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- Key words : trade credit, financial structure, oligopoly, distribution channel.

JEL Classification : G32, L13

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Is it possible for a firm to influence its output strategy by its financial structure's choice ? The outstanding idea was initiated by Modigliani and Miller (1958), who assert that the value of the firm as well as its investment decisions are independent of financial structure. However the Modigliani-Miller theorem disregards the fact that financial structure affects the allocation of profits and residual claims between different classes of stakeholders, and conveys information on investment opportunities. Some empirical observations allow us to perceive the link between financial decisions and output market decisions. Spence (1985) especially notices that highly competitive industries are characterised by a lower debt ratio. Harris and Raviv (1991) also observe that in the airline industry, companies whose strategic interactions are well-known show high debt levels.

A strand of literature, in the intersection of the literature on imperfect competition and the literature on financial structure, investigates the interactions between firms' financial structure and output market competition. In particular, the seminal paper of Brander and Lewis (1986) develops a model where two firms are engaged in a Cournot competition and face an uncertain demand. Financial decisions affect output market strategies because of what is referred to as the limited liability effect. As Brander and Lewis showed, debt financing may credibly commit the firm to higher output levels and thereby influence output market outcomes in the firm's favour. Following Brander and Lewis, several contributions came to the conclusion that debt, far from being neutral, may strengthen output market competition [Allen (1985), Poitevin (1989), Maksimovic (1988,1990)] or on the contrary soften it [Glazer (1994), Showalter (1995), Faure-Grimaud (2000)].¹

If these approaches demonstrate the influence of classical debt on output market strategies, they however neglect the impact of an alternative significant financing source : trade credit. Trade credit is a source of short-term financing, provided by non-financial firms, and connected to the purchase of goods and services. It results from the terms of payment offered to clients. The use of trade credit is widespread - Elliehausen and Wolken (1993) notice that 80% of firms make use of this form of credit – and represents the most important source of short-term financing of French firms. According to Bardes (2001), accounts payable amount to 359 billion euros in 1998, and are three times larger than short-term bank facilities.

¹ The cited articles rely principally on the limited liability effect. More generally, Maksimovic (1995) and Faure-Grimaud (1998) survey the literature studying the interactions between financial structure and product market competition.

The aim of the article is to analyse the strategic role that trade credit plays in the product market competition. We consider here the conflict upon terms of payment not only as a vertical competitor's rivalry, but also as a conflict between debt holders-suppliers on the one hand, and shareholders-retailers on the other. The model is drawn from Brander and Lewis's framework of strategic indebtedness, but brings two significant modifications to it. Firstly, in the Brander and Lewis model, the financial structure, by the choice of a debt – equity ratio, is determined by the shareholders of the firm. Conversely we entrust in the debt-holders the capacity to fix the amount of debt granted to the borrower. Secondly, credit is granted not by a traditional creditor, but by the supplier. We analyse then the particular links that associate the sale of goods and the sale of credit in the trade credit framework. On the one hand, trade credit allows separation of the time of purchase from the time of payment. It makes it possible for the retailer to await payment from his customers to pay himself his supplier. On the other hand, even if this credit is not formalised by a contract, it induces a limited liability effect. If the client becomes insolvent, practical experience shows that the supplier, in spite of legal adjustments, is most of the time not able to recover the entire amount of his credit.

The strategic role of trade credit also lies within the scope of the arguments raised by the theoretical literature to explain the substantial use of trade credit by firms. The traditional motives inducing suppliers to extend credit to the benefit of their clients are financial and commercial.

According to financial motive, firms that have a better access to credit markets are able to use this borrowing capacity and play a financial intermediary role in favour of firms that suffer from limited access [Schwartz (1974), Schwartz and Whitcomb (1979), Emery (1984)]. The second motive of trade credit extension is a commercial one. The use of trade credit, which reduces effective prices as well as cash requirements, may be an active strategy of sales support or price discrimination [Schwartz et Whitcomb (1979), Brennan, Maksimovic and Zechner (1988), Petersen et Rajan (1997)]. Suppliers are inclined to bring financial assistance because they have an interest in the survival of their clients. The credit attribution's decision results from a trade-off between a higher risk responsibility and expected profits on future sales resulting from the preservation of the trade relationship. Terms of payment are also a way of modifying the effective price of goods : net present value of prices, terms of payment constitute a strategic tool, which affects the channel profit allocation between producers and retailers. Terms of payment may be imposed to the suppliers rather than being controlled by them. Substantial credit comes from an involuntary mechanism of economic

dependence, and reflects the relative power of trade partners [Wilner (2000)]. This commercial motive is particularly significant in a market where firms act strategically. Trade credit may be used as a strategic way by firms in order to influence their output market position. By offering credit, the supplier trades off the positive effect from the sale of goods and credit, against the negative effect from assuming the default risk of the buyer.

The second contribution of this article lies in an empirical investigation, testing different explanations of trade credit. There is little evidence about why trade credit is extended [Mian and Smith (1992), Petersen and Rajan (1997), Dietsch and Kremp (1998), Ng, Smith and Smith (1999)]. Our main objective is to examine the empirical validity of the strategic motive of trade credit. We build an econometric model where previous traditional explanations for trade credit are completed by the strategic variables highlighted in the theoretical model. The originality of this study also lies in the nature of the database used here. Empirical studies usually come up against the difficulty of identifying the clients' portfolios of suppliers. Our database, issued from the credit insurance activity of COFACE SCRL, is interesting because it identifies clearly bilateral relationships between clients and suppliers. We can then consider both parts' characteristics in our analysis.

The rest of the article is organised as follows. Section 1 sets out the theoretical model. In section 2, we present the empirical test of trade credit theoretical explanations.

I THE STRATEGIC MOTIVE OF TRADE CREDIT : THEORY

We first outline briefly the model framework. Then the equilibrium is determined by backward induction, so as subgame perfection is ensured.

I.1 THE MODEL

1.1.1 The distribution channel

We consider a distribution channel where goods produced by two manufacturers are distributed through two rival retailers. Suppliers and clients are bound by an exclusive distribution contract. This market structure corresponds to car manufacturers and their dealers, or more generally franchisees and their head office. Figure 1 represents this distribution channel.



