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The Impacts of Supra-Regional Multi-Resort Season Passes: A Hedonic Pricing Model of Single-Day Lift Tickets for US Ski Areas

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Abstract

Numerous media analyses claim that supra-regional multi-resort season passes (mega passes) are negatively impacting skiing, snowboarding, and winter-sport communities. In particular, media claims that ski areas on these season passes are charging higher single-day lift ticket prices to nudge people to buy their season pass products. To test this claim, I use a hedonic pricing model to estimate the impact of season passes on adult single-day lift ticket prices. By applying OLS regressions to a dataset of 302 US ski areas for the winter of 2018-19, I find that the ski areas on the leading season passes (Ikon and Epic Pass) charge price premiums for their adult single-day lift tickets. However, the magnitude of the price premiums is much smaller after controlling for ski area characteristics and regional fixed effects.

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1. Introduction

The winter of 2018-19 was a busy season for US ski areas due to the development of mega passes (supra-regional multi-resort season passes) through mergers and acquisition and joint ventures, especially with the two leading season passes, Ikon and Epic Pass. Founded in 2017, Alterra Mountain Company developed the Ikon Pass to "change the landscape of the mountain resort industry."[1] The Ikon Pass lets pass holders enjoy access to its 46 ski resorts on the pass, discounts on gear rental and dining services, and other benefits such as public transportation.[2] The Ikon Pass introduced direct competition to Vail Resorts Inc. and its Epic Pass. A longtime industry leader, Vail went public in 1997 to innovate the industry through buying and improving ski resorts.[3] In 2008, Vail developed one of the first supra-regional multi-resort season pass in the US, the Epic Pass, which lets pass holders enjoy unlimited access to Vail's (then 5) resorts.[4] After Alterra announced the Ikon Pass, Vail started to accelerate its season pass expansion to offer access to 67 ski resorts in 8 countries on its Epic Pass.[5]

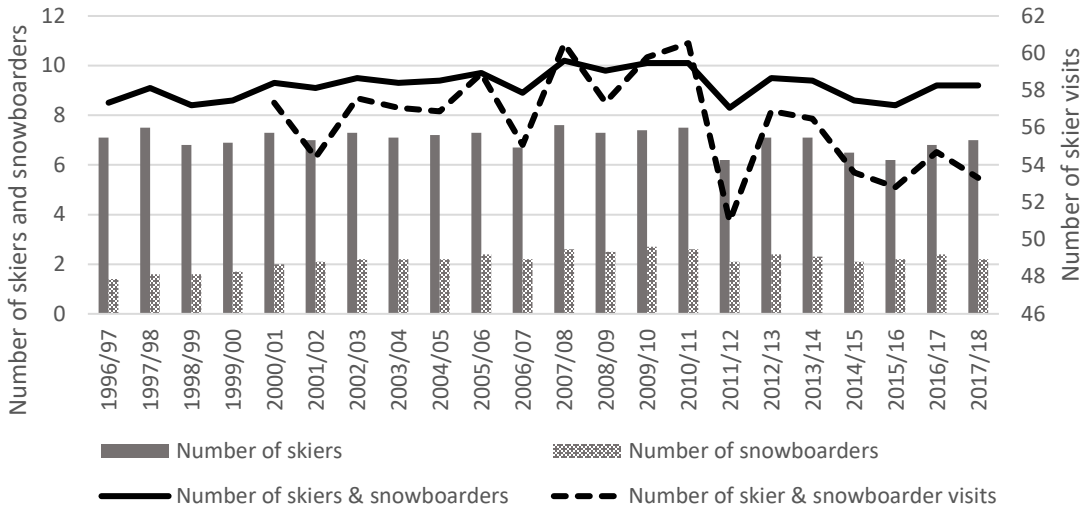
Before the mega passes, regular skiers and snowboarders often buy single-resort or regional season passes. Season pass products help ski areas to lock in pass-holders' loyalty and gain a steady cash flow that mitigates weather unpredictability. The new mega passes cost about the same or less than a traditional single-resort season pass, thus reducing the cost of skiing and snowboarding for pass-holders. Considering that the US has stagnant growth of active skiers and snowboarders and the US ski areas are experiencing declining visits (Figure 1), these season passes should

[1] Alterra Mountain Company is a joint venture of KSL Capital Partners and Henry Crown and Company. For more information, see https://www.alterramtnco.com/news/2018/01/11/announcing-alterra-mountain-company.
[2] See https://www.ikonpass.com/en/shop-passes/ikon-pass-2018-2019 for Ikon Pass details.
[3] See http://www.vailresorts.com/Corp/heritage.aspx for Vail's history.
[4] Bloomberg Businessweek's Kyle Stock wrote a detailes story on Ikon and Epic, "One Pass to Ski Them All," which can be viewed online at https://www.bloomberg.com/news/features/2019-03-01/epic-vs-ikon-battle-for-the-best-ski-pass.
[5] See http://news.vailresorts.com/corporate/international/2018-19epicpass.htm for Epic Pass details.

increase skier and snowboarder visits, thus boosting local retail, restaurant, and lodging businesses.[6]

Figure 1
Numbers of skiers, snowboarders, and visits in the US from 1996 to 2018 show stagnant growth of active skiers & snowboarders and decreasing visits.

Numbers in millions.

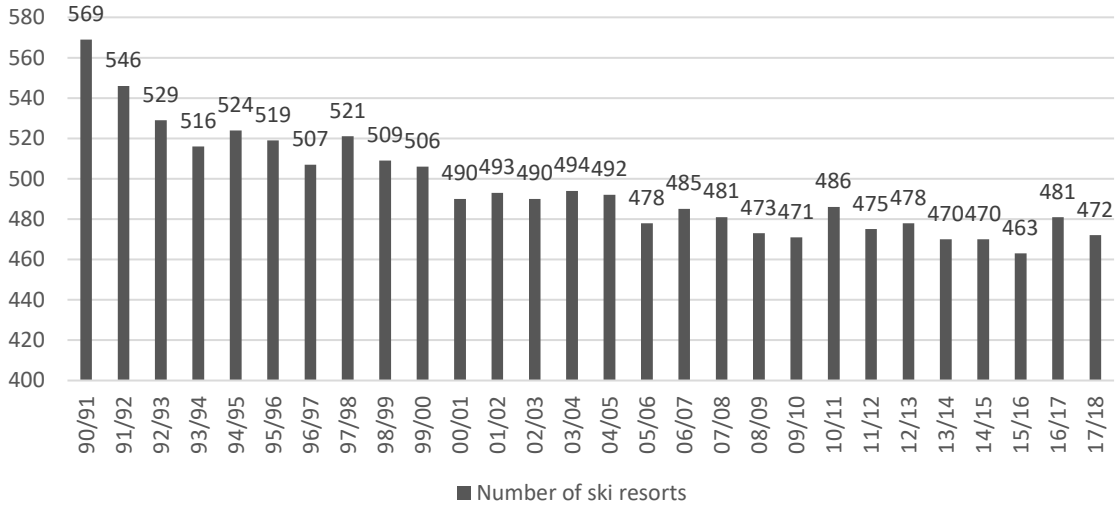


Source: National Ski Areas Association online survey.
https://www.statista.com/statistics/376710/active-skiers-and-snowboarders-in-the-us/
https://www.statista.com/statistics/206544/estimated-number-of-skier-visits-in-the-us-since-2000/

However, more people are concerned with the negative impacts of these new season passes. For local skiers, season passes mean including traffic jams, lift lines, and rising accommodation costs.[7] For smaller and independent ski areas, it is now harder to compete with ski areas on season passes because pass-holders would most likely stay within their pass network.[8] In the US, the number of operating ski areas has been decreasing over the years (Figure 2), and the development of the season passes might make the ski area industry even less competitive.

[6] For an analysis on the positive effects of season passes, see "The Giant Resort Companies You Hate Are Saving Skiing" by Marc Peruzzi at Outdoor Magazine. https://www.outsideonline.com/2367016/keep-skiing-weird.
[7] Brigid Mander at Outdoor Magazine wrote an analysis on the negative effects of season passes, see "Actually, the Mega Season Pass Is Killing Skiing" at https://www.outsideonline.com/2389964/ski-pass-epic-ikon.
[8] Many articles have addressed this concern. For an example, see "On Slippery Slopes" by Gordy Megroz in Bloomberg Businessweek.

Figure 2
Number of ski resorts operating in the US from 1990 to 2018 shows a decreasing trend.



Source: National Ski Areas Association online survey.
https://www.statista.com/statistics/206534/number-of-ski-resorts-operating-in-the-us-since-1990/

Moreover, critics are suggesting that ski areas on the mega passes might charge higher prices for single-day lift tickets to nudge people into buying their season passes products. With single-day lift tickets at Vail during the New Year hitting $209, Vail can claim that their season passes can quickly pay for itself with just 3 or 4 visits.[9] Considering that skiing and snowboarding are already expensive, this trend makes skiing and snowboarding less accessible to first-timers and can slow the growth of potential skiers and snowboarders.[10]

This paper examines the claim that supra-regional multi-resort season passes (mega passes) are increasing the price of single-day lift tickets. By using a hedonic pricing model to control for ski area characteristics and regional fixed effects, I find that ski areas on the leading season passes are charging price premiums for their weekday and weekend adult single-day lift tickets. However, the magnitude of the price differences is smaller than what media suggests, especially for smaller

[9] Vanat, Laurent. 2019 International Report on Snow & Mountain Tourism.
[10] Stock, Kyle. "One Pass to Ski Them All."

supra-regional multi-resort season passes. Consistent with previous studies, I also find that ski area characteristics such as vertical drop, base altitude, and lift chairs are significant determinants of lift ticket prices. I also find statistically significant price differences among different regions. This study contributes to the analysis of US ski areas, the application of the hedonic pricing model, and the impacts of market alliances by using new data from the season of 2018-19 with a focus on the development of season passes.

I organize this paper as follows. Section 2 is a brief literature review on the application of the hedonic pricing model and ski lift ticket prices. Section 3 presents the data and variables used. Section 4 details my hypothesis and model specifications. Section 5 presents the empirical results. And Section 6 concludes this paper with a discussion on limitations and possible further research.

2. Literature Review

Ever since Rosen (1974) formalized the hedonic pricing model, researchers have been using the model to analyze differentiated products and their "utility-bearing attributes.". The model is frequently used in real estate to analyze the market, and there have been studies that apply the hedonic pricing model to lift ticket pricing.

