A REGIONAL ANALYSIS OF THE MARGINAL BENEFIT OF SKI RESORT VISITATION

A THESIS

Presented to

The Faculty of the Department of Economics and Business

The Colorado College

In Partial Fulfillment of the Requirements for the Degree

Bachelor of Arts

By

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March 2020

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Abstract

Many of the mountain towns of Colorado have undergone a shift from a mining and resource-based economies to those of winter sports and tourism. With declined populations in many counties and many towns fearful of large ski resorts, this thesis aims to determine the impact of ski resorts at both the local level and county level for mountain towns. Due to the many different types of resorts, a second goal is to differentiate the impact of one additional visitor in one county versus another. Using a panel study regression, this thesis shows the marginal value of each visitor controlling for factors such as resort quality and local airports. It also shows that the average visitor in certain counties could be worth twice as much as the average in a different county.

KEYWORDS: (Ski Industry, Retail Sales, Tourism, Economic Growth)
JEL CODES: (Z23, L83, O40)

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ACKNOWLEDGEMENTS

First, I would like to thank my thesis advisor, Mark Smith, for his continued guidance and aid completing this study. I also would like to thank both of my parents for the endless dedication and phone calls needed to complete this thesis. I would also like to thank Mia Alvarado for her invaluable support and keeping this paper moving in the right direction

For time spent helping with data collection, learning about the ski industry, and GIS work dedicated toward this study, I would like to thank Patrick Harton, Clayton Shoemaker, and Matt Cooney.

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1. Introduction

As a region built on mining resources long depleted, the mountain towns and communities of Colorado rely on economies vastly different from those they were founded on. Many of today's resort towns and tourist hubs were settled in the late 19th century, by miners and those willing to supply the goods necessary for those miners to survive. As the last mines started to close from the 1960s to the 1990s, the economies started to transition toward tourism, especially around skiing and other recreational activities. (Brown, 2018)

Since the mining boom, twelve counties within Colorado have lost more than half of their peak population[1]. This problem is not only limited to small mining towns and outposts either, three county seats have also lost over half of their population.[2] (Brown, 2018) Now, Colorado is now home to many ski resorts, which have altered local economies by bringing new residents, as well as a new stream of tourists. (Colorado OEDIT, 2019) These resorts range from small mountains, populated mostly by day-trippers from major cities such as Denver, to large resorts with sprawling mountain towns growing around them.

However, many of these counties are unsure of the best steps in to drive economic growth without losing their identity. (Brown, 2018) Many local governments are working with residents to decide the best ways to inspire growth in their communities. (Brown, 2018) However counties can also create the risk of growth to the detriment of local populations, either through increasing costs of living or second-home ghost towns. In Pitkin county, home to Aspen, the average home price is above $1.5 million, far out of reach for the people who support that economy. (Trembath, 2015)

[1] The twelve counties, in order of percent decrease are: San Juan, Lake, Baca, Las Animas, Kiowa, Mineral, Huerfano, Sedgwick, Washington, Costilla, Hinsdale, and Cheyenne Counties.(Brown, 2018)
[2] The three county seats are Lake City, Silverton, and Creede (of Hinsdale, San Juan and Mineral counties, respectively) (Brown, 2018)

Just as the quality of the natural resources affected the miners and ranchers in Colorado, so too does it affect tourist hubs. “Natural environment is very important in determining the attractiveness of a region for tourism.” (Scott, 2003) When assessing the potential benefits of a recreational tourism attraction or ski resort, the quality of the mountain, the snow, or infrastructure has an effect on how much tourists are willing to pay. (Fonner & Berrens, 2014).

Another concern is the resiliency of mountain towns, either due to lack of snowfall or recession. Studies have shown the difference in job creation between good snow years and bad snow years. (Hagenstad, 2018) Looking at the impact on the ski industry in down years, one study showed that recessions impact European skier participation based on wealth and phase-of-life, during the European debt crisis. (Taks & Ragoen, 2016) This would imply that communities which attract differing skier demographics, will be able to weather a recession more successfully.

In order to determine the differing economic impact of ski resorts across different regions of Colorado, the main question of this study is how does the impact of one additional participant change across different regions? Also, in support of the main question, I would like to explore potential explanations for differences across regions. Given that physical attributes, such as snowfall or vertical drop, have been shown to increase lift ticket prices and consumer demand, are certain features of ski resorts culpable for the regional differences? (Hagenstad, 2018; Fonner & Berrens, 2014), Other factors I want to explore, is assessing whether distance from a major airport is to blame. Another component of the main question is to focus on the sphere of impact of a ski resort, and the degree a ski resort affects local communities versus the surrounding county as a whole.

By measuring the per annual visitor impact of ski resorts within different regions, this thesis has applications to uncover the differences between thriving and struggling mountain communities. This is valuable to those areas who are trying to evaluate the

potential impacts of ski resort development on their specific community and to determine what is most beneficial for the community as a whole. This study should also be beneficial on the producer side, showing what initiatives drive local economies and which are not as successful. Hopefully this will lead to a more robust framework, moving forward, to assess the economic impact of winter tourism on mountain communities.

In order to answer this question, I would first like to create an econometric model to determine the effect of ski resort annual visitation on the retail sales figures at both the nearest city and surrounding county level. By running two separate regressions I will be able to differentiate the localized impact versus the impact on the surrounding area. These regressions will control for ski resort characteristics that increase value to consumers, previously identified within Fonner and Berrens (2014), as well as the presence of an airport. Secondly, a simpler model will be used to evaluate, at the individual county level the differences between all of the different skiing regions of Colorado.