Figure 1 : Distribution channel.

I.1.1.1 Retailing and quantity determination

Retailers *i* and *j* distributing competing products q_i et q_j are engaged in a Cournot competition in the output market. The final demand addressed to these firms is defined by :

$$p = \int_{z_1}^{z_2} \left[z - a (q_i + q_j) \right] f(z) dz$$
 (1)

The consumers' inverse demand function depends on total quantity $q_i + q_j$, and random variable z. This variable reflects the effects of demand uncertainty. It is assumed to be distributed over the interval $[z_1, z_2]$, according to a uniform density function $f(z) = 1/(z_2 - z_1)$. Uncertainty does not concern quantities sold – retailers know for sure that they will sell off their entire stock – but the price retailers will be offered for their products. $a \in [0,1]$ represents price sensitivity to quantities.

Hence the retailer resells goods purchased from its supplier for a price p, established by the retail market demand. His operating profit is denoted by R^i :

$$R^{i} = q_{i} \int_{z_{1}}^{z_{2}} \left[z - a \left(q_{i} + q_{j} \right) \right] f(z) dz$$
(2)

I.1.1.2 Production and delay of payment selection

Each retailer purchases his products from a single and distinct producer. To meet the retail market demand, retailer *i* buys a quantity q_i of goods for a wholesale price *w*. The supplier allows terms of payment to his client, and grants a credit for a length of $0 < d_i < 1$. Variable d_i is a year fraction : it is practically number of days of credit divided by 365 days. The price of this trade credit tied to the purchase of goods is the annual interest rate *r*. The repayment of the debt contracted through the supplier is then :

$$B = q_i . w. (1 + r.d_i) \tag{3}$$

Trade credit differs from bank credit, insofar as it is function of the term of payment as well as the purchase volume. In our framework, the supplier is the only creditor of his client. Exclusive trade credit use may be explained by the cost advantage over traditional credit. Manufacturer and retailer have different access capacity to credit markets. The producer, because of his size and his reputation, easily obtains funds to a low interest rate, whereas the retailer that presents no guarantees has to pay a dissuasive risk premium. The supplier then gives his client the benefit of his own credit conditions. Suppliers become involved in credit activity if they have a comparative advantage over traditional lenders for the resolution of information asymmetry problems. In that way, suppliers have a triple advantage in investigating the creditworthiness of their clients, as well as better ability to monitor them and force repayment of the credit in case of default. Firstly, suppliers benefit from an advantage in information acquisition [Biais and Gollier (1997), Jain (2001)]. They are involved actors in the industry sector, have a good understanding of the market, and a better evaluation of the credit worthiness of a potential buyer. By their privileged and regular relationships, they get a better information about clients' business. This advantage is particularly significant in an exclusive distribution channel, where suppliers and clients are tied by close links. Secondly, the monitoring advantage of the supplier over financial institutions reduces moral hazard behaviour. The supplier may threaten his client to cut off future supplies if his risky actions compromise the chances of repayment [Cunat (2000)]. This threat is particularly credible when the client is dependent on the supplier, and accounts for a small part of the supplier's sales. In contrast, the bank's threat to withdraw future financing would have no effect if the bank were involved in long-term relationship with the borrower. Thirdly, if the client defaults,

the supplier has an advantage in credit recovering, because of the nature of collateral [Franck and Maksimovic (1999)]. If the ownership reservation clause is effective, the supplier can seize the goods delivered. He bears in that case lower seizure and resale costs than the traditional creditors. So because of this triple cost advantage, suppliers better control credit risks and are able to extend credit when financial institutions face too higher costs to maintain their credit offer.

The selection of terms of payment belongs to the supplier. In the certainty case, choosing the delay of payment is a means of affecting effective prices. In the uncertainty case, terms of payment include also a risk premium. Suppliers pass on the opportunity cost of invested funds, and adjust the credit return by modifying terms of payment.² They anticipate the strategic effects of trade indebtedness for firms. Finally, producers as well as retailers are risk neutral.

I.1.2 Chronology

The timing of events is as follows :



Figure 2 : Chronology of events

In date 0, the suppliers decide upon delay of payment offered to their client. The suppliers correctly anticipate the output equilibrium in second stage when choosing debt levels in this first stage. In date 1, clients select output levels, taken as given the debt levels

 $^{^{2}}$ Practically, suppliers rate for their credit by setting two-part terms of payment. A two-part contract offers the opportunity of a discount in case of early payment. If the client declines this discount for cash payment, he bears an implicit interest rate for the credit [Schwartz and Whitcomb (1979)]. Nevertheless, even if terms of payment do not include this possibility, it is reasonable to assume that suppliers take into account the financial cost of their credit activity when determining wholesale prices.

determined by suppliers, and receive the goods. In date $t = t_z$, once the random variable is realised, the retailers satisfy customers' demand by reselling goods.

In good states of nature - when z is such as $R^i - B > 0$ - the borrower pays his creditor out of his current profits in date $t = d_i$, and retains residual profit. In bad states of nature, when the firm is unable to meet its debt obligations, the firm goes bankrupt and the creditors obtain as compensation a portion γ from operating profits. This parameter $\gamma \in [0,1]$ is interpreted as the lender debt recovery rate.³ For simplicity, we assume that residual value of firm assets is zero, as if assets are completely used up in firm activity.

I.2 THE STRATEGIC ROLE OF TRADE CREDIT IN OUTPUT MARKET.

Game is resolved by backward induction. We first examine the second stage output equilibrium in retail market. Section 2 analyses how the limited liability aspects of trade indebtedness affect the strategic output decisions of the firms. Section 3 presents the wholesale market equilibrium and the delays of payment selection by suppliers.

I.2.1 Retail market equilibrium

In the retail market, retailer *i* selects quantity q_i sold to the customers, taking into account strategic interactions with rival firm *j*. The expected profit of retailer *i* is given by operating profit, debt repayment deducted :

$$\pi^{D_i} = q_i \int_{\hat{z}_i}^{z_2} \left[z - a \left(q_i + q_j \right) - w \left(1 + r.d_i \right) \right] f(z) dz$$
(4)

with \hat{z}_i such as $q_i \cdot [\hat{z}_i - a(q_i + q_j) - w(1 + r.d_i)] = 0$.

