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The carrying capacity and entry and exit flows in retailing

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Abstract

This paper introduces a new theory explaining entry and exit rates. According to our model emphasizing the carrying capacity of a market, net entry is a reaction to a disequilibrium situation. This is a situation in which the number of firms in the market is unequal to the carrying capacity of that market. We derive an expression for the carrying capacity and also some testable implications. We investigate the speed of adjustment towards equilibrium, the effect of changes in consumer demand on the carrying capacity and the relative importance of entry and exit in the adjustment process. The theoretical model is tested using a panel data set of 22 retail industries for the 1981–1988 period.
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1. Introduction

The process of entry and exit of firms serves as an important source of structural change in industries. Industries with low birth and death rates are alleged to be

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vulnerable to misallocation of resources, limited innovativeness, and formal or tacit collusion (Geroski and Jacquemin, 1985). The continuous flows of entry and exit represent a changing pool of potentially strong competitors, viz. the seedbed of new activities from which will emerge the successful businesses and industries of the future (Beesley and Hamilton, 1984).

Entry and exit rates vary strongly across industries (Dunne et al., 1988). Empirical studies have proposed and examined a large number of factors which explain these differences. These factors pertain to four broad categories. The first category is the industry's environment and comprises the basic exogenous demand and cost conditions. Some of these environmental characteristics may restrict entry and exit rates during the entire lifespan of the industry. Examples are extent of consumer loyalty, laws affecting start-ups and possession of strategic raw materials. The second category is the stage of the industry life cycle. Industries are often subject to large waves of entry in the early stage of their life cycles followed by a ''shake-out'' period in which many young inefficient firms exit while almost no firms enter (Gort and Klepper, 1982; Klepper and Graddy, 1990). Over the life span of an industry the average growth rate of demand usually declines while the number and height of entry barriers rises. Some of these barriers which become more important at each subsequent stage of the industry life cycle are cost advantages of incumbents, capital requirements and advertising intensity (Karakaya and Stahl, 1989). The third category is the strategic behaviour of incumbents. Incumbent firms may limit price or install excess capacity in order to forestall or regulate entry. Highly concentrated industries could, as a result, exhibit lower entry rates than comparable industries with a low degree of concentration (Bunch and Smiley, 1992; Masson and Shaanan, 1986). The last factor is the business cycle. During periods of a temporarily higher growth rate of demand entrants are attracted by increases in profitability due to the inability of incumbents to expand their capacity fast enough (Hause and Du Rietz, 1984). Entry and exit are interrelated in that they are both affected by the factors mentioned above. Entry and exit may however also be causally related: exit may cause entry and entry may cause exit. Entering firms may *replace* or *displace* exiting firms (Carree and Thurik, 1996; Love, 1996; Rosenbaum and Lamort, 1992).

Most empirical studies, with some exceptions such as Kessides (1986), (1990) and Bresnahan and Reiss (1990), do not derive testable implications of a theoretical model of industrial structure but instead use an ad-hoc specification for the rates of entry and exit. As a consequence, much of the ''knowledge'' about the processes of entry and exit is scattered (Schmalensee, 1989, p. 997). In this study we propose a different approach. Each industry is assumed to consist of a number of separate and relatively homogeneous markets for each of which a free-entry equilibrium number of firms exists. We then model entry and exit at the separate market level as adjustments to a disequilibrium situation. The number of firms in the market is said to have attained the equilibrium value when all entrepreneurs earn some critical level of profits. This equilibrium number of firms is called the

carrying capacity. This term was first used in population ecology work (Hannan and Freeman, 1977). It refers to the numbers of an organizational form that can be sustained in a particular environment in isolation from other populations (Hannan and Carroll, 1992, p. 29). When the actual number of firms in a market is larger than the carrying capacity, there is need for exit in the current or a subsequent period. However, if the actual number of firms is smaller than the carrying capacity this implies room for entry. The carrying capacity depends on the amount of consumer demand. In the case of a growing demand the carrying capacity will increase as well.

In this study we derive an expression for the carrying capacity which we apply to retail industries (shoptypes). These industries consist of many local markets with only a handful of establishments. The retail markets can usually be characterized by a high degree of product homogeneity, entrepreneurs facing similar cost functions and demand conditions, and low entry and exit barriers. These elements of market structure allow us to make some strong assumptions which facilitate the derivation of an equilibrium number of independent firms in a market. Our model may therefore be particularly applicable to traditional retailing where innovation does not play an important role. An error correction model is used to estimate the effect of changes in consumer demand on the carrying capacity, the speed of adjustment of the actual number of firms to the carrying capacity and the relative importance of entry and exit in the adjustment process. For this a panel data set at a low level of aggregation for the retail sector is used. This study is one of the very few to investigate the determinants of the selection process of entry and exit over time in a non-manufacturing industry.

The plan of this study is as follows. In Section 2 an expression for the carrying capacity of a market with oligopolistic competition is derived. Section 3 models the adjustment process towards the equilibrium number of firms. In Section 4 the data are presented and some characteristics of the retail sector are discussed. In Section 5 two implications of the model are tested for Dutch retailing. The empirical results for the error correction model are presented in Section 6, and Section 7 presents the summary and discussion.

2. The carrying capacity

In this section the carrying capacity of a market with oligopolistic competition is derived. This carrying capacity will be used as a benchmark for the actual number of firms. The derivation of the carrying capacity is analogous to that of the equilibrium number of firms in the homogeneous good exogenous sunk costs case discussed by Sutton (1991) (pp. 30–32). Consider a market with N firms producing an homogeneous good. Each of these firms is supposed to choose output, q, and to have identical cost functions, $C(q)$, and conjectural variations, ϕ. Firm j maximizes its profit, $\pi_j = pq_j - C(q_j)$, as follows:

$$\frac{\partial \pi_j}{\partial q_j} = p\left(1 + \frac{Q}{p}\frac{\partial p}{\partial Q}\frac{q_j}{Q}\frac{\partial Q}{\partial q_j}\right) - \frac{\partial C}{\partial q_j} = 0, \;\; j = 1, \ldots, N, \tag{1}$$

where $Q = \Sigma_{j=1}^{N} q_j$ is total market output and p is the market price. The term $\partial Q/\partial q_j$ is equal to the change in total market output resulting from a change in the output of firm j. It can be rewritten as

$$\frac{\partial Q}{\partial q_j} = 1 + \sum_{k \neq j} \frac{\partial q_k}{\partial q_j} = 1 + \phi_j, \;\; j = 1, \ldots, N, \tag{2}$$

where ϕ_j are the conjectural variations. They are assumed identical across firms and equal to ϕ. Note that ϕ is zero for a Cournot oligopoly. Introducing $\epsilon = (\partial Q/\partial p)(p/Q)$ as price elasticity of demand we have from (1) that

$$p\left(1 + \frac{1+\phi}{\epsilon}\frac{q_j}{Q}\right) = \frac{\partial C}{\partial q_j}, \;\; j = 1, \ldots, N. \tag{3}$$