Falk (2011) argues that with no transaction costs, ski lift ticket prices should be a function of the ski area's characteristics. Falk examines the international price differences in lift tickets by applying the hedonic pricing model to one-day and six-day lift tickets while controlling for ski areas characteristics. Falk uses a sample of 214 ski resorts in Austria, France, and Switzerland for the 2010-11 season and finds that there are significant price differences in international ski resorts with Swiss and Austrian resorts charging higher prices than French resorts. The higher price regions might be less price competitive and productive. Falk also finds that ski characteristics are significant determinants on lift ticket prices and ski resorts that are part of a greater ski alliance charge higher prices.

Similarly, Alessandrini (2013) uses a hedonic pricing model to estimate the weekdays and weekends prices of 19 ski resorts in Italy using data from 2008-2012. Alessandrini finds that ski area characteristics such as vertical capacity, length of ski slopes, the altitude of lifts, and percentage of intermediate slopes are significant determinants of the lift ticket price. Comparing predicted price to the actual price, Alessandrini identifies statistically over- and underpriced ski areas.

While there are more studies on the European ski resort industry, few looked into the US market. Fonner and Berrens (2014) apply the hedonic pricing model to ski areas in the US and examine the effects of crowding. They used data from 181 US ski areas of the 2011-12 season.

Their variables included the 2011 prices for single-day lift tickets, the vertical drop and base altitude of the ski area, the reported annual snowfall, lift capacity, and snowmaking. Using OLS, they find that physical characteristics are significant determinants of lift ticket prices, and there exist non-linear crowding effects on the lift ticket price. Increased skiers per hour per acre is associated with raising lift ticket prices at first and then decreasing lift ticket prices at high levels of crowding.

Besides the hedonic pricing model, there are other models that scholars have used to analyze lift ticket prices. Firgo and Kugler (2018) use a spatial autoregressive model to analyze cooperative pricing in ski areas. They applied the model on data of all ski resorts in Austria for the 2011-12 season while controlling for ski area characteristics and demand side variables. They find that single-day lift ticket prices of resorts in ski alliances are generally higher, and prices increase with the size of an alliance and towards the spatial center of an alliance. They also find that ski resort characteristics such as size and capacity are significant drivers of lift ticket prices. Their result shows that ski area alliances can have important policy implications.

Mulligan (2011) applies a two-sector Endogenous Fixed Costs model on selected ski areas in the US from 1980 to 2002 and found higher real prices of lift tickets. Mulligan finds that declining transportation costs encourage skiers and snowboarders to switch from regional markets to national resorts. With the wealthiest Americans experiencing the most significant increase in income, Mulligan finds ski areas raised lift ticket prices and chair lift capacity in both national and local markets despite stagnant growth of skier days per season and little change in market concentration.

Overall, few works have been published on ski areas and lift tickets. While some European scholars have been researching on the slopes, even fewer studies have been done on the US ski

resorts industry. I aim to contribute to the literature of applied hedonic pricing model and ski resorts analysis. My study uses new data from the season of 2018-19 and looks into the recent development of supra-regional multi-resort season passes in the US. Moreover, this paper uses a unique dataset web-scraped from OnTheSnow.com, providing a set of codes for future research and data collection.

3. Data and Variables

Whether ski resorts on supra-regional multi-resort season passes (mega passes) are charging higher single-day lift tickets is investigated by using a cross-sectional dataset containing 302 ski areas in the US for the 2018-19 season. I compiled data from OnTheSnow.com, websites of ski areas, and websites of season passes.[11] I completed the data collection in early April 2019. For each ski area, the dataset has information on lift ticket prices, season pass information, ski area characteristics, and location.

One limitation of my dataset is that it does not include some lesser known ski areas. There are about 472 operating ski resorts in the United States,[12] and OnTheSnow has information on 331 ski areas as of April 2019. Within these 331 ski areas, some lesser known ones do not have much information online, and I cannot include them in the dataset. Thus, my dataset is a sample of about 64% of all operating ski areas in the US with selection bias for ski areas with information online.

Another limitation of my dataset is that it is only for the 2018-19 season. Because mega passes are developed recently, it would be more comprehensive to see the difference in prices before and after the development of mega passes.

Comparing to previous literature, my dataset lacks detailed location data to test for spatial price correlation and price cone effect (Firgo and Kugler, 2018), lift capacity to control for the crowding effects (Fonner and Berrens, 2014; Falk, 2011), actual number of operating days for the season to control for efficiency (Falk, 2009), and local demand variables to control for differences in local customers (Firgo and Kugler, 2018; Falk, 2015).

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[11] I web scraped data on all available US ski areas from OnTheSnow (https://www.onthesnow.com/), a website maintained by Mountain News Corporation and a leading source of snow and resort information for travelers. OnTheSnow has some missing data for some ski areas, and I completed the dataset as best as I could through online research,

[12] U.S. Ski Resorts in Operation during 2017/18 Season. http://www.nsaa.org/media/340688/Number_of_Ski_Areas_by_Season_1718.pdf

Table 1 provides definitions and descriptive statistics on each variable used in my model. We can see there is a variety of lift ticket prices with the cheapest being $15 and the most expensive being $199. Appendix A provides additional information on data sources. For readers interested in seeing my complete dataset and web-scraping codes, I have published my work on Kaggle and Github, and the links can be found in Appendix B.

Table 1. Summary statistics

Variable	Definition	Obs	Mean	Std. Dev.	Min	Max
Price						
adultweekday	Adult weekday lift ticket price (2018-19 US$)	302	$64.83	$33.78	$15	$199
adultweekend	Adult weekend lift ticket price (2018-19 US$)	302	$71.19	$31.47	$20	$199
Mega Passes						
ikon	Binary variable for ski areas on Ikon Pass	302	0.09	0.29	0	1
epic	Binary variable for ski areas on Epic Pass	302	0.06	0.23	0	1
peak	Binary variable for ski areas on Peak Pass	302	0.04	0.20	0	1
powerpass	Binary variable for ski areas on Power Pass	302	0.03	0.17	0	1
powder	Binary variable for ski areas on Powder Alliance	302	0.04	0.20	0	1
freedom	Binary variable for ski areas on Freedom Pass	302	0.05	0.22	0	1
Characteristics						
famous	Binary variable for highly ranked or popular resorts	302	0.12	0.32	0	1
verticaldrop	Vertical drop in ft	302	1275.38	952.02	100	4425
base	Ski area base elevation in ft	302	3491.46	3150.29	78	10800
terrainsize	Acres of skiable terrain	302	796.55	1900.56	8	26819
daysopen	Projected days open	302	118.61	31.80	25	305
snowfall	Average snowfall in inches	302	189.67	136.75	18	669
gondola	Number of trams or gondolas	302	0.19	0.59	0	4
totalchairs	Total number of chair lifts	302	8.68	6.20	1	42
percentfast	Percentage of high speed chair lifts	302	11.11%	16.76%	0.00%	72.73%
terrainparks	Number of terrain parks	302	2.49	2.11	0	14
snowmakesize	Acres of snowmaking terrain	302	162.35	262.89	0	3379
nightskiing	Binary variable for ski area with night skiing	302	0.57	0.50	0	1
Regions						
newengland	Binary variable for ski areas in New England	302	0.17	0.38	0	1
midatlantic	Binary variable for ski areas in Mid Atlantic	302	0.17	0.37	0	1
southeast	Binary variable for ski areas in South East	302	0.04	0.20	0	1
midwest	Binary variable for ski areas in Mid West	302	0.22	0.42	0	1
rocky	Binary variable for ski areas in the Rocky Region	302	0.25	0.43	0	1
west	Binary variable for ski areas in the West	302	0.16	0.36	0	1

Lift ticket prices

Ski areas in the US use various strategies to set their lift ticket prices. Some ski areas set prices before the season starts, and some change the price based on demand and timing throughout

the season. Moreover, with the development of online lift ticket windows such as Liftopia (https://www.liftopia.com/), ski areas are experimenting with different discount strategies. The general trend is that weekend prices are higher than weekday prices, and peak season prices are higher than off-season prices. In this study, I will use the adult single-day lift ticket prices for weekday and weekend collected by OnTheSnow and published on the ski areas' websites.

Season passes

In the US, there are mainly three types of season passes. First, single-resort season passes for local skiers and snowboarders. Almost all ski areas offer these season passes for their loyal customers for a couple of hundred dollars. These passes usually include unlimited access to the ski lifts, discounts on ancillary services such as rental and dining, and some access to nearby partnering ski areas.

Second, local multi-resort programs. Regions such as Colorado and Utah that have many ski areas close to each other offer local programs for local skiers and snowboarders for a much more expanded experience. There are great varieties in these local programs. Some are fully transferable while some are just for one person. Some offer unlimited access while some offer limited days or discounts. The prices can range from $25 to $4,900.[13]

Third, supra-regional multi-resort season passes, or mega passes, are developed recently and are the focus of this paper. These mega passes include ski areas in multiple states, and some have international partnering ski areas. Most of these season passes offer unlimited access at some of their member resorts. This study examines whether ski areas on these mega passes are charging higher single-day lift ticket prices. I collected data on all US mega passes for the 2018-19 season.

[13] For more details on season passes, see https://www.snowridersinternational.org/news/2018/6/6/multi-mountain-season-passes-available-for-the-20182019-season-other-than-epic-and-ikon.

Table 2 provides a summary of these supra-regional multi-resort season passes. Appendix C shows a complete list of resorts on these season passes.

Table 2.
Summary of US supra-regional multi-resort season passes for the 2018-19 season.