³ It is reasonable to assume that suppliers suffer from bankruptcy costs. Brealey and Myers (2000) estimate the cost of recovery procedure to 15 to 40% of the credit amount. Moreover, in our model, the supplier is the only creditor of his client. However, suppliers are in reality confronted to the existence of lenders benefiting from priority rights. In France, the property reserve clause, instituted by the 1980 Dubanchet act, reserves for suppliers the property of goods sold until the payment of the bill. But this clause appears sometimes inoperative, because collateral obtained by bank creditors concern the same goods. Finally, goods are often transformed or rapidly resold by clients.

For simplicity, distribution variable cost is zero. The retailer only considers net profits realised in good states of nature $(z > \hat{z}_i)$, because of his limited liability. In bad states of demand $(z < \hat{z}_i)$, the retailer, unable to meet his debt obligations, goes bankrupt and the supplier becomes the residual claimant on the firm's profits. Parameters are restricted so as $z_1 < \hat{z}_i < z_2$.

When $z = \hat{z}_i$, retailer *i* is just able to meet his debt obligations, and his residual profit is zero. This crucial threshold is defined by :

$$\hat{z}_i = a \left(q_i + q_j \right) + w \left(1 + r.d_i \right)$$
(5)

Expression (5) shows the implicit dependence of \hat{z}_i on d_i , q_i , q_j . Following properties are observed :

- $\partial \hat{z}_i / \partial d_i > 0$: the solvency breaking point of firm *i* increases with delay of payment.
- $\partial \hat{z}_i / \partial q_i > 0$: the solvency breaking point of firm *i* increases with output.
- $\partial \hat{z}_i / \partial q_i > 0$: the solvency breaking point of firm *i* increases with output of rival firm *j*.

The rival firm's behaviour affects the firm's bankruptcy probability.

Moreover, it can be shown that :

$$\pi_z^{D_i} > 0 \tag{6a}$$

$$\pi_{q,z}^{D_i} > 0 \tag{6b}$$

where subscripts z and q_i indicate partial derivatives with respect to these variables. High values of z induce higher profits, i.e. higher realisations of z correspond to the better states of nature. It is also important to note that higher marginal profits occur in best states of nature. Retailer i maximises his expected profit. The output choice is obtained by setting the derivative of equation (4) with respect to q_i equal to zero :⁴

$$\pi_{q_i}^{D_i} = \int_{\hat{z}_i}^{z_2} \left[z - a \left(2q_i + q_j \right) - w \left(1 + r.d_i \right) \right] f(z) dz = 0$$
⁽⁷⁾

⁴ The derivative $\pi_{q_i}^{D_i}$ originally includes another term, $-q_i \cdot [\hat{z}_i - a(q_i + q_j) - w(1 + r.d_i)] f(\hat{z}_i).a$, equal to zero from equation (5).

For all z such as $z_1 < \hat{z}_i < z_2$, second-order condition is negative. The Cournot equilibrium in the retail market results from the simultaneous solution of equation (7) and its corollary $\pi_{q_j}^{D_j} = 0$ by firms *i* and *j*. This Cournot equilibrium requires that three standard conditions are verified :

$$\pi_{q_j}^{D_i} < 0 \tag{8a}$$

$$\pi_{q_i q_j}^{D_i} < 0 \tag{8b}$$

$$\pi_{q_i q_i}^{D_i} \pi_{q_j q_j}^{D_j} - \pi_{q_i q_j}^{D_i} \pi_{q_j q_i}^{D_j} > 0$$
(8c)

According to equation (8a), the firm's profit falls as the rival firm's output increases. Equation (8c) means that marginal profit of retailer i is more sensitive to his own output variations than to the rival's ones. This condition implies that the reaction functions are downward sloping. It holds if marginal profits decrease with the rival firm's output (equation 8b). This condition (8b) expresses the idea that firms' outputs are strategic substitutes as defined by Bulow, Geanakoplos and Klemperer (1985).

The reaction function of firm i follows from equation (7):

$$q_i^* = \frac{1}{3a} \Big[z_2 - aq_j - w \Big(1 + r.d_i \Big) \Big]$$
(9)

Taking into account the strategic behaviour of rival firms, optimal output level q_i^* is defined by :

$$q_i^* = \frac{1}{8a} \left[2z_2 - 2w - wr \left(3d_i - d_j \right) \right]$$
(10)

The quantity of goods sold by retailers depends on market demand : if profit prospects – materialised by z_2 – get better, the retailer will extend his activity. The retailer does not take into account unfavourable state of nature z_1 , because he is not the residual claimant on firm's profits in that case. Output level is by contrast affected by indebtedness. If the wholesale price of goods w is high, or if the financial cost of business is significant, the retailer limits his sales.

1.2.2 A strategic effect of trade indebtedness on sales levels.

In order to determine how the trade credit variations may affect the retailer's output level, we examine the situation of an asymmetric duopoly, where firm i experiences an unilateral delay of payment's extension.



Figure 3 : modification of \hat{z}_i following debt increase.

In that context, trade credit has two conflicting effects on the retailer's output choice. On the one hand, when the manufacturer grants longer delays of payment, the limited liability effect induces the retailer to adopt a more aggressive sales strategy. The intuition is as follows. As figure 3 shows, a higher debt level provokes a rise of \hat{z}_i , meaning that the range of states over which the firm is insolvent is expanded. Now marginal profits rise with states of nature. Then some low marginal profit states move from the solvency region, to the bankruptcy region where debt holders are residual claimants. As debt increases, states characterised by low marginal profits are no longer taken into account by the equity holders in their output choice, for in this case operating profits go to debt holders. Since the retailer restricts its attention to high marginal profit states, he would want output to rise and adopts a more aggressive strategy in the retail market.

