PN-ABK-751

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INSTITUTIONAL REFORM AND THE INFORMAL SECTOR PROJECT

Under contract to the Agency for International Development, Bureau for Private Enterprise, Office of Small, Micro, and Informal Enterprise.
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THE OUTPUTS OF RETAIL ACTIVITIES: FRENCH EVIDENCE

February, 1991

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Working Paper No. 23

Prepared for

Institutional Reform and the Informal Sector Project (IRIS)
AID Contract No. DHR-0015-A-00-0031-00

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Prime Contractor: University of Maryland at College Park

The Outputs of Retail Activities: French Evidence*

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February 1991

*We thank P. McNeil and E. Hoffnar for their excellent research assistance. A substantial part of the research for this project was carried out while both authors were at INSEAD. We acknowledge a sabbatical leave from the University of Maryland for the first author and the financial support of INSEAD's R&D committee for project 2135.

I. Introduction

Often discussions of retail activities acknowledge that services are an important aspect of these activities but do not pursue the economic implications of this idea very far. The starting point of our analysis is that these distribution services are outputs of retail firms and fixed inputs into the household production functions of consumers. Among the economic consequences of this view is a simple but powerful theoretical framework for the empirical analysis of retail margins. We have applied this framework to the analysis of U.S. 1982 Census data, Betancourt and Gautschi (1991b). In this paper we apply the same framework to the analysis of similar data for France.

Retail firms provide consumers with a variety of distribution services which can be classified into five broad categories: accessibility of location, assortment, assurance of product delivery in the desired form and at the desired time, information, and ambiance. In their economic role as outputs of retail firms higher levels of these services cost the firms more; in their economic role as fixed inputs of the households, higher levels of these servies reduce costs for consumers. Each of these categories can have several dimensions. Some of these services, or aspects of them, are provided for all items in an assortment (thus we label them 'common'); some of these services are provided for selected items in an assortment (thus we label them "specific"). Undoubtedly, it is difficult to capture all the dimensions of these concepts in our empirical measurements; nevertheless, we have developed a data base for France which contains empirical counterparts to these concepts comparable to what exists for other purposes at a similar level of aggregation (roughly the four digit level of the ISIC). Perhaps more

importantly we have tried to measure these concepts in as similar a way as possible to our measures of the same concepts in the U.S. data.

While our specific approach is new, several strands of literature overlap with some part of our formulation. Our insistence on viewing a set of distribution services as outputs of retail firms is paralleled in the work of Oi (1990), who presents a list of these services under the heading of output of a retail firm. His list can be easily reconciled with the five broad categories identified above. Other writers tend to select one of these broad categories, or an aspect of them, and explore their economic implications at the theoretical or empirical level, e.g. Mathewson and Winter (1986) or Smith and Hitchens (1985), respectively. To illustrate, we will consider specifically one contribution that is close to our work in its integration of theoretical and empirical considerations.

Ratchford and Stoops (1988, 1991) adapt to the analysis of retail activities a model developed by Ehrlich and Fisher (1982) for the analysis of the demand for advertising. Furthermore, they develop several implications for the estimation of an econometric model that allows for one distribution service (information). This model is implemented with proprietary store level data. As they point out, the theoretical work underlying our analysis can be viewed as a generalization of the Ehrlich and Fisher model. This generalization takes place in two dimensions: the specification of a broader set of distribution services and a rich theoretical framework for demand analysis. This framework obviates the need to impose the assumption of additivity between the retail price and the determinants of the opportunity cost of time in affecting the price paid by the consumer. One difficulty of this general approach noted by these authors is empirical implementation.

The present contribution demonstrates how to implement empirically this more general approach with publicly available aggregate data.

One strand of the literature on retail markets focuses on the analysis of price behavior, in particular explanations of price dispersion. For instance, Borenstein (1989) and Shepard (1989) appeal to price discrimination to explain price dispersion in gasoline retail markets. By contrast, Pashigian (1988) appeals to the increased uncertainty generated by an increased demand for fashion goods in order to explain the increased price dispersion generated by more frequent markdowns and higher percentage markups. Finally, Reinsdorf (1991) finds evidence from the consumer price index that there is substitution toward lower priced outlets after allowing for variations on some distribution services. These studies suggest consideration of the hedonic approach. The framework presented here can be made to yield the hedonic approach by assuming a single item firm and quantity setting behavior. The first assumption generates a one to one correspondence between the retail margin and the retail price and the second one generates a positive relation required by the hedonic approach between distribution services and price (the retail margin). A by-product of our analysis is to show that the data is inconsistent with these two assumptions.