In order to conduct the model, there are two main categories of data that must be collected: ski resort data and economic data. Within ski resort data is skier participation, which will come from mostly United States Forest Service (USFS) proposals, as well as ski resort acreage and vertical drop which is widely available due to most ski resorts being located on National Forest land. Other qualitative data will include the presence of a municipal or local ski area within the areas being studied, as well as airport data which is widely available from the Federal Aviation Administration (FAA).

Economic data will primarily include county and city retail sales, which are available from the Colorado department of Revenue, stretching back 20 years to 1999.

I expect to show a clear relationship between ski resort visitors and retail sales growth, however I expect this relationship to be stronger at the more local level. I would also like to see counties known for destination resorts or a high number of out-of-state skiers, to be impacted more per participant, this includes wealthy counties such as Pitkin, where an individual will likely spend more per day. I expect to see previous research

conclusions echoed, such as a beneficial impact of an airport to the county, as well as boosting the per participant impact.

This thesis will provide a comprehensive overview of the previous literature relating to winter tourism affecting mountain town development, as well as provide necessary context about the ski industry and the state economy of Colorado. Within the analysis section, the study will examine the steps needed to answer the question, overview the data collection that took place, outline the econometric models used, and finally describe the results of those models. Finally, there will be an acknowledgment of the potential limitations of this study and a discussion of future research.

2. Literature Review

To measure the differing marginal impact of a ski area across different regions, we first must look at the previous literature on winter tourism and consumers. One of the largest ski industry analyses is released by Protect Our Winters (POW), a nonprofit group centered on climate change and protecting the ski industry. In their 2018 report, we can see that employment driven by the ski industry varies year to year depending on the quality of the snowfall, as shown in Table 1. (Hagenstad, 2018) This table is important as it establishes that the qualitative skiing condition year-to-year is linked with substantial economic impact, through both skier visits and jobs creation. Looking at Colorado in particular, traffic increased 2% in the top 5 snow years but decreased by twice that in the worst 5 years; this trend was mirrored in number of people employed as well. However, Colorado was one of the more resilient regions; the table shows how different states are impacted to different degrees, which could either be due to higher snowfall consistency

Table 1. State-level average skier visits (2001-2016), percentage change in skier visits and associated change in economic contributions during the five highest and lowest snow years

State	Average Skier Visits 2001-2016	Average % change in skier visits in top five snow years	Average difference in jobs in top five snow years	Average difference in labor income in top five snow ($ millions)	Average difference in value-added in top five snow years ($ millions)	Average % change in skier visits in bottom five snow years	Average difference in jobs in bottom five snow years	Average difference in labor income in top five snow ($ millions)	Average difference in value-added in bottom five snow years ($ millions)
AK	343,551	0%	69	$2.5	$4.1	-14%	-152	-$5.4	-$9.0
AZ	310,251	31%	365	$13.0	$21.5	-11%	-240	-$8.6	-$14.1
CA	6,578,334	13%	2980	$106.6	$175.7	-17%	-4182	-$149.6	-$246.6
CO	12,008,432	2%	715	$25.6	$42.2	-4%	-1530	-$54.7	-$90.2
CT/RI	334,803	7%	81	$2.9	$4.8	-11%	-122	-$4.4	-$7.2
ID	1,378,992	7%	307	$11.0	$18.1	-5%	-254	-$9.1	-$15.0
IL/IN	459,206	8%	116	$4.2	$6.9	-17%	-254	-$9.1	-$15.0
MA	1,254,822	6%	262	$9.4	$15.4	-17%	-688	-$24.6	-$40.5
ME	1,298,778	6%	234	$8.4	$13.8	-9%	-372	-$13.3	-$21.9
MI	2,324,407	3%	212	$7.6	$12.5	-5%	-391	-$14.0	-$23.1
MN	1,520,787	3%	137	$4.9	$8.1	-2%	-76	-$2.7	-$4.5
MT	1,259,573	7%	271	$9.7	$16.0	-2%	-86	-$3.1	-$5.1
NH	2,116,948	7%	510	$18.2	$30.1	-12%	-813	-$29.1	-$47.9
NM	882,603	-17%	-237	-$8.5	-$14.0	14%	411	$14.7	$24.2
NV	419,859	-2%	-20	-$0.7	-$1.2	-5%	-72	-$2.6	-$4.2
NY	3,685,620	5%	635	$22.7	$37.4	-12%	-1407	-$50.3	-$82.9
OH	538,344	-1%	-20	-$0.7	-$1.2	-10%	-173	-$6.2	-$10.2
OR	1,556,083	7%	320	$11.4	$18.8	-18%	-890	-$31.8	-$52.5
PA/NJ	3,473,258	10%	1092	$39.1	$64.4	-11%	-1232	-$44.0	-$72.6
UT	3,855,421	7%	835	$29.8	$49.2	-7%	-899	-$32.2	-$53.0
VA/MD	549,543	-3%	-58	-$2.1	-$3.4	-11%	-198	-$7.1	-$11.6
VT	4,211,658	8%	1093	$39.1	$64.4	-9%	-1289	-$46.1	-$76.0
WA	1,692,472	20%	1117	$39.9	$65.8	-31%	-1569	-$56.1	-$92.5
WI	1,932,628	9%	552	$19.7	$32.5	-12%	-761	-$27.2	-$44.9
WV	662,658	3%	57	$2.0	$3.4	0%	4	$0.1	$0.2
WY	732,243	5%	127	$4.5	$7.5	-7%	-126	-$4.5	-$7.4
Total	**55,381,272**	**7%**	**11752**	**$420.2**	**$692.9**	**-9%**	**-17358**	**-$620.7**	**-$1,023.5**

Source: Hagenstad, 2018

or that different regions are more resilient to change (e.g. snowmaking). This could also be due to people having different travel patterns in years with good versus bad snow.