On the other hand, as delay of payment gets longer, the debt burden becomes heavier. This higher debt repayment tends to diminish the retailer's expected profit. The retailer would therefore reduce sales *ceteris paribus*.

The optimal strategy of sales for the retailer results from a trade-off between the positive effect due to limited liability, and the negative effect due to the heavier debt burden. We show that the second effect more than offsets the first one. Sales capacities chosen by the retailer decrease with commercial debt.

Proposition 1 : the leveraged retailer *i* reduces his sales when his debt level grows due to delays of payment offered by his supplier.

□ Proof of proposition 1 :

At first sight, proof of proposition 1 is obvious. We easily observe that $\partial q_i^* / \partial d_i < 0$. However, it is interesting to precise this result in order to understand consequences of indebtedness and to decompose its effects.

The effect of debt increase is determined by totally differentiating first-order conditions $\pi_{q_i}^{D_i} = 0$ and $\pi_{q_j}^{D_j} = 0$ with respect to q_i, q_j, d_i . By transforming this equations system into matrix form and using Cramer's rule, we isolate comparative static effects dq_i / dd_i and dq_j / dd_i :

$$dq_i / dd_i = (-\pi_{q_i d_i}^{D_i} \times \pi_{q_j q_j}^{D_j}) \div (\pi_{q_i q_i}^{D_i} \cdot \pi_{q_j q_j}^{D_j} - \pi_{q_i q_j}^{D_i} \cdot \pi_{q_j q_i}^{D_j})$$
(11a)

$$dq_{j} / dd_{i} = (\pi_{q_{j}q_{i}}^{D_{j}} \times \pi_{q_{i}d_{i}}^{D_{i}}) \div (\pi_{q_{i}q_{i}}^{D_{i}} \cdot \pi_{q_{j}q_{j}}^{D_{j}} - \pi_{q_{i}q_{j}}^{D_{i}} \cdot \pi_{q_{j}q_{i}}^{D_{j}})$$
(11b)

From condition (8c), $\pi_{q_iq_i}^{D_i} \cdot \pi_{q_jq_j}^{D_j} - \pi_{q_iq_j}^{D_i} \cdot \pi_{q_jq_i}^{D_j} > 0$: the denominator of expressions (11a) and (11b) is positive. As $\pi_{q_jq_j}^{D_j} < 0$ and $\pi_{q_jq_i}^{D_j} < 0$ - from equation (8b) -, $\partial q_i^* / \partial d_i$ has the same sign as $\pi_{q_id_i}^{D_i}$, and $\partial q_j^* / \partial d_i$ has the opposite sign to $\pi_{q_id_i}^{D_i}$. The sales of retailer *i* decrease with delay of payment if the extension of delay causes his marginal profits to fall. $\pi_{q_id_i}^{D_i}$ is given by :

$$\pi_{q_i d_i}^{D_i} = -\int_{\hat{z}_i}^{z_2} wrf(z) dz - \pi_{q_i}^{D_i}(\hat{z}_i) \times \frac{d\hat{z}_i}{dd_i}$$
(12)

The first term of this equation expresses the negative effect of a heavier debt burden on the retailer's marginal profits. The second term sets out the increase of expected marginal profit following the modification of the residual rights' distribution between shareholders. The term $\pi_{q_i}^{D_i}(\hat{z}_i)$ is marginal profit evaluated at the worst state of nature \hat{z}_i considered by the retailer. We know by (6b) that $\pi_{q_i}^{D_i}$ increases in z. $\pi_{q_i}^{D_i}$ evaluated at \hat{z}_i must be negative since the weighted average of $\pi_{q_i}^{D_i}$ over all the states of nature from \hat{z}_i to z_2 is zero, from equation (7). Furthermore, $d\hat{z}_i/dd_i$ is positive. The limited liability effect induces then a joint increase of debt and output levels. By simplifying equation (12) it is possible to decide between the two effects :

$$\boldsymbol{\pi}_{q_i d_i}^{D_i} = -wr \times \boldsymbol{\pi}_{q_i}^{D_i}(\boldsymbol{z}_2) \tag{13}$$

From (6b) and (7), $\pi_{q_i}^{D_i}(z_2)$ is a positive term. Therefore, $\pi_{q_i d_i}^{D_i}$ is negative. We then verify that $\partial q_i^* / \partial d_i$ is negative : commercial leverage softens competition in the output market. When retailer *i* unilaterally increases his debt level, his position is weakened, to the benefit of the rival firm j ($\partial q_j^* / \partial d_i > 0$). Commercial indebtedness is then a credible commitment to sales moderation.

1.2.3 Wholesale market equilibrium and delay of payment's selection.

The manufacturer offers to his client a credit tied to the sell of goods. He decides alone of the terms of credit, because he has a bargaining power towards his client owing to the market structure and the financing needs of the latter. The supplier that has a better access to credit markets plays a financial intermediary role in favour of his client, and makes him benefit from his better credit terms. If as every financial intermediary, the manufacturer passes on cost of credit *r* to his borrower, he suffers from the increased default risk of his client as well. The supplier undergoes the risk linked to the random demand in the client's behalf. He therefore conceives the terms of credit so as to limit the incurred risks. Trade credit has a strategic role to play because the supplier could use it as a means of influencing the retailer's output strategies. Practically, the supplier has an expected profit π^{P_i} :

$$\pi^{P_i} = \gamma q_i \int_{z_1}^{\hat{z}_i} \left[z - a \left(q_i + q_j \right) \right] f(z) dz + q_i w \left(1 + r \cdot d_i \right) \left[1 - F(\hat{z}_i) \right]$$
(14)

The fist term corresponds to states of nature where z goes from z_1 to \hat{z}_i : the retailer's profit is insufficient to meet its debt obligations. The borrower firm goes bankrupt, and the

supplier obtains a portion γ of operating profits. The second term reflects favourable states of nature $-z_i$ is superior to \hat{z}_i – where the retailer's profit exceeds the repayment of debt. For simplicity, we assume that the production cost of goods is zero. The removal of this hypothesis does not change fundamentally the results presented here.