Surprisingly enough, there is a paucity of studies seeking to explain retail margins with interindustry data. What makes this scarcity remarkable is the abundance of studies seeking to explain profit margins with the same type of data, e.g., Schmalensee (1988). The existing body of literature on the empirical explanation of variations in retail margins across retail sectors is primarily due to Nooteboom (1985) and his coworkers, for example Nooteboom, Kleijweg and Thurik (1988). This literature is based on assuming a mark-up model in which different variables are added to capture empirically

the role of other factors. A recent collection of sophisticated econometric studies from this perspective is available in Bode (1990). Our conceptual framework provides an alternative to this one. Of course, in terms of the empirical variables there is some complementarity between the two approaches. For instance, Nooteboom, Kleijweg and Thurik (1988) introduce a variable empirically to capture "the product service package" in the mark-up model. This variable is measured in the same manner as one of our distribution services.

Our argument proceeds in the following manner. Section II contains the main implications of the conceptual framework for the analysis of retail margins. Imposing quantity setting or price setting behavior under monopolistic competition allows additional implications for empirical analysis to be derived. These issues are presented in Section III. Implications for the choice of functional form are discussed in Section IV. Measurement issues, the link between theory and data and estimation procedures constitute the subject of Section V. Results are presented in Section VI. Finally, a brief conclusion highlights our main findings and relates them to our earlier empirical results for the U.S.

II. Conceptual Framework

Consider the following definition of the retail margin (R), which follows from manipulating the definition of profits (π)[1]

$$R = \pi/p^{*}X_1 + VQ/p^{*}X_1 , \qquad (1)$$

[1]That is, $\pi = P^{*}X_1 - pX_1 - VQ$, where p represents suppliers' prices, V is a vector of input prices, Q is a vector of input quantities and the other variables are defined in the text.

where p^* can be interpreted as a vector of retail prices or as a single retail price. Similarly, X_1 can be interpreted as a vector of quantities of items sold at retail or as the quantity of a single item. This identity simply states that the retail margin equals the ratio of profits to sales plus the ratio of the costs of retailing to sales.

By assuming cost minimizing behavior by retailers and by treating distribution services as outputs of retail firms, we can replace the numerator of the second term in (1) with a joint cost function, Betancourt and Gautschi (1988), i.e.,

$$VQ = C(X_1, \underline{X} ; V) , \tag{2}$$

where $\underline{X}$ represents a vector of distribution services, and C is a classical cost function with the usual properties. In particular, a relevant implication for the empirical analysis is that this cost function must be increasing in outputs X_1, $\underline{X}$.

Similarly, assuming utility maximizing behavior by consumers and treating distribution services as fixed inputs into the production functions of consumers, we can replace the denominator in the ratio of the costs of retailing to sales by an inverse demand function (to analyze quantity setting behavior), Betancourt and Gautschi (1988), or by a standard demand function (to analyze price setting behavior), Betancourt and Gautschi (1990a, 1991a). Thus, we can replace the denominator in (1) by either one of the two expressions below

$$p^*X_1 = p^*(X_1, \underline{X}; r)X_1 = p^*X_1(p^*, \underline{X} ; r) , \tag{3}$$

where r is a vector of other variables that affect the household demand functions. Important implications of these demand specifications are $\partial p^*/\partial X_j$

> 0 and $\partial X_1/\partial X_j > 0$ as well as the usual $\partial p^*/\partial X_1 < 0$ and $\partial X_1/\partial p^* < 0$.

At this point we have a theory for the second term in (1). It can be specified for empirical purposes as follows

$$C(X_1, \underline{X} ; V)/p^*(X_1, X ; r)X_1 = f(X_1, \underline{X} ; V,r) + \mu$$
$$= C(X_1(p^*, \underline{X} ; r, \underline{X} ; V)/p^*X_1(p^*, \underline{X} ; r) , \tag{4}$$

where μ is a disturbance term with the usual properties. The interpretation of (4) will depend on whether one assumes quantity setting or price setting behavior. This topic is addressed in the next section.

In principle there are two alternatives for completing the specification in (1). If profits were directly observable, one could proceed by subtracting the ratio of profits to sales from both sides of (1) and specify (4) as the estimating equation. When profits are not directly observable, one needs a theory of profits. We will assume that profits are proportional to sales, i.e.,

$$\pi = G\, p^*\, X_1 , \tag{5}$$

where the proportionality factor depends on the assumptions made about market structure. The specification of this factor provides a link with the voluminous literature on the empirical analysis of profit margins.[2] An excellent guide through the main issues is Waterson (1984, ch. 10) who argues that the essence of the literature is captured by the systematic component in the following specification.

$$G = g(c, b, \theta) + \epsilon , \tag{6}$$

[2]The ratio of profits to sales is used in this literature as an approximation to the profit margin, which is not directly observable because it depends on marginal costs.

where c stands for concentration, b stands for barriers to entry, θ is the elasticity of demand and ϵ is a disturbance term. Subsequently, Mueller (1986, ch. 4) argues that barriers affect the profit margin through θ and in this case (6) becomes

$$G = k(c, \theta(b)) + \epsilon \ . \tag{7}$$

This specification is consistent with a variety of market structures. If oligopolistic structures prevail we would expect k to be positive. If the market structure is that of monopolistic competition or perfect competition, we would expect k to be zero. Since we don't expect markets to be observed in long-run equilibrium, even if k is zero firms could be experiencing nonzero profits under either perfect or monopolistic competition, in which case $E\epsilon = \beta_0 > 0$. This specification provides a convenient test of whether competitive or noncompetitive market structures prevail in retail markets. That is, if concentration and barriers to entry are not 'statistically significant' determinants of retail markets, we cannot reject the hypothesis that retail markets are characterized by either perfect or monopolistically competitive market structures.

