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Weather risk management in ski resorts: Financial hedging and geographical diversification

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ABSTRACT

As weather volatility increases, weather risk has become a critical management issue in weather sensitive industries. This study uses ski resorts as an example to examine two promising weather risk management strategies: geographical diversification and financial hedging. The empirical analysis results suggest that financial hedging might be a more effective strategy for ski conglomerates. Guidelines for ski conglomerates to achieve better weather risk management outcomes are provided based on simulating the interactions between geographical diversification and financial hedging. Although based on ski resorts and snowfall risk, the methodology is also applicable to other weather sensitive hospitality businesses.

1. Introduction

1.1. Impact of weather volatility

As a result of climate change, the volatility and intensity of shorter-period weather patterns have increased (Intergovernmental Panel on Climate Change, 2007). Beyond ecological and social challenges, volatile weather increasingly poses economic ramifications as well (Chichilnisky and Heal, 1998). The Chicago Mercantile Exchange (2005) estimates that nearly 20% of the U.S. economy is directly affected by weather. The impact of weather volatility is especially significant on nature-based tourism businesses because the natural setting determines not only demand and supply but also the quality of tourism offerings (Scott, 2003). As weather volatility grows, managing weather risk, especially in weather sensitive industries, has become a key component of creating shareholder value.

The ski industry has long been identified as vulnerable to weather risk. First, the number of visit is closely tied to snow depth (Fukushima et al., 2002) and daily ski lift ticket sales are highly influenced by weather variations (Shih et al., 2009). Second, capacity and quality of the tourism offerings are determined by the amount of snowfall because snow has to be at least 30 cm deep to be skiable (Scott et al., 2003). While the uncertainty in demand and supply poses direct challenges for ski resort management in terms of planning facilities, operations, and marketing programs, based on financial theories (Smith and Stulz, 1985), higher cash flow volatility could also cause additional financial burdens such as bankruptcy and financial distress costs, taxes, external financing costs, and higher underinvestment costs. Reducing cash flow volatility could decrease these financial costs, therefore increasing firm value. Empirically, Allayannis and Weston (2001) demonstrated that firm value can increase 4.87% just by reducing cash flow volatility caused by foreign exchange fluctuation.

1.2. Purpose and contributions of the study

A number of studies have examined the impact of long-term climate changes on tourism demand (e.g. Gomez Martin, 2005; Hamilton et al., 2005) and the ski industry (e.g. Hamilton et al., 2007; Scott & McBoyle, 2007). Yet, few studies have explored strategies that could address shorter-term weather volatility and the interaction between long-term and short-term strategies. In this study, we aim to fill this gap by examining the interaction between two promising weather risk management strategies in the context of ski resorts: geographical diversification and financial hedging. Theoretically, this study extends the literature of weather risk management by incorporating multiple risks in weather risk hedging. In the finance domain, many researchers have studied the effect of basis risk on hedging effectiveness, but most studies (Castelino et al., 1991; Figlewski, 1984; Netz, 1996) consider only one basis risk and are based on price risks, such as stock index futures and commodity futures. Golden et al. (2007) extended the literature by studying the interaction between credit risk and basis risk for weather derivatives, but they still considered only a single basis risk. This study fills this gap in the weather risk management literature. Practically, the study provides decision making guidelines for coordinating geographical diversification and financial hedging

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strategies. Although the present study is based on ski resorts and snowfall risk, the methods and results are applicable to all nature-based businesses sensitive to weather risks. With this study, we hope to provide a stepping stone towards the integration of these two weather risk management strategies.

Specifically, there are two objectives in this study: (1) exploring the effects of geographical diversification on the exposure of company-level cash flow to snowfall risk and (2) examining the effects of geographical diversification on snowfall risk hedging. Ski resorts provide an ideal platform for our analysis because weather risk is a major business risk for ski resorts and can be managed by either geographic diversification or financial hedging. Furthermore, the outcomes of these two strategies are interrelated due to their correlations with snowfalls, providing an opportunity to examine the interaction between the two strategies.

2. Literature review

2.1. Weather risk and weather derivatives

Brockett et al. (2005) define weather risk as "the uncertainty in cash flows and earnings caused by non-catastrophic weather events." Subsequently, exposure to weather risk is measured as the sensitivity of cash flows to weather indices. Weather risk is different from commodity price risk and other financial risks in several aspects (Cogen, 1998). First, weather risk is a 'volume' risk in that it affects quantity not price. Second, weather risk is a highly localized risk because micro-climates can vary from one location to another. Third, local weather risks have low correlations with most of the financial risks, such as exchange rate risk and interest rate risk. Fourth, there is no physical market in weather. We cannot store the snow from this year to use it next year. Fifth, weather risk is a pure exogenous risk that is beyond human control. Even with current technology, the weather still cannot be accurately forecasted beyond a few days. Since it is almost impossible to directly "manage" or store weather in order to reduce weather-related cash flow volatility, weather derivatives become one of the most viable tools to manage weather risk.

