International Journal of Forecasting 32 (2016) 344–357

Contents lists available at ScienceDirect

International Journal of Forecasting

journal homepage: www.elsevier.com/locate/ijforecast

Forecasting branded and generic pharmaceuticals

Konstantinos Nikolopoulos [a,*], Samantha Buxton [b], Marwan Khammash [c], Philip Stern [d,e]

[a] Bangor University, Bangor Business School, Hen Coleg 2.06, Bangor, Gwynedd LL57 2DG, United Kingdom
[b] Swansea University, School of Management, Swansea, United Kingdom
[c] University of Sussex, School of Business and Economics, Brighton, United Kingdom
[d] University of Exeter, Business School, Exeter, United Kingdom
[e] Ehrenberg-Bass Institute, University of South Australia, Australia

ARTICLE INFO

Keywords:
Pharmaceuticals forecasting
Diffusion models
New products
Branded
Generics

ABSTRACT

We forecast UK pharmaceutical time series before and after the time of patent expiry. This is a critical point in the lifecycle, as a generic form of the product is then introduced into the market, while the branded form is still available for prescription. Forecasting the numbers of units of branded and generic forms of pharmaceuticals dispensed is becoming increasingly important, due to their huge market value and the limited number of new 'blockbuster' branded drugs, as well as the imposed cost for national healthcare systems like the NHS. In this paper, eleven methods are used to forecast drug time series, including diffusion models (Bass model & RPDM), ARIMA, exponential smoothing (Simple and Holt), naïve and regression methods. ARIMA and Holt produce accurate short term (annual) forecasts for branded and generic drugs respectively, while for the more strategic horizons of 2–5 years ahead, naïve with drift provides the most accurate forecasts.

1. Introduction

Marketing professionals and academics alike should strive to become more socially aware (Andreasen, 1978); and to that end, forecasting plays a major role in increasing the relevance of marketing. It is included in more than 98% of companies' marketing plans, and should be taught in all business schools as a vital marketing tool (Armstrong, Brodie, & McIntyre, 1987). However, despite its importance, most managers do not appear to use forecasting effectively, as was evident from a survey of marketing managers that found that the self-reported forecast accuracy did not exceed 47% for new category entrants, and 40% for products that were new to the world (Kahn, 2002).

The introduction of new products changes the existing industry, as it adapts to include them (Darroch & Miles, 2011) and affects how forecasting managers perform. Many companies cite the forecasting of genuinely new products as one of the most difficult forecasting problems they face, given that new product forecasting is a leap into the unknown, with little or no historical information being available, which can cost the sales forecasting team substantial time, hurt its credibility through poor forecasting accuracy, and reduce its morale (Mentzer & Moon, 2005).

In this study, we forecast pharmaceutical life cycles before and after the time of patent expiry. This is a critical point in a product's lifecycle, as a generic form of the product can be introduced to the market for the first time, while the branded form is still available for prescription. From an economic and financial point of view, assessing the numbers of units of the branded and generic

* Corresponding author.
E-mail address: k.nikolopoulos@bangor.ac.uk (K. Nikolopoulos).

http://dx.doi.org/10.1016/j.ijforecast.2015.08.001
0169-2070/

forms of pharmaceuticals dispensed becomes increasingly important, due to their huge market value and the limited number of new 'blockbuster' branded drugs. As a result, pharmaceutical companies make every effort to extend the commercial life of each of their branded products and to forecast their sales into the future. On the other hand, public health institutes seek insights for effective governance, as the use of a branded drug is quite costly when a generic form is available.

The rest of this paper is structured as follows: Section 2 summarizes the background literature, and Section 3 the pharmaceutical sector. Section 4 describes the dataset used for the empirical forecasting evaluation, and Section 5 discusses the forecasting models that were evaluated (with more details in the respective appendices). Section 6 provides the empirical results and a short discussion, while Section 7 elaborates more on the optimal drift. The last section concludes the study and provides avenues for future research.