To sum up, our conceptual framework leads to the following equation for the retail margin

$$R = k(c, \theta(b)) + f(X_1, \underline{X} \ ; \ r, V) + \epsilon^* \ , \tag{8}$$

where $\epsilon^* = \epsilon + \mu$.

III. Quantity Setting vs. Price Setting Behavior

By coupling the framework developed in the previous section with the assumption of short-run profit maximization, it is possible to discriminate between price setting behavior and quantity setting behavior.

If we assume price setting behavior we have from the second equality in (4) that

$$\partial R/\partial X_j = [(C_j + C_1(\partial X_1/\partial X_j))p^*X_1 - Cp^*(\partial X_1/\partial X_j)]/(p^*X_1)^2 = f_j \ . \qquad (9a)$$

where $C_i = \partial C/\partial X_i$, and $f_i = \partial f/\partial X_i$.

Since $(\partial X_1/\partial X_j)$ is positive, f_j is of ambiguous sign. Similarly, we have for the quantity of retail items under price setting behavior

$$\partial R/\partial X_1 = (C_1p^*X_1 - Cp^*)/(p^*X_1)^2 = f_1 \ , \qquad (9b)$$

which is also ambiguous. Use of the first-order conditions for short-run profit maximization under price setting behavior, however, allows (9a) to be rewritten as[3]

$$\partial R/\partial X_j = [(p^* - p)X_1 - C]p^*(\partial X_1/\partial X_j)/(p^*X_1)^2 = f_j \ . \qquad (9a)'$$

Manipulation of (9b) yields

$$\partial R/\partial X_1 = [C_1X_1/C - 1]/(p^*X_1)^2 = f_1 \ . \qquad (9b)'$$

The sign of (9a)' will be positive (negative) when net revenues from retailing exceed the costs of retailing, i.e., when the retailing activity generates profits (losses). While the effect of a distribution service on the retail margin may be positive or negative, it must be of the same sign for all distribution services. This implication provides an exacting test of the price setting hypothesis. From (9b)' we conclude that the effect of explicit outputs on the retail margin is in general ambiguous but likely to be negative. If there is only a single output and the representative firm is

[3]For any distribution service, profit maximization under price setting implies $(p^* - p)\partial X_1/\partial X_j = C_j + C_1\partial X_1/\partial X_j$, Betancourt and Gautschi (1990b).

in long-run equilibrium, it must operate on the increasing returns portion of the average cost schedule. Hence, $f_1 < 0$. If there are many outputs, then the proportionate contribution to total marginal costs of any one of them is likely to be less than total costs and $f_1 < 0$. Nonetheless, circumstances can be constructed in which $f_1 > 0$, for example, a single output case where the representative firm is not in long run equilibrium and it operates on the rising portion of the average cost curve.

If we assume quantity setting behavior (the first term in (4)), we have that

$$\partial R/\partial X_j = (C_j p^* X_1 - C(\partial p^*/\partial X_j)X_1)/(p^* X_1)^2 = f_j \ . \tag{10a}$$

Since $(\partial p^*/\partial X_j)$ is positive, f_j would seem to be of ambiguous sign. Similarly, we have

$$\partial R/\partial X_1 = (C_1 p^* X_1 - C[(\partial p^*/\partial X_1)X_1 + p^*])/(p^* X_1)^2 = f_1 \ , \tag{10b}$$

which would also seem of ambiguous sign. Use of the first-order conditions for profit maximization under quantity setting behavior, however, allows (10a) and (10b) to be rewritten as follows[4]

$$\partial R/\partial X_j = [p^* X_1 - C](\partial p^*/\partial X_j)X_1 = f_j > 0 \tag{10a$'$}$$

$$\partial R/\partial X_1 = [C_1[p^* X_1 - C] - pC]/(p^* X_1)^2 \ . \tag{10b$'$}$$

From (10a)' one can conclude that the effect of distribution services on the retail margin must always be positive and use this result as the basis

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[4]For these outputs, profit maximization under quantity setting behavior implies $C_j = (\partial p^*/\partial X_j)X_1$ and $C_1 = (p^* - p) + (\partial p^*/\partial X_1)X_1$, Betancourt and Gautschi (1988, p. 133).

for an exacting test of the quantity setting hypothesis. Note that C includes only the costs of retailing and not the costs of goods sold; on the other hand, p^*X_1 is the total revenues from the product, including what must be used to cover the costs of goods sold. From (10b)' we conclude that the effect of explicit output on the retail margin is ambiguous.