The manufacturer anticipates the influence of his credit decision on the second-stage sales equilibrium. In practical terms we determine for every delay of payment d_i the optimal quantity purchase q_i^* by the retailer, and include it in the manufacturer's profit expression (14):

$$\pi^{P_{i}} = \frac{1}{8a} \left[2z_{2} - 2w + wr(d_{j} - 3d_{i}) \right] \left[\gamma \int_{z_{1}}^{z_{i}} \left[z + \left(\frac{1}{4} \left(-2z_{2} + 2w + wr(d_{i} + d_{j}) \right) \right) \right] f(z) dz \right] + \frac{1}{8a} \left[2z_{2} - 2w + wr(d_{j} - 3d_{i}) \right] \left[\frac{w(1 + r.d_{i})(2z_{2} - 2w + wr(d_{j} - 3d_{i}))}{4(z_{2} - z_{1})} \right]$$
(15)

Taking into account the strategies of rival producers allows to determine optimal delay of payment d_i^* chosen by producers *i* and *j* in equilibrium. The resolution of profit maximising programs by manufacturers induces reaction functions, which determine the producer's best response to the delay selected by the rival firm. Solving this equation system yields optimal delays selected by producers *i* and *j* in the wholesale market equilibrium :

$$d_i^* = d_j^* = -\frac{1}{r} + \frac{(20 - 3\gamma)z_2 - 8\gamma z_1 - 2\sqrt{X}}{(32 - 23\gamma)wr}$$
(16)

with $X = (36 - 24\gamma + 31\gamma^2)z_2^2 + (-96\gamma + 85\gamma^2)z_1^2 + (48\gamma - 80\gamma^2)z_1z_2$.

For certain values of parameters, this optimal delay could be inferior to t_z . Now the supplier cannot fix a delay shorter than the time when the retailer is paid by his own clients. The delay actually offered is then $d_i = \min[t_z, d_i^*]$. To simplify, we restrict parameters in a way that $t_z < d_i^* < 1$.

The non-profitability of trade credit is exclusively determined by demand uncertainty. The producer assumes the default risk of his client, but requires in return remuneration for the incurred risk. The delay of payment offered by the supplier may be longer than the one that corresponds to the date t_z of goods resale by the client. But the client accepts this « take it or leave it » offer because he depends on this cheaper financing of exploitation cycle. Furthermore, commercial debt has for retailers a credible commitment value, and allows them to commit to reduce sales, i.e. moderate competition in the output market to their mutual benefit.

II THE STRATEGIC ROLE OF TRADE CREDIT : EVIDENCE

Trade credit may be used by firms as a strategic tool intended to affect their position in the output market competition. In that way, the theoretical model presented before shows that the suppliers determine the credit offered to their clients, taking into account the financial risk tied to their creditor position and the commercial advantage they get from the transaction. We try here to verify this motive of trade credit attribution. The econometric model and data are described in the first part. The second part presents results.

II.1 ECONOMETRIC MODEL AND DATA

The econometric model aimed at testing different explanations of trade credit is presented first. Variables outlined by the model are included in a structural equation of trade credit offer by suppliers. Then we describe the data.

II.1.1 Presentation of econometric model

The dependent variable is trade credit AR_{ij} offered by the supplier firm *i* to the client firm *j*. Practically, it is measured by accounts receivable to client purchases ratio, expressed in days.

According to theories exposed before, three factors explain trade credit importance : strategic behaviour, financing advantage, and commercial policy.

First of all, in the strategic behaviour model, three variables influence the supplier in his credit decision : demand uncertainty, wholesale price, and interest rate. In this approach, the supplier estimates the risk due to demand uncertainty. Comparative static results show that $\partial d_i^* / \partial z_2 > 0$ and $\partial d_i^* / \partial z_1 > 0$: if the client's potential gains are high, the supplier is disposed to bring its financial assistance, for he has more to earn from the investment in this trade relation. On the contrary, if potential losses incurred were higher, the amount offered would be lower. Practically, random demand RD_j is estimated by sales volatility of the client firm, that is to say the ratio $\sum_{t=1}^{n} |\dot{y}_{it} - \dot{y}_{i.}| / n$, i.e. the deviations average of annual sales growth rate from the average growth rate, calculated on the five years available. This deviation average of sales growth rate accounts for a potential bracket of sales variation.

Furthermore, accounts receivable should depend negatively on the market interest rate $(\partial d_i^*/\partial r < 0)$. In fact, the supplier takes into account the refinancing cost of trade credit, or alternatively the opportunity cost of invested funds. This interest rate is approximated by the supplier's average cost of debt INT_i , measured by the ratio (interest expenses / debt) × 100.

As financial institutions, the supplier controls the total amount of extended credit. So, if the wholesale price W_i is high, delays offered should be shorter, such as the global amount of debt keeps a reasonable size. We approximate the wholesale price by the gross profit margin, that is to say (sales – purchase cost of goods sold) / sales. If raw materials market is perfectly competitive, suppliers have the same purchase cost of goods sold. Then gross profit margin differentials can be attributed to wholesale prices' differentials.

Secondly, trade credit can be explained by financial or commercial motives.

The literature predicts that suppliers play a financial intermediary role to the benefit of their clients that are unable to raise capital through more traditional channels. Hence the supplier's capacity to offer credit to his clients depends on his own access to credit markets. We then control the availability of external funds. We introduce in the model several indicators of this access to credit markets. The debt level would have represented a direct measure. But debt level is simultaneously determined by the firm's willingness to borrow, as well as the bank willingness to lend. A low debt ratio is sometimes the sign of a financial autonomy strategy, rather than credit rationing. We neglect then this variable and consider indirect indicators, reflecting funds availability. Age is a proxy for the credit worthiness of the firm, and its reputation with lenders. An older firm has survived a longer time, and has then a

better survival probability.⁵ He has developed long-term lending relationships. Age should have a positive influence on accounts receivable of the firm. Variable AGE_i simply measures years of firm's existence.

We consider also credit risk. Each firm is attributed by COFACE-SCRL a rating evaluating its solvency. From these ratings we build the dummy variable $QUALITY_i$, separating firms which obtain a good rating from those which get a medium or bad one. The underlying intuition is that good rating firms are identified by lenders as low risk firms, and benefit from an easier access to credit.

