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Vendor Financing

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ABSTRACT

This paper shows that, even in the presence of a perfectly competitive banking industry, it is optimal for firms with market power to engage in vendor financing if credit customers have lower reservation prices than cash customers or if adverse selection makes it infeasible to write credit contracts that separate customers according to their credit risk. We analyze how the advantage of vendor financing depends on the relative size of the cash and credit markets, the heterogeneity of credit customers, and the number of firms in the industry.

IN ADDITION TO THE pure financial intermediation that is provided by banks and other specialized financial institutions, intermediary services are also provided by sellers of goods, such as firms in the automobile industry, that borrow in order to provide long-term credit to the purchasers of their products. We refer to this form of financial intermediation, performed by goods sellers, as vendor financing. While there is now an extensive literature concerned with the role of pure financial intermediaries,[1] the conjunction of financial intermediation with the sale of goods remains largely unexplored. In this paper, we provide a theory of vendor financing that is quite distinct from recent theories of pure financial intermediation and that explains both why firms offer vendor financing and why the financing may be below market rates.

Classical models of financial and product markets without transactions costs or informational asymmetries leave no room for financial intermediation, so that it is necessary to relax one or more of the classical assumptions in order to provide a role for financial intermediaries. Thus, Townsend [12, 13] develops a model in which transactions costs in financial markets provide a reason for the development of intermediaries. More recent models, such as those of Diamond [2] and Ramakrishnan and Thakor [10], which follow from the early work of Leland and Pyle [8], emphasize the information-gathering role of financial intermediaries and show that the cost of delegating the information gathering is reduced by the diversification possible in the intermediary. In Boyd and Prescott [1], the emphasis is also on transaction gathering although the "financial intermediary coalitions" are more closely related to cooperatives than to traditional forms of financial intermediation; they are formed to overcome problems of

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[1] Diamond [3] provides a useful survey.

adverse selection in an environment in which information about investment projects is a public good that may be acquired at private expense. In a somewhat different vein, Diamond and Dybvig [4] construct a model of the banking firm in which the primary focus is on the bank as a provider of liquidity services.

In contrast to the foregoing, the model of vendor financing that we present here relies primarily on lack of competition in the product market, which, possibly in conjunction with adverse-selection problems, makes price discrimination potentially profitable. Vendor financing makes it possible to price discriminate between cash and credit customers, and this will be advantageous whenever the elasticity of demand of cash customers exceeds that of credit customers or whenever cash customers' reservation prices are systematically higher than those of credit customers. In Section I, we present a simple model in which a monopolist selling to cash and credit customers finds it profitable to price discriminate in favor of credit customers by setting credit terms that are attractive to them but not to the cash customers. In this model, the incentive to price discriminate is created by exogenous differences in the reservation prices of cash and credit customers. In Section II, we show that, even when there is no systematic difference between the reservation prices of cash and credit customers, adverse selection in the credit market is sufficient to provide the incentive for price discrimination and hence for vendor financing. Section III relaxes the assumption of a monopolistic goods market. We show that vendor financing may also arise in an oligopolistic setting and demonstrate its role as a strategic instrument. In Section IV, we contrast our theory with earlier explanations of trade credit and argue that our theory is in broad agreement with the available empirical evidence.

I. Homogeneous Credit Customers

Consider a company that manufactures tractors for sale to farmers. The tractors that are produced at a constant marginal cost, v, may be purchased by the farmers either for cash or on credit. Credit is offered by a competitive banking system, and we shall contrast the system in which banks are the only source of credit with that in which credit is also offered by the company itself or, equivalently, by a captive finance subsidiary. We assume that there are two classes of farmers, rich and poor, and that class membership is public information. Rich farmers have sufficient cash to purchase a tractor outright if they wish; alternatively, they may purchase on credit. However, we assume that, in contrast with the poor farmers, the rich farmers have sufficient other assets that there is a zero probability that they will default on a credit contract. Poor farmers, on the other hand, have no immediate cash,[2] and, therefore, if they are to purchase the tractor, they must use credit that is provided either by the banking system or by the vendor. Moreover, the only collateral that poor farmers can pledge for their loans is the return on the tractor itself. Both types of farmers have a demand for only a single tractor.

[2] This assumption is made for simplicity; all that is important is that the poor farmers have to finance at least a part of the purchase.