2.1 Ski Resort Quality Increases Consumer Value

As shown, above, by Hagenstad (2018), skiers are sensitive to a number of different factors, which could also influence willingness-to-pay (WTP), and therefore drive number of visitor days. Fonner and Berrens (2014) created a Hedonic pricing model for the prices of ski lift tickets, assigning value to the ski area attributes. Looking at ski resorts with over 700 feet of vertical drop, they found a number of physical and qualitative characteristics that have a significant impact on determining lift ticket prices. Physical characteristic included number of trails, vertical drop, and base elevation, as well as snowfall. The study showed a that a consumer's WTP, is increased by each additional ski trail (US$0.12), 100 feet of vertical drop (US$0.61) and 1000 feet base altitude (US$0.59). By showing an impact of base elevation, this could be indicative of regional differences in consumers' WTP controlling for resort size, as the mountains of Colorado are much higher elevation than those in other states. (Fonner & Berrens, 2014)

The study also included snowfall as a variable as the authors believed that consumers considered snow conditions important when choosing a destination. However, they acknowledged the shortcomings of the variable not accounting for snow quality or timing. Their regressions each showed a small and insignificant effect of snow on lift prices, explaining, "Regular adequate snow cover is a prerequisite for development of competitive alpine ski areas and is an expectation rather than an amenity for skiers. If snow coverage is sufficient, the value to skiers of additional snowfall depends largely on

snow quality." (Fonner & Berrens, 2014) This idea, that snowfall does not drive consumer demand, conflicts with the Hagenstad (2018), which shows snow-water-equivalent (SWE) readings from individual resorts against yearly visits as positive within Colorado (to 90% confidence interval). Shelesky (2016) also shows the correlation between skier participation and SWE within Colorado.

Qualitative variables such as lift quality (measured by percentage high-speed chairlifts), presence of a gondola/tram, and lodging within walking distance all showed a positive significant impact on consumers' WTP to visit that particular resort. Snowmaking capabilities also increased prices, however, was not significant in all models. The authors attribute this to "while snowmaking equipment allows resorts to operate when there is insufficient snowfall (as in early season and late season), and thus reduces uncertainty for skiers, it does not improve the overall skiing experience otherwise" Another focus of the study was on crowding, which looked at lift capacity to skiable acreage. They also included a crowding-squared variable to measure overcrowding. What they found was that up to a certain point, crowding added value to the ticket prices, however at some point, congestion became a detriment. This was unique from prior studies outside of the US, according to the authors. (Fonner & Berrens, 2014), This was attributed to cultural differences resulting in skiing being more of a social activity within the United States.

This study helps to establish the idea that consumers are sensitive to differences between certain resorts and others. Though this is important to account for when looking at the regional differences between ski areas across Colorado, the next study helps

connect increased consumer demand and traffic and the economic impact on communities.

2.2 Ski Participation affects Economies

In order to establish a clear framework to determine the economic impact, county to county, of additional ski visitors, we need to look at how individual tourists impact communities. Another study, Orens and Seidl (2009), assigned economic value to ranch open space by surveying tourists with willingness-to-spend and perceived value of ranch land questions. They also asked, whether skiers would still come to Crested Butte, Gunnison county, if it cost *x* dollars more, and quantified the measured and stated expenditure preferences of winter tourists. To assign an economic value to the ranch land, they looked at sectors influenced by a loss of skier days. Of the five sectors directly affected by a loss in skier days, they measured, per skier day: Eating and drinking establishments: $3.67, Food stores $5.95, Amusement and recreational services (including lift tix, snowmobiles, etc) $40.99, Gas/service stations $2.55, Hotels and lodging $15.35, Misc. retail $4.00. (Orens & Seidl, 2009) This is relevant to determining benchmark impact per visitor day, especially for Gunnison County.

The study also mentions that the impact per skier would vary between counties, and that participants represent a snapshot of Crested Butte visitors. “The analysis does not take into account potential influences on winter tourism visitation to the county, such as weather, income change, population change or the effects of potential changes in substitute sites.” (Orens & Seidl, 2009) Though the dollar impact of a day-tripper to a local hill versus an international visitor at a destination resort is dramatically different,

this shows that by driving higher skier traffic, there is some value added to local communities.

Orens and Seidel (2009) show, through measuring consumer WTP for open ranch lands, the potential economic losses or benefits of each additional acre of land. Shelesky, (2016) shows that when grouping skiing counties, Pitkin, Gunnison, La Plata, Routt, Eagle, San Miguel, Summit, Grand and Chaffee together, found that "the correlation coefficient is being produced from both skier visits and county retail sales revenue data from 1999 – 2014. The correlation found a strong, positive relationship of .748 [between skier visits and county retail sales]" (Shelesky, 2016, p.54). This study shows that retail sales is an effective method of testing the impact of skier visits. However, one of the limitations of the study was looking at participation from a statewide perspective, rather than focusing on the differences between the individual counties.