Finally, accounts payable - AP_i - are a traditional source of financing accounts receivable, because of similar maturity. We should observe a positive relation.

Beyond these different sources of external financing, we consider as well internal funds availability. It would be relevant to introduce indicators for internal liquidity, but variables such as operating margin or net profit margin present a too high degree of collinearity with gross profit margin. Instead we use a financial balance ratio, which corresponds to long-term liabilities divided by fixed assets ($FINEQ_i$).

In addition, as client and supplier are identified, it is also possible to introduce variables describing the characteristics of clients. Suppliers analyse financial situation of their clients in order to determine their credit offer. That is indeed the purpose of their request to COFACE-SCRL. As traditional lenders, they consider in their credit decision the client's credit risk as well as the guarantees presented by the latter. The client's SCRL rating is a direct measure of this credit risk. We then include a dummy variable $QUALITY_j$, discriminating low risks from the others. This synthetic variable expresses at the same time the firm's financial autonomy and its profitability, which represent solvency guarantees for the lender. The age of the client firm AGE_j should moreover influence the supplier's credit decision. The older the firm, the lower its default probability. It is the supplier's interest to invest in this reliable and low-risk relationship.

Furthermore, trade credit decision may be based on commercial motives. We include two distinct variables reflecting supplier's activity dynamics. Changes in firm's sales may indicate economic shocks, which affect the activity of firm and induce divergent commercial

⁵ Blazy (2000) underscores a negative relation between the firms' age and their default rate.

strategies. We split sales variation up into positive sales growth and negative sales growth. The sales' decrease variable $SALESDOWN_i$ equals to the absolute value of sales growth if negative, to zero otherwise. On the contrary, the sales' increase variable $SALESUP_i$ equals to sales growth if positive, to zero otherwise.

Finally, at least part of the pattern of trade credit can be explained by firm size and activity sector. As the supplier size seems to be a significant factor in trade credit explanation, we will then pay particular attention to large firms. In order to control the clients' size influence, we introduce dummy variables for small firms (sales from 3 to 15 million euros), medium firms (15 - 76 million euros) or large firms (more than 76 million euros).

Terms of payment strongly vary across industries, and with the position in the distribution channel. To take this influence into account, we include dummy variables which inform about suppliers' belonging to industry (IND_i), or non-food wholesale trade ($NFWT_i$).

Finally, we consider the following log-log model :

$$\ln AR_{ij} = \alpha + \beta_1 \ln RD_j + \beta_2 \ln W_i + \beta_3 \ln INT_i + \beta_4 \ln AGE_i + \beta_5 QUALITY_i + \beta_6 \ln AP_i + \beta_7 \ln FINEQ_i + \beta_8 \ln SALESDOWN_i + \beta_9 \ln SALESUP_i + \beta_{10}IND_i + \beta_{11}NFWT_i + \beta_{12} \ln AGE_j + \beta_{13}QUALITY_j + \beta_{14}SMALL_j + \beta_{15}MEDIUM_j + \beta_{16}LARGE_j$$

II.1.2 Sample description

To test the econometric model, we use a database provided by the credit insurance company COFACE-SCRL. This database contains for a year, from the 15th of July 1998 to the 15th of July 1999, information requests from firms concerning potential clients. Precisely, each firm consults COFACE-SCRL about a defined amount of credit for a potential client. In answer COFACE-SCRL confirms the required amount, if the client is judged as solvent, recommends a lower amount or even discourages credit, if it considers this lending operation as risky. Assuming that the requiring firm follows recommendation, we get there the actual credit offered.⁶

⁶ If we remind the cost incurred by the requiring firm in order to obtain this information, as well as the commitment of COFACE-SCRL as credit insurance company, this hypothesis seems relevant.

The great interest of these data is that they provide precise information about commercial relationships between firms. Through this database we can clearly identify bilateral ties joining suppliers and clients. Because of the nature of data, fragile firms may be over-represented yet. In fact, suppliers probably call on COFACE-SCRL services when they have a doubt on a potential client's solvency. In other terms, if the solvency rating is doubtful, transaction would actually not happen. To solve this problem, we exclude from the sample firms presenting a high credit risk. So our sample only keeps healthy clients, who suppliers surely establish business relations with. Financial data completing our sample also come from COFACE-SCRL accounting database.

After usual truncations of data, we get a cross-section sample, which contains valuable information about suppliers as well as their clients.⁷ For simplicity, we consider only suppliers from industry and trade activity sectors. Moreover, according to the theoretical model, we focus on suppliers benefiting from a certain bargaining power, whose sales exceed 3 million euros. Finally, the sample includes 40 000 couples of suppliers and clients, which carry out a redistribution of funds amounting to 1,95 billion euros through trade credit.

		Suppliers			
		3 – 15 millions	15 – 76 millions	More than 76 millions	Total
	0,15 – 3 millions	50.18 %	46.35 %	36.19 %	45.68 %
lients	3 – 15 millions	33.17 %	32.05 %	36.49 %	33.39 %
	15 – 76 millions	12.90 %	16.62 %	20.54 %	16.03 %
0	More than 76 millions	3.74 %	4.98 %	6.78 %	4.89 %
	Total	37.65 %	41.61 %	20.75 %	100 %

 Table 1 : Clients and suppliers stratification (by million euros of sales)

Source : COFACE-SCRL and our computations

⁷ A first truncation is realised on financial ratios (liquidity ratio, internal funding ratio, financial balance, value added to sales ratio, working capital to sales ratio, operating margin) as well as sales growth and dependent variable. The two extreme centiles are excluded from the sample. A second truncation concerns the whole variables included in the estimated model. Values inferior to the first centile or superior to the last centile were affected respectively first and 99th centile's values.

Firms are distributed among four classes according to their sales. Table 1 presents cross proportions of suppliers and clients. Requests emanate mainly from more than 15 million sales firms. Large and medium firms represent 41,6 % and 20,7 % of requests, though they are only respectively 18,1 % and 2,9 % of total firms (COFACE-SCRL). Larger firms seem then to have a more sophisticated credit management policy. Furthermore, requests concern principally small firms : 45,7 % of clients have less than 3 million euros sales.