Each tractor lasts for one period and yields a return of $R_i + h$ or $R_i - h$ with equal probability for $i = \{r, p\}$, where r and p refer to the rich and poor farmers, respectively. Both rich and poor farmers are risk neutral, and there is no discounting, so that the reservation price for rich farmers is R_r and for poor farmers is R_p. The tractors are less productive in the hands of the poor farmers, so that $R_r > R_p$. The variable cost, v, is assumed to be less than R_p. There are N_r rich farmers and N_p poor farmers.

The competitive banking system faces a perfectly elastic supply of funds at an exogenously determined interest rate, which we take as zero. Then, since class membership is public information, competition will force the banks to charge a zero interest rate on their loans to the rich farmers who never default. Let $r(C)$ denote the interest rate charged by the banks to poor farmers when the manufacturer charges a cash price C for each tractor and there is no vendor financing.

The banks must break even on their loans, so that the rate they must charge to the poor farmers is given by

$$r(C) = \begin{cases} 0 & \text{if } C \leq R_p - h, \\ 1 - (R_p - h)/C & \text{if } R_p > C > R_p - h, \end{cases} \tag{1}$$

since, in the bad state, the bank will collect only the return from the tractor if $C > R_p - h$.

A necessary condition for the poor farmers to purchase a tractor is that there must be a positive expected net return for them after loan repayments; therefore, $r(C)$ must satisfy

$$C(1 + r) \leq R_p + h. \tag{2}$$

Substituting for $r(C)$ from equation (1), a necessary and sufficient condition for the poor farmers to purchase is that $C \leq R_p$. Similarly, rich farmers will purchase if and only if $C \leq R_r$.

Consider the profit opportunities of a tractor manufacturer who does no financing but relies on the banking sector to provide credit to the poor farmers. If the manufacturer sets $C = R_p$, he or she will sell to both classes of farmers, whereas, if the manufacturer sets $C = R_r$, he or she will sell only to the rich farmers. Assume that the relative number of members of the two classes and their reservation prices are such that it is optimal to sell to both rich and poor farmers. Then the tractor manufacturer's profit, $\pi(C)$, is given by

$$\pi(C) = (N_p + N_r)(R_p - v). \tag{3}$$

Now suppose that the manufacturer offers vendor financing and competes with the banks by offering credit at the rate r^*. His or her profit now depends on both the price of the tractor and the interest rate offered. Assuming that it is optimal to sell to both classes of farmers, the manufacturer's expected profit is $\pi(C, r^*) = N_r(C - v) + (N_p/2)(C(1 + r^*) + R_p - h - 2v)$.[3] The tractor manufacturer's

[3] The manufacturer will find it optimal to sell to both the rich and the poor farmers if $R_r \leq R_p + h + \frac{N_p}{N_r}(R_p - v)$.

optimization problem can be written as

$$\max_{C,r^*} \pi(C, r^*), \tag{4}$$

subject to

$$C(1 + r^*) \leq R_p + h, \tag{5}$$

$$C \leq R_r, \tag{6}$$

and

$$r^* \geq 0. \tag{7}$$

Condition (5) guarantees that the poor farmers will purchase, and (6) is the corresponding condition for rich farmers. Condition (7) ensures that the manufacturer does not charge an interest rate below the risk-free rate of return, which is assumed to be zero. If the manufacturer did charge a negative interest rate, rich farmers would also seek vendor financing, so that a negative interest rate is equivalent to a reduction in the cash price, C.[4] There are two cases to consider according to whether the non-negative interest rate restriction is binding:

Case A: $R_r \leq R_p + h$. *Nonbinding interest rate constraint.*

It may be verified that the optimal strategy is to set $C = R_r$ and to charge the highest interest rate consistent with condition (5): $r^*(R_r) = (R_p + h)/R_r - 1$. Then the manufacturers' total expected profit $\pi(R_r, r^*)$ is given by

$$\pi(R_r, r^*) = N_r[R_r - v] + N_p[R_p - v]. \tag{8}$$

It is evident in this case that the manufacturer is able to extract all of the farmers' surplus. Note that, although the manufacturer is charging a positive contractual interest rate, his or her expected rate of return on the vendor financing is $R_p/R_r - 1 < 0$; therefore, there is no incentive for the banks to compete for this business since the manufacturer is offering subsidized financing as a way of discriminating in favor of the poor farmers. On the other hand, the positive contractual interest rate is sufficient to deter the rich farmers from applying for credit from the manufacturer.

