



## Modelling consumer choice behaviour in space tourism

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### ABSTRACT

This paper presents the results of stated-preference, discrete choice experiments designed to examine potential consumer reactions to various options emerging in the embryonic space tourism industry. The research investigated choice behaviour between four types of space tourism: high-altitude jet fighter flights, atmospheric zero-gravity flights, short-duration sub-orbital flights, and longer duration orbital trips into space. Each type of space tourism was represented in terms of an array of major features that potentially may have a major impact on the perceptions, attitudes, and choice behaviour of likely customers in this market. The choice experiments were embedded in an information-rich, online survey. Choice data from the experiments were analysed with the mixed logit model, which is a random coefficient model that allows for a continuous distribution of the preferences (effects) for each feature. The results identify a number of features for each type of flight option as well as a number of customer characteristics that appear to impact the choice of space tourism type.

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### 1. Introduction and background

Since the publication of Schumpeter's *Theory of Economic Development* (Schumpeter, 1961), it is well-recognized that the birth of new industries creates a dilemma for understanding and predicting consumer choice behaviour. New industries typically present customers with conceptually or practically radical products that do not benefit either from the advantage of being able to reflect on past patterns of demand and choice, or from a history of competitive offerings, variations in product features, and market share performances. Thus, there is little basis for extrapolation and, at best, only poor market analogues (Gregan-Paxton, Hibbard, Brunel, & Azar, 2002) exist to provide entrepreneurs with some basis for anticipating or gaining insights into likely customer responses to really new products. Despite this challenge, the need to understand how consumers are likely to react to radically new product and service offerings is particularly acute in these circumstances. Unlike well-established markets, where more 'incremental' products are the norm, the risks, uncertainties, investment, and potential commercial rewards at stake are often considerably greater (Song & Montoya-Weiss, 1998).

The birth of 'space tourism' is a case in point. If the likes of Richard Branson are to be believed, the next few years could herald

in a space tourism industry that is nothing short of an economic 'behemoth' if it succeeds to the same extent as the civil aviation industry during the 20th century. From the first powered flight in 1903 through the early 'barnstorming' years of flight, advances in aircraft technology stimulated by two world wars, the development of jet aircraft engines, and most notably the Boeing 747, aviation advanced rapidly during the first several decades of technological and then commercial development. According to Belfiore (2007a):

"Private companies took air travel out of the exclusive domain of militaries and governments and gave it first to the very rich; then low cost carriers such as Ryanair started turning around aircraft faster, increasing the frequency of flights and thus making them affordable for many more people. Space travel is taking the first step in this process."<sup>1</sup>

However, forecasts of demand for the products and services of this industry require particular caution as the prevailing view in the 1960s and 1970s, during the heydays of the space race, was that by the late 20th Century the general public would already be travelling into space *en masse*. The benefit of hindsight tells us that this was an overly optimistic expectation based more on hope than on realistic assessments or appreciations of the costs, technical realities, risks, and/or commercial imperatives space tourism requires.

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<sup>1</sup> See also Belfiore (2007b) for a useful reference detailing the pioneers involved in creating a commercial space tourism industry.

Nonetheless, hopes and expectations have been renewed over the past several years in light of a number of developments (Crouch, Laing, & Smith, 2004) including:

- flights of several, fare-paying tourists (Carey, 2005; Malik, 2005) to the International Space Station via the Russian Soyuz spacecraft, with the assistance of *Space Adventures*, a commercial space tourism 'go-between'.
- the first successful flights of SpaceShipOne (a sub-orbital venture) to win the Ansari XPrize (David, 2004), followed by the announcement that the company that designed and built SpaceShipOne (i.e., Scaled Composites) had entered into an agreement with a new venture created by Sir Richard Branson (known as Virgin Galactic) to build a fleet of sub-orbital spacecraft for space tourism based on the SpaceShipOne prototype (David, 2005a).
- a change in the attitudes of NASA and US policy makers and regulators who now seem to be willing to facilitate and encourage development of the industry and ensure that the lead of the United States is maintained (David, 2005b; Werner, 2004). The US Federal Aviation Administration has adopted the lead regulator role at this stage and has sought to facilitate rather than hinder the development of sub-orbital space tourism enterprise.
- a flurry of other developmental activities involving design, testing, and facilitating of sub-orbital and orbital initiatives and ventures including the participation of, and investment by, several wealthy individuals (see David, 2005c, 2005d, 2005e; Malik, 2004 for examples).
- the willingness of market mavens to buy into the initial product concepts. Sir Richard Branson's Virgin Galactic has sold out its Founders Group with 100 individuals preparing to pay \$200,000 for flights of just under 2 h duration. The company, Space Adventures, which to date has played a role in assisting the Russian Space Agency to find space tourism customers for its Soyuz flights to the International Space Station, has over 200 people prepared to pay \$100,000 for a 90-min sub-orbital flight.