Name	Company	# US ski areas	# Unlimited ski areas	Total ski areas
Ikon Pass	Alterra Mountain Co.	33	15	46
Epic Pass	Vail Resorts, Inc.	18	19	67
Peak Pass	Peak Resorts, Inc.	14	14	14
Power Pass	Mountain Capital Partners	10	6	11
Powder Alliance	partnership of mountains	13	1	19
Freedom Pass	partnership of mountains	19	1	19
Mountain Collective	distributed by Liftopia, Inc.	11	0	17

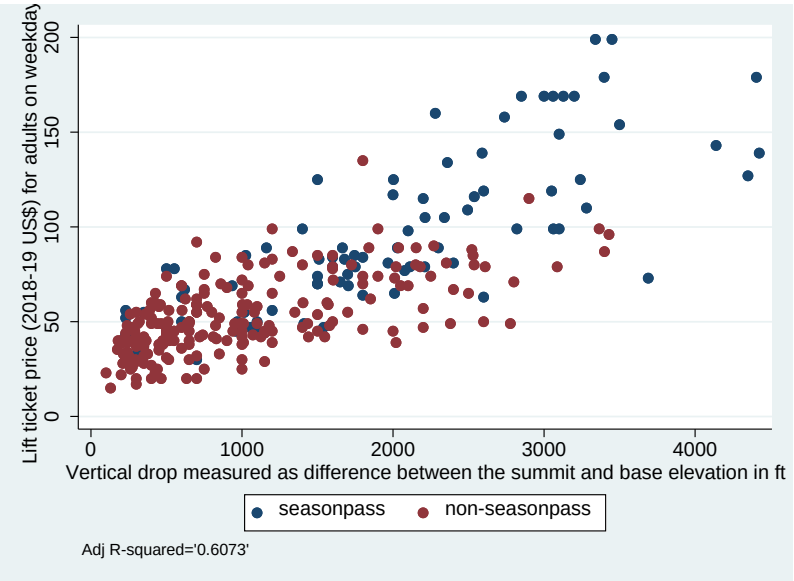
Notes
For more information on Power Pass, see https://www.outsideonline.com/2159326/ski-king-southwest
Powder Alliance is a partnership of ski areas. Pass-holders enjoy unlimited access to one home mountain.
Freedom Pass is a partnership of ski areas. Pass-holders enjoy unlimited access to one home mountain.
Mountain Collective is not a season pass to any resort, thus excluded from my model.
Mountain Collective gives pass-holders 2-day access and discounts to resorts in its network.
Appendix C contains lists of resorts for these season passes.

Ski areas characteristics

To control for market power from being famous or highly ranked, I generated a dummy variable "*famous*" for resorts that are listed in recent articles on highly ranked, most famous, and most popular ski resorts.

A ski area's vertical drop is a proxy of a ski area's experience. In this study, the vertical drop in ft (*verticaldrop*) is calculated as the difference between the summit and base elevation by OnTheSnow. The bigger the vertical drop, the longer one can ski from top to bottom, and the more different kinds of terrain there might be. In my dataset, the mean vertical drop is 1,275.3ft, the minimum is 100ft, and the max is 4,425ft. The skiable acre of each ski area, *terrainsize*, is also a proxy for the potential experience at the ski area. The mean terrain size is 796.55 acres, with a minimum of 8 acres and a maximum of 26,819 acres.

Figure 3.
Ski areas on the supra-region multi-resort season passes tend to have bigger vertical drop.



The altitude of the base (*base*), average snowfall in inches (*snowfall*), and projected numbers of days open this season (*daysopen*) are proxies for the ski area snow quality. The higher the altitude of the base, the more snow the ski area might get. Altitude can also mean better view, another factor skiers and snowboarders value.

The number of gondolas or trams (*gondola*), the total number of chair lifts (*totalchairs*), and percentage of high-speed chair lifts (*percentfast*) are important indicators of the investment, experience, and lines at the ski area. Gondolas and trams are expensive technology, and therefore a good indicator of the development of the ski area. The more express chair a ski area has, the more guests the ski area can have, the faster it is to get to the top. The more chairs a ski area has, the shorter the lines.

The number of terrain parks (*terrainparks*), the acre of snowmaking area (*snowmakesize*), and whether the ski area has night skiing (*nightskiing*) are additional control variables.

There are other data that I collected from OnTheSnow. However, due to multicollinearity concerns, I will not include variables with strong correlations in my model. Interested readers can access my full dataset on Kaggle.

There are other characteristics that skiers and snowboarders consider. For example, activities available after a day on the mountain, the food and bar scene, and the overall atmosphere on the slopes are essential to the overall experience. However, these are hard to quantify and thus left out of my model.

Regional fix effects

To control for regional fixed effects, I collected the information on each ski area's state, then generated binary variables indicating the region of each ski area.

4. Empirical Strategy

The development of season passes

As mentioned in the introduction, supra-regional multi-resort season passes (mega passes) in the US were developed in recent years. The reason for such innovation is a response to the challenges that ski areas face. First, climate change is expected to have significant impacts on snowfall. While the 2018-19 season has seen significant snowfall, snowfalls in the previous years have been low.[14] By offering season pass products and ending the sale before the season starts, ski areas can get steady cash flows regardless of the actual snowfall in the coming season. By owning or partnering ski areas in different parts of the US and the world, ski conglomerates can reduce risk to a specific region's environment.

Second, there is stagnant growth in the number of skier and snowboarder visits to US ski areas.[15] By offering season pass products, ski areas can encourage pass-holders to visit more often because there are no more costs on single day lift tickets. Season pass products also incentivize skiers and snowboarders to visit during non-peak times and avoid peak days, which alleviate crowds on holidays and create a better experience.

The season pass is also another way for ski areas to develop different revenue streams. For example, Vail has developed three segments of business: Mountain, Lodging, and Real Estate. Vail's lift ticket revenue for the year ended July 31, 2018 was only 43.76% of the total revenue.[16] By offering season passes, ski alliances are locking in pass-holders' loyalty before the season starts and encouraging pass-holders to spend on restaurants, hotels, or other services owned by the ski resort. Because season passes eliminate the costs on lift tickets, skiers and snowboarders might

[14] Vanat, Laurent. 2019 International Report on Snow & Mountain Tourism.
[15] National Ski Areas Association, http://www.nsaa.org/media/303945/visits.pdf
[16] Vail Resorts, Inc. 10-K for the fiscal year ended July 31, 2018.

spend more on après-ski activities and other amenities. Moreover, because skiing and snowboarding are social sports, pass-holders might bring their friends and families to season pass ski resorts, creating a network effect.

Under this new dynamic with mega passes, how will ski areas price their single-day lift ticket prices? The smaller and independent ski areas might have to lower their prices in order to compete with ski areas on mega passes. The ski areas on mega passes might raise their prices to nudge people into buying their season pass products.

There are other possible impacts on the single-day lift ticket prices. Ski conglomerates with their mergers and acquisitions might improve their efficiency through the transfer of knowledge and economies of scale, which might lower prices. However, multi-resort season passes act as alliances of ski areas, making the industry less competitive and increasing the market power of ski areas in the network. Moreover, by investing in ski areas, ski alliances are improving the quality of their portfolio mountains, thus able to demand higher prices.

Thus, to test the hypothesis that being a member of a mega pass is related to higher single-day lift ticket prices, we need to control for important factors that influence prices.

Model specifications

Rosen (1974) argues that differentiated goods are valued for their "utility-bearing attributes." The implicit prices of these utility-bearing attributes are called "hedonic prices." In the market, sellers and buyers often compare the prices of differentiated goods with the attributes that they value, and then clear the market under equilibrium prices. Econometrically, we can estimate the hedonic prices by regressing the actual prices of differentiated goods on their observed attributes.

Rosen (1974) describes differentiated products with n observed characteristics. Each product has z amount of the ith characteristics, and this relationship can be expressed as $\mathcal{Z} = (z_1, z_2, \dots, z_n)$. There are many differentiated products in the market, offering different packages of $\mathcal{Z}$. The market clearing price of each differentiated product is a function of $\mathcal{Z}$, consumer tastes, and production costs.

Assuming perfect competition and utility maximizing behavior and ignoring random terms, Rosen (1974) suggests prices of differentiated goods can be modeled as

$$P_i(z) = F^i(z_1, z_2, \dots, z_n, Y_1) \qquad \text{(demand)},$$

$$P_i(z) = G^i(z_1, z_2, \dots, z_n, Y_2) \qquad \text{(supply)},$$

for $i = 1, \dots, n$. Y_1 represents exogenous demand side variables such as income and taste. Y_2 represents exogenous supply side variables such as costs and technologies.

The US ski area industry is a differentiated market with information and lift ticket purchase options widely accessible online. Each ski area has various "utility-bearing" characteristics differentiated through natural geography, capital investments, and operation efficiency. The lift ticket price is essentially the price of using the ski area because it is time-consuming and challenging to hike up the ski area without the help of chair lifts. While there are markets for backcountry, helicopter, snowcat, and other forms of skiing and snowboarding, I will limit my analysis to traditional alpine ski areas.

From surveying ski area literature and interviewing skiers and snowboarders, I find that snow quality, vertical drop and variety of terrain, social scene and après-ski activities, chair lifts quality, crowds and lines, season pass, and total costs are some factors considered by skiers and snowboarders. Considering limited available data, multicollinearity, and potential data error, I will

follow Fonner and Berrens (2014) to use a simple ordinary least squares linear form to estimate lift ticket prices.

My full model can be expressed as follows:

$$P_i = \alpha + \beta(SP_i) + \gamma(SC_i) + \delta(R_i) + \mathcal{u}_i$$

where i represents ski areas, P is the price of single-day lift tickets, SP is a vector of season passes including Ikon Pass, Epic Pass, Peak Pass, Power Pass, Powder Alliance, and Freedom Pass, SC is a vector of ski area characteristics including reputation, vertical drop, base elevation, skiable acres, projected days open, average snowfall, number of gondolas, total number of chair lifts, percentage of high-speed chair lifts, number of terrain parks, acres of snowmaking terrain, and nightskiing. R is a vector of region fixed effects including New England, Mid Atlantic, Southeast, Midwest, the Rocky Mountains, and the West (as the reference category). Lastly, $\mathcal{u}$ is the error term. With the estimate results, I can then estimate the implicit marginal prices for each ski area characteristics:

$$\frac{\partial P_i}{\partial SC_i} = \gamma_i$$

For all of my models, I will use both weekday and weekend adult single-day lift ticket prices. I will first regress single-day lift ticket prices on binary variables of season passes, without controlling characteristics and regions. The first model estimates the information when skiers and snowboarders compare ski areas on and off the season pass. The binary variables on season passes should capture the net price level shift resulting from being on the season pass.

5. Results

Based on the discussion above, ski areas on the supra-regional multi-resort season passes (mega passses) might charge higher adult single-day lift ticket prices depending on the interaction of market power and competition, efficiency and quality improvement, and their goals of making mega pass products more attractive.

The OLS results of my models are presented below in Table 3. Season passes, ski area characteristics and regional fixed effects are subsequently introduced. To make the results easier to interpret, I transformed *verticaldrop*, *base*, *terrainsize*, and *snowmakesize* numbers to be in hundreds. The estimated coefficients describe the dollar amount impacts on lift ticket prices. Statistically significant estimates are indicated with stars.

