ESSAYS IN TIME SERIES ECONOMETRICS AND FORECASTING WITH APPLICATIONS IN MARKETING

A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy (by Publication)

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DECLARATION

I certify that except where due acknowledgement has been made, the work, integrative essay and published papers, is that of the author alone; and, the work has not been submitted previously, in whole or in part, to qualify for any other academic award.

Francisco Fernando Ribeiro Ramos

July 2006
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Responsibility for any errors is solely mine.
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SUMMARY

Marketing data often include measures on, for example, sales and marketing-mix variables at equally spaced intervals over time and time series econometric models are well suited to capture the time dependences in these variables.

This dissertation is composed of two parts, an integrative essay and a set of published papers written by the author\(^1\) during the period of 1996 to 2003. The essay and the collection of papers are placed in the context of development and application of time series econometric models in a temporal-axis from 1970s through 2005, with particular focus in the Marketing discipline. These papers and the essay express the point of the view taken by the author on time series econometric models in Marketing: *these models are useful for understanding the dynamic behaviour of markets and for forecasting the impact of decision variables.*

The main aim of the integrative essay is on modelling the effects of marketing actions on performance variables, such as sales and market share in competitive markets. Such research required the estimation of two kinds of time series econometric models: (1) multivariate time series models where the dependent variable is explained by past values, random shocks, and explicitly formulated exogenous variables, and (2) multiple time series models that treat all variables symmetrically, the basic form, without making reference to the issue of dependence versus independence and permitted causality testing of all variables simultaneously. I use Autoregressive Integrated Moving Average (ARIMA) intervention models, outlier robust estimation methods and the Pierce and Haugh statistical test to model the impact of a single marketing instrument, mainly price promotions, to measure own and cross-short term sales effects, and to study asymmetric marketing competition. I also aim to capture the dynamics of the market in an appropriate model. I develop and apply Vector AutoRegressive (VAR) and Bayesian Vector AutoRegressive (BVAR) models to estimate dynamic relationships in the market and to forecast market share. Especially, BVAR models are advantageous because they contain all relevant dynamic and interactive effects. They are appropriate for the analysis of competitive markets in which the detection of causality between the variables, the accommodation of feedback effects, and the identification of dynamic relationships between variables are crucial. Furthermore, they can capture the complex interplay of the different contributing factors, they translate the underlying short-term dynamics into long-run consequences and they outperform all other models in forecasting market shares. BVAR

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\(^1\) The only exception is Paper 8, which is a joint equally contributed work with Ana Daniel.
models accommodate not only classical competitive reaction effects, but also own and cross-market share brand feedback effects and internal decision rules and provided substantively useful insights into the dynamics of demand.

The integrative essay is structured in four main parts with several sections and subsections. The introduction sets the basic ideas behind the published papers, with particular focus on the motivation of the essay, the types of competitive reaction effects analysed, an overview of the time series econometric models in marketing, a short discussion of the basic methodology used in the research and a brief description of the inter-relationships across the published papers and structure of the essay.

The discussion critically evaluates the main results of the papers in the context of the discipline. It is centred on how to model the effects of marketing actions at the selective demand or brand level and at the primary demand or product level. At the brand level I discuss the research contribution of my work on (i) modelling promotional short-term effects of price and non-price actions on sales and market share for consumer packaged goods, with no competition, (ii) how to measure own and cross short-term sales effects of advertising and price, in particular, cross-lead and lag effects, asymmetric sales behaviour and competition without retaliatory actions, in an automobile market, (iii) how to model the marketing-mix effectiveness at the short and long-term on market shares in a car market, (iv) what is the best method to forecast market share (multiple comparisons and evaluations), and (v) the study of causal linkages at different time horizons between sales and marketing activity for a particular brand.

At the product or commodity level, I propose a way to model the flows of tourists that come from different origins (countries) to the same country-destination as market segments defining the primary demand of a commodity – the product “tourism” offered by the country of destination. This approach could be easily extended to the case of modelling multiple sales territories or different consumer segments of a product.

In the third part I outline the status of publications, citations and awards.

The last part ends with the main conclusions, including the most important theoretical and empirical findings and directions for future research.