Rejection of quantity setting also implies a rejection of the perfectly competitive model for the analysis of the retail margin. An interesting special case brings out this point most clearly. Under perfect competition, we would expect the first term on the right hand side of (8) to be zero or constant. If we now assume that there is only a single item in the assortment, then there is a one to one direct relationship between the retail margin and the retail price of the item, i.e.

$$R \equiv (p^*X_1 - pX_1)/p^*X_1 \equiv (p^* - p)/p^* \qquad (1)'$$

Hence, we can replace R with p^* in (8) and together with the assumption of perfect competition obtain

$$p^* = f(X_1, \underline{X}; r, V) + \epsilon^{**} , \qquad (8)'$$

which is a typical hedonic equation, Rosen (1974). The vector of distribution services ($\underline{X}$) would be expected to behave as attributes of the item and to have positive signs.[5]

IV. Functional Form

While economic theory does not normally provide much guidance in the specification of functional form, in this instance some features of the

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[5]In this special case the distinction between common and specific distribution services disappear, since by assumption there is only a single item.

previous discussion suggest characteristics of the functional form. In particular, equations (9a) and (9b) as well as (10a) and (10b) suggest that the functional form should be general enough to allow the response of the retail margin to retail output and distribution services to be a function of these same variables. Thus, an additive linear specification of the second term in (8) is unacceptable on a priori grounds.

Among the several nonlinear functional forms that allow one to incorporate this feature of the theory into the empirical analysis, we selected a logistic functional form for two reasons: parsimony and tractability. With respect to parsimony, consider one of the most frequently used alternative nonlinear forms--a quadratic in the variables or in the logarithms of the variables. This alternative would require the estimation of at least 35 (29 for the logarithmic version) parameters in order to capture the behavior implied by (9a) and (9b) or (10a) and (10b).[6] With respect to tractability, consider another of the frequently used nonlinear forms--a CES type of power function. This alternative requires that the values of the element being raised to a power be positive. Since the slopes in (9a) and (9b) can be either positive or negative, the positivity restriction on the argument of the power function must be imposed by constraining some parameters for different range of values of the variables. No general estimation techniques with this property are available.

Consider now the logistic specification of the second term on the right hand side of (8), i.e.,

$$f(X_1,\underline{X};r,V) = e^{\beta' X}/(1 + e^{\beta' X}) \ , \tag{11}$$

[6]These numbers are based on our identification in the data of one explicit output variable, five variables representing common distribution services and one variable representing specific distribution services as well as one variable representing concentration and another barriers to entry.

where $X = [X_0^*, X_1, \underline{X}]$ and β is a 1x8 vector of parameters that determines the sign of the response of the retail margin to output (β_1), common distribution services (β_2 - β_6), and specific distribution services (β_7).[7] This form allows us to capture the intrinsic nonlinearity implied by (9a) and (9b) and (10a) and (10b) with a minimum of 8 parameters. Furthermore, it can be estimated by relatively straightforward nonlinear techniques. Finally, the range of values generated by the right hand side of (11) lies in the zero to one interval, thus coinciding with the feasible range of values of the retail margin.

Regarding the specification of the determinants of the profit margin, we follow the literature by adopting a polynomial specification. More precisely, the following quadratic specification of the first term on the right hand side of (8) will be employed, i.e.,

$$k(c,\theta(b)) = \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_8 X_9 + \beta_{11}(X_8)^2 + \beta_{12}(X_9)^2 , \qquad (12)$$

where X_8 is concentration (c) and X_9 is barriers to entry (b).

V. Empirical Implementation

Our main data sources are the 1982 survey of firms in commerce, and the 1983 survey of firms in services (INSEE 1982, E. 88, 1983, E. 97, respectively). These reports provide a wide variety of information for 50 retail sectors classified at the four digit level. To preserve continuity in the exposition, the exact definition of the variables is presented in the

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[7] X_0^* is a vector of ones with associated coefficient β_0^*. This intercept permits the right hand side of (11) to take a value other than 1/2 when the coefficients of all explanatory variables are zero. That is, if $\beta_1 = \beta_2 \ldots = \beta_7 = 0$, the ratio of the costs of retailing to sales will equal $e^{\beta_0^*}/(1 + e^{\beta_0^*})$; otherwise, this ratio would be forced arbitrarily to equal 1/2, i.e. $e^0/(1 + e^0) = 1/2$.

Data Appendix. Here, we discuss measurement issues, estimation procedures and the assumptions linking the theory to the data.

The first assumption imposed on the data is that the cost and demand function parameters are the same in each of the 50 sectors.[8] The data point for each sector represents a different equilibrium in the retail market. An interpretation of this assumption is that the cost function embodies the range of techniques available for operating and the representative firm selects in each sector the levels of distribution services and items to provide to satisfy the demands of the representative consumer. In turn, the demand function embodies the range of options desired by the representative consumer <u>at different times</u> during a given calendar period, let us say a year. The representative consumer operates different consumption and purchase activities at nonzero levels at different times within the calendar period. Different equilibria result for each sector as a consequence of the interaction between the representative consumer's demand at a particular time and the representative firm's ability to meet that demand in a cost minimizing framework. A second assumption imposed on the data is that the parameters which capture the effect of concentration and barriers to entry are the same across retail sectors. This assumption follows from (12) and it requires no further discussion.