Overall, the OLS model fit well with an adjusted R-squared of 0.833 for weekday lift tickets in model (3) and 0.826 for weekend lift tickets in model (6). The adjusted R-squared means that my model explains about 83% of the variation in single-day lift ticket prices. I plotted the residuals using kernel density estimate and test normality in residuals. Appendix D shows plots for model (3) and (6), and they approach normality. The mean VIF row reports the variance inflation factors for each model. Usually, a VIF above 10 indicates multicollinearity. Model (1) to (6) show low correlations among the variables. Appendix E shows the correlation matrix for the variables used in my models.

Table 3.
OLS Estimates of lift ticket hedonic prices.
Dependent variable: adult single-day lift ticket prices, weekday and weekend, season 2018-19.

	Weekday Prices			Weekend Prices		
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Season Passes						
ikon	63.5804***	16.5748***	15.4896***	59.0523***	14.8227***	13.1133**
epic	72.6269***	20.6080***	19.9757***	67.3727***	17.6515**	17.5258***
peak	7.1071	4.9752	4.6695	6.2433	2.2240	2.0452
powerpass	16.8225*	4.1371	5.8557	11.1937	2.6114	4.9047
powder	21.3169**	3.8826	2.9164	15.4925*	.2219	-.1166
freedom	-4.36147	-.2172	-1.2809	-3.4565	1.2352	.1038
Characteristics						
famous		4.9026	3.5450		5.0838	3.6813
vdrop100		.5901**	.71293***		.5910**	.6126**
base100		.1144**	.3448***		.0625	.3371***
terrain100		.0118	.0162		-.0006	.0183
daysopen		.0638	.0232		.0744	.0210
snowfall		-.0019	.0073		-.0086	.0111
gondola		4.7496	5.6351*		3.6450	4.8039*
totalchairs		1.1614***	1.2370***		1.2516***	1.4015***
percentfast		.4559***	.4420***		.4458***	.4305***
terrainparks		-.0518	-.2652		-.0185	-.1446
snowmake100		.9051	.6775		1.0025	.7024
nightskiing		-5.2539*	-2.8082		-1.9585	.2796
Regions						
newengland			12.6394*			18.0968***
midatlantic			9.6770*			15.2339***
southeast			3.3155			19.5624***
midwest			8.4324			8.9376
rocky			-9.6933*			-10.8661**
_constant	53.3544***	27.8401***	17.0211*	60.8335***	34.0775***	19.4376*
Observations	302	302	302	302	302	302
R-squared	.5195	.8359	.8458	.5068	.8093	.8396
Adj. R-squared	.5098	.8255	.8330	.4968	.7972	.8263
Mean VIF	1.09	2.03	2.93	1.09	2.03	2.93

legend: * p<0.05; ** p<0.01; *** p<0.001

Season pass price premium becomes smaller after adding control variables

Model (1) and (2) show that including control variables of ski area characteristics in the hedonic pricing model lowers the predicted price premium associated with season passes. Model (1) shows that if we only compare lift ticket prices based on whether a ski area is on a season passes, there are expensive premiums associated with season passes. For example, on average, ski areas on the Ikon Pass charge $63.58 more for a lift ticket than ski areas not on a season pass, other

things being equal. Appendix F shows a more comprehensive comparison of ski areas on different season passes. Model (2) adds measures of ski areas characteristics and the coefficients of season passes drop significantly. For example, the Ikon Pass price premium drops from $63.58 to $16.57, other things being equal. Model (3) adds binary variables to control for regional fixed effects, and the estimated coefficients for season passes are similar to model (2) estimations. This pattern is mirrored in model (4), (5), and (6) for weekend prices. The estimates in Table 3 are consistent with the hypothesis that season passes are increasing their single-day lift ticket prices, but on a smaller scale than we hypothesized.

Ikon and Epic Pass are associated with higher price premiums

Comparing the coefficients of season passes in model (3) and (6), only Ikon and Epic Pass show statistical significance. Peak and Power Pass are associated with price premiums on their lift ticket prices but a much smaller scale. Powder Alliance and Freedom Pass have unclear impacts on their lift ticket prices. A possible explanation is that Ikon and Epic Pass have more member ski areas and other amnesties, thus charging more for their market power and quality. Another possible explanation is that the owners of Ikon and Epic Pass, Alterra Mountain Co. and Vail Resorts Inc., are the leading players in the development of supra-regional multi-resort season passes. Thus, Ikon and Epic Pass are more actively nudging their customers to buy season passes by putting higher price premiums on their single-day lift tickets.

Ski area characteristics and implicit marginal prices

The coefficients of characteristics confirm the hedonic hypothesis that differentiated products such as ski areas are valued for their “utility-bearing” characteristics. Looking at model (3) and (6), characteristics such as vertical drop, base altitude, number of gondolas, the total

number of chair lifts, and percent of high-speed chair lifts are statistically significant. A 100-foot increase in the vertical drop is associate with a marginal implicit price of $0.61 for weekdays and $0.71 for weekends.[17] A 100-foot increase in base altitude is associated with $0.34 for weekdays and weekends. An additional gondolas or trams (*gondola*) is associated with $5.6 higher price for weekdays and $4.8 for weekends. An additional chair lift (*totalchairs*), regardless of technologies, is associated with $1.2 for weekdays and $1.4 for weekends. Lastly, one percent increase in the percentage of high-speed chair lifts is associated with $0.4 increase in weekdays and weekend price. These are consistent with intuition because higher measures of these characteristics usually mean better skiing and snowboarding experiences.

Most characteristics show the expected sign except *snowfall*, *terrainparks*, and *nightskiing*. A one-inch increase in average snowfall in inches (*snowfall*) has negative signs in model (2) and (5) but positive signs in model (3) and (6). The unclear sign and statistical insignificance suggest that while snow quality is vital to skiers and snowboarders, the average snowfall is not a good indicator. The accuracy of the snowfall level is also up for debate. Zinman and Zitzewitz (2016) find that ski areas often report more snowfall than other sources, and the difference is more pronounced on weekends.

In model (2), (3), (5), and (6), *terrainparks* has negative signs, which means that having one more terrain park is associated with a decrease in lift ticket price. This result is surprising because having terrain parks means there is a variety of terrain to perform or practice tricks. One possible explanation is that terrain parks might be associated with the risk of injury. Another possibility is that terrain parks only appeal to a subset of skiers and snowboarders, and ski areas cannot charge a price premium. Similarly, the impact of having night skiing is unclear, with mostly

[17] Consistent with Fonner and Berrens (2014).

negative signs in model (2), (3), and (5). It is possible that night skiing is less appealing than day skiing, and ski areas cannot place a price premium.

Table 4
Marginal implicit prices of statistically significant ski area characteristics.

	Weekday Prices		Weekend Prices		
Variable	(2)	(3)	(5)	(6)	Definition
vdrop100	0.5901**	0.7129***	0.5910**	0.6126**	Additional 100ft vertical drop.
base100	0.1144**	0.3448***	0.0625	0.3371***	Additional 100ft base elevation.
gondola	4.7496	5.6351*	3.6450	4.8039*	One additional tram or gondola.
totalchairs	1.1614***	1.2370***	1.2516***	1.4015***	One additional chair lifts.
percentfast	0.4559***	0.4420***	0.4458***	0.4305***	One percent increase in percentage of high speed chair lifts.

legend: * p<0.05; ** p<0.01; *** p<0.001

Differences between weekday and weekend and regional fixed effects

Model (3) and (6) show that regions become statistically significant on the weekends. The results suggest that ski areas in New England, Mid Atlantic, and South East charge higher lift ticket prices on the weekends than on weekdays. For example, the coefficient of *southeast* is 3.3155 in model (3) and 19.5624 in model (6), which means that ski areas in the South East, on average and other things being equal, charge about $16 more on the weekends.

However, ski areas in the Mid-West, Rocky Mountains, and the West (*_constant*) do not have much price differences between weekdays and weekends. The regional difference can be an indicator of local market competitions.

Robustness check

Appendix C is a list of all ski areas on all mega passes for season 2018-19, and it shows that Powder Alliance and the Freedom Pass has many ski areas that are also in other mega passes. Moreover, Powder Alliance and the Freedom Pass are structured differently from the other passes. Powder Alliance and the Freedom Pass are complementary when one purchases a

single-resort season pass at a ski area that is part of the alliance. Pass-holders enjoy unlimited access to one home ski resort and some access to the other ski areas on the pass. On the other hand, Ikon, Epic, Peak, and Power Pass all offer unlimited access to multiple ski areas. Therefore, including Powder Alliance and the Freedom Pass in my models might be incorrect.

Table 5 presents the OLS estimates of my models excluding Powder Alliance and the Freedom Pass. The results are similar to my models in Table 3. Previously significant variables are still significant in model (2), (3), (5), and (6).

Table 5.
OLS estimates without powder and freedom pass variables show similar results to previous models.

	Weekday Prices			Weekend Prices		
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Season Passes						
ikon	62.8131***	16.1447***	15.2203***	58.5139***	14.7538***	13.1217**
epic	73.1739***	20.6450***	20.0146***	67.7843***	17.6374**	17.5230***
peak	6.4002	4.9502	4.7091	5.7436	2.1635	2.0411
powerpass	18.5150**	4.4369	5.5448	12.2762	3.3064	4.9454
Characteristics						
famous		4.2198	2.9927		5.1188	3.7063
vdrop100		.6034**	.7233***		.5973**	.6123**
base100		.1171**	.3478***		.0617	.3370***
terrain100		.0092	.0147		-.0015	.0183
daysopen		.0675	.0266		.0738	.0208
snowfall		-.0006	.0081		-.0085	.0111
gondola		4.5197	5.4616*		3.6352	4.8113*
totalchairs		1.1902***	1.2608***		1.2479***	1.4004***
percentfast		.4612***	.4478***		.4438***	.4302***
terrainparks		-.0911	-.2998		-.0181	-.1431
snowmake100		.8928	.6664		1.0018	.7028
nightskiing		-4.9591*	-2.5659		-1.9807	.2693
Regions						
newengland			12.4491*			18.1081***
midatlantic			9.5741*			15.2364***
southeast			3.1783			19.5655***
midwest			8.3974			8.9375
rocky			-9.8802**			-10.8590**
_constant	54.0613***	26.8597***	16.2326*	61.3333***	34.2211***	19.4778*
Observations	302	302	302	302	302	302
R-squared	.5020	.8355	.8455	.4960	.8093	.8396
Adj. R-squared	.4953	.8263	.8339	.4892	.7986	.8276

legend: * p<0.05; ** p<0.01; *** p<0.001

6. Conclusion, Limitations, and Further Research

Using a hedonic pricing model on a dataset of 302 US ski areas for the season of 2018-19, I estimate the impact of supra-regional multi-resort season passes on adult single-day lift ticket prices. I find that the ski areas on the leading season passes (Ikon and Epic Pass) charge price premiums for their adult single-day lift tickets. However, the magnitude of the price premiums is much smaller after controlling for ski area characteristics and regional fixed effects. The estimated implicit marginal prices of ski area characteristics are intuitive and mostly show expected signs. The model results also point out differences between weekday and weekend prices as well as regional price differences.