Case B: $R_r > R_p + h$. *Binding interest rate constraint.*

In this case, it is not possible to simultaneously sell to the rich farmers at their reservation price and sell to the poor farmers without charging the latter a negative interest rate, which, we here argued, is tantamount to a reduction in the cash price. The optimal price and interest rate are given by $C = R_p + h$, $r^* = 0$. Under this policy, the firm extracts all of the surplus from the poor farmers, and its profit is given by

$$\pi(R_p + h, 0) = N_r[R_p + h - v] + N_p[R_p - v]. \tag{9}$$

[4] Note that a negative interest rate will benefit rich farmers more than poor ones, as long as there is any probability that the latter will default.

Again, the banks have no incentive to compete with the manufacturer in offering credit to the poor farmers since the expected rate of return on vendor financing is $R_p/(R_p + h) - 1 < 0$.

Contrast the manufacturer's profit with vendor financing, as given by expressions (8) and (9), with his or her profit without vendor financing, which is given by expression (3). Whether or not the non-negativity constraint on the contractual interest rate is binding, manufacturer's profit with vendor financing strictly dominates the profit without vendor financing, so that in this context there is a role for vendor financing.

It has been suggested to us that the price discrimination accomplished by vendor financing might also be achieved by subsidizing bank loans to customers. In fact, this is being done by some manufacturers.[5] This is equivalent to vendor financing if the manufacturer can restrict the subsidy to loans made to poor farmers. However, this might well be difficult to enforce, for, to the extent that rich farmers have ongoing customer relationships with their banks, there will be scope for the banks to claim the subsidy on loans to rich farmers, also charging them the same rates as the poor farmers, but then rebating the interest charge and a portion of the subsidy through other transactions.

The model in this section has relied on exogenously specified differences in the reservation prices of rich and poor farmers to demonstrate a potential role for vendor financing. In the following section, we shall demonstrate that vendor financing may be optimal, even if rich and poor farmers are identical, if there is a problem of adverse selection in the credit market.

II. Heterogeneous Credit Customers

Assume now that $R_p = R_r = R$, so that the return on the tractor is $R + h$ or $R - h$, with equal probability. However, in contrast to the case considered in the previous section, we now assume that the risk parameter, h, varies across farmers and, for both classes of farmers, is uniformly distributed on the interval $(\underline{h}, \bar{h})$. The risk parameter, h, is known by the farmer but cannot be observed by the lender.

A rich farmer will purchase a tractor as long as the cash price, C, is less than R, and a poor farmer with risk parameter h_i will purchase on credit as long as $C(1 + r) \leq R + h_i$. Let h^* denote the lowest level of risk of a poor farmer who purchases on credit. Then

$$h^* = C(1 + r) - R. \tag{10}$$

Note that credit sales are made to the high-risk farmers and that the average risk of credit customers increases with both the cash price and the loan rate. To analyze the manufacturer's optimization problem in the absence of vendor financing, consider first the loan rate $r(C)$, which will be set by the competitive banking system when the cash price is C. Assuming that $C(1 + r) > R - h_i$, the profit on a loan to farmer i is $\{R - h_i + C(1 + r)\}/2 - C$.

[5] See *Business Week*, August 26, 1986, p. 77.

Then, since only farmers with $h > h^*$ take loans, the expected profit on a bank loan is

$$\{R - (h^* + \bar{h})/2 + C(1 + r)\}/2 - C.$$

Setting this expression equal to zero and substituting for h^* from equation (10), the competitive-loan rate is given by

$$r(C) = 3 + (\bar{h} - 3R)/C. \tag{11}$$

Substituting for the loan rate from equation (11) in equation (10), the lowest risk level of a poor farmer who purchases is $h^* = \bar{h} - 4(R - C)$; then the number of tractors sold to poor farmers, q_p, is given by

$$q_p(C) = 4(R - C)N_p/d, \tag{12}$$

where $d = \bar{h} - \underline{h}$. Thus, in the absence of vendor financing, the problem of the tractor manufacturer may be written as

$$\max_C \pi(C) = (N_r + q_p(C))(C - v), \tag{13}$$

subject to

$$C \leq R. \tag{14}$$

Differentiating (13) with respect to C and using equations (12) and (14), the expression for C^*, the optimal price, depends on whether $z + v$ is greater or less than R, where $z = N_r d/4N_p$.