2.3 Impact of Resorts on Development

When looking at growth within Colorado mountain towns, it is important to account for other factors that are involved in the transition from a resource based economy to a tourism based one, such as public lands, or nearby metropolitan areas. Rasker (2006) looks at the value of protected lands and those managed for resource extraction to the economic growth of a county, as measured by income growth. They found that, though protected public lands hold value to economic growth in the American west, the land classified as "3a" or "industrial, but close or next to protected lands" (Rasker, 2006) had the strongest correlation with income growth. The authors attribute this to a large number of airports and ski resorts within this classification of land. More

than a third of the ski areas in the West are found in counties where more than 20% of the public lands are Class 3a." (Rasker, 2006)

The regression also showed a positive relationship between presence of a ski resort and real personal income growth across all county types, however strongest within nonmetropolitan counties containing an airport or within the "commuter shed" of one. Also positive, were availability of producer services, education as measured by percent with BA degree or higher, and presence of an airport. Rasker (2006) also finds the importance of protected lands to the economic development: "the environmental amenities on public lands, in the form of permanent protected land designation, can play an important role in stimulating growth."

These lands may also play a secondary role in the consumer's WTP function. Scott (2003) states that "Natural environment is very important in determining the attractiveness of a region for tourism." Therefore, in order to approach the impact of a ski resort accurately, the literature shows that it is important to consider variables that differentiate one region from another.

3. Background

Located within the Rocky Mountain West, Colorado is one of the fastest growing states in the United States, largely due to people migrating to the state. From 2017 to 2018, the state population grew 1.4%, which was the seventh highest that year in state growth rates by percentage. (US Census Bureau, 2018) At the same time you also have extremely high workforce participation, with the fifth lowest unemployment rate in the country, at 2.5%. (US Bureau of Labor Statistics, 2020)

3.1 Colorado Economy

One of the largest impacts on Colorado's economy is tourism, with 85.2 million visitors bringing in $22.3 billion in direct travel spending in 2018 alone, according to a report by the Colorado Office of Economic Development and International Trade. This sector also directly creates 174.4k jobs the same year, which is significantly higher than the 165k jobs in 2016- which created $5.8bn in salary earnings. (Colorado OEDIT, 2019) Also, in 2018, there were 19.5 million overnight stays (by discretionary market leisure travelers), which is definitely supported by the overnight stays by skiers shown above. The tourism report also noted that, "for the first time, Colorado attracted more than 1 million international visitors to the state, at 1,048,000 visitors," who spent, "an average of $1,770 per person per trip while visiting the state" (Colorado OEDIT, 2019, p. 27) The report also clarifies, that these same international visitors bring in more per visitor than other visitors.

Another industry, vital to Colorado, and intertwined with the ski industry is the overall outdoor recreation industry. This giant sector, in 2018 had an economic impact

larger than $62 billion, driving $37 billion in consumer spending. It also helped to support 511k Colorado jobs which resulted in more than $21 billion in salaries and wages. (Colorado OEDIT, 2019) This represents an increased focus on outdoor recreation and is supported by the natural environment of the state.

3.2 Ski Industry Nationwide Impact

Within the Protect Our Winters 2018 report, the authors detail the impact of the ski industry across the United States. Looking at the national contribution, the 2015-16 season resulted in a $11.3 billion value added to the economy, as a result of over 20 million participants in downhill skiing and snowboarding as well as snowmobiling. This added 52.8 million days of skiing and snowboarding (and 11.6 snowmobiling days). (Hagenstad, 2018)

This resulted in the supporting of over 191 thousand jobs (resulting in $6.9 bn in wages), 43.2 thousand of which were in Colorado alone. Colorado alone also contributed over $2.5 billion in economic value, according to Hangenstad (2018), which was less than what the joint Colorado study reported (below). By breaking the economic value into sectors, resort operations were only 41% of value added nationally, with much of the impact from retail sectors (other than real estate). These values are shown in Table 2, which is from the same report. (Hagenstad, 2018)

Table 2. National economic impact in the top 10 industries, ranked by employment

Industry	Winter Tourism Employment (thousands)	Labor Income (millions)	Value Added (millions)
Resort operations	73.0	$ 1,707.2	$ 2,603.7
Full-service restaurants	29.0	$ 706.9	$ 778.8
Accommodations	15.2	$ 579.9	$ 1,135.8
Real estate	5.1	$ 132.6	$ 804.7
Food and beverage stores	3.9	$ 126.3	$ 185.9
General merchandise stores	3.2	$ 90.5	$ 151.4
Gasoline stores	2.5	$ 93.9	$ 107.8
Wholesale trade	2.1	$ 191.1	$ 361.8
Employment services	2.1	$ 86.3	$ 124.4
Fast-food restaurants	2.0	$ 40.9	$ 99.0

Source: Hagenstad, 2018

Colorado Ski Industry. The Colorado Ski industry has become one of the largest ski industries in the country, housing a number of resorts both small and large. A joint analysis between Vail Resorts, Inc. and Colorado Ski Country USA (CSCUSA) in 2015, found that the Colorado Ski Industry has a $4.8 billion annual economic impact. Of this, skiing creates $1.9 billion annually in labor income for Coloradoans, supporting over 46,000 (year-round equivalent) jobs. (CSCUSA, 2015)

One unique aspect of Colorado is that though more than half a million Colorado residents participated in the 2013-14 season, the state generated over 7 million additional visits. These "valued guests spend more than $300 per skier visit including more than 8.4 million nights in lodging accommodations." (CSCUSA, 2015) This makes Colorado the most travelled to state for skiing and snowboarding, which is important due to the high spending patterns of these visitors, this also acts as a benchmark for this thesis study, for retail sales impact per visitor. Within the 2013-14 season, there were an estimated

588,000 skier/snowboarder deplanements at Denver International Airport, accounting for 8% of total non-connecting flights during the measured ski season. (CSCUSA, 2015)

According to the Kottke National end of year survey for 2018/19, the 18/19 season had the most snow sports visits ever for the Rocky Mountain region, 24.41 million, of which Colorado makes up a large portion. Also, interestingly, this region has exhibited the most growth over the period shown (78/79-18/19). For example, of the 41 seasons included, 2015/16 was only the 25th highest participation nationally, but at the time was the record high for Rocky Mountain region, and is currently the second highest season in the time frame. (NSAA, 2019) This shows that amid concerns of climate change and decreasing snowfall, the region has grown participation while all others were stagnant.