While my research shows that there are price premiums associated with leading season passes, I cannot conclude whether ski areas are doing so to nudge people into buying the season passes. However, the price premiums on single-day lift tickets might mean day-trippers are paying the premium without getting the benefit of a season pass. However, one interesting note is that season passes offer friends and families of their pass holders discounted tickets based on the single-day lift ticket window prices. To make up for the potential loss of revenue, they might charge higher single-day lift ticket prices.

One limitation of my research is that I am only looking at the full priced single-day lift ticket as published on OnTheSnow.com and the ski area website. In reality, many people are able to find discounted tickets on websites such as liftopia.com. The expected price of a single-day lift ticket can be much lower than the full price. Since percentage discounts is an important form of advertisement, ski areas might want to charge a higher full price.

For future research, some more extensive data collection might be needed. OnTheSnow.com has many ski areas, but not all. This research uses a simple OLS regression, but further statistical sophistication might be more insightful. For example, Firgo and Kugler (2018)

use a spatial autocorrelation model to analyze lift ticket prices and find price level shift, price cone effect, and spatial price correlation. By having more detailed location data, future research can get a better sense of the US ski area market structure.

7. Appendices

Appendix A.

Description of the data sources.

Data	Sources
Prices	OnTheSnow.com
	Web sites of individual ski areas.
Mega Passes	Web sites of individual passes.
	https://www.ikonpass.com/en/shop-passes/ikon-pass-2018-2019
	http://news.vailresorts.com/corporate/2018-19lastchanceepicpassvailresorts.htm
	https://www.epicpass.com/info/stowe-faq.aspx
	https://www.peakpass.com/
	Season pass guides.
	https://www.forbes.com/sites/robreed/2018/09/11/epic-versus-ikon-comparing-the-20182019-multi-resort-ski-passes/#5e2ac856714a
	https://www.snowridersinternational.org/news/2018/6/6/multi-mountain-season-passes-available-for-the-20182019-season-other-than-epic-and-ikon
Famous	Recent articles on ski areas.
	https://www.forbes.com/sites/christophersteiner/2018/11/28/the-top-10-ski-resorts-in-north-america-for-2019/#5d0fa73a5ec7
	https://www.snowpak.com/usa/best-ski-resorts
	https://www.zrankings.com/
	https://www.planetware.com/world/top-rated-ski-resorts-in-the-world-us-co-88.htm
	https://snowbrains.com/top-10-most-popular-us-ski-resorts/
	https://www.travelandleisure.com/hotels-resorts/mountain-ski-resorts/best-in-snow-liftopia#magic-mountain-vermont
Other Characteristics	OnTheSnow.com
	Web sites of individual ski areas.
Regions	OnTheSnow.com

Appendix B.

Links to Kaggle and Github.

Kaggle.com	Kaggle is an online platform for data scientists.
	My datasets can be found here:
	https://www.kaggle.com/sijialai/onthesnow
Github.com	Github is a software development platform.
	My web-scrapers can be found here:
	https://github.com/SijiaLai/OnTheSnow

Appendix C.

List of ski areas on supra-regional multi-resort season passes for season 2018-19.

Name of ski resort	Mega Pass	US Ski Area	Unlimited
Steamboat, CO	Ikon Pass	1	1
Winter Park Resort, CO	Ikon Pass	1	1
Copper Mountain Resort, CO	Ikon Pass	1	1
Eldora Mountain Resort, CO	Ikon Pass	1	1
Squaw Valley Alpine Meadows, CA	Ikon Pass	1	1
Mammoth Mountain, CA	Ikon Pass	1	1
June Mountain, CA	Ikon Pass	1	1
Bear Mountain, CA	Ikon Pass	1	1

Snow Summit, CA	Ikon Pass	1	1
Stratton, VT	Ikon Pass	1	1
Snowshoe, WV	Ikon Pass	1	1
Crystal Mountain, WA	Ikon Pass	1	1
Tremblant, Canada, QC	Ikon Pass	0	1
Blue Mountain, ON	Ikon Pass	0	1
Solitude Mountain Resort, UT	Ikon Pass	1	1
Jackson Hole Mountain Resort, WY	Ikon Pass	1	0
Big Sky Resort, MT	Ikon Pass	1	0
Sugarbush Resort, VT	Ikon Pass	1	0
Boyne Highlands, MI	Ikon Pass	1	0
Boyne Mountain, MI	Ikon Pass	1	0
The Summit at Snoqualmie, WA	Ikon Pass	1	0
Revelstoke Mountain Resort, Canada, BC	Ikon Pass	0	0
Cypress, Canada, BC	Ikon Pass	0	0
Sunday River, ME	Ikon Pass	1	0
Sugarloaf, ME	Ikon Pass	1	0
Loon Mountain, NH	Ikon Pass	1	0
Taos, NM	Ikon Pass	1	0
Deer Valley Resort, UT	Ikon Pass	1	0
Brighton, UT	Ikon Pass	1	0
Thredbo, Australia	Ikon Pass	0	0
Niseko United, Japan	Ikon Pass	0	0
Valle Nevado, Chile	Ikon Pass	0	0
Snowmass, CO	Ikon Pass	1	0
Aspen Mountain, CO	Ikon Pass	1	0
Aspen Highlands, CO	Ikon Pass	1	0
Buttermilk, CO	Ikon Pass	1	0
Snowbird. UT	Ikon Pass	1	0
Alta. UT	Ikon Pass	1	0
Killington, VT	Ikon Pass	1	0
Pico, VT	Ikon Pass	1	0
Banff Sunshine, Canada, AB	Ikon Pass	0	0
Lake Louise, Canada, AB	Ikon Pass	0	0
Mt. Norquay, Canada, AB	Ikon Pass	0	0
Mt Hutt, New Zealand	Ikon Pass	0	0
Coronet Peak, New Zealand	Ikon Pass	0	0
The Remarkables, New Zealand	Ikon Pass	0	0
Sum		**33**	**15**
Total			**46**
Vail, CO	Epic Pass	1	1
Beaver Creek, CO	Epic Pass	1	1
Breckenridge, CO	Epic Pass	1	1
Arapahoe Basin, CO	Epic Pass	1	1
Park City, UT	Epic Pass	1	1
Keystone, CO	Epic Pass	1	1
Crested Butte, CO	Epic Pass	1	1
Heavenly, CA	Epic Pass	1	1
Northstar, CA	Epic Pass	1	1
Kirkwood, CA	Epic Pass	1	1
Stevens Pass, WA	Epic Pass	1	1
Wilmot, WI	Epic Pass	1	1
Afton Alps, MN	Epic Pass	1	1

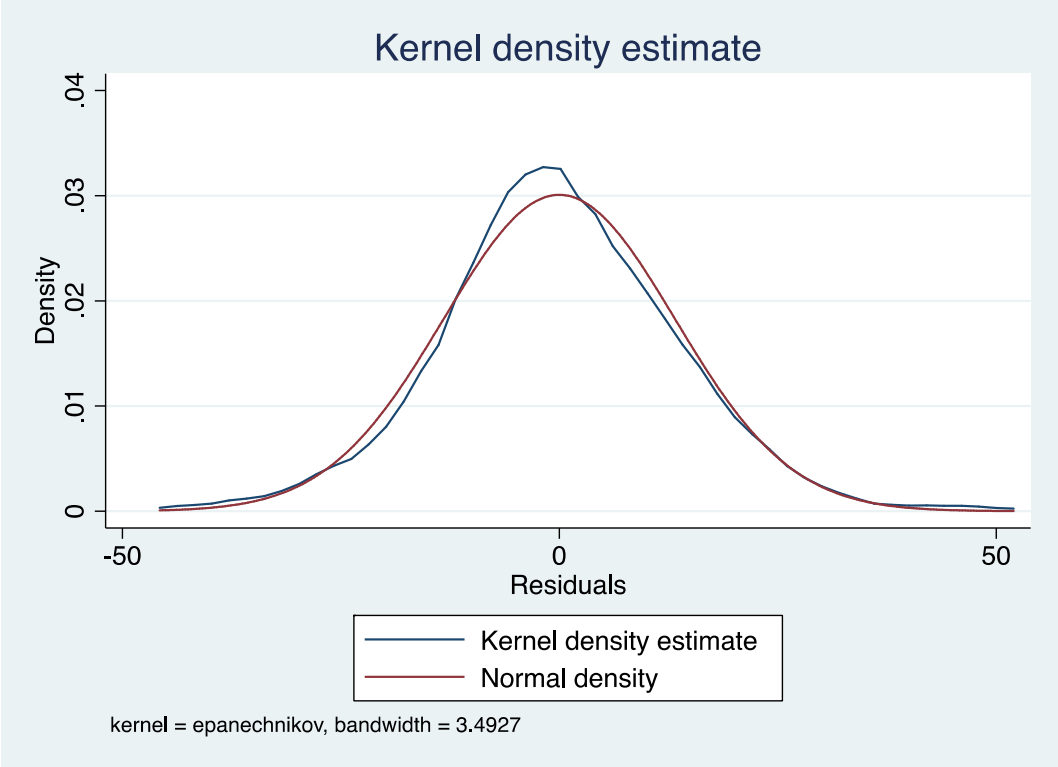
Mt Brighton, MI	Epic Pass	1	1
Stowe, VT	Epic Pass	1	1
Okemo, VT	Epic Pass	1	1
Mount Sunapee, NH	Epic Pass	1	1
Whistler Blackcomb, Canada, BC	Epic Pass	0	1
Telluride, CO	Epic Pass	1	0
Fernie Alpine Resort, Canada, BC	Epic Pass	0	0
Kicking Horse Mountain Resort, Canada, BC	Epic Pass	0	0
Kimberley Alpine Resort, Canada, BC	Epic Pass	0	0
Nakiska Ski Area, Canada, Alberta	Epic Pass	0	0
Mont-Sainte Anne, Canada, Quebec	Epic Pass	0	0
Stoneham, Canada, Quebec	Epic Pass	0	0
Hakuba 47 Winter Sports Park, Japan	Epic Pass	0	0
Hakuba Cortina Snow Resort, Japan	Epic Pass	0	0
Hakuba Goryu Snow Resort, Japan	Epic Pass	0	0
Hakuba Happo-One Snow Resort, Japan	Epic Pass	0	0
Hakuba Iwatake Snow Field, Japan	Epic Pass	0	0
Hakuba Norikura Onsen Snow Resort, Japan	Epic Pass	0	0
Jiigatake Snow Resort, Japan	Epic Pass	0	0
Kashimayari Ski Resort, Japan	Epic Pass	0	0
Tsugaike Kogen Snow Resort, Japan	Epic Pass	0	0
Hakuba Sanosaka Snow Resort, Japan	Epic Pass	0	0
Perisher, Australia	Epic Pass	0	1
Val Thorens, Les 3 Vallees, France	Epic Pass	0	0
Méribel, Les 3 Vallees, France	Epic Pass	0	0
Courchevel, Les 3 Vallees, France	Epic Pass	0	0
Les Menuires, Les 3 Vallees, France	Epic Pass	0	0
Saint Martin de Bellevelle, Les 3 Vallees, France	Epic Pass	0	0
La Tania, Les 3 Vallees, France	Epic Pass	0	0
Orelle, Les 3 Vallees, France	Epic Pass	0	0
Brides-Les-Bains, Les 3 Vallees, France	Epic Pass	0	0
Les Arcs, Paradiski, France	Epic Pass	0	0
La Plagne, Paradiski, France	Epic Pass	0	0
Peisey-Vallandry, Paradiski, France	Epic Pass	0	0
Tignes, France	Epic Pass	0	0
Val D'Isere, France	Epic Pass	0	0
Madonna di Campiglio, Skirama Dolomiti, Italy	Epic Pass	0	0
Pinzolo, Skirama Dolomiti, Italy	Epic Pass	0	0
Folgarida-Marilleva, Skirama Dolomiti, Italy	Epic Pass	0	0
Peio, Skirama Dolomiti, Italy	Epic Pass	0	0
Ponte di Legno-Tonale, Skirama Dolomiti, Italy	Epic Pass	0	0
Andalo-Fai della Paganella, Skirama Dolomiti, Italy	Epic Pass	0	0
Monte Bondone, Skirama Dolomiti, Italy	Epic Pass	0	0
Folgarida-Lavarone. Skirama Dolomiti, Italy	Epic Pass	0	0
Verbier, 4 Vallees, Switzerland	Epic Pass	0	0
La Tzoumaz, 4 Vallees, Switzerland	Epic Pass	0	0
Nendaz, 4 Vallees, Switzerland	Epic Pass	0	0
Veysonnaz, 4 Vallees, Switzerland	Epic Pass	0	0
Thyon, 4 Vallees, Switzerland	Epic Pass	0	0
Lech, Arlberg , Austra	Epic Pass	0	0
Zurs, Arlberg , Austra	Epic Pass	0	0
Stuben, Arlberg , Austra	Epic Pass	0	0
St Christoph, Arlberg , Austra	Epic Pass	0	0

