sector seems to reduce its receivables when the user cost of lending increases. It increases its payables when the cost of borrowing from alternative sources rises. The liquidity component of the user cost for both accounts is an important factor, and the effects of changes in monetary policy are felt through this element.

(iii) Gross trade credit granted or received responds positively to changes in monetary policy instruments, while net trade credit is insensitive to these changes. The monetary policy indicator used in this study is changes in the money supply, which is a direct policy measure. The rate of interest is not an appropriate measure of the intentions of the monetary authorities; it is a part of the user cost of credit. Contrary to findings of other investigators, no evidence was found that the manufacturing sector significantly contributes to inflationary pressures by increasing the flow of its net trade credit to other sectors in the period 1949–1964.

(iv) The responses of accounts receivable and payable to their determinants are sufficiently different to warrant separate estimation of each of them. Estimating net trade credit directly conceals some of the dynamic behavior of its component accounts.

(v) Trade credit transfers could be mainly among manufacturing firms, e.g., large firms give credit to small firms in this sector. To test this hypothesis we need data on asset size; unfortunately our data preclude such a test. It can be argued, however, that most of the small firms are in nonmanufacturing sectors. Even if the credit transfers occur exclusively within the manufacturing sector, the impact of tight monetary policy is very negligible in increasing net trade credit within this sector.

_Columbia University_

_and_

_National Bureau of Economic Research, Inc._

**STATISTICAL APPENDIX**

The main sources of the data used in estimating the equations specified in Section III are [5, 8, 9, 31, 32, and 33]. The data are seasonally unadjusted but dummy variables are used in the estimating equations to account for seasonal variations in the data. The variables used in this study are defined as follows:

- \( N \) is net trade credit, in billions of current dollars; it is the difference between receivables and accounts payable [33];
- \( AR \) is accounts receivable, in billions of current dollars [33];
- \( AP \) is accounts and notes payable excluding bank notes in billions of current dollars [33];
- \( X_1 \) is the level of net sales, in billions of current dollars [33];
- \( X_2 \) is total purchases in billions of current dollars and is the sum of costs of goods sold and changes in inventories [33];
- \( r \) is the rate of interest on commercial paper [9];
- \( r' \) is the short term interest rate on government bills [9];
- \( \hat{r} \) is the first difference of \( r \) and serves as a proxy for \( \hat{p}_u/p_u \), capital gains (loss) on bonds [9];
- \( \hat{p}/p \) is the change in the GNP price deflator [31];
- \( s_i \) is the carrying cost of credit and equals \( r - \hat{r} + \hat{p}/p \);
\( t \) is the period of discount [28];
\( T \) is the net discount period [28];
\( \beta \) is the ratio of bad debts to receivables calculated from [32]; the quarterly series is interpolated according to the formulae
\[
Q_{1t} = \frac{4}{3}A_t + \frac{1}{3}A_{t-1},
\]
\[
Q_{2t} = \frac{2}{3}A_t + \frac{1}{3}A_{t-1},
\]
\[
Q_{3t} = \frac{1}{3}A_t + \frac{2}{3}A_{t+1},
\]
\[
Q_{4t} = \frac{1}{3}A_t + \frac{2}{3}A_{t+1},
\]
where \( A_t \) represents the annual weight for the period \( t \) and \( Q_{1t}, Q_{2t}, Q_{3t}, \) and \( Q_{4t} \) represent the quarterly weights for this period;
\( \alpha \) is the percentage rate of failure taken from [5]; quarterly series are obtained according to the interpolation scheme mentioned above;
\( \psi \) is the previous quarter quick ratio—defined as the ratio of cash plus government securities to current liabilities [33];
\( \mu \) is the user cost of trade credit and is constructed according to expressions (10a) and (10b) of the text;
\( z \) is the quarterly money supply defined as the sum of currency, demand and time deposits. Other measures of \( z \), such as high-powered money suggested by Friedman and Schwartz [11] and the adjusted reserve requirement (\( k^* \)) and “Maximum Earning Assets” developed by Karaken and Solow [18], were extended to 1964-IV. These measures of monetary policy were used to estimate equations (15) and (16). The results were similar to those reported in Tables I and II where \( z \) is measured by the quarterly money supply taken from [9].

REFERENCES