Because marginal costs are equal for each firm, the production levels are also equal: $q_j = Q/N$. Taking a linear cost function, $C(q) = \alpha + \beta q$, the following market price can be derived:

$$p = \beta\left(1 + \frac{1+\phi}{N\epsilon}\right)^{-1}. \tag{4}$$

We shall return to the justification of linearity of the cost function when discussing the application of the model to the retail sector. The price elasticity of demand ϵ is usually assumed to be below zero. This implies that $N\epsilon < -1 - \phi$ and $\phi > -1$ in order to have prices higher than marginal costs. Profits for each firm, π, can be expressed as follows:

$$\pi = \frac{\beta Q \epsilon}{N\epsilon + 1 + \phi} - \alpha - \frac{\beta Q}{N}. \tag{5}$$

The demand elasticity of profit, η_Q, and the number of firms elasticity of profit, η_N, can now be determined:

$$\eta_Q = \frac{\partial \pi}{\partial Q}\frac{Q}{\pi} = \frac{\beta Q(1+\phi)}{\beta Q(1+\phi) + \alpha N(N\epsilon + 1 + \phi)} \tag{6}$$

and

$$\begin{aligned}\eta_N &= \frac{\partial \pi}{\partial N}\frac{N}{\pi} = \frac{-\beta Q(1+\phi)(2N\epsilon + 1 + \phi)}{\beta Q(1+\phi)(N\epsilon + 1 + \phi) + \alpha N(N\epsilon + 1 + \phi)^2} \\ &= -\eta_Q \frac{2N\epsilon + 1 + \phi}{N\epsilon + 1 + \phi}.\end{aligned} \tag{7}$$

Note that η_N must be more than twice η_Q in absolute terms because $N\epsilon < -1 - \phi$.

The question now is how many firms can this market carry. Assume that there is an exogenously given critical profit level, π^*. This level is determined by alternative opportunities for the owners of the firm to receive income.[1] The carrying capacity is that number of firms at which this ''reservation wage'', π^*, is equal to the firms' profit, π, in the industry. Solving for N in Eq. (5), one finds that[2]

$$N^* = \frac{1}{2\epsilon}\left(-1-\phi-\sqrt{(1+\phi)^2-4\beta Q\epsilon(1+\phi)/(\pi^*+\alpha)}\right). \tag{8}$$

The carrying capacity, N^*, enlarges when total market demand, Q, increases, while it shrinks when the critical level of profits, π^*, increases. The carrying capacity is lower in markets with high fixed costs, α, and low variable costs, β, when compared to markets with low fixed and high variable costs. Low price elasticity of demand, ϵ, and high conjectural variation, ϕ, lead to a less competitive environment and therefore to a higher carrying capacity. The market is said to be in a state of equilibrium when the actual number of firms is equal to the carrying capacity. This is a free-entry equilibrium in which each entrepreneur earns the same critical level of profits.

The demand elasticity of the carrying capacity, ν_Q, is derived as follows:

$$\begin{aligned}\nu_Q &= \frac{\partial N^*}{\partial Q}\frac{Q}{N^*} = \frac{1}{2} - \frac{1+\phi}{2\sqrt{(1+\phi)^2-4\beta Q\epsilon(1+\phi)/(\pi^*+\alpha)}} \\ &= \frac{N^*\epsilon+1+\phi}{2N^*\epsilon+1+\phi}.\end{aligned} \tag{9}$$

An important implication of Eq. (9) is that ν_Q must be less than 0.5 because $N^*\epsilon < -1-\phi$.[3] From Eqs. (7) and (9) it is easy to derive that $\nu_Q = -\eta_Q/\eta_N$ in the equilibrium situation. It can also be derived that in this situation Eq. (6) simplifies to $\eta_Q = (\pi^*+\alpha)/\pi^*$.

[1] De Wit and Van der Winden (1990) find that the probability of becoming self-employed is higher, the greater the difference between profit in the case of self-employment and wage in the case of employment.

[2] Note that conjectural variations are not constrained to be ''consistent'' (see, e.g., Kamien and Schwartz, 1983).

[3] Schmalensee (1992) (p. 126) also derives a free-entry equilibrium number of firms. His expression also implies that a doubling of market demand less than doubles the equilibrium number of firms. Bresnahan and Reiss (1990) estimate the size of the market needed to support two automobile dealers to be larger than two times the size of the market needed to support a monopoly dealer. From Eq. (9) one would expect this size to be at least three times the size of the market needed to support a monopolist.

3. Entry, exit and disequilibrium

The net entry of firms is assumed to be a reaction to a state of disequilibrium. This reasoning is in line with the Kirznerian notion of entrepreneurial activity originating from the existence of disequilibria characterized by the existence of profit opportunities (Ikeda, 1990; Kirzner, 1973, 1979). We define disequilibrium as the discrepancy between the carrying capacity in a market in a certain period and the actual number of firms in that market. This notion of disequilibrium is strongly connected to the existence of profit opportunities. One derives from Eqs. (5) and (8) using Taylor expansion that

$$\frac{\pi_i - \pi_i^*}{\pi_i^*} \approx -\frac{1}{\nu_Q}\frac{N_i - N_i^*}{N_i^*}, \tag{10}$$

when evaluated in $N_i = N_i^*$ where i is the market index. Eq. (10) shows the relation between two discrepancies: that between the carrying capacity and the actual number of firms in a market on the one hand and that between the exogenously given critical level of profits and the actual level of profits in a market on the other. Entrepreneurs are inclined not to accept a disequilibrium situation expected to arise in period t because of the profit opportunities involved, but are hampered by costs of entering (or exiting) immediately in period t. These costs are assumed to rise quadratically because of congestion when many entrepreneurs want to enter or exit a market. That is, entrepreneurs minimize the following loss function (see Gilbert, 1986, for similar analyses):

$$\Lambda_{it} = \lambda_1(E_{t-1}(\ln(N_{it}^*)) - \ln(N_{it}))^2 + \lambda_2(\Delta\ln(N_{it}))^2, \;\; \lambda_1, \lambda_2 > 0, \tag{11}$$

where E_{t-1} is the expectancy operator using information up until period $t-1$. Minimizing Eq. (11) with respect to N_{it} yields

$$\Delta\ln(N_{it}) = \frac{\lambda_1}{\lambda_1 + \lambda_2}(E_{t-1}(\ln(N_{it}^*)) - \ln(N_{i,t-1})). \tag{12}$$