Cross percentages show a slight matching tendency in commercial relationships : small firms require more information about small clients than large ones (50,2 % versus 36,2 %), whereas large clients are almost twice more examined by large suppliers than small ones. Globally, the average amount of credit is 49 113 euros.

	Industry	Non food wholesale trade	Food wholesale trade	Non food retailing	Food retailing
Suppliers	45.42 %	50.22 %	2.94 %	1.39 %	0.04 %
Clients	51.59 %	27.16 %	4.16 %	13.20 %	3.89 %

Table 2 : Suppliers and clients activity sectors.

Source : COFACE-SCRL and our computations

Sector repartition of the sample is described in table 2. Requests come from firms rather located upstream in the production-distribution channel (45,4% for industry, 53,2% for wholesale trade). Retailing firms situated downstream are more counted among clients than suppliers (17,1% versus 1,4%). Table 3 reports summary statistics of our model.

	Mean	Median	Standard deviation	
Credit offered by supplier <i>i</i> to client <i>j</i> (in days of purchases)	5.931	2.509	9.599	
Supp	lier characteris	tics		
Gross profit margin	24.652	24.370	19.826	
Interest rate	2.248	1.753	1.811	
Accounts payable	67.785	68.838	26.407	
Firm age	32.914	28	22.536	
Financial balance	2.71	1.81	2.88	
Sales growth	8.502	6.671	17.406	
Client characteristics				
Firm age	22.04	16	18.983	
Random demand	14.186	10.651	13.092	

Table 3 : Summary statistics.

Source : COFACE-SCRL and our computations

II.2 RESULTS

The econometric model is first estimated for the whole sample, and then for large firms only. The results confirm the relevance of commercial and financial explanations of trade credit, and outline that strategic motive of trade credit is particularly acute for large firms, which is consistent with the theoretical model.

II.2.1 The determinants of trade credit

Table 4 presents the results of the regression obtained using ordinary least squares upon our 39 665 firms sample. As all variables - except dummies - are logarithmic, coefficients express elasticity. Student *t* statistics are in parentheses.⁸

⁸ Normality test and multicollinearity test – following Belsley, Kuh and Welsch (1980) approach – were carried out succesfully.

Table 4 : Accounts receivable determinants.

	All f	Large firms (+76 billion sales)	
number of firms	39665		8035
Intercept α	0.998*** (11.82)	0.988*** (11.74)	-4.344*** (-18.40)

Strategic behaviour

RD.	0.064***	0.063***	0.102***
j	(5.81)	(5.73)	(3.90)
W.	-0.079***		-0.104***
,, i	(-14.37)		(-5.86)
W - HC		-0.132***	
W _i He		(-19.89)	
$W_{\rm c} - LC$		-0.042***	
		(-6.91)	
INT	-0.220***	-0.237***	-0.628***
IIII i	(-15.15)	(-16.29)	(-11.02)

Supplier characteristics

AGE.	0.143***	0.150***	0.188***
1102	(14.90)	(15.63)	(6.22)
OUALITY	0.195***	0.190***	-0.258***
Q OTHERT <i>i</i>	(9.46)	(9.23)	(-3.77)
AP	-0.322***	-0.338***	-0.199***
i i i	(-26.23)	(-27.46)	(-8.00)
FINEO	0.185***	0.193***	0.273***
$1 m \mathcal{L} \mathcal{L}_i$	(12.50)	(13.07)	(5.95)
SALESDOWN	0.059***	0.063***	-0.037
	(5.00)	(5.26)	(-1.32)
SALESUP	0.074***	0.073***	0.152***
	(8.66)	(8.55)	(7.15)
IND	0.746***	0.828***	6.008***
	(20.99)	(23.05)	(32.84)
NFWT	0.781***	0.744***	6.119***
i i i	(22.70)	(21.62)	(33.83)

Client characteristics

AGE	0.033***	0.032***	0.081
	(3.42)	(3.35)	(3.63)
OUALITY.	0.645***	0.646***	0.962***
\mathfrak{L} or \mathfrak{L} \mathfrak{L}	(35.58)	(35.72)	(21.02)
SMALL	-1.189***	-1.192***	-1.269***
~····j	(-74.75)	(-75.11)	(-33.11)
MEDIUM.	-2.534***	-2.537***	-2.504***
	(-121.30)	(-121.74)	(-52.74)
LARGE.	-4.322***	-4.315***	-4.358***
	(-130.70)	(-130.76)	(-64.45)
adjusted R ²	0.444	0.447	0.502

Source : COFACE-SCRL and our computations

The results confirm the relevance of the strategic explanation of trade credit. The three variables outlined by the theoretical are significant. As expected, the relation between random demand and accounts receivable is positive and statistically significant, though rather weak. The credit offered to the client firm increases by 0,06 % on average when the volatility of sales increases by one per cent. As regards wholesale price, results are consistent with our hypothesis: credit offered is negatively correlated with wholesale price. The gross profit margin is also the sign of the supplier's bargaining power : a higher gross profit margin may imply that the manufacturer has more ability to determine prices and does not act in a highly competitive sector. He may then be more able to shorten delay of payment to the detriment of his client. The model is modified in order to take into account the influence of competitive environment. The sector's concentration is measured by the sales of ten larger firms in the sector's total sales. We separate firms belonging to highly concentrated sectors, where the index exceeds the value of the third quartile -42,4% -, from firms included in the three other quartiles. The variable $W_i - HC$ is equal to the gross profit margin for the fourth quartile firms, and zero otherwise. On the contrary, variable $W_i - LC$ measures the impact of W_i in low concentration sectors. Estimations presented in the second column indicate that the correlation between accounts receivable and wholesale price is three times stronger in highly concentrated sectors.

Finally, offered credit should decrease with interest rate. This is indeed the case : when average interest rate paid by suppliers increases by one per cent, client credit falls by 0,22 %.