4. Analysis

4.1 Introduction

The study aims to estimate the economic benefit of additional skier participants on economies in Colorado, at both the local and county levels. This study conducts two separate regressions, while accounting for physical characteristics that may influence consumers. The, dependent, economic variable being studied is total retail sales, over a ski season, in order to measure impact on a mountain community. This data was collected from the 1999-2000 ski season to the 2017-2018 ski season, due to state data collection limitations prior to this season. The county and city data are from the same source, over the same "ski season" collection period, so that both regressions have equal length seasons.

The, independent, ski resort variables I measure include annual visitation data, vertical drop (fixed measurement in 2019), and ski resort acreage. As municipal and small local ski hills do not publish visitation data, the presence of a small, local, area is included in the regression. Unlike in Shelesky (2016), skier visitation data was not estimated using historic data- in order to preserve yearly differences between ski resorts. This created the need for an alternate method of collecting annual skier visits, using public records. The ski resort data was collected and used to the extent available, but this means that only years where a complete set of data for a county is reported can be included. This is more complicated for counties like Summit or Pitkin, with many ski resorts, limiting the years I can include.

I also attempt to determine whether it is the crowds or the quality of a ski resort that determines economic growth, and used both the acreage and the vertical drop, two

variables that add consumer value, to measure the quality of a ski area. Though these variables change slightly over time with development, I use a present day "snapshot".

Another variable being measured, is the presence of an airport or metropolitan area nearby, which as Rasker (2006) indicates, is important to control for. Within that study they controlled for both the presence of a ski resort and that of an airport. The regressions in this study also looked the presence of an airport, to account for the influence on development.

4.2 Description of Data

Dependent Variable

The dependent variable data for these models is county and city retail sales. A skier's impact has been measured as impacting local businesses in both Orens & Seidl (2009) and in Hagenstad (2018), where they examined the daily spending of skiers. For this study, I look at the county and city-level retail sales revenues, in order to measure local economic health. All economic data was brought into real dollars (adjusted to January 2018), from non-seasonally adjusted CPI data.

County Data. The County Data was collected, similarly to Shelesky (2016), who conducted a similar analysis, at the statewide level, combining all 14 ski counties. The retail sales revenue came from the County Sales Report from the Colorado Department of Revenue, from 1999 to 2018, which as stated by Shelesky (2016), "while reports exist for many decades prior they fail to detail this information by county" (p.31). This data was collected monthly, which was then adjusted by month using the CPI-U-RS data (not seasonally adjusted), for all U.S. cities, into January 2018 dollars. Later retail sales

revenues were measured in thousands of dollars, these have all been converted into total values.

The county data was then converted into yearly or seasonal data by summing up values from November 1 to June 30, (Quarter 4 to Quarter 2). Though the ski season only runs into April, I extended the ski season for county data, as city-level data was only available on a quarterly basis. Differently from Shelesky (2016), the counties were not "summed" into one statewide number, as I wanted to look at the impact at the local level.

***City Data*.** The City Data was collected in a very similar manner to county data, with similar limitations. The retail sales revenue data came from the City Sales Report, from the Department of Revenue, from 1999 to 2018. Though city level data has been reported monthly since 2016, from 1999 to late 2015, the data was in quarterly increments. As mentioned above, this elongated the ski season into June. Also, differently from the county data, when adjusting this data for inflation, the CPI-U-RS data for the three months in each quarter was averaged. The CPI bundles were averaged by quarter, even for the, newer, monthly data in order to remain consistent.

For city level data, the same process was used to create annualized data, including Q4 to Q2. Shown in Table 3 are the corresponding counties, cities, and ski resorts I use in this study. Notably, in the table, the cities of Crested Butte and Mt. Crested Butte are combined, as both are extremely close and affected by Crested Butte Mountain Resort. As Ski Cooper Area is located on the county line between Eagle and Lake counties, and even though previous writing has placed it in Eagle county, the ski area will be included for Lake county, as the closest town is Leadville. Also, important is even though

Buttermilk Mountain is technically located in an unincorporated community, it is very close to the city of Aspen and was treated as such.

Independent Variables

***Table 3**: List of Colorado ski areas*

Ski Area	County	Nearest Town
Wolf Creek	Archuleta	Pagosa Springs
Eldora	Boulder	Nederland
Monarch Mountain	Chaffee	Salida
Echo Mountain	Clear Creek	Idaho Springs
Beaver Creek	Eagle	Avon
Vail	Eagle	Vail
Ski Cooper	Eagle/Lake	Leadville
Sunlight	Garfield	Glenwood Springs
Granby Ranch	Grand	Granby
Winter Park	Grand	Winter Park
Crested Butte	Gunnison	Crested Butte/ Mt. Crested Butte
Cranor Ski Area	Gunnison	Gunnison
Chapman Hill	La Plata	Durango
Hesperus Ski Area	La Plata	Durango
Purgatory Resort	La Plata	Durango
Powderhorn	Mesa	Grand Junction
Aspen Highlands	Pitkin	Aspen
Aspen Mountain	Pitkin	Aspen
Buttermilk Mountain	Pitkin	Aspen
Snowmass Mountain	Pitkin	Snowmass Village
Howelsen Hill	Routt	Steamboat Springs
Steamboat	Routt	Steamboat Springs
Kendall Mountain	San Juan	Silverton
Silverton	San Juan	Silverton
Telluride	San Miguel	Telluride
Breckenridge	Summit	Breckenridge
Arapahoe Basin	Summit	Dillon
Copper Mountain	Summit	Frisco
Keystone	Summit	Keystone
Loveland	Summit	Silverthorne