We make the following assumption about the expected carrying capacity. Denote the growth rate of the carrying capacity from period $t-1$ to period t by g_{it}. It follows that $\ln(N_{it}^*) = \ln((1+g_{it})N_{i,t-1}^*) \approx g_{it} + \ln(N_{i,t-1}^*)$ using that $\ln(1+x) \approx x$ when x is small. Defining $\gamma = \lambda_1/(\lambda_1 + \lambda_2)$ we now obtain Eq. (13):

$$\Delta\ln(N_{it}) = \gamma(\ln(N_{i,t-1}^*) - \ln(N_{i,t-1}) + E_{t-1}g_{it}), \;\; \gamma > 0. \tag{13}$$

From this equation it is clear that net entry serves as an adjustment mechanism to a disequilibrium situation. The adjustment process towards the carrying capacity in the present study corresponds to that used in population ecology work (see Hannan and Freeman, p. 941).

We assume that entrepreneurs have adaptive expectations about the growth rate of the carrying capacity: $E_{t-1}g_{it} = \delta_{0i} + \delta_1 g_{i,t-1}$. That is, the expected growth rate

of the carrying capacity is assumed to be determined by a shoptype-specific element and the growth rate in the current period. In Appendix A we discuss four alternatives for determining the value of δ_1. We have no a priori beliefs about the value of δ_1 in the case of retailing unless that it is unlikely to lie below zero or to be in excess of unity. As a consequence, we have to rely on the criteria of empirical fit or parsimony. It is shown in Appendix A that the data cannot discriminate between any two values of δ_1 which lie in the unit interval [0,1]. For reasons of parsimony we choose δ_1 equal to zero, i.e. the expected growth of the carrying capacity is assumed not to depend on its current growth. Appendix A presents empirical results for each of the four alternatives to determine the value of δ_1. By taking the first difference of Eq. (13) we derive Eq. (14) as follows:

$$\Delta\Delta\ln(N_{it}) = \gamma(g_{i,t-1} - \Delta\ln(N_{i,t-1})). \tag{14}$$

We assume the growth rate of the carrying capacity to be determined completely by changes in consumer demand:[4]

$$g_{it} = \nu_Q \frac{\Delta Q_{it}}{Q_{i,t-1}}. \tag{15}$$

Considering that $\ln(1+x) \approx x$ when x is small and adding a disturbance term assumed to be independently and identically distributed over the markets and over the years, we have the following relation to be estimated:

$$\Delta\frac{\Delta N_{it}}{N_{i,t-1}} = \gamma\left(\nu_Q \frac{\Delta Q_{i,t-1}}{Q_{i,t-2}} - \frac{\Delta N_{i,t-1}}{N_{i,t-2}}\right) + e_{it}. \tag{16}$$

That is, the change in the net entry rate, $\Delta N_{it}/N_{i,t-1}$, is equal to the adjustment rate, γ, times the development over time of the level of disequilibrium plus a disturbance term.

The change in the net entry rate is the result of a change in the gross entry rate and a change in the gross exit rate. Gross entry and exit rates show substantial and persistent differences across industries (see, e.g., Dunne et al., 1988). Especially in the retail sector, gross entry and exit rates are very stable over the years. This is a consequence of little change over time in the relative ease of entry and exit and of

[4] In this study we concentrate on the effect of market demand on the carrying capacity. That is, we assume for simplicity that the price elasticity of demand, ϵ, the conjectural variation, ϕ, the parameters of the cost function, α and β, and the exogenously given critical level of profits, π^*, are constant. In retailing it is likely that the price elasticity of demand depends upon the average (regional) household income, that the critical level of profits depends upon average (regional) wages and that the parameters of the cost function depend upon average (regional) labour costs. From the beginning (1980) to the end (1988) of the period of investigation the general real wage index and the real wage index in retailing in the Netherlands declined just a few percent.

a continuously large pool of potential entrants for an industry.[5] Each year a fairly constant flow of entrepreneurs would like to enter or to exit (retail) industries. This is partly caused by entrepreneurs retiring and being replaced by younger entrepreneurs. We assume that deviating from the stable gross entry and exit rate levels comes at a cost. This allows us to investigate the relative importance of entry and exit in the adjustment process. We extend the loss function Λ_{it} by considering loss occurring from the gross entry rate (ent_{it}) and the gross exit rate (ext_{it}) to be different from an industry-specific constant, denoted by d_{1i} and d_{2i}, respectively:

$$\Lambda_{it} = \lambda_1(E_{t-1}(\ln(N_{it}^*)) - \ln(N_{i,t-1}) - ent_{it} + ext_{it})^2 + \lambda_2(ent_{it} - ext_{it})^2 + \lambda_3(ent_{it} - d_{1i})^2 + \lambda_4(ext_{it} - d_{2i})^2, \quad \lambda_1, \lambda_2, \lambda_3, \lambda_4 > 0. \tag{17}$$

Note that $ent_{it} - ext_{it} = \Delta N_{it}/N_{i,t-1} \approx \Delta\ln(N_{it})$. When $\lambda_3 \neq \lambda_4$, entry and exit differ in their sensitivity to a state of disequilibrium and, hence, in their relative importance in the adjustment process to a state of equilibrium. Solving for ent_{it} and ext_{it} from the first-order conditions gives

$$ent_{it} = \frac{\lambda_3(\lambda_1 + \lambda_2 + \lambda_4)d_{1i} + \lambda_4(\lambda_1 + \lambda_2)d_{2i} + \lambda_1\lambda_4(E_{t-1}(\ln(N_{it}^*) - \ln(N_{i,t-1}))}{(\lambda_1 + \lambda_2)(\lambda_3 + \lambda_4) + \lambda_3\lambda_4}, \tag{18}$$

$$ext_{it} = \frac{\lambda_3(\lambda_1 + \lambda_2)d_{1i} + \lambda_4(\lambda_1 + \lambda_2 + \lambda_3)d_{2i} - \lambda_1\lambda_3(E_{t-1}(\ln(N_{it}^*) - \ln(N_{i,t-1}))}{(\lambda_1 + \lambda_2)(\lambda_3 + \lambda_4) + \lambda_3\lambda_4}. \tag{19}$$