It is useful to note here one measurement problem that arises in our data. Namely, one obvious measure of information is advertising expenditures of each retail sector. This measure is not available in our European data and no reasonable proxy could be found for this variable. Hence, the possibility of an omitted variable bias arises. Due to other econometric

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[8]We should note that we are not seeking to separately identify the cost and demand parameters with our data.

issues discussed below, four alternative estimating equations will be implemented. Since the bias would differ according to the correlations among variables in different specifications, those results that are robust to changes in specification will be free of this possible omitted variable bias problem.

The next measurement issue leads us into a discussion of estimation procedures. The output of the retail sector will be measured as sales per establishment X_1.[9] Since the definition of the retail margin is $(X_1 - CG)/X_1$, where CG is cost of goods sold per establishment, this raises the possibility of an error in the variables problem. We address this issue by estimating a reduced form equation for sales per establishment and using the predicted value in a second stage estimation of the equation for the retail margin. In addition, we considered the following reformulation of (8)

$$R = (X_1 - CG)/X_1 = h(X_1, \bar{X}) + \epsilon^* , \tag{13}$$

where $\bar{X}$ is a vector of all other explanatory variables. (13) implies

$$CG = X_1[h(X_1, \bar{X}) + \epsilon^*] , \tag{14}$$

which has X_1 on only one side of the equation. If (14) is corrected for heteroskedasticity using the predicted value for sales per establishment, we have

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[9]Since retail markets are local and the data for each of the retail sectors is national, all variables are defined on a per establishment basis. Variables measured as ratios are not affected because the deflation in numerator and denominator cancel each other out. The intercept in the logistic specification is affected in that β_0^* is now the coefficient of $1/X_2$. Of course, β_2 is now the coefficient of a vector of 1s.

$$\frac{CG}{\hat{X}_1} = \frac{X_1}{\hat{X}_1} [h(X_1, \bar{X}) + \epsilon^*] \tag{15}$$

This issue thus leads to four versions of the model for estimation, (13) using sales per establishment or its predicted value, (14) and (15).[10]

The estimation method employed is nonlinear least squares. This choice was based on several considerations. First, the method was well documented and supported in the SAS packages available at INSEAD and at Maryland. Secondly, the asymptotic properties of the estimator are well established, as demonstrated by Amemiya's (1985, ch. 4) discussion of the estimator in the context of extremum estimators. Finally, the Monte Carlo experiments undertaken by Gallant (1975a,b) relied on a model specification similar to ours. It consisted of a first degree polynomial added to an exponential. The experiments allow one to ascertain the accuracy of employing testing procedures in the nonlinear case that were similar to those valid for the linear one. Therefore, Gallant's results can be used confidently to guide our choice of testing procedures. For example, our joint tests of hypotheses will be carried out by using ratios of differences in residual sums of squares to residual sums of squares instead of ratios of explained sum of squares to residual sums of squares, i.e., by applying equation 4.3 in Amemiya (1985). The rationale is that tests based on the former statistic were found by Gallant (1975b) to have higher power than those based on the latter statistic in the context of a model similar to ours. For the model employing the predicted value of sales per establishment (RC) this method becomes nonlinear two stage least squares, Amemiya (1985, ch. 8).

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[10]The predicted value of sales per establishment was obtained in a regression using all other exogenous variables and selling space per establishment as explanatory variables.

VI. Results

Three classical joint tests of hypotheses were performed on each of the four specifications of the model. These tests are presented in Table 1. For all combinations of specifications, we reject the null hypothesis that the variables identified as determinants of the ratio of the costs of retailing to sales and of profits to sales have no effect on the relevant dependent variable (F^1) at the 1 percent level of significance. Similarly, for all combinations of specifications, we reject the null hypothesis that the variables identified as determinants of the ratio of the cost of retailing to sales have no effect on the relevant dependent variable (F^3) at the 1 percent level of significance. The last result in particular is a powerful endorsement of the analysis of retail activities underlying our empirical work. It implies that the outputs of retail activities identified and measured here need to be incorporated into the analysis of this service sector.

Our remaining classical hypothesis test (F^2) yields somewhat mixed results. In that version of the model where sales per establishment is an independent variable (R), the hypothesis that the determinants of the ratio of profits to sales have no effect on retail margins cannot be rejected at the 1, 5, or even 10 percent level of significance. By contrast, in the other three specifications this hypothesis is rejected at the 1 percent level

Table 1. Classical Test Statistics

Model[0]	F^1	F^2	F^3
R	11.96	.695	17.77
RC	4.420	3.468	6.227
C	376944.	21.61	74.59
CC	682.5	5.351	18.52

[0]R corresponds to the estimation of (13): RC corresponds to the estimation of (13) with sales per establishment replaced by its instrument; C corresponds to the estimation of (14) and CC to the estimation of (15).