Ski Resort Data. The first step of collecting data for the ski resorts was compiling a list of all Colorado ski areas and resorts. The base list I use is from Colorado Ski Country, USA (n.d.), which includes basic information for all resorts excluding those owned by Vail, whose information was added from individual Vail Ski resort websites. Small and municipal ski areas are excluded from the dataset, as visitation data was either too small, like Silverton Ski Area or difficult to find, such as Echo Mountain or Chapman Hill. Shown in Table 3, are the ski areas and the names of the towns and counties included in this study. Ski Resorts shown in orange have been excluded from the dataset.

To measure the economic impact of ski resorts on a local economy, one of the most vital parts of the study was to find a method to collect skier participation data, as ski resort annual visitation is now proprietary. As a result, aside from one historical source from CSCUSA and a local advocate group, Friends of Snodgrass Mountain, skier visitation data was found using United States Forest Service (USFS) filings and resort master plans; this method was used, as ski resorts need to file both master development plans as well as environmental impact statements in order to undertake certain projects, due to leases on USFS land. Aside from White River National Forest 2002 Land and Resource Management Plan: Environmental Impact Statement (EIS), each report was resort-specific and usually included 3-10 seasons of participation data. These sources included:

> Arapahoe Basin 2006 Improvement Plan, 2012 Master Development Plan, 2016 Ski Area projects: Final Environmental Impact Statement (FEIS); Aspen Highlands 2013 Mountain Master Plan Amendment; Aspen Mountain 2018 Master Development Plan; Beaver Creek 2010 Master development plan update; Breckenridge ski resort 2007 master development plan; Buttermilk 2008 Mountain Master Plan Amendment; Copper Mountain Resort 2006 Trails and Facilities Improvements: EIS, 2013 Mountain Improvements Project:

environmental assessment; Crested Butte 2009 Master Development Plan, 2013 Master Development Plan; Eldora 2015 ski area projects FEIS; Keystone 2009 Master Development Plan; Loveland Ski Area 2013 Master Plan; Monarch Mountain 2011 Master Development Plan; Snowmass Mountain 2015 Resort Master development plan; Telluride Ski Resort 2017 Master Development Plan; Vail Ski Area 2007 Improvements Project; and Wolf creek ski area 2012 Master Development Plan.

To measure qualitative variables of ski resorts on economic development, I needed to collect both ski area vertical drop and acreage at the city and county level. This data came from the same sources as the ski area list, and represented a "snapshot" of ski area size in 2020. Ski area vertical was taken using the base and summit elevations from CSCUSA and Vail Ski Resorts websites, which was then both averaged and summed for each city and county. The same was done to the acreage.

Airport data. Rasker (2006), included airports with annual enplanements greater than 25,000, "influenced by the authors' personal experiences traveling extensively via commercial airplane throughout the West; these are airports with daily commercial service." For this study I used FAA enplanement data, to include all commercial airports with a "P" designation (greater than 10,000 passenger enplanements annually),

4.3 Model

For this study, I use panel data, to measure the effects of ski resort characteristics on individual regions. Also included are two separate regressions: one for cities and one for counties. The independent variable names are explained in Table 4. Shown in Equation 1, below, is for cities; in this regression the panel id is the closest town or city to the resorts, and the time interval is yearly.

Table 4. *Variables that may affect Retail Sales*

Variables that may affect Sales	Variable Name	Explanation, Notes
Ski area annual visitors	VISITORS	Winter visitors annualized, summed within City/County
Ski Resort Vertical drop	VERTDROP	Sum of all ski area vertical drops within City/County
Ski Resort Acreage	ACREAGE	Sum of all ski area acreages within City/County
Airport	AIRPORT	Presence of an airport within the County that meets FAA "P" classification (greater than 10,000 enplanements/year) (yes/no)
Municipal Ski Area	MUNISKI	Presence of a local or Municipal hill, not counted in visitation data (yes/no)

Note. From United States Forest Service (listed above), Colorado Ski Country USA (n.d.)

Equation 1.

$$\text{CITY\_SALES} = \beta_1(\text{CITY\_VISITORS}) + \beta_2(\text{CITY\_VERTDROP}) + \beta_3(\text{CITY\_ACREAGE}) + \beta_4(\text{AIRPORT}) + \beta_5(\text{MUNISKI})$$

Similarly, to the city regression, the county regression looks at the same variables, measured by county. For this regression the panel id is the name of the county and the time interval is yearly.

Equation 2.

$$\text{COUNTY\_SALES} = \beta_1(\text{COUNTY\_VISITORS}) + \beta_2(\text{COUNTY\_VERTDROP}) + \beta_3(\text{COUNTY\_ACREAGE}) + \beta_4(\text{AIRPORT}) + \beta_5(\text{MUNISKI})$$

Thirdly, included is the regression on SALES of each individual county against COUNTY_VISITORS. This is included to show a stronger relationship between skiers

and retail sales in counties where skiing and recreation makes up a larger portion of the economy- and a weaker relationship in those where it is less important. One example would be Eldora Ski Area, which is located in Boulder county, of which Eldora makes up a very small part of the economy.