St Anton, Arlberg , Austra	Epic Pass		0	0
Sum			**18**	**19**
Total				**67**
Attitash Mountain, NH	Peak Pass		1	1
Crotched Mountain, NH	Peak Pass		1	1
Wildcat Mountain, NH	Peak Pass		1	1
Hunter, NY	Peak Pass		1	1
Alpine Valley, OH	Peak Pass		1	1
Boston Mills, OH	Peak Pass		1	1
Brandywine, OH	Peak Pass		1	1
Mad River, OH	Peak Pass		1	1
Jack Frost, PA	Peak Pass		1	1
Big Boulder, PA	Peak Pass		1	1
Liberty Mountain, PA	Peak Pass		1	1
Roundtop , PA	Peak Pass		1	1
Whitetail, PA	Peak Pass		1	1
Mount Snow, VT	Peak Pass		1	1
Sum		**0**	**14**	**14**
Total				**14**
Purgatory, CO	Power Pass		1	1
Hesperus, CO	Power Pass		1	1
Arizona Snowbowl, AZ	Power Pass		1	1
Pajarito, NM	Power Pass		1	1
Sipapu, NM	Power Pass		1	1
Nordic Valley, UT	Power Pass		1	1
Copper Mountain, CO	Power Pass		1	0
Kiroro Ski Resort, Japan	Power Pass		0	0
Loveland, CO	Power Pass		1	0
Monarch, CO	Power Pass		1	0
Powderhorn, CO	Power Pass		1	0
Sum		**0**	**10**	**6**
Total				**11**
Angel Fire, NM	Powder Alliance		1	NA
Bogus Basin, ID	Powder Alliance		1	NA
Bridger Bowl, UT	Powder Alliance		1	NA
China Peak, CA	Powder Alliance		1	NA
Castle Mountain Resort, Canada, AB	Powder Alliance		0	NA
Loveland, CO	Powder Alliance		1	NA
Kiroro, Japan	Powder Alliance		0	NA
La Parva, Chile	Powder Alliance		0	NA
Mountain High, CA	Powder Alliance		1	NA
Ski Marmot Basin, Canada, AB	Powder Alliance		0	NA
Monarch Mountain, CO	Powder Alliance		1	NA
Sierra-at-Tahoe. CA	Powder Alliance		1	NA
Mt. Hood Skibowl, OR	Powder Alliance		1	NA
Schweitzer, ID	Powder Alliance		1	NA
Sugar Bowl Resort, CA	Powder Alliance		1	NA
SilverStar, Canada, BC	Powder Alliance		0	NA
Stevens Pass, WA	Powder Alliance		1	NA
Whitewater, Canada, BC	Powder Alliance		0	NA
Timberline, OR	Powder Alliance		1	NA
Sum			**13**	**NA**
Total				**19**

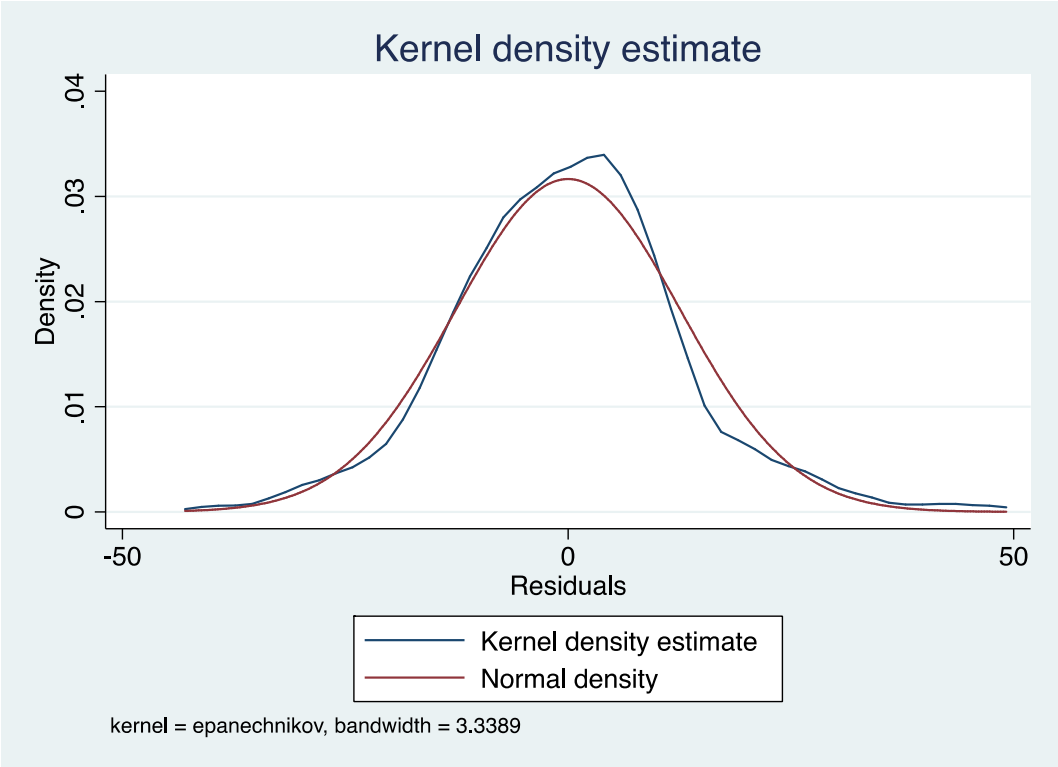
Lost Valley, ME	Freedom Pass		1	NA
Black Mountain, NH	Freedom Pass		1	NA
Dartmouth Skiway, NH	Freedom Pass		1	NA
Whaleback, NH	Freedom Pass		1	NA
McIntyre, NH	Freedom Pass		1	NA
Bolton, VT	Freedom Pass		1	NA
Magic, VT	Freedom Pass		1	NA
Plattekill, NY	Freedom Pass		1	NA
Yawgoo, RI	Freedom Pass		1	NA
Buck Hill, MN	Freedom Pass		1	NA
Ski Cooper, CO	Freedom Pass		1	NA
Sunlight, CO	Freedom Pass		1	NA
Ski Hesperus, CO	Freedom Pass		1	NA
Purgatory, CO	Freedom Pass		1	NA
Nordic Valley, UT	Freedom Pass		1	NA
Pajarito, NM	Freedom Pass		1	NA
Sipapu, NM	Freedom Pass		1	NA
Arizona Snowbowl, AZ	Freedom Pass		1	NA
Eaglecrest, AK	Freedom Pass		1	NA
Sum			**19**	**NA**
Total				**19**
Alta, UT	Mountain Collective		1	NA
Aspen Snowmass Mountains, CO	Mountain Collective		1	NA
Banff Sunshine, Canada, AB	Mountain Collective		0	NA
Big Sky, MT	Mountain Collective		1	NA
Coronet Peak and The Remarkables, New Zealand	Mountain Collective		0	NA
Jackson Hole, WY	Mountain Collective		1	NA
Lake Louise, Canada, AB	Mountain Collective		0	NA
Mammoth Mountains, CA	Mountain Collective		1	NA
Revelstoke, Canada, BC	Mountain Collective		0	NA
Snowbasin, UT	Mountain Collective		1	NA
Snowbird, UT	Mountain Collective		1	NA
Squaw Valley Alpine Meadows, CA	Mountain Collective		1	NA
Sugarbush VT	Mountain Collective		1	NA
Sun Valley, ID	Mountain Collective		1	NA
Taos, NM	Mountain Collective		1	NA
Thredbo Alpine Village, Australia	Mountain Collective		0	NA
Niseko United, Japan	Mountain Collective		0	NA
Sum		**0**	**11**	**NA**
Count				**17**

Appendix D.