Case A: $z + v < R$. *Tractors bought by rich and poor farmers.*

In this case, the optimal cash price charged is $C^* = (z + v + R)/2$, and the profit realized by the manufacturer is

$$\pi(C^*) = \left[\frac{N_r}{2} + \frac{N_p}{d}(R - v - z)\right][R - v + z]. \tag{15}$$

It is apparent from the form of the objective function (13) that, since $C^* < R$, sales are made to both rich and poor farmers.[6]

Case B: $z + v > R$. *Tractors bought by rich farmers only.*

In this case, the optimal price is $C^* = R$, and

$$\pi(C^*) = N_r(R - v). \tag{15a}$$

No sales are made to the poor farmers, for, when the cash price is R, there is no loan rate at which the banks can break even on their sales to credit customers. Thus, the credit market collapses due to the adverse-selection problem.

Consider now the role of vendor financing. The problem of the manufacturer who offers vendor financing is most easily analyzed by reference to equation (13). Thus, let C_1 denote the price charged to the cash customers, and let C_2 denote

[6] It can be verified that, if $z + v < R$, all poor farmers who purchase tractors also default in the bad state.

the internal transfer price at which tractors are sold to a captive finance subsidiary that just breaks even on its loans. The situation is then precisely as described above except that the manufacturer is able to charge a lower price to the poor farmers by setting the internal transfer price below the cash market price, so that the manufacturer's profit becomes[7]

$$\pi(C_1, C_2) = N_r(C_1 - v) + q_p(C_2 - v).$$

The maximization can now be written as

$$\max_{C_1, C_2} \pi(C_1, C_2) \tag{13a}$$

subject to

$$C_1 \leq R, \tag{14a}$$

$$4C_2 + \bar{h} - 3R \geq C_1, \tag{16}$$

and

$$C_2 \leq C_1. \tag{17}$$

Constraint (16) serves to ensure that the quoted credit price $C_2(1 + r)$ is not less than the cash price, for this would cause the rich farmers also to buy on credit;[8] constraint (17) ensures that the effective credit price is no greater than the cash price, so that there is no incentive for the banks to offer better credit terms than the captive finance company. The optimal prices to charge in the two markets are then $C_1^* = R$ and $C_2^* = (R + v)/2$.

These prices satisfy constraints (14a) and (17); constraint (16) also will be satisfied provided that $R < v + \bar{h}/2$, and, to avoid unnecessary complexity, we assume that this condition is met. Then the expected profit of the manufacturer with vendor financing is

$$\pi(C_1, C_2) = N_r(r - v) + N_p(R - v)^2/d. \tag{15b}$$

Comparing expression (15b) with the corresponding expressions for the profit in the absence of vendor financing, (15) and (15a), we see that the profit gained from vendor financing, g, is

$$g = \begin{cases} N_p(R - v)^2/d & \text{if } z + v \geq R, \\ N_r^2 d/16N_p & \text{otherwise.} \end{cases} \tag{18}$$

If $z + v \geq R$, vendor financing opens the market to poor farmers who had previously not been able to buy tractors; in the other case, it makes it possible for the manufacturer to extract all the rents from the rich farmers while still selling to poor farmers.

[7] It is assumed that manufacturers can legally set internal transfer prices below the cash market price. Alternatively, the manufacturer can set transfer prices equal to the market price and make losses on their financing operations.

[8] This constraint is obtained by substituting for $r(C)$ from equation (11) in the condition $C_2(1 + r) > C_1$.

Inspection of equation (15b) reveals that the gain from forming a captive is always positive, and the following comparative-static results can be verified for $z + v \geq R$:

$$(\partial g/\partial v) < 0;$$

$$(\partial g/\partial N_r) > 0;$$

$$(\partial g/\partial N_p) > 0;$$

$$(\partial g/\partial h) < 0.$$

Higher variable costs decrease the optimal quantity of tractors sold to the poor farmers and, therefore, if there is no vendor financing, increase the resulting equilibrium price. This reduces the advantage from price discrimination. Similarly, as the number of farmers in either the cash market or the credit market increases, it becomes more profitable to service the credit market by providing the vendor financing. Finally, as h increases, i.e., as the adverse-selection problem becomes more severe, it becomes less profitable to sell to credit customers with or without vendor financing, and the absolute advantage from vendor financing declines.