Within the independent variables, I expect to see a positive relationship between VISITORS and SALES, even with a limited dataset, at both the city and county levels. Even though this should be positive at both the county and city levels, there should be a higher confidence level within the local regression, where ski resorts make up a larger portion of the economy. I expect to see, based off Rasker (2006), a positive economic benefit to the counties with airports, though the effect year-to-year within counties. Though previous studies such as Fonner and Berrens (2014), have indicated that ski resort characteristics drive consumer value, I do not expect to see a large impact, due to lack of year to year change.

4.4 Results

After regressing both the city and county level panel data for Models 1 and 2, using random effects models, I found a number of results that address the initial question of the study (full regressions in Appendices 1a and 1b). Within Model 1, or the city regression, I found that the variables (VISITORS, VERTDROP, ACREAGE, MUNISKI, and AIRPORT) accounted for 15.4% of the variance in SALES, with an R-squared of 0.1539. Within Model 2, or the county regression, I found that the variables (same as listed above) accounted for 26.6% of the variance in retail sales, with and R-squared of

0.2659. This is, surprisingly, higher than at the city level, considering variables had less overall confidence at the broader county-level.

Table 5. Random-effects regression coefficients for variables that may explain retail sales, for both County and City regressions, 1999/00-2017/18

Variable Name	City b/p	County b/p
VISITORS	104.635**	351.574
	(0.00)	(0.15)
VERTDROP	-16683.651	644449.081
	(0.88)	(0.13)
ACREAGE	-124692.534	-834593.952
	(0.23)	(0.07)
MUNISKI	-2.60E+08	-5.45E+08
	(0.38)	(0.69)
AIRPORT	6.272e+08*	4.11E+08
	(0.02)	(0.72)
Constant	4.18E+08	7.15E+08
	(0.27)	(0.52)

p-values in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Table 5, shows the coefficients of both the City and County regressions in a consolidated chart. Looking at VISITORS, the primary explanatory variable of focus, was significant at the 99% confidence level at the city level; what this shows is that for every additional skier visit, it resulted in just over $104, in real 2018 USD. At the county level, each additional skier resulted in a larger dollar amount (which makes sense considering that the nearest town is included in the overall county), however this was not significant. Also significant at the city level, at the 95% confidence level, was that the presence of an airport in the county resulted in a retail sales jump of USD $627,200,000. Surprisingly, this is not significant when looking at the effects on the overall county. A final note to consider is that in the county regression, at the 90% confidence level, the sum of ski resort acreage had a negative effect on overall sales, though this could be due

to outliers such as Boulder County. Looking at the effects of vertical drop, there were no significant findings, even at the local level. This goes against the idea that increased consumer value of ski areas, aside from driving participation, may result in economic growth.

Table 6. Individual county regressions of annual visitors on retail sales, 1999/00-2017/18

County	**Coefficient (P-Value)**
Archuleta	223.27703
	(0.25)
Boulder	-17066.385**
	(0.01)
Chaffee	625.23255
	(0.06)
Eagle	838.58712
	(0.08)
Garfield	-3174.7843
	(0.22)
Grand	33.9426
	(0.78)
Gunnison	919.03074
	(0.49)
La Plata	458.2213
	(0.65)
Lake	-689.95608
	(0.28)
Mesa	27112.027*
	(0.02)
Pitkin	752.94721
	(0.17)
Routt	-1240.5583
	(0.09)
San Miguel	366.56819**
	(0.00)
Summit	422.63678**
	(0.00)

P values in parentheses

* p<0.05, ** p<0.01, *** p<0.001

Table 6 shows the results of Annual Visitors on Retail Sales for each individual county. Some of the least surprising results are San Miguel and Summit County, each had strong impacts of each additional visitor on retail sales, $367 and $423 respectively, at the 99% confidence level. San Miguel county is home to Telluride Mountain Resort, which is a large tourism draw to the area; Summit county is home to a number of resorts, including Breckenridge Ski Resort and Keystone, and is a county fueled by tourism. At the 95% confidence level, is a very surprising coefficient, that indicates that for each additional participant at Powderhorn Ski Resort, there is a $27,112 increase in retail sales in Mesa County. This is most likely due to the large economy of Grand Junction, where Powderhorn is located, and only makes up a small fraction of retail sales.

At the 90% confidence level, Chaffee and Eagle were both significant, with $625, and $839 increases in sales, respectively. Though not significant, Pitkin County had a similar increase to Eagle, at $753; this makes sense due to the large number of wealthier tourists visiting the destination resorts within the two counties (Eagle is home to Beaver Creek and Vail, Pitkin is home to the Aspen resorts). Another county significant at the 90% confidence level but with a negative coefficient was Routt, home to Steamboat Resort. This is unexpected, as the largest city in the county is Steamboat Springs, of which is driven largely by the resort. Another county that had a very large negative relationship was Boulder, which was significant at the 95% level; a potential explanation for Boulder county, was that when economic times were good, more people travelled to the larger resorts in either Eagle or Summit counties, rather than Eldora Mountain Resort nearby.

5. Discussion

5.1 Conclusion

As Colorado mountain towns have undergone a major shift from resource to tourism-based economies.. The goal of this study was to answer how ski resorts affect mountain towns and their surrounding counties, and to look at the impact across these levels of one additional ski participant. To compare the impact of a participant across the local and county levels, I estimated two models, each controlling for the same variables. These models attempted to control for consumer demand for certain ski area characteristics impacting skier traffic across counties, as well as other variables such as the presence of an airport.