[1]Observed value of the F statistic when all coefficients, except for β_0, are set to zero ($\beta_0^* = \beta_1 = \ldots = \beta_{12} = 0$).

[2]Observed value of the F statistic when the five coefficients of the determinants of the ratio of profits to sales are set to zero ($\beta_8 = \ldots = \beta_{12} = 0$).

[3]Observed value of the F statistic when the eight coefficients of the determinants of the ratio of the costs of retailing to sales are set to zero ($\beta_0^* = \beta_1 = \ldots \beta_7 = 0$).

of significance. Moreover, in every case these variables alone have a less statistically powerful effect than those capturing distribution services, i.e., $F^3 > F^2$.

Before discussing the individual results, it is useful to consider a test of functional form suggested by our analysis. A simple linear regression of the predicted value from the nonlinear estimation of (13), as in model R, on the retail margin yields an $R^2 = .7314$, the R^2 in the corresponding linear regression with the same explanatory variables yields $R^2 = .6177$. To supplement this descriptive information on our choice of

functional form a nonnested hypothesis test designed to discriminate between the two functional forms was performed.[11]

The test is based on the artificial embedding procedure developed by Davidson and McKinnon (1981) and subsequently extended by other authors, e.g., McKinnon, White and Davidson (1983). This procedure is known as the J-test. For instance, consider the null hypothesis

$$H_0 : R_i = g(X_i\beta) + u_i^0 , \tag{16}$$

and the alternative

$$H_1 : R_i = h(Z_i\gamma) + u_i^1 , \tag{17}$$

where $X_i\beta$ represents the linear specification and $Z_i\gamma$ represents the nonlinear specification. One can then construct a compound model in the following manner:

$$H_0 : R_i = (1 - \theta)g(X_i\beta) + \theta h(Z_i\hat{\gamma}) + u_i , \tag{18}$$

where ^ indicates the nonlinear least squares estimator of the parameter vector.

Estimation of (18) by nonlinear least squares yields estimates of θ. When one uses the linear specification as the null hypothesis one obtains $\hat{\theta}$ = .8704 with a standard error of (.0975). If one uses instead the nonlinear specification as the null hypothesis, one obtains $\hat{\theta}$ = .4757 with a standard error of (.0923). If one uses 0 to test the null hypothesis, the test is inconclusive. Nevertheless, if one uses 1 to test the null hypothesis the linear specification is rejected at the 1 percent level of significance

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[11]We thank M. Burda for suggesting the need for this test.

whereas the nonlinear specification is accepted. These results provide support for the nonlinear specification.

Just as one would expect from the joint hypotheses tests, several of the variables identified as outputs of retail activities have 'statistically significant' coefficients in Table 2 when one uses 2 as the critical value. The results differ, however, across econometric specifications. For the two models using the retail margin as the dependent variable, the coefficients of accessibility of location (β_2) are negative and 'statistically significant' in both specifications whether or not the variables determining the ratio of profits to sales are included. The coefficients of output (β_1), ambiance (β_6) and specific distribution services (β_2) are also 'statistically significant' in three of the four possible cases. Perhaps more importantly, none of the coefficients of the determinants of the ratio of profits to sales is 'statistically significant' in these two specifications, regardless of the inclusion of the variables representing the outputs of retail activities. For the other two models (C and CC), the results are similar for the variables representing the output of retail activities. That is, output (β_1) ambiance (β_6) and specific distribution services (β_7) are 'statistically significant' in all four possible cases and accessibility of location (β_2) is 'statistically significant' in three of the four possible cases. Furthermore, the 'statistically significant' coefficients have the same sign as before. In contrast, several of the coefficients of the determinants of the ratio of profits to sales now become 'statistically significant'.

To sum up, these individual results support the earlier conclusion on the importance of the role of distribution services as outputs of retail activities and they yield a somewhat mixed conclusion with respect to the

Table 2. Nonlinear Least Squares Estimates: Models R and RC[0]