III. Vendor Financing and Market Structure

In the previous section, it was shown that the existence of adverse selection in the credit market makes it advantageous for a monopolist to offer vendor financing, even though customers in the cash and credit markets are identical except for their credit risk. In this section, we relax the assumption of monopoly and evaluate the gains from vendor financing in an industry in which rival firms compete for market share. We demonstrate how vendor financing can affect the ability of the firms to exploit product-market opportunities in an oligopolistic setting by increasing their market power. Counterintuitively, in some cases all the firms can extract greater rents if only some of them offer vendor financing. The characteristics of farmers are as described in the previous section. Thus, there is adverse selection in the credit market.

We restrict our attention to a duopoly and compare the profits with and without vendor financing.[9] Each firm is assumed to set its production to maximize profits, given the production level of its rival, so that, in equilibrium, each firm's choice of production level is the best response to its rival's choice of production level.[10] We begin with the case in which sales to the poor farmers are financed by competitive banks. As before, banks realize revenue either from the repayment of loans or, in the case of bankruptcy, from the return of the tractor. Since the banks' expected profits are zero, their expected revenue curve is also the demand curve of poor farmers. Equation (12) corresponds to the following inverse demand curve for poor farmers:

$$C = R - q_p d/4N_p. \tag{19}$$

[9] In the Appendix, we also analyze the case of an oligopoly with n firms.

[10] Market equilibrium in oligopolies is discussed in Friedman [5].

The total demand for tractors is obtained by aggregating the demand curves of rich and poor farmers. Let q be the total quantity of tractors sold. The aggregated inverse demand curve for both rich and poor farmers is then

$$C = \begin{cases} R & \text{if } q < N_r, \\ R - (q - N_r)d/4N_p & \text{otherwise.} \end{cases} \tag{20}$$

We assume that it is optimal for the duopolists to sell to at least some poor farmers, so that $q > N_r$. This will be the case if

$$N_r < 2(R - v)N_p/d. \tag{21}$$

Then the optimal production level of firm i, q^{i*}, is given by

$$q^{i*} = \arg\max_{q^i} \{q^i(a - v - b(q^i + q^{j*}))\}, \quad i \neq j,$$

where $a = R + N_r d/4N_p$, $b = d/4N_p$, and q^{j*} is the equilibrium output of the rival firm. In equilibrium, each firm produces $q^* = (a - v)/3b$. The corresponding equilibrium price is given by $C = (a + 2v)/3$, and profit of each firm is

$$\pi = (a - v)^2/9b. \tag{22}$$

We shall now compare the profits in this base case with profits attainable when one or both firms offer vendor financing. We assume that firms have already made their decisions on whether to engage in vendor financing in the current period, and we determine their equilibrium outputs and profits.[11]

Case A: One firm offers vendor financing.

Consider the case in which one firm, firm f, offers vendor financing and its rival, firm c, bills only for cash. Firm f can, by varying the credit terms, decide whether to sell the marginal unit of output to a rich or to a poor farmer. Firm c can only choose its total output. We first show that vendor financing can only be advantageous to firm f if, in equilibrium, banks find it unprofitable to extend credit to poor farmers.

Let the number of tractors sold by firm f to rich and poor farmers be q_r^f and q_p^f, respectively, and the total number sold by firm c be q^c. The number of tractors financed by banks and bought by poor farmers is $q^b = q_r^f + q^c + N_r$. The expected profits of the two firms are

$$\pi^f = q_r^f[C - v] + q_p^f[R - d[q_p^f + q^b]/4N_p - v] \tag{23a}$$

and

$$\pi^c = q^c[C - v]. \tag{23b}$$

[11] Engaging in vendor financing usually involves the setting up of financial captives and changes in marketing strategy. The decision on whether to engage in vendor financing is thus costly to reverse in the short run. The analysis can be formalized if we view duopolists as playing a two-stage game. The equilibria discussed in Section III can be interpreted as subgame perfect Nash equilibria of that game. See Kreps and Scheinkman [7] for such an analysis in another context.