Using kernel density plots to check normality of residuals of model (3).



Using kernel density plots to check normality of residuals in model (6).



Appendix E.

Pairwise correlation coefficients for data used in model (3) and (6).

	ikon	epic	peak	powerp~s	powder	freedom	famous	vdrop100	base100	terr~100	daysopen	snowfall	gondola	totalc~s	percen~t	terrai~s	snow~100	nights~g	neweng~d	midatl~c	southe~t	midwest	rocky	west
ikon	1.00																							
epic	-0.08	1.00																						
peak	-0.07	-0.05	1.00																					
powerp~s	0.01	-0.04	-0.04	1.00																				
powder	-0.07	0.02	-0.04	0.15	1.00																			
freedom	-0.08	-0.06	-0.05	0.39	-0.05	1.00																		
famous	0.35	0.41	-0.03	-0.06	-0.08	-0.04	1.00																	
vdrop100	0.41	0.28	-0.08	0.08	0.17	0.00	0.58	1.00																
base100	0.19	0.15	-0.16	0.30	0.22	0.07	0.32	0.59	1.00															
terr~100	0.19	0.18	-0.07	0.03	0.08	-0.05	0.35	0.53	0.40	1.00														
daysopen	0.31	0.21	-0.03	0.08	0.22	-0.09	0.38	0.59	0.38	0.36	1.00													
snowfall	0.29	0.12	-0.16	0.11	0.25	0.01	0.44	0.67	0.64	0.44	0.54	1.00												
gondola	0.36	0.38	-0.07	-0.02	-0.04	-0.08	0.50	0.59	0.23	0.35	0.37	0.30	1.00											
totalc~s	0.43	0.44	0.03	0.01	0.05	-0.12	0.49	0.54	0.20	0.35	0.43	0.25	0.66	1.00										
percen~t	0.43	0.28	-0.03	0.00	0.13	-0.12	0.48	0.70	0.32	0.32	0.55	0.47	0.58	0.53	1.00									
terrai~s	0.33	0.18	0.04	0.08	0.03	-0.06	0.17	0.34	0.10	0.14	0.33	0.12	0.33	0.59	0.38	1.00								
snow~100	0.26	0.42	0.00	-0.01	-0.03	-0.07	0.42	0.43	0.16	0.25	0.33	0.18	0.56	0.60	0.45	0.38	1.00							
nights~g	-0.18	-0.13	0.02	-0.16	-0.01	-0.09	-0.27	-0.50	-0.51	-0.24	-0.31	-0.47	-0.28	-0.18	-0.28	-0.04	-0.22	1.00						
neweng~d	0.07	0.00	0.08	-0.08	-0.10	0.13	0.03	0.03	-0.35	-0.12	0.06	-0.16	0.00	-0.04	0.03	0.03	0.05	-0.08	1.00					
midatl~c	-0.14	-0.11	0.12	-0.08	-0.09	-0.07	-0.16	-0.20	-0.33	-0.15	-0.19	-0.29	-0.08	-0.09	-0.15	-0.04	-0.06	0.23	-0.20	1.00				
southe~t	-0.01	-0.05	-0.04	-0.04	-0.04	-0.05	-0.07	-0.10	0.00	-0.08	-0.09	-0.16	-0.07	-0.08	-0.06	-0.08	-0.06	0.14	-0.09	-0.09	1.00			
midwest	-0.12	-0.03	0.04	-0.09	-0.11	-0.09	-0.17	-0.50	-0.42	-0.19	-0.26	-0.40	-0.16	-0.07	-0.24	-0.06	-0.11	0.31	-0.24	-0.24	-0.11	1.00		
rocky	0.14	0.09	-0.12	0.31	0.11	0.11	0.27	0.51	0.75	0.35	0.19	0.46	0.22	0.13	0.24	0.01	0.06	-0.37	-0.26	-0.25	-0.12	-0.30	1.00	
west	0.05	0.05	-0.09	-0.08	0.22	-0.06	0.04	0.19	0.30	0.12	0.25	0.45	0.05	0.09	0.14	0.11	0.10	-0.14	-0.20	-0.19	-0.09	-0.23	-0.24	1.00

Appendix F.
Summary statistics for ski areas on each mega passes and not on mega passes in my dataset,

	Ski areas on the Ikon Pass.				
Variable	Obs	Mean	Std. Dev.	Min	Max
adultweekday	28	$117.54	$31.63	$70.00	$179.00
adultweekend	28	$120.29	$29.77	$78.00	$179.00
verticaldrop	28	2,505.46	999.07	500	4,406
base	28	5,325.50	3,292.69	620	9,712
gondola	28	0.86	1.04	0	3
totalchairs	28	16.96	9.89	6	42
percentfast	28	33.5%	16.2%	8.3%	66.7%

	Ski areas on the Epic Pass.				
Variable	Obs	Mean	Std. Dev.	Min	Max
adultweekday	17	$127.24	$49.54	$52.00	$199.00
adultweekend	17	$129.12	$47.04	$59.00	$199.00
verticaldrop	17	2,380.18	1,247.06	230	4,425
base	17	5,461.94	3,463.59	800	9,600
gondola	17	1.12	1.22	0	4
totalchairs	17	19.88	9.23	10	41
percentfast	17	30.4%	19.7%	0.0%	64.5%

	Ski areas on the Peak Pass.				
Variable Obs	Obs	Mean	Std. Dev.	Min	Max
adultweekday	13	$60.46	$15.31	$39.00	$79.00
adultweekend	13	$67.08	$17.89	$43.00	$89.00
verticaldrop	13	920.54	660.68	230	2,112
base	13	1,109.00	487.27	570	1,950
gondola	13	0.00	0.00	0	0
totalchairs	13	9.69	4.48	5	20
percentfast	13	9.1%	10.5%	0.0%	23.1%

	Ski areas on the Power Pass.				
Variable	Obs	Mean	Std. Dev.	Min	Max
adultweekday	9	$79.56	$34.79	$45.00	$158.00
adultweekend	9	$80.11	$34.20	$47.00	$158.00
verticaldrop	9	1,723.78	626.53	960	2,738
base	9	8,907.33	1,616.76	5,440	10,800
gondola	9	0.11	0.33	0	1
totalchairs	9	9.11	6.11	4	24
percentfast	9	10.7%	11.7%	0.0%	29.2%

	Ski areas in the Powder Alliance.				
Variable	Obs	Mean	Std. Dev.	Min	Max
adultweekday	13	$82.85	$16.76	$63.00	$125.00
adultweekend	13	$83.23	$17.36	$63.00	$125.00
verticaldrop	13	2,017.69	646.29	1,162	3,690
base	13	6,684.92	2,288.11	3,600	10,800
gondola	13	0.08	0.28	0	1
totalchairs	13	10.23	2.28	7	14
percentfast	13	21.3%	20.0%	0.0%	62.5%

	Ski areas on the Freedom Pass.				
Variable	Obs	Mean	Std. Dev.	Min	Max
adultweekday	16	$54.25	$18.47	$29.00	$89.00
adultweekend	16	$60.88	$14.78	$45.00	$89.00
verticaldrop	16	1,257.88	584.29	240	2,300
base	16	4,371.44	3,853.70	255	10,500
gondola	16	0.00	0.00	0	0
totalchairs	16	5.50	2.28	3	12
percentfast	16	2.3%	6.8%	0.0%	25.0%

	Ski areas not on a supra-regional multi-resort season pass.				
Variable	Obs	Mean	Std. Dev.	Min	Max
adultweekday	215	$53.06	$20.06	$15.00	$135.00
adultweekend	215	$60.56	$18.79	$20.00	$135.00
verticaldrop	215	1,006.40	743.38	100	3,430
base	215	2,963.03	2,862.32	78	10,780
gondola	215	0.07	0.30	0	3
totalchairs	215	6.82	3.17	1	18
percentfast	215	6.9%	13.3%	0.0%	72.7%

Appendix G.

List of ski areas used in this study.

Ski area name	State
Alyeska Resort	AK
Eaglecrest Ski Area	AK
Hilltop Ski Area	AK
Arizona Snowbowl	AZ
Sunrise Park Resort	AZ
Yosemite Ski & Snowboard Area	CA
Bear Mountain	CA
Bear Valley	CA
Boreal Mountain Resort	CA
Dodge Ridge	CA
Donner Ski Ranch	CA
Heavenly Mountain Resort	CA
June Mountain	CA
Kirkwood	CA
Mammoth Mountain Ski Area	CA
Mt. Shasta Ski Park	CA
Mountain High	CA
Mt. Baldy	CA
Northstar California	CA
Sierra-at-Tahoe	CA
Ski China Peak	CA
Snow Summit	CA
Snow Valley	CA
Soda Springs	CA
Squaw Valley - Alpine Meadows	CA
Sugar Bowl Resort	CA
Tahoe Donner	CA
Arapahoe Basin Ski Area	CO
Aspen / Snowmass	CO
Beaver Creek	CO
Breckenridge	CO
Copper Mountain Resort	CO
Crested Butte Mountain Resort	CO
Purgatory	CO
Eldora Mountain Resort	CO
Howelsen Hill	CO
Keystone	CO
Loveland	CO
Monarch Mountain	CO
Powderhorn	CO
Silverton Mountain	CO
Cooper	CO
Ski Granby Ranch	CO
Sunlight Mountain Resort	CO
Telluride	CO
Vail	CO
Winter Park Resort	CO
Wolf Creek Ski Area	CO
Mohawk Mountain	CT
Mount Southington Ski Area	CT
Powder Ridge Park	CT
Ski Sundown	CT
Woodbury Ski Area	CT