	R	RC	R	RC	R = RC[1]
β_0	.2925*	.3388*	0.2012*	.2922*	.3954*
	(.0742)	(.0511)	(.0251)	(.0419)	(.0617)
β_0^*	-2887.	-529.4	-320.3	-177.8	--
	(1840.)	(8571.)	(280.5)	(1730.)	
β_1	-3.827*	-.6729	-3.120*	-.6957*	--
	(1.052)	(1.260)	(.6706)	(.2512)	
β_2	-.7714*	-2.544*	-.9597*	-1.788*	--
	(.3450)	(.8613)	(.1889)	(.6800)	
β_3	.1832	1.502	.0422	.3617	--
	(.4706)	(1.090)	(.3393)	(.8701)	
β_4	.4679	-24.61	-.2153	-5.227	--
	(1.499)	(18.32)	(1.126)	(3.497)	
β_6	53.99*	148.7	47.22*	89.93*	--
	(8.927)	(103.9)	(6.565)	(8.472)	
β_7	21.74*	9.774	19.72*	.9467	--
	(5.123)	(18.08)	(4.087)	(3.630)	
β_8	-.0159	-.0355	--	--	-.0596
	(.0268)	(.0353)			(.0509)
β_9	-.3316	.0049	--	--	.0330
	(.2047)	(.2767)			(.3288)
β_{10}	.0146	.0373	--	--	.0520
	(.0189)	(.0203)			(.0360)
β_{11}	.0002	.0002	--	--	.0006
	(.0005)	(.0008)			(.0010)
β_{12}	.2741	-.1625	--	--	-.1793
	(.2566)	(.3512)			(.4191)
RSS[2]	.2555	.5124	.2822	.7525	1.116

[0]No coefficient for β_5 was estimated as it represents a variable not available in our data.
[1]Models R and RC become identical when the coefficients of the determinants of the ratio of the costs of retailing to sales are set to zero.
[2]Residual sum of squares.
*t-ratios greater than 2 in absolute value.

Table 2. Nonlinear Least Squares Estimates: Models C and CC[0]

	C	CC	C	CC	C	CC
β_0	-.1924 (.1578)	.2737* (.0366)	-.1664* (.0007)	-.1521* (.0225)	.2743* (.0281)	.5356* (.0260)
β_0^*	-268.5 (156.5)	-150.5 (245.6)	-2772.* (1297.)	17.66 (387.8)	--	--
β_1	-.2874* (.0524)	-2.933* (.6242)	-1.923* (.8421)	-3.464* (.8664)	--	--
β_2	.4327 (.6427)	-.8963* (.2005)	-1.040* (.3728)	-.7405* (.2552)	--	--
β_3	.2445 (.3370)	.0874 (.5710)	.1137 (1.433)	-1.200 (.8800)	--	--
β_4	-1.202* (.3299)	-.9629 (.5918)	-1.451 (1.815)	-.2200 (.6703)	--	--
β_6	11.46* (2.938)	108.2* (25.19)	116.8* (48.27)	127.7* (34.12)	--	--
β_7	3.326* (.7152)	15.92* (3.394)	9.576* (4.606)	17.83* (4.662)	--	--
β_8	-.1142 (.0628)	-.0649 (.0386)	--	--	.0178* (.0064)	-.0225 (.0585)
β_9	-.3391* (.1013)	-.4643* (.2061)	--	--	-.4561* (.1389)	-.8834* (.2163)
β_{10}	.0254 (.0312)	.0516* (.0267)	--	--	.0017 (.0058)	.0303 (.0459)
β_{11}	.0034* (.0011)	.0011 (.0007)	--	--	-.0006* (.0001)	.0001 (.0010)
β_{12}	.4814* (.2046)	.2140 (.3140)	--	--	.4456* (.1538)	.4761 (.3937)
RSS[2]	.4814	.3959	1.887	.6822	7.274	1.783

[0]No coefficient for β_5 was estimated as it represents a variable not available in our data.
[1]Residual Sum of Squares
*t-ratio greater than 2 in absolute value.

determinants of the ratio of profits to sales. Their importance is not robust to changes in specification.

An important reason for our interest in the individual results, however, stems from what they can tell us about the relevance of quantity setting or price setting behavior in retail markets. In every possible specification, the hypothesis of quantity setting behavior was rejected at the 5 percent level of significance. Recall from Section II that this hypothesis implies all the coefficients of distribution services must be positive (β_2 - β_7). A quick check of Table 2 shows that in every case one of the coefficients of distribution services is negative and statistically significant at the 5 percent level. Similarly, the hypothesis of price setting behavior implies that all of the coefficients must be of the same sign, either positive or negative, and the individual results also reject this hypothesis conclusively in every specification.

Conclusion

Our most important findings are that treating distribution services as outputs of retail firms provides a sound conceptual framework for the empirical analysis of retail margins, suggests a number of feasible empirical constructs as measures of these outputs, and generates empirical results that provide strong support for viewing distribution services as critical determinants of retail margins. In terms of the two empirical traditions in industrial organization, as articulated by Schmalensee (1988) and Bresnahan (1988), we have gone considerably beyond the approach of doing "...a search for empirical regularities..." and we have stopped just short of the approach of doing "...an econometric model of an industry" or identifying separately the cost and demand function parameters. Our main finding, however, furnishes a solid foundation on which to search for bodies of data more

amenable to the development of a complete econometric model, for example micro panel data.