Using (14), taking the first difference and adding disturbance terms, we have the following two equations to be estimated:

$$\Delta ent_{it} = \gamma_E\left(\nu_Q\frac{\Delta Q_{i,t-1}}{Q_{i,t-2}} - \frac{\Delta N_{i,t-1}}{N_{i,t-2}}\right) + e_{Eit}, \tag{20}$$

$$\Delta ext_{it} = \gamma_X\left(\nu_Q\frac{\Delta Q_{i,t-1}}{Q_{i,t-2}} - \frac{\Delta N_{i,t-1}}{N_{i,t-2}}\right) + e_{Xit}. \tag{21}$$

There is a clear connection between the adjustment rates γ_E and γ_X and the

[5] Van Praag and Van Ophem (1995) find, for example, that there are almost seven times more individuals who wish to switch to self-employment than the actual number of switchers.

parameters λ_3 and λ_4 of the loss function: $-\gamma_E/\gamma_X = \lambda_4/\lambda_3$. When this ratio exceeds 1, the entry rate is more sensitive to a state of disequilibrium than the exit rate. The disturbance terms e_{Eit} and e_{Xit} are probably positively correlated because fluctuations in takeover activity are not incorporated in our model. The correlation between the disturbance terms gives an indication of the importance of replacement and displacement in an industry *within the same period*. Displacement and replacement which take more than one period are accounted for by the adjustment process. An entry which leads to an increase of the actual number of firms in excess of the carrying capacity is bound to lead to an exit in a subsequent period provided the carrying capacity does not grow. An exit reducing the actual number of firms below the carrying capacity paves the way for an entry in a subsequent period.

Eqs. (16), (20), (21) should be estimated at the market level or, equivalently, at the level of a distinct organizational population. The firms which produce and sell a homogeneous good on the same geographical market are assumed to constitute a single population effectively isolated from interaction with other populations. Only on this level of analysis is the concept of a carrying capacity useful.[6] In our empirical application we will use aggregated data to estimate the parameters of the model and then use Eqs. (7) and (9) to estimate the average (equilibrium) number of firms in the separate markets. A condition for using aggregated data to estimate parameters at the population (market) level is that the populations do not interact. In this case, we can change from market to industry index. This is viable for retail industries because firms which trade on distinct local retail markets usually barely compete. The parameters of the models when applied to the industry level are then weighted averages of these same parameters at the market level. We use aggregated data for two reasons.

First, the number of firms in a market is an integer and will generally be small. In most periods the net entry rate will be zero and in the periods when it is not, the difference from zero is necessarily large. This complicates the estimation of the parameters at a very disaggregated level of analysis. Second, in most applications, as in ours, only aggregated industry level data are available, for example because of the lack of clear market boundaries. In manufacturing this implies that several separate markets each with a limited number of competitors producing an homogeneous good are compressed into one manufacturing industry usually at best at the 4-digit level. In distribution this implies that several geographically separated markets each with a limited number of local competitors are compressed into one retailing industry usually at best at the regional or state level. In both

[6] See Hannan and Carroll (1992) (chapt. 7) for a discussion of the appropriate level of analysis of organizational populations for the US brewing industry. In their survey of the influence of economics on sociology, Baron and Hannan (1994) (pp. 1128–1130) pay attention to the similarities between recent ecological work and research on the evolution of markets.

cases populations which differ with respect to either the good produced or the geographical scope are aggregated.

4. Data and characteristics of the retail sector

In this section we start with a short discussion of our data set for Dutch retailing. Subsequently, some remarks will be made on characteristics of retailing which are important to keep in mind when applying the model. For the retail sector we seek to estimate the effect of demand change on the carrying capacity, the speed of adjustment to an equilibrium situation, and the relative importance of entry and exit in this adjustment process. We use a panel data set for the Dutch retail trade. Despite its economic importance retailing has received only limited attention from industrial economists. The retail sector has a significant contribution to the economy. It accounted for about 23% of the total number of economically active enterprises and for about 13% of total labour force in the Dutch private sector in 1988 (Bode, 1990). These figures are in line with those of other countries of the European Union (EIM, 1995). The total number of economically active enterprises in retailing (92 000) in the Netherlands is twice that in manufacturing (46 700) (EIM, 1991). Retailing is also prominent when we consider the vividity of entry and exit movements. On average, annual entry and exit rates are almost 10% for the Dutch retail trade (see Table 1). This indicates that sunk entry and exit costs in Dutch retailing are low.

Our data are available per shoptype (retail industry) in which establishments sell relatively homogeneous goods. The source of the data on profits is an ongoing panel of independent, mainly small Dutch retailers. This panel is operated by the EIM Small Business Research and Consultancy in Zoetermeer. Each year and for

Table 1
Average yearly entry and exit rates in Dutch shoptypes (1981–1988)

Shoptype	*ent*	*ext*	Shoptype	*ent*	*ext*
Bicycle stores	0.041	0.052	Pet shops	0.089	0.086
Tobacco shops	0.035	0.070	Household goods	0.087	0.089
Druggists	0.053	0.060	Greengrocers	0.083	0.094
Do-it-yourself shops	0.052	0.066	Supermarkets	0.079	0.098
Bakers	0.060	0.062	Liquor stores	0.085	0.111
Paint, glass, wallpaper	0.049	0.082	Confectioners	0.092	0.107
Dairy shops	0.051	0.081	Furniture stores	0.100	0.105
Shoe stores	0.071	0.073	Fish shops	0.113	0.107
Butchers	0.071	0.079	Furnishing stores	0.109	0.138
Photographers' shops	0.082	0.079	Textiles mens wear	0.140	0.125
Jewellery	0.080	0.083	Florists	0.154	0.132

Note: The entry and exit rate figures are yearly averages over the 1981–1988 period.

each shoptype a questionnaire has been sent to a sample of shopkeepers and an average number of about 70, averaged over the 1981–88 period and the 22 shoptypes in Table 1, have completed and returned it. The source of data on total consumer demand for product packages sold in the shoptypes is the Central Bureau of Statistics in Voorburg. The Central Registration Office (CRK) in The Hague provided data of entry and exit rates of establishments. These data may suffer from changes in counting procedures which could lead to ''outlying'' observations. We use the Jarque–Bera statistic to test for normality of the residuals of the regression equations (Jarque and Bera, 1980). When normality is rejected at a reasonable level of significance we also estimate the model without the ''outlying'' observations.[7] For 22 shoptypes data are available in each of the three data sources for the period 1981 through 1988 (176 data points).[8] The correlation between the entry and exit rates for this panel data set is 0.77. The average entry and exit rates over the 1981–88 period can be found in Table 1.