Bogus Basin	ID
Brundage Mountain Resort	ID
Kelly Canyon Ski Area	ID
Lookout Pass Ski Area	ID
Magic Mountain Ski Area	ID
Pebble Creek Ski Area	ID
Pomerelle Mountain Resort	ID
Schweitzer	ID
Silver Mountain	ID
Sun Valley	ID
Tamarack Resort	ID
Chestnut Mountain Resort	IL
Four Lakes	IL
Ski Snowstar Winter Sports Park	IL
Villa Olivia	IL
Paoli Peaks	IN
Perfect North Slopes	IN
Mt. Crescent Ski Area	IA
Seven Oaks	IA
Sundown Mountain	IA
Camden Snow Bowl	ME
Lost Valley	ME
Mt. Abram Ski Resort	ME
New Hermon Mountain	ME
Shawnee Peak	ME
Sugarloaf	ME
Sunday River	ME
Wisp	MD
Berkshire East	MA
Blandford Ski Area	MA
Bousquet Ski Area	MA
Jiminy Peak	MA
Nashoba Valley	MA
Otis Ridge Ski Area	MA
Ski Butternut	MA
Ski Ward	MA
Wachusett Mountain Ski Area	MA
Alpine Valley Ski Area	MI
Big Powderhorn Mountain	MI
Bittersweet Ski Area	MI
Big Snow Resort - Blackjack	MI
Boyne Highlands	MI
Boyne Mountain Resort	MI
Caberfae Peaks	MI
Cannonsburg	MI
Crystal Mountain	MI
Big Snow Resort - Indianhead Mountain	MI
Marquette Mountain	MI
Mont Ripley	MI
Mount Bohemia	MI
Mt. Brighton	MI
Mt. Holiday Ski Area	MI
Mount Holly	MI
Mulligan's Hollow Ski Bowl	MI
Norway Mountain	MI
Nubs Nob Ski Area	MI
Schuss Mountain at Shanty Creek	MI
Ski Brule	MI
Swiss Valley	MI
The Homestead	MI
Afton Alps	MN
Andes Tower Hills Ski Area	MN
Buck Hill	MN
Buena Vista Ski Area	MN
Coffee Mill Ski & Snowboard Resort	MN
Giants Ridge Resort	MN
Hyland Ski & Snowboard Area	MN
Lutsen Mountains	MN
Mount Kato Ski Area	MN
Spirit Mountain	MN
Welch Village	MN
Wild Mountain Ski & Snowboard Area	MN
Hidden Valley Ski Area	MO
Snow Creek	MO
Big Sky Resort	MT
Blacktail Mountain Ski Area	MT
Bridger Bowl	MT
Discovery Ski Area	MT
Great Divide	MT
Lost Trail - Powder Mtn	MT
Maverick Mountain	MT
Montana Snowbowl	MT
Red Lodge Mountain	MT
Showdown Montana	MT
Teton Pass Ski Resort	MT
Whitefish Mountain Resort	MT
Diamond Peak	NV
Elko SnoBowl	NV
Lee Canyon	NV
Mt. Rose - Ski Tahoe	NV
Attitash	NH
Black Mountain	NH
Bretton Woods	NH
Cannon Mountain	NH
Cranmore Mountain Resort	NH
Crotched Mountain	NH
Dartmouth Skiway	NH
Gunstock	NH
King Pine	NH
Loon Mountain	NH
Mount Sunapee	NH
Pats Peak	NH
Ragged Mountain Resort	NH
Waterville Valley	NH
Whaleback Mountain	NH
Wildcat Mountain	NH
Campgaw Mountain	NJ
Mountain Creek Resort	NJ

Angel Fire Resort	NM
Pajarito Mountain Ski Area	NM
Red River	NM
Sandia Peak	NM
Sipapu Ski Resort	NM
Ski Apache	NM
Ski Santa Fe	NM
Taos Ski Valley	NM
Belleayre	NY
Brantling Ski Slopes	NY
Bristol Mountain	NY
Catamount	NY
Dry Hill Ski Area	NY
Gore Mountain	NY
Greek Peak	NY
Holiday Mountain	NY
Holiday Valley	NY
Holimont Ski Area	NY
Hunt Hollow Ski Club	NY
Hunter Mountain	NY
Kissing Bridge	NY
Labrador Mt.	NY
McCauley Mountain Ski Center	NY
Mount Peter Ski Area	NY
Oak Mountain	NY
Peek'n Peak	NY
Plattekill Mountain	NY
Royal Mountain Ski Area	NY
Snow Ridge	NY
Song Mountain	NY
Swain	NY
Titus Mountain	NY
Toggenburg Mountain	NY
West Mountain	NY
Whiteface Mountain Resort	NY
Willard Mountain	NY
Windham Mountain	NY
Woods Valley Ski Area	NY
Appalachian Ski Mountain	NC
Cataloochee Ski Area	NC
Sapphire Valley	NC
Beech Mountain Resort	NC
Sugar Mountain Resort	NC
Wolf Ridge Ski Resort	NC
Alpine Valley	OH
Boston Mills	OH
Brandywine	OH
Mad River Mountain	OH
Snow Trails	OH
Anthony Lakes Mountain Resort	OR
Cooper Spur	OR
Hoodoo Ski Area	OR
Mt. Ashland	OR
Mt. Bachelor	OR
Mt. Hood Meadows	OR
Mt. Hood Skibowl	OR
Timberline Lodge	OR
Willamette Pass	OR
Bear Creek Mountain Resort	PA
Ski Big Bear	PA
Blue Knob	PA
Blue Mountain Resort	PA
Camelback Mountain Resort	PA
Elk Mountain Ski Resort	PA
Jack Frost	PA
Liberty	PA
Mount Pleasant of Edinboro	PA
Roundtop Mountain Resort	PA
Seven Springs	PA
Shawnee Mountain Ski Area	PA
Ski Sawmill	PA
Montage Mountain	PA
Spring Mountain Ski Area	PA
Tussey Mountain	PA
Whitetail Resort	PA
Deer Mountain Ski Resort	SD
Terry Peak Ski Area	SD
Alta Ski Area	UT
Beaver Mountain	UT
Brian Head Resort	UT
Brighton Resort	UT
Deer Valley Resort	UT
Eagle Point	UT
Park City	UT
Powder Mountain	UT
Snowbasin	UT
Snowbird	UT
Solitude Mountain Resort	UT
Sundance	UT
Nordic Valley Resort	UT
Bolton Valley	VT
Bromley Mountain	VT
Burke Mountain	VT
Jay Peak	VT
Killington Resort	VT
Mad River Glen	VT
Magic Mountain	VT
Mount Snow	VT
Okemo Mountain Resort	VT
Pico Mountain	VT
Smugglers' Notch Resort	VT
Stowe Mountain Resort	VT
Stratton Mountain	VT
Sugarbush	VT
Suicide Six	VT
Bryce Resort	VA
Wintergreen Resort	VA
49 Degrees North	WA

Bluewood	WA
Crystal Mountain	WA
Mission Ridge	WA
Mt. Baker	WA
Mt. Spokane Ski and Snowboard Park	WA
Stevens Pass Resort	WA
The Summit at Snoqualmie	WA
White Pass	WA
Canaan Valley Resort	WV
Snowshoe Mountain Resort	WV
Timberline Four Seasons	WV
Winterplace Ski Resort	WV
Alpine Valley Resort	WI
Bruce Mound	WI
Cascade Mountain	WI
Christie Mountain	WI
Devils Head	WI
Grand Geneva	WI
Granite Peak Ski Area	WI
Mount La Crosse	WI
Nordic Mountain	WI
Sunburst	WI
Trollhaugen	WI
Tyrol Basin	WI
Whitecap Mountain	WI
Wilmot Mountain	WI
Grand Targhee Resort	WY
Hogadon Basin	WY
Jackson Hole	WY
Sleeping Giant Ski Resort	WY
Snow King Resort	WY
Snowy Range Ski & Recreation Area	WY
White Pine Ski Area	WY

8. References

Alessandrini, S. (2013). Quality of ski resorts and competition between the emilian apennines and altipiani trentini: An estimate of the hedonic price. *Review of Economic Analysis, 5*(1), 42-69. doi://www.rofea.org/index.php?journal=journal&page=issue&op=archive

Falk, M. (2009). Are multi-resort ski conglomerates more efficient? *Managerial and Decision Economics, 30*(8), 529-538. doi://onlinelibrary.wiley.com/journal/10.1002/%28ISSN%291099-1468/issues

Falk, M. (2011). International price differences in ski lift tickets. *Schweizerische Zeitschrift Fur Volkswirtschaft Und Statistik/Swiss Journal of Economics and Statistics, 147*(3), 303-336. doi://www.sjes.ch/published.php

Falk, M. (2015). The demand for winter sports: Empirical evidence for the largest french ski-lift operator. *Tourism Economics, 21*(3), 561-580. doi://www.ingentaconnect.com/content/ip/tec

Firgo, M., & Kugler, A. (2018). Cooperative pricing in spatially differentiated markets. *Regional Science and Urban Economics, 73*, 51-67. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=ecn&AN=1749194&site=ehost-live&scope=site http://dx.doi.org/10.1016/j.regsciurbeco.2018.07.008

Fonner, R. C., & Berrens, R. P. (2014). A hedonic pricing model of lift tickets for US alpine ski areas: Examining the influence of crowding. *Tourism Economics, 20*(6), 1215-1233. doi://www.ingentaconnect.com/content/ip/tec

Mander, B. (2019, Mar 13,). Actually, the mega season pass is killing skiing. *Outside Magazine*, Retrieved from https://www.outsideonline.com/2389964/ski-pass-epic-ikon

Megroz, G. (2018). On slippery slopes. *Bloomberg Businessweek*, (4588), 66. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=buh&AN=132295407&site=ehost-live&scope=site

Mulligan, J. G. (2011). Market size, service quality and competition in the US downhill ski industry. *Applied Economics Letters, 18*(13-15), 1497-1500. doi://www.tandfonline.com/loi/rael20

Multi-mountain season passes available for the 2018/2019 season (other than epic and ikon). (2018). Retrieved from https://www.snowridersinternational.org/news/2018/6/6/multi-mountain-season-passes-available-for-the-20182019-season-other-than-epic-and-ikon

O'Neil, D. (2017, Feb 24,). The ski king of the southwest. *Outside Magazine*, Retrieved from https://www.outsideonline.com/2159326/ski-king-southwest

Peruzzi, M. (2018, Nov 26,). The giant resort companies you hate are saving skiing. *Outside Magazine,* Retrieved from https://www.outsideonline.com/2367016/keep-skiing-weird

Rosen, S. (1974). Hedonic prices and implicit markets: Product differentiation in pure competition. *Journal of Political Economy, 82*(1), 34-55. doi://www.journals.uchicago.edu/loi/jpe

Stock, K. (2019). One pass to ski them all. *Bloomberg Businessweek,* (4605), 56-61. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=buh&AN=134982589&site=ehost-live&scope=site

Vail Resorts, I.*Vail resorts, inc. 10-K for the fiscal year ended july 31, 2018*

Vanat, L. (2019). *2019 international report on snow & mountain tourism.* (). Retrieved from https://www.vanat.ch/RM-world-report-2019.pdf

Zinman, J., & Zitzewitz, E. (2016). Wintertime for deceptive advertising? *American Economic Journal: Applied Economics, 8*(1), 177-192. doi://www.aeaweb.org/aej-applied/