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Modeling the Retail System Competition

Luigi De Giovanni[a], Roberto Tadei[b,*]

[a]*Dipartimento di Matematica - Università degli Studi di Padova, via Trieste 63, 35121 Padova, Italy*
[b]*Dipartimento di Automatica e Informatica - Politecnico di Torino, C.so Duca degli Abruzzi, 24 - 10125 Torino, Italy*

Abstract

The retail system is a competitive environment and its transformations have a relevant socio-economic impact. In this context, it is important to represent customer-store interactions, and, to this end, literature mostly proposes logit models. It is well-known that these models present some behavioral and structural anomalies (e.g., the Independence-from-Irrelevant-Alternatives) making them hardly applicable to retail system analysis. In this paper, we show that even some alternative approaches (e.g. Nested-logit or Paired-Combinatorial logit models) do not suitably represent the competition between retail stores, and we present a new modeling framework. It aims at overcoming the above limits by using two cooperating logit-based models: the first one analyzes customer-store interactions; the second model uses the interaction information to evaluate the impact of some major transformations. The framework has been integrated in a decision support system and used in real-life cases to determine the impact of new stores in some Italian regions.

Keywords: Retail System Competition ; Logit Model ; Spatial Clusters ; Customer-Store Interactions ; Impact Analysis

1. Introduction

The analysis of a retail system consists in studying the demand, the supply and their economic and spatial interactions determined by the customer choice of the stores to patronize. Roughly speaking, the store choice depends, among other factors, on the store type (Gonzalez-Benito, 2005) and customer preferences, which in turn depend on customer socio-economic characteristics. To this end, stores can be clustered into different types characterized by efficiency, competition levels, marketing, and retail strategies. In particular, two main groups can be identified:

* Corresponding author. Tel.: +39-011-090-7032; fax: +39-011-090-7099.
E-mail address: roberto.tadei@polito.it

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- *Traditional* stores (i.e. corner shops): they are small sized shops, with, generally, high price levels, low efficiency and productivity and, often, high product quality. They are related to customers by *neighborhood functions* and personal relationships and they have an important urban and social role;
- *Modern* stores (i.e. super-markets, hyper-markets and shopping centers): they are characterized by modern market strategies, large sale surfaces, high productivity and efficiency, low price levels and access to privileged supply markets. They are related to customers by *marketing functions* and have a high competing power.

Many transformations are taking place in the retail system, where the market competition is intensifying and relevant is the *substitution* of traditional corner shops with modern stores. In order to understand and control these phenomena, it is necessary to model the competition between stores and measure their substitution effects.

In a retail system, the demand can be quantified by customer expenditures, the supply by store sales and the demand-supply interactions by expenditure flows: the main aim of the retail system analysis is to model such expenditure flows.

Literature mainly suggests logit models to represent interactions in the retail system, deriving them as solution of particular optimization problems (e.g., Fotheringham & O'Kelly, 1989, Train, 2003). Notwithstanding this solid theoretical derivation, the different families of logit models, including some recent extensions, present some behavioral and structural anomalies making them unsuitable to capture the retail system competition.

The aim of this paper is to provide the retail system analyzers and planners with a modeling tool for both the interaction and the impact analysis, related in particular to substitution effects due to new stores location. In Section 3, we propose a new modeling framework able to differentiate interactions by store and customer types, and to take retail market competition into account. The framework is based on two combined logit models and overcomes the anomalies of literature models. The modeling framework has been integrated in a decision support system and actually used by the retail system planners in different urban and regional contexts to analyze the retail system interactions and to evaluate the impact of new stores.

The rest of the paper is organized as follows. In Section 2 the main anomalies of the existing retail models are discussed. In Section 3 a new modeling framework which overcomes such anomalies is presented. In Section 4 some computational results and concluding remarks are given.

2. Anomalies of the state-of-the-art models

Most models in the literature for the analysis of demand-to-supply allocation are *spatial interaction models* and *discrete choice models*. In fact, customer choices derive from the trade-off between the utility related to store attractiveness and the cost incurred to cover the distance between customer and store. A detailed survey can be found, e.g., in Fotheringham & O'Kelly (1989) or Train (2003), together with some applications to retail systems. *Logit models* (Berkson, 1944, Cramer, 2003) are a widespread used family of spatial interaction models having both a macro-economic justification (entropy maximization or information minimization) and a micro-economic derivation (random utility maximization): the origin-destination flows are the macro-economic effect of the individual choices about stores to patronize (Fotheringham & O'Kelly, 1989). Notwithstanding this solid theoretical outline, at least two main limits are related to using the logit framework for modeling the choice behavior.

The first limit affects the interaction analysis; it comes from the assumption that individuals (customers) choose alternatives (stores) according to a globally-optimal information-processing strategy. In spatial choice situations, with a generally large number of alternatives, individuals are more likely to employ a hierarchical information-processing strategy. For instance, the number of stores in the area of interest may be large so that each customer first identifies a cluster of stores (e.g., the set of hyper-markets within a given distance), and then