Retail markets differ from manufacturing markets. Porter highlighted the most important elements of the structure of retailing as follows: ''In contrast with typically low national concentration ratios for a given retail outlet class, the concentration of retail establishments in the relevant retail market is often high. Two to five retail establishments commonly make up such a market. The limited geographic extent of the market and the magnitude of demand within this market area impose a strong constraint on the maximum number of retailers. The equivalent constraint on a national manufacturing industry is much weaker, so that the number of sellers in a retail market is typically smaller than that in even a 'tight oligopoly' in manufacturing... . Locational proximity and substantial similarity of product lines promote the structural symmetry of competing retailers. Local demand trends, important input costs and other key structural market conditions are likely more similar than among manufacturers. Retail firms can quickly and accurately detect strategy changes by competitors, and the possibilities for secret changes are minimal... . A straightforward application of oligopoly theory suggests, then, that mutual dependence recognized among retail competitors in a given retail market will be higher than in an equally concentrated manufactur-

[7] Wagner (1994) suggested applying both ordinary and reweighted least squares to regression equations with the entry (or exit) rate as the dependent variable. A weighting procedure is used to limit the influence of a small number of ''outlying'' observations on the regression results.

[8] Supermarkets constitute one of the 22 shoptypes. This shoptype differs from the other shoptypes in two respects, both of which are not included in the model. The first difference is the *chain effect* of supermarkets. Nationwide chains are important in the supermarket shoptype. The second difference is the *combined assortment effect*. Supermarkets typically compete with shops in other shoptypes because of their broad assortment of goods. The chain effect can be controlled for by leaving out the supermarket shoptype. The empirical results barely changed as a consequence of this. The combined assortment effect has caused sales to shift from specialist shops to supermarkets in the Netherlands in the 1980s but the shares of sales of specialist shops have since stabilized.

ing industry because detection and retaliation lags are low... . It follows that competition may lack vigor and the chances for tacit agreement will be high.'' (Porter, 1976, pp. 13–14).

The oligopoly model presented in Section 2 predicts that the market price level decreases as the number of independent firms increases (see Eq. (4)). This is due to the assumption of ϕ to be in excess of -1, at which value the model would become equivalent to Bertrand competition. From Porter's remarks we would certainly expect ϕ to be well above -1 in retailing. Weiss (1989) (chapt. 9) provides a survey of empirical studies dealing with the relation between price and market concentration for US food and gasoline retailing. All these studies indicate a clear positive effect of market concentration on prices.[9] For example, it is found for a data set covering 32 US SMSAs in 1974 that supermarket price levels decline about 15% when going from a monopoly to a completely unconcentrated market. In the remainder of the paper we will assume Cournot competition ($\phi = 0$), although the empirical studies for (US) retailing only indicate a ϕ larger than -1.[10]

Because of the geographically dispersed demand the shoptypes can be divided into a large number of local oligopolies usually consisting of only a handful of establishments selling a relatively homogeneous good. This is a precondition for the use of the oligopoly model. However, we made two other important assumptions. First, we assumed a linear cost function. The linearity of the cost function for retail establishments is theoretically supported by Nooteboom (1982) and Frenk et al. (1991). See also Dean (1973), Douglas (1973), Nooteboom (1982) and Thurik (1984) for empirical support. Second, we assumed firms to have identical cost functions and conjectural variations and as a consequence to have equal production levels. Porter's description of the structure of retailing suggests that retail establishments are indeed confronted with very similar conditions. The average relative sizes, measured in number of employees, of entering and exiting firms in Dutch retailing compared to that of incumbents are about 0.55 and 0.70, respectively (Klomp and Thurik, 1995).[11] This too provides at least some support for not discriminating in size between entering, exiting and incumbent firms.

[9] A recent exception, however, is Newmark (1990), who finds that retail grocery prices are not significantly related to concentration.

[10] Aiginger (1996) finds empirical data on Austrian manufacturing firms to be to some extent compatible with and favourable to the basic Cournot model. Both market share and price elasticity seem to affect the profit margin of firms in the way predicted by Cournot.

[11] Dunne et al. (1988) report that relative sizes of entering and exiting firms in 2-digit US manufacturing industries are much smaller, between about 0.11 and 0.52.

5. Two implications of the oligopoly model

In this section we test two implications of the model derived from the elasticities of profit Eqs. (6) and (7). Therefore, we need an estimate of the cost function in the various shoptypes. Data of average costs and sales of (three) size classes (indexed by g) are available for 14 shoptypes from the EIM 1988 questionnaire. The estimation results for the linear cost function for these shoptypes in 1988 are similar across shoptypes.[12] The estimates for α range between $-32\,442$ and -5715 with a mean of $-21\,738$ and the estimates for β range between 0.903 and 0.942 with a mean of 0.927. In the analysis we use the estimates when the data of the 14 shoptypes are pooled (t-values between parentheses):[13]

$$C_{gi} = \underset{(4.4)}{-19\,553} + \underset{(165.9)}{0.924}Q_{gi},\ R^2 = 0.9985, N = 42. \tag{22}$$

We proceed as follows. The demand elasticity η_Q and number of firms elasticity η_N are estimated for the panel data set. Two implications of the model from Eqs. (6) and (7), $\eta_N < -2\eta_Q$ and $\eta_Q < 1$ (because $\alpha < 0$), are then examined. From the discussion below Eq. (9) we know that $\eta_Q = (\pi^* + \alpha)/\pi^*$ in equilibrium. We do not know the value of π^* but it should be higher than the modal wage to compensate for the additional risk and working hours when compared to working as an employee. In 1988 the modal wage in the Netherlands was 46 440 guilders.[14] We therefore expect the demand elasticity of profit in equilibrium to exceed $(46\,440 - 19\,553)/46\,440 = 0.58$. However, note that the estimate of α was based upon data of a subset of 14 shoptypes.

The estimates for the two elasticities, η_Q and η_N, for the Dutch retail sector are based upon 22 shoptypes for the 1981–88 period. The effect of the relative change

[12] Our definition of costs includes purchase value of products, wages for employees, rent, interest payments over debt, interest loss over equity, depreciation, transportation, energy, promotion and other costs. It does not include a reward for the entrepreneur.