If the banks offer credit, competition ensures that the average revenue realized on a loan equals the cash price of a tractor, so that, using equation (20),

$$C = R - d[q_p^f + q_r^f + q^c - N_r]/4N_p. \tag{24}$$

Then, substituting for c from (24) in (23a) and (23b), we obtain

$$\pi^f = q^f[R + N_r d/4N_p - d[q^f + q^c]/4N_p - v] \tag{25a}$$

and

$$\pi^c = q^c[R + N_r d/4N_p - d[q^f + q^c]/4N_p - v], \tag{25b}$$

where $q^f \equiv q_p^f + q_r^f$ is the total sales by firm c.

Since the two expressions are identical, firm f does not derive any benefit from vendor financing. The reason for this is that prices in the cash and credit markets are linked by the banks' zero-profit condition (24), so that the expected revenue from sale to a rich or a poor farmer is equalized, and there is no possibility of segmenting the markets.

This does not rule out the existence of other equilibria in which firm f sells to the poor farmers on credit but the banks do not offer loans. For this to be possible, firm f must leave firm c a sufficiently large share of the sales to rich farmers so that it is optimal for the latter to produce for that market only and not to lower the cash price enough for it to be feasible for the banks to finance sales to poor farmers. Under these conditions, firm f is able to act as a monopolist in the poor-farmer market. This is optimal for the industry taken as a whole since the reduction of competition in the poor-farmer market will increase the economic rents that may be earned there. To investigate this possibility, we derive the minimum market share of the rich-farmer market that will induce firm c to forego sales to poor farmers by maintaining the cash price above the banks' break-even level. Firm c can choose between a high-price, low-output policy in which the banks do not offer credit to poor farmers and a low-price, high-output policy in which (24) is satisfied and the banks finance purchases by poor farmers.

If the banks do not finance purchases by poor farmers, firm c's output will be purchased only by rich farmers and its profit will be

$$\pi^c = (N_r - q_r^f)(R - v). \tag{26a}$$

Alternatively, firm c can decide to produce enough to drive down the price to a level at which banks will find it profitable to finance purchases by poor farmers. If it does so, it will take firm f's output of $(q_p^f + q_r^f)$ as given and will produce the quantity that is its best response to that output, or $(a - v - b(q_p^f + q_r^f))/2b$. Firm c's profit from producing optimally when the price is sufficiently low for the banks to break even on their loans is

$$\pi^c = (a - v - b(q_p^f + q_r^f))^2/4b. \tag{26b}$$

Hence, firm c confines itself to the low-output policy that leaves the credit market to firm f if

$$(N_r - q_r^f)(R - v) > (a - v - b(q_p^f + q_r^f))^2/4b. \tag{27}$$

Substituting the monopoly output in the credit market for q_p^f, inequality (27) can be solved for q_r^f (and therefore for $q^c = N_r - q_r^f$):

$$q^c \geq 4N_p(R - v)/d(3/2 - \sqrt{2}). \tag{28}$$

If condition (28) is satisfied, firm c has no incentive to follow the high-output policy. It produces q^c tractors and sells to rich farmers at the price R. Firm f sells $N_r - q_r^c$ tractors for cash to rich farmers and the monopoly quantity, $(R - v)/2b$, on credit, to poor farmers. The expected revenue per tractor sold to a poor farmer is $(R + v)/2$. The joint profits of the two firms are given by

$$\pi^c + \pi^f = N_r(R - v) + N_p \frac{(R - v)^2}{d}. \tag{29}$$

The total industry gain from offering vendor financing is the difference between the profit given by equation (29) and twice the profit of a duopolist given by equation (22):

$$g = \frac{7}{9} N_r(R - v) + \frac{N_p}{9d}(R - v)^2 - \frac{dN_r^2}{36N_p}. \tag{30}$$

For the relevant range of N_r, defined by inequality (21), g is positive. Comparing expression (30) with expression (18), it can be verified that the total gain from vendor financing is greater in the duopolistic market than in the monopolistic market in Section II. The comparative-static results derived from equation (18) also hold for equation (30).

Case B: Both firms offer vendor financing.

