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Incorporating heterogeneity to forecast the demand of new products in emerging markets: Green cars in China

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ABSTRACT

Emerging markets are becoming increasingly important for many companies and it is not surprising to see that an increasing number of new products, especially technology products, are now being launched in these markets fairly quickly after they are launched in Western markets. However, most of the research on forecasting demand for new products focuses on developed markets. Marketing managers in multinational companies may therefore be tempted to use models that have been applied in developed markets to forecast demand of new products in emerging markets. However, there is ample evidence that supports the contention that emerging markets are different to markets in developed economies. This research proposes a dynamic segmentation approach to forecast demand that explicitly incorporates heterogeneity of consumers within and across segments: a key distinguishing feature of emerging markets. The research is applied in the context of the Chinese green car market but can be replicated for other products and in similar market conditions.

1. Introduction

Multinational companies are no longer delaying the launch of their products in emerging markets given the growth potential in such markets compared to the more established markets which are still recovering from the recession. For instance, the time lag of Apple's iPhone3 launch between China and the U.S. was 854 days but for iPad it was 167 days and 93 days for iPhone4 [1]. Alternative fuel cars, or green cars, are such types of new products that are of great strategic interest and importance to China. Petrol cars are currently dominating the market but the Chinese government is very keen to encourage consumers to adopt two types of alternative fuel cars, hybrid and electric cars to reduce the dependency on oil and the growing concern about pollution. Car manufacturers, local as well as multinational, are interested in the green car market in China. For example, Volkswagen has collaborated with its two Chinese partners to develop new brands specifically for electric cars [2]. General Motors also plans to develop its electric cars locally through a joint-venture company in China [3]. Local pioneers in this industry, BYD and Chery, have also started to sell their electric cars to the Chinese consumers [4,5]. While car manufacturers are interested in manufacturing and selling such types of cars in China, they need insight into the potential of that market before making strategic decisions. Although clean diesel cars are available in both Europe and the U.S. [6,7], they are not widely available in China for two main reasons. First, the Chinese government prioritizes diesel for commercial vehicles such as heavy duty trucks and discourages private use of diesel [8,9]. Second, the diesel in China is of worse quality than in Europe [10], so it would require huge investments to upgrade the production equipment of a large amount of petrochemical enterprises to produce clean diesel. The main choice options of non-petrol fuel cars are electric and hybrid vehicles.

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Forecasting the demand for new products is challenging and even more so when the market characteristics are changing rapidly. Emerging markets are different to other developed markets and researchers have found that they have different institutional characteristics [11,12]. More specifically, such markets have a higher level of within-market diversity or preference heterogeneity [13–16]. Furthermore, market dynamics in the emerging markets should also be accounted for and these refer to rapid socioeconomic changes that take place during economic growth [11,16]. This also means that different segments that define heterogeneity within the same market may change over time. The size of each pre-defined segment is likely to change over time in emerging markets while it is typically assumed that the size of the segments remains constant in developed markets (see an example in Robertson, Soopramanien and Fildes [17]).

In order to forecast the demand for new and innovative products with limited history, some recent studies propose a market simulation approach based on conjoint analysis [18–21]. Using conjoint experiment data, these studies employ one specification of discrete choice model for the whole population and then conduct market simulation based on the changes in the product attributes or the demographic variables. Although such non-segmental approach provides some valuable insights, we contend that these models do not sufficiently account for the institutional characteristics of emerging markets and in particular the high level of preference heterogeneity within the market. Therefore, a segmental approach, which can accommodate different parameters in the respective segments, is proposed to address the higher level of heterogeneous preferences in the emerging markets [11].

In this paper, we demonstrate the challenge and the value of accounting for preference heterogeneity and market dynamics in forecasting demand for new products in emerging markets. We illustrate this using the case of green cars and in the market context of China. We propose a dynamic segmentation approach that accounts for not only heterogeneity across segments but also within-segment heterogeneity by allowing for a different choice specification in each segment. Furthermore, our approach addresses market dynamics by considering the dynamic change of segment sizes (i.e. dynamic segmentation) in addition to the simulation based on the changes in key product attributes and demographics over time. When we apply this approach to forecast the demand for alternative fuel cars (hybrid and electric cars) in the Chinese car market, we define two segments, car owners and non-car owners. This is because consumers in these two segments are likely to have different preferences towards the green cars. At the same time, we account for the fact that the segment sizes are dynamic over time by modeling the change in car owners using a diffusion model. We then combine the segment-specific choice models with the segmentation diffusion model and forecast market shares of alternative fuel cars in China.

To demonstrate the benefit of our approach, we compare our forecasts to those generated by a benchmark model. The benchmark model in this research is based on the non-segmental approach as in [18–20]. The benchmark model does not address heterogeneity across segments. This effectively means that it fails to allow for different choice structures for each segment and does not fully capture the heterogeneity. In comparison, our proposed approach allows for flexible choice structures in different segments which can more appropriately account for consumer behavior instead of a priori imposing a choice structure. In addition, our study designs and tests different future scenarios that relate to changes in vehicle price, fuel price and household income. This is to demonstrate how the diffusion of green cars will be affected by these different factors and to also illustrate how car manufacturers can effectively use the approach to get an insight into future market trends.

The remainder of this paper is organized as follows. In the next section we briefly review the literature on new product forecasting. The third section of the paper presents the proposed modeling methodology followed by the empirical application of the approach in Section 4. The forecasts and scenario analysis are presented in Section 5 including a comparison with the benchmark model. The research implications, conclusions and potential areas for future research are discussed in the last section of the paper.

2. Literature review

When modeling the demand for new products, there are two main types of generic approaches which are suggested in the literature: diffusion modeling and individual behavior-based choice models [22]. The diffusion models are usually based on the time series data and assume a sigmoid-shaped growth curve of the product penetration levels at the aggregate level. The choice models are based on individual level data to investigate consumer preferences for different characteristics of the products and how this will affect the choice of different options presented to the consumer.

Researchers recommend using diffusion models for new product forecasting when only early sales data is available [23] and individual level data is limited in the emerging markets [24]. However, diffusion models have some limitations [19,25]. Firstly, diffusion models are usually used to forecast demand at an aggregate level so that they cannot explicitly accommodate competition for different types of products or between new and mature products. Secondly, diffusion models typically need some historical data for parameter estimation so that forecasting demand for new products remains a challenge if data is limited. Multi-generation diffusion method or the analogy approach, such as [26,27], extends the simple diffusion models based on the assumption that similar diffusion patterns across different generations of products. However, this assumption could be a limitation of the analogy approach when applied in emerging markets where there is a high degree of market dynamics which may mean that the diffusion pattern of new products may differ significantly from that of the mature products.

At a disaggregated level, discrete choice models in conjunction with choice-based conjoint (CBC) analysis are widely used to investigate consumers' stated preference (SP) and the potential demand for new products, such as the empirical studies for green cars' preferences or demand based on CBC experiments and consumer surveys [28–30]. However, analyzing what influences consumer preferences has its limitations in terms of providing the take-up rate and long term demand forecasting insights which influences how resources should be devoted to supplying such products to the market[31]. Firstly, researchers only take a snapshot of

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