[13] Note that heteroskedasticity has no important effect on the estimates. This can simply be seen by comparing the following regression with that given in Eq. (22):

$$C_{gi}/Q_{gi} = \underset{(130.0)}{0.923} - \underset{(6.1)}{19\,204}(1/Q_{gi}),\ R^2 = 0.4837.$$

[14] For the 22 shoptypes in our data set the average profit is equal to 69 017 Dutch guilders in 1988. The average reward for entrepreneurial activity in Dutch retailing is therefore about 50% more than for the activities of an (modal) employee. This is not unreasonable as starting a retail venture is relatively simple when compared to starting ventures in most other sectors of the economy. See also Carree and Thurik (1994).

in consumer demand for the products primarily sold in the shoptype ($\Delta Q_{it}/Q_{i,t-1}$) on the relative change in average profit in the shoptype ($\Delta\pi_{it}/\pi_{i,t-1}$) is taken as an estimate for η_Q.[15] Similarly, the estimate for η_N is equal to the effect of the relative change in the number of firms in the shoptype ($\Delta N_{it}/N_{i,t-1}$) on the relative change in average profit. That is, we estimate the ''total differential'' equation:

$$\frac{\Delta\pi_{it}}{\pi_{i,t-1}} = \zeta + \eta_Q \frac{\Delta Q_{it}}{Q_{i,t-1}} + \eta_N \frac{\Delta N_{it}}{N_{i,t-1}} + e_{it}. \tag{23}$$

The least squares estimates of η_Q and η_N can be found in Table 2. From the Jarque–Bera statistic in the first column of the table it is clear that the residuals are highly non-normally distributed. This is caused by one outlier (liquor stores, 1981) with an estimated residual of $+1.87$, while the second largest estimated residual is $+0.64$. After removing this observation non-normality can no longer be rejected. The estimates of η_Q and η_N are 0.71 and -1.87, respectively. The estimate for η_Q is below unity, while the estimate for η_N is -2.64 times that of η_Q. We conclude that reactions of profits on changes in consumer demand and number of firms are in line with oligopolistic behaviour. From Eq. (7) we estimate $N\epsilon$ to be -2.55, on average, in Dutch retailing (in the case of Cournot oligopoly: $\phi = 0$). Considering that the price elasticities of demand in retailing are roughly between -0.4 and -0.9 (Zeelenberg, 1986, p. 116), the average market sizes of the local oligopolies

Table 2
Estimates of the determinants of $\Delta\pi_{it}/\pi_{i,t-1}$ using Eq. (23)Eq. (24)

ζ	0.035	0.029	0.010	−0.004
	(1.7)	(1.7)	(0.2)	(0.1)
η_Q	0.815	0.708	0.801	0.689
	(2.2)	(2.4)	(2.2)	(2.3)
η_N	−2.216	−1.872		
	(2.8)	(2.9)		
η_{N_E}			−2.206	−1.859
			(2.8)	(2.9)
η_{N_X}			2.490	2.225
			(2.5)	(2.7)
JB	2334.76	6.21	2372.27	6.60
	(0.000)	(0.045)	(0.000)	(0.037)
R^2	0.066	0.071	0.067	0.074
$\chi^2_{\eta_{N_E}=-\eta_{N_X}}$			0.21	0.49

Note: Absolute t-values in parentheses. JB stands for the Jarque–Bera test statistic on normality of the residuals (P-value in parentheses). In the second and fourth columns one outlier has been removed to guarantee (near-)normality.

[15] Both the consumer demand and the average profit are divided by a general consumer price index to correct for growth in these variables simply due to inflation.

in retailing are estimated to be between three and seven firms. This can be compared with the estimated equilibrium market sizes derived in the next section. When the number of firms is equal to the carrying capacity $\nu_Q = 0.378$.[16]

We may also consider the effects of entry and exit separately. The results are presented in the last two columns of Table 2 both with and without the outlying observation. The equation to be estimated reads:

$$\frac{\Delta \pi_{it}}{\pi_{i,t-1}} = \zeta + \eta_Q \frac{\Delta Q_{it}}{Q_{i,t-1}} + \eta_{N_E} ent_{it} + \eta_{N_X} ext_{it} + e_{it}. \tag{24}$$

The variables ent_{it} and ext_{it} stand for gross entry and exit rates, respectively. Of course, Eq. (23) is a special case of Eq. (24), where $\eta_{N_E} = -\eta_{N_X}$. It appears that an exit has a somewhat larger effect on changes in average profits than an entry. This may be a consequence of exiting firms to be somewhat larger in size on average. However, note that the difference of the magnitude of the effects is not statistically significant. Entry and exit appear to be symmetric in their effect on changes in the average profit in a shoptype.

6. Empirical results for entry and exit flows in retailing

In this section the empirical results of Eqs. (16), (20), (21) are presented. This provides us with insight into the effect of demand growth on carrying capacity and the speed of adjustment in the Dutch retail trade. We study the relative importance of gross entry and exit in the adjustment process by estimating their sensitivities to a state of disequilibrium. We will also investigate whether the estimates differ between shoptypes with generally small shops and shoptypes with somewhat larger shops on average. The results for the least squares estimation of Eq. (16) can be found in Table 3.

Only after removing four outlying observations (liquor stores, 1987; furnishing stores, 1985; confectioners, 1985; photographers' shops, 1983) could the Jarque–Bera test on normality not be rejected at the 1% significance level. However, estimation results barely changed as a result of this. See the first and second

[16] The quality of this estimate of ν_Q in an equilibrium situation is not much affected by a strong correlation between the estimates of η_Q and η_N. This correlation is -0.117. Eq. (23) could also be estimated using fixed shoptype (ζ_i) or time effects (ζ_t), but the hypothesis of equal effects across shoptypes or time cannot be rejected. For example, the log-likelihood of the estimation results in the second column of Table 2 is 31.127. When we add shoptype-dummies the log-likelihood increases to 37.615. The value of the likelihood ratio statistic is therefore equal to 12.98 and is not significant at the 5% significance level (degrees of freedom: 21). When we add time-dummies the log-likelihood increases to 37.645. The value of the likelihood ratio statistic equals 13.04 and is again not significant at the 5% significance level (degrees of freedom: 7).