In this case, both firms will find it optimal to treat the rich and poor farmers as distinct markets and to set production levels for each market separately. In the symmetric Nash equilibrium, each firm will produce $N_r/2$ units for sale to rich farmers and $(\bar{R} - v)4N_p/3d$ for the poor farmers. The equilibrium cash price,C_1, is equal to R, and the expected revenue from a sale to a poor farmer is $(R + 2v)/3$.[12] Since v is less than R, the "effective" price charged to poor farmers is again less than the cash price, C_1. Each firm's expected profit will be

$$\pi = [N_r(R - v)/2] + [(R + v)^2 N_p 4/9d]. \tag{31}$$

By comparing expression (31) with the corresponding expression for profit when neither firm uses vendor financing, equation (22), we see that the gain to each firm due to vendor financing is given by

$$g = 5N_r(R - v)/18 - dN_r^2/18N_p. \tag{32}$$

Comparison of equations (18) and (32) shows that, over the relevant range of N_r, defined by inequality (21), the advantage of vendor financing to each firm is smaller for a duopolist than for a monopolist. In contrast, the *total* advantage, if both firms engage in vendor financing, is greater in a duopoly than in a monopoly.

[12] This result can be verified by inserting the total number of tractors sold to poor farmers, $4N_p(R - v)/3d$, into equation (19).

Doubling the profit given in equation (31) and comparing with equation (29) shows that the joint profits of the two firms are greater if only one of them offers vendor financing. The reason for this is that the full advantage of vendor financing is realized when one of the firms is able to act as a monopolist in the credit market and maximize the economic rent that is extracted from poor farmers. In this case, vendor financing allows price discrimination and eliminates competition in the credit market. This will be feasible—as can be seen from condition (28)—if the credit market is not too large and if there is sufficient heterogeneity across farmers. As the credit market grows relative to the cash market, or if there is less heterogeneity across farmers, condition (28) will not hold for any $q_r^c < N_r$. Then only the equilibrium in which both firms offer vendor financing is sustainable.

The foregoing analysis generalizes readily to industries with more than two firms. As in the duopoly, economic rents are increased if only some of the firms service the credit market by supplying vendor financing and all the remaining firms sell to rich farmers only. In the Appendix, we derive a lower bound for the proportion of firms engaging in vendor financing that is necessary to make price discrimination feasible.

IV. Conclusion

The models we have presented in this paper suggest that vendor financing may be optimal for a firm when demand is less elastic in the credit market than in the cash market because of adverse selection and when the reservation prices of credit customers are systematically lower than those of cash customers. We have also shown that, in oligopolistic markets, vendor financing can be used to reduce competition since some firms can concentrate on the credit market while other firms maintain a larger market share in the cash market.

In all cases in which vendor financing is advantageous, the firms offering vendor financing offer subsidized loans. This seems to accord well with casual empiricism concerning the experience of captive finance companies in the automobile industry, which have offered subsidized credit when they have been allowed to do so without restrictions. In 1941, Ford and Chrysler both signed consent decrees according to which they agreed to allow outside lenders such as banks to participate in their subsidized interest rate programs; GM, which had fought similar charges brought against it, finally signed a consent decree in 1952. These consent decrees expired in 1982; since then, the auto companies have renewed their subsidized financing programs and have captured a much larger share of the new-car financing market, to the consternation of the banks.[13]

In our model, it is not optimal for the manufacturer to offer credit at a rate below the riskless interest rate, for then all purchasers would select credit financing, reducing the ability of the manufacturer to price discriminate. While

[13] A vice-president of a major bank was reported as saying: "We simply can't compete with those subsidized interest rates. Our costs of funds are higher than the rates that the captive finance companies were offering." *ABA Banking Journal*, Vol. 77, No. 12, December 1985.

this appears to be contradicted by the offers of credit by the auto companies at well below comparable market rates for riskless investments, these offers are accompanied by cash discounts that effectively raise the interest rate above the quoted rate. The substantial increase in market share gained by the auto finance captives suggests, however, that there remains a net subsidy in their credit terms.[14]

An alternative theory of vendor financing to the one we have proposed here rests on the notion that tax savings are possible through vendor financing, on account of the IRS treatment of installment sales, under which a vendor reports taxable income in proportion to the payments received. It is certainly the case that installment sales give rise to tax deferrals; however, they also give rise to a deferral of cash income. If the cost basis of the sale is zero and the present value of the sales price is maintained despite the installment terms, then the present value of the taxes payable will be the same whether or not the sale is made on an installment basis and there will be no tax advantage to vendor financing. On the other hand, if the cost of goods sold is positive, the installment method will delay recognition of the cost, giving rise to a tax *disadvantage* of installment financing. For this reason, we do not believe that tax considerations provide an adequate rationale for vendor financing; nor, of course, are they capable of explaining the subsidized vendor financing we observe.