Overall, the result I want to focus on is the impact of annualized ski resort visitors on nearest city retail sales, compared to at the county level. The regression suggests that $105, in 2018 dollars, can be created by one additional skier visit. That is not a small amount in spending per skier, which according to Hagenstad (2018), only 41% of all sales created by ski areas go to the resorts themselves. Also interesting at the city level are the retail sales attributable to an airport, which in the case of Pitkin or Eagle counties, are in a large way influenced by ski resorts. This would be interesting to consider whether an airport drives ski resorts in mountainous regions or if the inverse is true. Unfortunately, the county coefficient for annual visitors was not significant, however this was less surprising after looking at the individual county regressions.

Looking at the individual counties, the lack of significance for Pitkin County, and the lower confidence level for Eagle County is surprising, due to the importance of skiing to these counties. This could be due to the lack of data for these counties, as, to include

Pitkin county, you need a complete dataset for all four ski areas. Another interesting finding was Boulder county which had a very confidence level yet had an inverse relationship between retail sales and skier participation. This could be due to an increase in the skier participation at local resort, Eldora Mountain Resort, over the more expensive resorts further from the city during economic downturns.

A final, positive finding, was that, at the 99% confidence level, both Summit and San Miguel counties had relatively similar coefficients for retail sales; this is a great finding, as both of these counties are driven by skiing, and show that the positive economic benefits of ski resorts extend beyond the localized mountain towns and into the surrounding communities.

5.2 Limitations of Analysis

Looking back on this study, there were definitely limitations, whether it be from time constraints or proprietary data for some of the independent variables. One of the biggest challenges facing this study, and one of the biggest limitations, was lack of skier visitation data. As mentioned earlier, much of this data is proprietary and is not public information. With a more consistent dataset, the regression results may have been more significant, resulting in more clear conclusions. On this topic, when looking at counties such as Pitkin or Summit, those that are home to many ski resorts, and should be some of the most important case studies when looking at the ski industry's effect on communities, are more difficult to collect a complete dataset for.

Another limitation of this study is that, when collecting the qualitative variables for ski resorts, both acreage and vertical drop, due to time constraints, only a present-day

snapshot was taken. This was justified, due to the fact that these variables do not change often, but this could have been improved. Another constraint due to time was the regressions themselves, where the study could have been improved with further specification and work on the model, the possibility of human error in either the data collection or regressions is also possible.

A final, small potential limitation was that, for the economic datasets, as county data was available monthly and city data was available quarterly, they were adjusted for inflation differently. For city data, the CPI values for the three months were averaged before adjusting the nominal retail sales, where county data was simply adjusted monthly. This means that there is room for potential inconsistency due to different methods as one month could be consistently over/underweighted, however this should have been negated by annualizing the ski season data.

5.3 Directions for Future Study

Moving forward, there are many exciting directions I would like to see this study go. Following inspiration from the literature, and the results, I would love to dive deeper on the effects of an airport. Rather than simply including airport presence as a variable, I would love to look at driving times from ski resorts to nearest airport as a categorical variable or even look at commuter sheds, similarly to Rasker (2006). Similarly, this would also be interesting to look at for distances to Metropolitan areas.

As the results showed, the value of an additional skier is higher for destination versus day-trippers from the Front Range. I would love to expand on this idea that a higher proportion of destination or even international visitors can have different effects

than skiers local or commuters from nearby cities, and whether it is possible to run a similar regression accounting for percent out-of-state skiers.

Finally, I believe that this study is applicable to the rest of the Rocky Mountain region, if not other skier hubs such as the Northeast or the Pacific Northwest. Other states have undergone shifts similar to Colorado as well, and it would be very interesting to see whether the same factors are important there as they are in Colorado.

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APPENDICES

Appendix 1a. County Regression results

SALES	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
VISITORS	351.574	246.229	1.43	0.153	-131.027	834.175	
VERTDROP	644000.000	431000.000	1.50	0.135	-200000.000	1490000.000	
ACREAGE	-835000.000	458000.000	-1.82	0.069	-1730000.000	63802.784	*
MUNISKI	-545000000.000	1360000000.000	-0.40	0.689	-3220000000.000	2130000000.000	
AIRPORT	411000000.000	115000000.000	0.36	0.721	-1850000000.000	2670000000.000	
Constant	715000000.000	111000000.000	0.64	0.521	-1470000000.000	2900000000.000	

Mean dependent var	1185490666.234	SD dependent var	1816464586.056
Overall r-squared	0.266	Number of obs	113.000
Chi-square	5.423	Prob > chi2	0.366
R-squared within	0.019	R-squared between	0.284

*** *p<0.01, ** p<0.05, * p<0.1*

Appendix 1b. Regression results

SALES	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
VISITORS	104.635	34.460	3.04	0.002	37.094	172.177	***
VERTDROP	-16700.000	112000.000	-0.15	0.882	-236000.000	203000.000	
ACREAGE	-125000.000	105000.000	-1.19	0.233	-330000.000	80407.039	
MUNISKI	-260000000.000	298000000.000	-0.87	0.383	-845000000.000	325000000.000	
AIRPORT	627000000.000	266000000.000	2.36	0.018	107000000.000	1150000000.000	**
Constant	417000000.000	375000000.000	1.11	0.265	-317000000.000	1150000000.000	

Mean dependent var	276713290.574	SD dependent var	385661438.759
Overall r-squared	0.154	Number of obs	189.000
Chi-square	14.907	Prob > chi2	0.011
R-squared within	0.055	R-squared between	0.250

*** *p<0.01, ** p<0.05, * p<0.1*