Table 3
Estimates of the adjustment rate and the demand elasticity using Eq. (16)

γ	0.381	0.387		0.391
	(6.5)	(7.9)		(8.0)
γ_S			0.453	
			(6.9)	
γ_L			0.322	
			(5.4)	
ν_Q	0.301	0.303	0.322	
	(3.5)	(4.2)	(4.4)	
ν_{Q_S}				0.397
				(3.8)
ν_{Q_L}				0.235
				(2.8)
JB	142.25	2.21	1.86	2.89
	(0.000)	(0.332)	(0.395)	(0.235)
R^2	0.255	0.324	0.334	0.331
$\chi^2_{\gamma_S=\gamma_L}$			2.70	
$\chi^2_{\nu_{Q_S}=\nu_{Q_L}}$				1.82

Note: Absolute t-values in parentheses. JB stands for the Jarque–Bera test statistic on normality of the residuals (P-value in parentheses). With the exception of the first column four outliers have been removed to guarantee (near-)normal residuals.

columns of Table 3, respectively. The estimates for γ and ν_Q are 0.387 and 0.303, respectively. The estimate of the demand elasticity is below the value expected at equilibrium of 0.378. This implies that the equilibrium size of markets is smaller than the actual size of markets in Dutch retailing. Because $N^*\epsilon$ is estimated to be -1.77 using Eq. (9), we expect equilibrium market sizes in retailing to be between two and five firms (in the case of Cournot oligopoly: $\phi = 0$). In the previous section we found the actual market sizes to be somewhat larger. This corresponds to the decrease in the total number of firms in retailing in the period 1981 through 1988 (see also Nooteboom, 1986).

Eq. (16) is estimated assuming that all shoptypes have equally sized equilibrium market sizes. Some shoptypes may however have smaller equilibrium market sizes due to higher entry and exit barriers or important scale advantages. These shoptypes are expected to have a lower adjustment rate and a lower demand elasticity ν_Q. A variable which may effectively distinguish between shoptypes with relatively high and relatively low barriers and scale advantages is average floorspace in a shoptype. For example, tobacco shops and dairy shops had an average floorspace of only 103 and 138 m^2 in 1988. On the other hand, furnishing stores with mainly furniture and furnishing stores had an average of 3319 and 2634 m^2 in that year. The average floorspace in the data set is 558 m^2 with a standard deviation of 671. In the third and fourth columns of Table 3 we divide our sample into two equally sized sub-samples: one sample with average floorspace smaller than 309 m^2 and one sample with average floorspace larger than

309 m^2. The results show that the speed of adjustment is about 40% higher in shoptypes with small floorspace. The difference is, however, not statistically significant. The elasticity of demand may also be estimated separately for the two groups. The fourth column of the table shows that this elasticity is higher for shoptypes with little floorspace. The estimate of ν_Q in this sample of (very) low barriers and scale advantages is even larger than the value expected at equilibrium of 0.378. The difference between the elasticities is, however, again not significant.

We now turn to the relative importance of the entry and exit rate in the adjustment process. Eqs. (20) and (21) are estimated with Iterative SUR with demand elasticity ν_Q assumed to be equal in the two equations. The estimation results can be found in Table 4. Both the residuals of the gross entry and gross exit rate equation were non-normally distributed. Only after removing seven outlying observations (furniture stores, 1988; furnishing stores, 1985; florists, 1982 and 1985; butchers, 1988; and fish shops, 1982 and 1985) could the Jarque–Bera test on normality not be rejected for both equations at the 1% significance level. From the second column of Table 4 we find estimates of γ_E, γ_X and ν_Q of 0.227, −0.137

Table 4
Estimates of adjustment rates of gross entry and exit rates using Eq. (20)Eq. (21)

γ_E	0.206	0.227	
	(3.7)	(5.5)	
γ_{E_S}			0.332
			(5.8)
γ_{E_L}			0.133
			(2.6)
γ_X	−0.170	−0.137	
	(3.6)	(3.7)	
γ_{X_S}			−0.061
			(1.2)
γ_{X_L}			−0.197
			(3.9)
ν_Q	0.314	0.266	0.282
	(3.6)	(3.3)	(3.7)
JBE	489.91	2.97	1.24
	(0.000)	(0.226)	(0.538)
JBX	352.38	5.17	1.96
	(0.000)	(0.075)	(0.375)
R_E^2	0.051	0.098	0.135
R_X^2	0.066	0.070	0.091
$corr(\hat{e}_E,\hat{e}_X)$	0.540	0.220	0.197
$\chi^2_{\gamma_E=-\gamma_X}$	0.17	2.39	
$\chi^2_{\gamma_{E_S}=-\gamma_{X_S}}$			10.53*
$\chi^2_{\gamma_{E_L}=-\gamma_{X_L}}$			0.75

Note: Absolute t-values in parentheses. With the exception of the first column seven outliers have been removed to guarantee (near-)normal residuals.

*Significant at the 5% significance level. JBE and JBX stand for the Jarque–Bera test statistics on normality of the residuals in the entry and exit equations, respectively (P-values in parenltheses).

and 0.266, respectively. These results show a higher adjustment rate for entry than for exit, but not significantly so. The correlation between the residuals of Eqs. (20) and (21) is 0.220 and positive, as expected.

We have also investigated the difference between shoptypes with relatively little floorspace and much floorspace using the same distinction as in Table 3. Results in the third column (after removing outlying observations) show that adjustment for a state of disequilibrium in shoptypes with small floorspace is completely dominated by changes in the entry rate. A state of disequilibrium seems not to have an effect on the exit rate. This suggests that when the number of firms is higher than the carrying capacity a negative net entry rate is caused by a decline in the gross entry rate rather than by an increase in the gross exit rate. The results for the shoptypes with the larger shops are quite different. There seems to be no difference in the ability of the entry or exit rate to generate adjustment in the direction of equilibrium for these shoptypes.

The relative importance of entry and exit in the adjustment process to a state of equilibrium can be estimated as follows. Using the estimates 0.227 and -0.137 for γ_E and γ_X we are able to derive an estimate of the ratio λ_4/λ_3 of 1.66. The penalty on the deviation of the entry rate from the desired level is somewhat smaller than that of the exit rate. Some evidence for the larger flexibility of the entry rate can also be found by simply considering the correlation between the net entry rate, $ent_{it} - ext_{it}$, and the deviation of the gross entry and exit rates from their averages over time, $ent_{it} - \overline{ent_i}$ and $ext_{it} - \overline{ext_i}$. These correlations are 0.50 and -0.17, respectively. An increase in the number of firms in a shoptype is therefore more likely to be accompanied by a relatively high entry rate than by a relatively low exit rate.