2. Background literature

This study contributes to the existing body of literature by applying forecasting methods to the life cycles of pharmaceutical drugs and assessing the numbers of units dispensed. Previous studies by Cox (1967) and Easingwood (1987) modelled pharmaceutical life cycles but did not incorporate the forecasting element. This research aims to update and extend the existing work, with a specific focus on the life cycles of branded drugs, for which sales decline as soon as generic alternatives enter the marketplace.

In this context, successful forecasts and assessments of the numbers of units dispensed enable marketing managers to implement strategies that allow them to modify a product's life cycle advantageously in order to increase sales and profitability, and decrease losses. If managers know how products are likely to perform at the yearly level, they can use this information to construct annual budgets and respective plans. They can also employ proactive strategies in order to slow down the decline of the drug, or look at introducing alternatives.

Many models have been used to predict new product sales, but previous studies have been limited to consumer goods, and have not addressed pharmaceuticals (Wind, Mahajan, & Cardozo, 1981). Models considering pharmaceutical drugs specifically have been proposed (Lilien, Rao, & Kalish, 1981) and subsequently adjusted, and their predictive abilities have been tested using pharmaceutical data (Rao & Yamada, 1988). The traditional (Bass, 1969) model, like other methods that are used to predict consumer goods, may not be suitable for pharmaceutical products. The applicability and predictive ability of diffusion models have received limited empirical testing with mixed results; however, complicated forecasting techniques do not always generate the most accurate results, and simpler approaches can be more effective in some situations (Makridakis & Hibon, 2000).

3. The pharmaceutical market

The pharmaceutical industry is one of the UK's largest manufacturing sectors. In 2009, it was ranked 8th in the world, with an income of £7 billion. The UK pharmaceutical market is equally lively, with drugs entering the market continually. This fact creates a particular interest in the study of the interactions between the branded and generic versions of these drugs, as generic versions of branded drugs can cause pharmaceutical companies their greatest loss of revenue (according to the Association of the British Pharmaceutical Industry (ABPI)[1]). On the other hand, healthcare agencies and regulating bodies may wish to make life-saving drugs available to the entire population at an affordable price through some form of regulation (Verniers, Stremersch, & Croux, 2011).

Two types of drugs tend to be available in a given market: branded drugs and their generic equivalents. At times, these may both be owned by the same pharmaceutical company, although it is more common for them to be owned by competing companies. A branded drug is generally protected by a patent that prevents the introduction of cheaper alternatives until the patent has expired. A patent is granted when the molecule is developed initially, and lasts for approximately 20 years. This means that the drug is protected through the pre-clinical and clinical trials, the approval process, and finally the introduction to the market. This introduction may occur 10–15 years after the drug was first developed, and thus, the drug is protected in the marketplace for only a limited amount of time. Generic equivalents are able to enter the market quickly upon the expiry of the patent, as they are not subject to the same lengthy development and approval process as the branded drug. Though equivalent to the branded drugs in terms of their bio-activity, generics can differ from the brands in their colour, shape, and packaging, as well as price.

When a generic drug enters the market, the number of prescriptions written for the branded version declines and the number of generic prescriptions increases at the same rate (or even faster). It was found that the persuasive role associated with detailing is responsible for GPs (general practitioners) switching between brands that contain the same active ingredient; thus, detailing should not be limited as this is likely to limit the learning rate of GPs (Ching & Ishihara, 2012). On the contrary, detailing is most effective as an acquisition tool (Montoya, Netzer, & Jedidi, 2010). Detailing should be targeted and combined with journal advertising in order to have a positive influence on an individual GP's adoption of a new drug (Liu & Gupta, 2011).

In addition, GPs have a tendency to switch to cheaper generic alternatives as they become available (Frank & Salkever, 1997; Kvesic, 2008), which can occur even before the patent has expired. Moreover, not only does generic entry lead to the expected decrease in the prescription of the branded molecule bioequivalent to the generics, it also unexpectedly benefits other non-bioequivalent branded drugs, as detail-sensitive physicians switch from the contested molecule to other branded alternatives (Gonzalez, Sismeiro, Dutta, & Stern, 2008). However, conflicting evidence suggests that some GPs do not switch

[1] http://www.abpi.org.uk/industry-info/Pages/default.aspx.