Our theory also casts some light on the puzzling empirical evidence concerning security price reactions to the establishment of captive finance companies. Both Kim, McConnell, and Greenwood (KMG) [6] and Malitz [9] report stockholder gains of the order of seventeen to eighteen percent at the time of the establishment of a captive. KMG interpret this finding in terms of a bondholder expropriation hypothesis, according to which the captive allows the firm to expand its debt financing against a given level of receivables. They do find evidence of negative bondholder returns at the time a captive is established. However, this is not confirmed by Malitz [9], who uses a more carefully selected control sample of bonds (except in one case where the firm was already in financial distress); nor is the magnitude of the bond price reaction found by KMG commensurate with that required to explain the stockholder gains.

An alternative hypothesis suggested by our theory is that captives are established as a prelude to an extensive program of vendor financing[15] and that the stock price reaction is a reaction to the improved profitability this will make possible. More subtly, since vendor financing is profitable only for firms that have some kind of market power in the cash market, establishment of a captive, insofar as it is costly, may serve as a signal of this market power.

[14] According to the President of the Consumer Bankers' Association, "A significant shift of auto loan business from traditional lending organizations to finance companies, including those owned by the 'Big Three' auto makers, makes it essential that consumer banks, savings and loans and credit unions be allowed access to the loan subsidies paid by GM, Ford and Chrysler" (press release September 15, 1986).

[15] Malitz [9] provides evidence that firms that establish captives subsequently increase their receivables. Roberts and Viscione [11] discuss how establishment of a captive will facilitate the provision of intermediation services by a manufacturer.

Appendix

Define

n = total number of firms,
m = number of firms engaging in vendor financing, and
$\hat{q}(m)$ = the quantity of tractors sold to rich farmers by a firm without vendor financing.

To induce a firm not engaging in vendor financing to stay out of the credit market, it is necessary that

$$\hat{q}(m)(R - v) > (a - v - b(N_r - \hat{q}(m) = q_p^m))^2/4b, \tag{A1}$$

where q_p^m is the total number of tractors sold to poor farmers by firms offering vendor financing. Inequality (A1) states that the profit to the firm from selling $\hat{q}$ to rich farmers exceeds the profit from producing optimally for both markets, foregoing the advantage from price discrimination. Inequality (A1) holds if[16]

$$\hat{q}(m) \geq (R - v)/b \left[\frac{2m + 1}{m + 1} - \sqrt{\frac{m}{m + 1}} \right]. \tag{A2}$$

The upper bound on the number of such firms, $n - \bar{m}$, is given by

$$(n - \bar{m}) = N_r/\hat{q}_{\min}(\bar{m}), \tag{A3}$$

where $\hat{q}_{\min}(m)$ is determined by (A2) holding as an equality.

Similarly, the maximum ratio of firms not offering vendor financing, M, is

$$M = \frac{N_r}{\hat{q}_{\min}(\bar{m})}. \tag{A4}$$

To analyze the relationship between industry concentration and M, we take the partial derivative of M with respect to n:

$$\frac{\partial M}{\partial n} = \frac{N_r \left[\hat{q}_{\min}(\bar{m}) - \dfrac{\partial \hat{q}_{\min}(\bar{m})}{\partial n} n \right]}{\hat{q}^2_{\min}(\bar{m})}. \tag{A5}$$

To determine the sign of $\delta M/\delta n$, note that we can write

$$\frac{\partial \hat{q}_{\min}(\bar{m})}{\partial n} = \frac{\partial \hat{q}_{\min}(m)}{\partial \bar{m}} \times \frac{\partial \bar{m}}{\partial n}.$$

From (A2), it follows that $\dfrac{\partial \hat{q}_{\min}(\bar{m})}{\partial \bar{m}} < 0$. Totally differentiating equation (A2), we obtain $\dfrac{\partial \bar{m}}{\partial n} > 0$ and, hence, $\partial \hat{q}_{\min}(\bar{m}) < 0$. Thus, expression (A5) is positive. The minimum fraction of firms offering vendor financing that allows the industry to derive economic rents is higher in more concentrated industries.

[16] Equation (A1) can be derived by substituting the oligopoly output for q_p^m, i.e., $q_p^m = \dfrac{(R - v)m}{(m + 1)b}$.

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