7. Summary and discussion

Entry and exit are reactions to (the lack of) profit opportunities. In this study we use this simple notion to propose a new and more uniform approach to the study of entry and exit processes. Following Kirzner, these opportunities may be considered market ‘‘errors’’. In this study we formalize this line of reasoning by using an error correction mechanism to explain the extent of entry and exit flows in retailing. This is done using the notion of carrying capacity. The carrying capacity is that number of firms at which there is no incentive for net entry (entry minus exit) as each of the entrepreneurs earns the critical level of profits. It is the (maximum) number of firms which can be sustained by the market. This is a special case of the general meaning of carrying capacity in the population ecology literature, which is the capacity of the environment to support a certain population size. When the actual number of firms in an industry is below the carrying capacity, an increase in the net entry rate adjusts for that disequilibrium. This increase may be the result of an increase in the entry rate or a decrease in the exit rate. The present study

develops an expression for the carrying capacity. Obviously, changes in consumer demand are an important determinant of changes in this capacity. This study tests the theoretical model for Dutch retailing and gives estimates of the effect of demand change on the carrying capacity, of the speed of adjustment to an equilibrium situation, and of the relative importance of entry and exit in this adjustment process. A panel data set of 22 retail industries for the 1981–88 period is used for this purpose.

Estimation results do not contradict the use of the model at local market levels which are typical for the retail sector. The demand elasticity of the carrying capacity in retailing is estimated to be about 0.3. This estimate is comparable to estimates of the effect of demand growth on net entry found in studies of US manufacturing (e.g., Acs and Audretsch, 1989; Hirschey, 1981). The speed of the adjustment process to a situation where the total number of firms is equal to the carrying capacity is estimated to be about 40% per year in retailing. This corresponds to complete adjustment in about 5 years, which is consistent with empirical evidence found by Levy (1987) for US manufacturing. The role of change in the entry rate as a means of adjusting to disequilibrium for shoptypes with mainly small stores was found to be much more important than the role of the change in the exit rate. MacDonald (1986) also finds for 46 US manufacturing industries over the period 1976–82 that the effect of growth on the entry rate is much larger than on the exit rate. The roles of industry profitability and growth appear to play a more important role, on average, for entry decisions than for exit decisions. Although Dutch retailing and US manufacturing differ, empirical results for these two sectors are, by and large, very much in line.

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Appendix A

In this appendix we discuss some alternative adjustment processes which result from the expected growth in consumer demand depending on the current growth in consumer demand. The expected growth rate of the carrying capacity is assumed to be determined by a shoptype-specific element and the growth rate in the current

period, i.e. $E_{t-1}g_{it} = \delta_{0i} + \delta_1 g_{i,t-1}$. Using $g_{it} = \nu_Q(\Delta Q_{it}/Q_{i,t-1})$ a generalization to Eq. (16) becomes:

$$\Delta\frac{\Delta N_{it}}{N_{i,t-1}} = \gamma\left(\nu_Q\left((1+\delta_1)\frac{\Delta Q_{i,t-1}}{Q_{i,t-2}} - \delta_1\frac{\Delta Q_{i,t-2}}{Q_{i,t-3}}\right) - \frac{\Delta N_{i,t-1}}{N_{i,t-2}}\right) + e_{it}. \tag{A.1}$$

We discuss four alternatives for choosing the value of δ_1:

1. The expected growth in consumer demand does not depend on the current growth in consumer demand. That is, $\delta_1 = 0$. In this case Eq. (A.1) is identical to Eq. (16).
2. The expected growth in consumer demand equals the current growth in consumer demand. That is, $\delta_1 = 1$.
3. Entrepreneurs use their previous experience of the relation between the growth in consumer demand in two consecutive years. The estimation results for the 22 shoptypes over the 1981–88 period with and without shoptype-specific constants are as follows (t-values between brackets):

$$\frac{\Delta Q_{it}}{Q_{i,t-1}} = \delta_{0i} + \underset{(4.7)}{0.346}\frac{\Delta Q_{i,t-1}}{Q_{i,t-2}},\ R^2 = 0.250, \tag{A.2}$$

$$\frac{\Delta Q_{it}}{Q_{i,t-1}} = \underset{(1.7)}{0.006} + \underset{(6.5)}{0.425}\frac{\Delta Q_{i,t-1}}{Q_{i,t-2}},\ R^2 = 0.193. \tag{A.3}$$

The hypothesis of equal shoptype-specific constants ($\delta_{0i} = \delta_0$) cannot be rejected at the 10% significance level ($\chi^2(21) = 12.88$). Therefore, we choose δ_1 equal to 0.425.

4. Estimate δ_1 directly from Eq. (A.1). The way in which entrepreneurs expect consumer demand to change is thus derived from the way in which they react to this expected change in demand by entering and/or exiting the shoptype.

In Table 5 we show the estimation results for Eq. (A.1) for these four different alternatives. We use data for the 22 shoptypes over the 1982–88 period (154 data points). In the lower part of the table we show the results when the four outliers (liquor stores, 1987; furnishing stores, 1985; confectioners, 1985; photographers' shops, 1983) are removed from the sample.

From Table 5 we find that a positive value of δ_1 may lead to a lower estimated adjustment parameter γ and a lower estimated demand elasticity ν_Q when compared to the case of $\delta_1 = 0$. The results also show that the variance explained is highest for values of δ_1 between about 0.25 and 0.5. However, the large standard

Table 5
Estimation results using alternative specifications for expected demand growth

	Alternative			
	(i)	(ii)	(iii)	(iv)
γ	0.399	0.370	0.381	0.380
	(6.2)	(5.7)	(6.0)	(5.8)
ν_Q	0.310	0.188	0.261	0.258
	(3.3)	(3.1)	(3.3)	(2.5)
δ_1	0	1	0.425	0.452
				(1.0)
R^2	0.264	0.268	0.272	0.272
γ	0.408	0.380	0.389	0.394
	(7.6)	(7.0)	(7.3)	(7.2)
ν_Q	0.313	0.180	0.256	0.276
	(4.1)	(3.7)	(4.0)	(3.3)
δ_1	0	1	0.425	0.293
				(0.9)
R^2	0.339	0.334	0.344	0.344

Note: Absolute t-values in parentheses. In the upper part of the table results for the complete data set (154 data points) are reported while, in the lower part, results are reported after removing four outlying observations.

error of the estimated value of δ_1 in the case of alternative (iv) indicates that the data cannot discriminate between the four alternatives.

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