Furthermore, suppliers that have easier access to credit markets should offer more financing facilities to their clients. As we noted before, the age of the firm is an indicator of his credit worthiness and reputation among lenders, and should be positively correlated to the amount of credit extended by the firm. Indeed, increasing firm age from 15 to 44 years (the first to the third quartile) raises accounts receivable from 5,05 to 7,78 days of purchase. Furthermore, the credit quality dummy has a positive impact on credit offered by the firm. Surprisingly, accounts receivable and accounts payable seem negatively correlated. Important accounts payable may be typical of fragile suppliers, which are not able to help their own clients. Important resort to trade credit financing by suppliers may result from bank credit rationing.

The presence of a reliable working capital – reflected by financial balance ratio – encourages suppliers to extend trade credit in favour of their clients. When long-term liabilities strongly exceed fixed assets, the firm has residual funds to finance current assets, and particularly accounts receivable. In fact, coefficient is statistically significant and economically strong.

In addition, the sales variation of firms may help to explain their credit attribution policy. The inclusion of the raw growth rate of sales is inconclusive : the variable is not significant. Following Petersen and Rajan (1997), we then consider two distinct variables reflecting increase and decrease of sales. Results show that as their sales rise, suppliers tend to extend more credit to their clients. Healthy firms probably have a better financial position, and are able to offer more credit. On contrast, sales increase may be resulting from a commercial strategy of trade credit extension. Otherwise, firms that see their sales decline find their accounts receivable increase significantly. It seems that firms suffering from a negative shock extend more credit in order to soften harmful consequences. Clients, noticing their supplier's difficulties, may also take advantage of his fragility to postpone their payment.

At last, differences of sector practices are confirmed through dummies. Firms of industry or non-food wholesale trade typically extend more credit than food and retailing trade firms. This result is consistent with traditional evidence. Retailing firms sell goods to households, and food sector firms are governed by special regulation due to perishable nature of goods. They usually have shorter delays than other sectors' firms do.

In addition, as traditional lenders, suppliers are caring about the credit quality and solvency of clients. The variable $QUALITY_j$ constitutes a direct measure of the client's credit worthiness. It is significant : a low-default risk firm receives on average half a day of credit more than a higher risk firm. Moreover, the age of client firm should positively influence the amount of credit offered to the firm. This is indeed the case, though the effect is economically small. Finally the size of client firm is an important determinant of credit extended, as highly significant dummies show. The larger the firm, the lower his commercial debt.

II.2.2 The strategic motive is particularly relevant for large firms.

Large firms should better correspond to producers described in our theoretical model. They probably benefit more from bargaining power in their trade relations as well as scope to freely fix the terms of payment. The strategic behaviour explanation of trade credit should be more acute for this size category. To test this intuition, we isolate large firms, which sales exceed 76 million euros.

Results are consistent to our expectations (column 3). Concerning strategic behaviour variables, coefficients are qualitatively similar, but stronger. Interest rate takes on particular importance: a one per cent increase causes the amount of client credit to fall by 0,6%. Large suppliers are more sensitive to financial motive and have a better control of trade credit policy. The strategic explanation of trade credit seems then particularly relevant for large firms.

Internal and external funds availability influence is confirmed here. The negative impact of the credit quality dummy may be interpreted as another manifestation of the commercial motive. Suppliers judged as fragile extend more credit to their clients. We could assess that firms having difficulties use trade credit as a tool to redress their situation. Furthermore, sales changes seem to have a one-way impact : sales decrease is indeed non significant. By contrast, sales increase is strongly correlated to accounts receivable ratio : it probably points out an aggressive commercial strategy.

Financial solidity and credit quality coefficients attest that large firms pay attention to these features. They prefer to lend to profitable clients, which own equity capital as collateral, and benefit from a good credit reputation. Sector dummies coefficients are subject to caution, because there are only 42 firms in the food wholesalers and retailers category. Globally, the explanatory power of regression rises : adjusted R² is 0,50 for large firms versus 0,44 for the whole sample.

CONCLUSION

This paper makes the basic point that firms' financial structure is a strategic means of influencing their competitive position. We have analysed this relationship for a particular market structure in which relations between manufacturers and retailers are governed by exclusive distribution, and retailers face uncertain demand. In this situation, we show that commercial debt financing induces retailers to change their output strategy and to favour sales moderation. The limited liability effect of debt on the retailer's profits is more than balanced by the negative impact of heavier burden of debt expenses. Trade credit may finally allow retailers to commit to limit sales, and soften output market competition to their mutual benefit.

Our results differ from those of Brander and Lewis (1986). Trade credit has a disciplining effect on equity holders that does not have a traditional debt contract as modelled by Brander and Lewis. Our conclusions are closed to Faure-Grimaud (2000) which asserts that optimal debt contract, including an incentive reward for managers, causes firms to compete less aggressively. We should point out that these conclusions, like most contributions in this strand of literature, are sensitive to the type of competition – price or quantities – in which firms are engaged. This model describes also particular market structures as exclusive distribution or franchise.

Furthermore, in this paper we have applied econometric techniques in order to estimate the empirical relevance of different explanations of suppliers' credit decision. Particularly, results tend to confirm the existence of a strategic motive of trade credit extension. In accordance with the theoretical model, we observe that suppliers trade off potential commercial advantage and costs generated by their creditor role. This strategic behaviour is particularly relevant for large powerful firms having the capacity to fix unilaterally terms of payment, which is consistent with the model. The suppliers' behaviour as regards trade credit is also guided by commercial and financial considerations. They carry out a financial intermediation function for their clients. The trade credit policy of the supplier depends on his own access to external and internal funds, and presents the same solvency requirements as traditional lenders do. Moreover, trade credit seems considered a tool of sales support. This result is consistent with those of Petersen and Rajan (1997) and Dietsch and Kremp (1998), which outline the supplier's will to curb the sales fall or maintain the trade relation with clients experiencing difficulties in economic downturns.

The database used determines interest as well as limits of this empirical study. The virtue of this sample is that it identifies clearly the bilateral relations between suppliers and clients. However, the static nature of this sample deprives us of a dynamic analysis of suppliers' credit policy changes, depending on economic climate or client situation.

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