Such developments suggest that we are seeing the birth of a nascent commercial space tourism industry, although the way ahead appears very uncertain, with a wide range of economic, technological, political, legal, environmental, financial and commercial issues eventually shaping the rate and direction the industry takes. Industry experts are keenly aware that among the most important of these uncertainties is the way in which consumers perceive and respond to the competitive options on offer. For example, many in the industry expect that prices will fall, allowing the industry to become more mainstream. According to Will Whitehorn, president of Virgin Galactic: "We hope ticket prices will come down by the end of the first decade of flight as all profits prior to this will be reinvested in the business." Yet when pressed on what future prices might be, his response was telling: "On an unproven business model, we cannot accurately give that figure currently" (Kolesnikov-Jessop, 2006). In such circumstances, valid, reliable and accurate estimates of market demand are essential to capture the interest, participation and cooperation of many disparate businesses, organisations and individuals, and particularly capital markets. Simberg (2000, p. 10) suggests that "the current technology level is the least of the problems confronting space tourism entrepreneurs ... the most difficult problem remains not in design and implementation, but in raising needed investment funds." Although venture capitalists such as Boston Harbour have provided support for space tourism ventures "wooing venture capitalists and private equity firms has proven more difficult. Such investors are skittish [not only] because commercial

human space flight is risky [but because] firms compete with traditional software, Internet, biotechnology and medical-device start-ups where the risk is lower and returns are potentially higher" (Sydney Morning Herald, 2007). As O'Neil, Bekey, Mankins, Rogers, and Stallmer (1998) note, "validation of the real market for general public space travel and tourism is going to be an essential step. A central issue will be: is it possible to get that validation with current vehicles?" (p. 8). In light of these challenges, the purpose of this paper is to take a modest step in the direction of assessing the demand for certain types of space tourism services. We did so by modifying and applying a promising approach to modelling and forecasting the likely consumer response. Our analysis allowed us to explore the effect of various configurations of specific features which may form potential future space tourism offerings.

## 2. Space tourism and consumer choice

### 2.1. Current evidence of the demand for space tourism

Several studies of the potential public interest in space tourism have been conducted over the last decade, either by "independent" academic researchers, government or public organisations, or commercial enterprises wishing to verify their belief that space tourism is a viable investment. Crouch (2001) reviewed and compared the results of many of these studies, undertaken in Japan, the United States, Canada, Germany and the UK. Overall, there was some broad consistency in the findings indicating that about 40–80% of respondents in these studies had an interest or desire to travel into space depending on nationality, gender (females expressed interest that was 5–10% points lower than males), and age (80% for those under age 20 years, declining to 45% for those over 60 years). Crouch also reported that about 10–20% of respondents stated that they would be prepared to spend a year's salary to travel into space.

Futron Corporation (2002), in a study for NASA, surveyed 450 affluent Americans. They concluded that sub-orbital space travel could reach 15,000 passengers annually by 2021, representing revenues in excess of US\$700 million, and that orbital travel could reach 60 passengers per year amounting to revenues of US\$300 million by 2021. Perhaps surprisingly, half the respondents indicated that they would be indifferent to travelling in a privately developed sub-orbital vehicle with a limited flight history, versus a government-developed spacecraft. Similar to other studies, Futron concluded that "[o]rbital travel is a fairly elastic market; there are significant jumps in demand when the price drops to US\$5 million and again at US\$1 million" as the price for orbital travel is expected to decline over time from the current level of US\$20 million.

In a comparative study, Crouch and Laing (2004) assessed Australian public interest in space tourism using a survey approach similar to several studies summarised above. They found a level of interest in the prospects for public space travel in Australia broadly comparable to the results of similar studies in Japan, the United States and Canada, the UK, and Germany. Their findings suggest that, conceptually at least, most respondents would like to travel into space if they could (58%), but cost, safety, and product design factors would significantly impact their responses. Demographic and behavioural characteristics of consumers also were strongly associated with their attitudes and interests. Younger and male respondents were significantly more interested in space tourism and, as might be expected, there was a strong positive association between current risk-taking behaviour in recreation and leisure activities and a desire to travel into space. Consistent with other survey results, the question, "How long would you like to stay in space?", resulted in a modal response of two to three days (37%). Although the majority of respondents indicated they would be

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