Another important finding of our analysis is the systematic and categorical rejection of the quantity setting and price setting hypotheses by the data. There is a substantial literature on the implications of whether firms choose prices or quantities for the analysis of conjectural variations, Kamien and Schwartz (1983), or for the existence of equilibrium in game theoretic contexts, Friedman (1987). To our knowledge empirical evidence on this issue has been largely nonexistent and, therefore, our results should stimulate further research on the issue. Since the development of these hypotheses for testing with our data was based on the maintained hypothesis of monopolistic competition, our interpretation of these results is that they suggest the development of models of oligopolistic behavior for the analysis of retail markets. Of course, one could also interpret them as challenging the assumption of short-run profit maximization.

Mention should also be made of the relation between these results and our earlier ones using U.S. Census data. Despite the fact that the retail categories in the two countries are substantially different and some of the variables had to be measured differently, including one, information (X_5), that was not available in the French data, the results are strikingly similar. The tests of functional form yield similar results; the classical tests also yield similar results and the sign and significance of individual coefficients are often the same. For instance, the sign and significance for β_1, β_2 and β_7 in the regression for the retail margin are exactly the same in both countries; the coefficient of β_6 is insignificant in the U.S. but the variable (X_6) is measured differently. Undoubtedly, our results have uncovered substantial empirical regularities.

DATA APPENDIX

We start with the dependent variable, R. For each sector the retail margin is measured as [sales - cost of goods sold]/sales. The first of these variables is taken directly from the original data source and requires no further discussion. The second one is constructed by adding up purchases and net changes in stocks, both of which are available in the original data sources.

The output of a retail sector (X_1) is measured as sales per establishment. Because of the error in the variables problem indicated in the text, we developed another measure for output, which is constructed from the data sources, namely selling space per establishment. The original sources provide information for each sector on the number of enterprises in five different size categories with respect to selling space. For each sector we constructed a weighted average of selling space using the relative frequency of stores in these categories as weights. The basic idea is that higher quantities of output are associated with larger spaces.

Accessibility of location (X_2) is measured by the number of establishments in each sector, which was obtained from INSEE's microfiche d'Observatoire Economique for both commerce (1982) and services (1983). While the theoretical concept is broader than this empirical measure, e.g., it could include other dimensions of access such as size of parking lot, etc., the empirical measure is as good a counterpart of the theoretical concept as any that one finds in an economic study.

A distribution service which has a well defined empirical counterpart is the breadth of product assortment (X_3). For each sector the data contain information on the sales made on a particular product line for a universe of

four product lines. Thus, we construct an index of assortment for each sector or observation as follows:

$$X_{3i} = -\sum_{j=1}^{30} (S_{ji}/S_i)\ln(S_{ji}/S_i) \ , \tag{A2}$$

where $X_{3i}(S_i)$, is the percentage of sales of a product line in a sector relative to total sales in this sector. This index simply measures the level of breadth of assortment in a sector by the entropy of sales over product lines in that sector. There is a direct relation between the value of the index and the level of assortment.

For some of the remaining distribution services, there is a wider gap between the theoretical construct and the empirical counterpart and little that can be done about it. For instance, assurance of product delivery at the desired time and in the desired form has several dimensions. Our empirical measure (X_4) will be the average of inventory holdings at the beginning and at the end of the year (both pieces of information are directly available in the original source) per establishment. This empirical measure captures the idea that the greater the number of goods available the more likely the consumer is to find the desired product, but it does so imperfectly because it is a value term rather than a quantity measure.[12] Moreover, this measure captures mainly the common aspects of this distribution service, i.e., those that are available to all the items in the assortment, but not the specific ones, i.e., those that would be available to

[12]In addition, for five observations, this information is missing but information on the net change in inventories is available. Thus, we estimated the value for these five observations by using the coefficients of a regression of this variable on our measure of X_4 for the 45 observations where both pieces of information are available.

particular items in the assortment as a result of the efforts for example of specialized sales personnel.

As mentioned in the text, advertising expenditures per establishment is a logical measure of information but is not available in the French data.

Last among the common distribution services is ambiance, (X_6). It will be measured empirically by the value of expenditures for new construction, which is taken directly from the data sources and put on a per establishment basis. This distribution service varies across retail sectors and our argument is that higher levels of this 'quantity' will be associated with higher values of building and structures.

Finally, different sectors provide different levels of specific distribution services, that is, those associated with a particular item or sets of items in the assortment. Thus, we will define a variable (X_7) to capture the levels of these specific distribution services. Since most of them require the use of labor resources, sometimes specialized ones, we will use the sector's payroll per establishment (including payments in kind), which is available in our data sources, as an indication of the level of specific distribution services provided.

Turning to the determinants of the profit margin, we will be measuring concentration (X_8) by the value of accounting profits per enterprise in the sector. This measure is directly available in the data. Finally, we note that barriers to entry (X_9) will be measured by a variable that proxies for the ratio of multi-establishment firms to single establishment firms: Namely, (the number of establishments - the number of enterprises)/the number of establishments. Both variables are directly available in the data. While this construct is a sensible measure of barriers to entry, it may also proxy for economies in purchasing thus capturing part of the effect of concentration.

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