Due to deregulations and increasing competition in the late 1990s, energy and utility firms started to use weather derivatives to manage the adverse effects of demand fluctuations caused by unexpected weather conditions (Cao and Wei, 2004). Weather derivatives are financial instruments with a value that is contingent on underlying weather factors such as temperature, rainfall, or snowfall. They can exist in the form of forwards, futures, options, or swaps (Manfredo and Richards, 2009). Since energy and utility firms are the key drivers of the growth and innovation of weather derivatives, it is not surprising that temperature-related deals account for more than 80% of all transactions (Cao and Wei, 2004).

Currently, CME offers snowfall index futures and options based on Boston and New York. Because weather risk is highly localized, pay-offs based on the snowfall for New York are unlikely to exactly compensate for the fluctuation of cash flows at a ski resort located in another location. Therefore, individual ski resorts would benefit more from forward based on local snowfalls, which offers more direct correlation with ski resort cash flows. A snowfall forward is an agreement between two parties to buy or sell a snowfall index at a specified point of time in the future. The use of forwards also simplified the analysis by excluding the consideration of contract price fluctuation and the time value of money on the deposit. The analysis in this study will be based on snowfall forwards.

2.2. Weather risk management strategies

Ski resorts commonly respond to snowfall risks by changing operations that are directly exposed to the risk (e.g. snowmaking or slope development) in order to mitigate the fluctuation in snowfall. With the growing popularity of the ski conglomerate business model, geographical diversification has also emerged as an effective approach for weather risk management (Scott and McBoyle, 2007). On the company level, the negative impact of poor snow conditions on a single property can be mitigated by spreading the risk to other resorts within the firm and channeling resources and capital from other properties. In general, operational hedges such as snowmaking and geographical diversification require substantial capital investment and cannot be easily reversed (Pantzalis et al., 2001). As a result, they are more suited for managing long-term risk exposure.

The conglomerate business model also provides ski resorts with greater access to capital and expertise, which enables the company to take advantage of recent innovations in weather derivatives. With weather derivatives, companies can directly transfer the risk without changing the risk exposure (Kim et al., 2006). In other words, ski resorts do not have to alter their operations for risk management purposes. Financial hedging also provides higher liquidity and requires less capital commitment. Therefore, it is generally better suited for managing short-term risk exposures.

The first weather derivative transaction occurred in 1997 between Enron and Koch Industries. The weather derivatives market has grown rapidly ever since. Based on a Price Waterhouse Coopers survey (2006), the notional value of all weather risk contracts reached $45.2 billion in 2006. In addition to the utility industry, insurance, banking, and agriculture are the major users of weather derivatives for their low correlation with other financial assets and as a form of insurance against the adverse effect of weather conditions (Quinn, 1999). Although not commonly adopted by hospitality and tourism industry practitioners, weather derivatives have shown some potential in the industries. Using two Midwest golf courses, Leggio (2007) showed that weather options can reduce revenue volatility by up to 80%. Dawkins and Stern (2004) also found that ground pass ticket sales for the Australian Open are negatively correlated with temperature and suggested that the use of weather derivatives may be a useful strategy in managing revenue from a major sporting event.

Although we examine the potential benefits of operational and financial hedging, it is not our intention to argue for the superiority of any one specific strategy. In fact, researches (Petersen and Thiagarajan, 2000; Allayannis et al., 2001; Kim et al., 2006) have shown that the decision to implement these strategies and the outcomes are interrelated. Instead, this study hopes to provide a stepping stone towards the integration of these two weather risk management strategies.

2.3. Effects of geographical diversification on risk exposure

In this section, we will examine the effects of geographical diversification on snowfall risk exposure using in two scenarios: (1) single-property versus multiple-property and (2) before- versus after-adding a new property to a multiple-property ski conglomerate ("multiple-property plus one" hereafter). Previous studies on the effects of geographical diversification on risk exposure have yielded inconsistent results. In examining the impact of operational hedges by US multinational corporations on their exchange rate exposure, Pantzalis et al. (2001) shows that the more geographically diversified a firm is, the less exposure they have to exchange rate risk. On the contrary, Allayannis et al. (2001) indicate that more geographically dispersed firms have relatively high exposures to exchange rate risk. One possible explanation for this inconsistency could be that exchange rate risk involves both price risk from the exchange rate and quantity risk from demand uncertainty in foreign units. As exemplified by Chowdhry and Howe (1999), while price-related exchange rate risk can be mitigated by geographi-