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Article

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Investment competition among Swiss ski areas

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ABSTRACT

In recent years, ski area operators in Switzerland have faced decreasing demand while ski lift and snowmaking capabilities have increased – partly using financial aid from public funds. It is therefore crucial to determine to what extent ski area investment supports demand and affects the competition for the remaining guests. Exploiting firm-level and natural snowpack data, we find that ski areas with above-median snowmaking capabilities decrease their natural snow dependency and that ski lift investments induce a positive, albeit small, effect on outcomes in the winter following their construction. Additionally, we document adverse effects on demand for nearby neighboring ski area expansions. The results imply that investments in high-capacity lifts are relatively ineffective at retaining demand and sustaining revenue.

1. Introduction

Ski areas in Switzerland generate winter transportation revenue of around 700 million CHF (Vanat, 2023), operate 1380 ski lifts, and had a vertical capacity of almost 500,000 persons per hour per kilometer at the end of winter 2018.² The operator firms are often the largest employers in the Alps and help reducing regional economic disparities (Troxler et al., 2024). Recently, Swiss ski areas have been exposed to two opposing trends: On the one hand, skiing demand declined significantly between the 1990s and 2016 due to a warming climate and its detrimental effect on the snowpack (Elsasser & Bürki, 2002; Gössling et al., 2012; Koenig & Abegg, 1997; Marty et al., 2017; Vanat, 2023). Further reasons for the decline include exchange rate pressure (Abrahamsen & Simmons-Süer, 2011), price reductions for air travel (Müller-Jentsch, 2017), and demographic changes (Lütolf et al., 2020). Fig. 1 shows that ski area first entries decreased by 12 % between 2010 and 2018 alone accompanied by a decline in average snow days.

On the other hand, ski area supply grew by 7 % in terms of average capacity over the same period and sample. This raises the question of

why ski area capacity is still growing despite little to no growth in demand.³ One explanation is that ski area operators try to increase their attractiveness by investing in new ski lifts with greater capacity to gain a competitive advantage (Falk & Tveteraas, 2020; Mayer, 2009). Additionally, governments may offset such investments by financially supporting ski area operators by providing subsidies or assuming ownership (Derungs et al., 2019; Lengwiler & Bumann, 2018). However, higher capacity and accompanying snowmaking facilities increase procurement, operational, and environmental costs (Berard-Chenu et al., 2021; Falk & Tveteraas, 2020; Kremer, 2015).

Despite the rising costs, the average firm has expanded its capacity and snowmaking capabilities without hiking prices (while average prices of daily passes increased by 9 % between 2010 and 2018, average prices per first entry remained constant; see Vanat, 2023), yet demand has deteriorated. It is, therefore, crucial to study how ski area investment affects skiing demand and, if so, whether it creates new demand or attracts skiers from competing areas. No research has yet rigorously identified the demand-side effects of ski area investments while simultaneously considering local competition.

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¹ She declares that she has a mandate on the board of directors in the firm Bergbahnen Destination Gstaad AG. However, the ski area in which this firm operates does not benefit in any form from this research article.

² In the remainder of the article, we use the term ‘ski lift’ to cover all facilities that transport skiers (or other persons engaged in a snowsports activity) uphill. These include all surface lifts (such as t-bar and platter lifts), aerial cableways (such as chairlifts, gondolas, cablecars, funitels, funitors and hybrid lifts), cable railways, funiculars and, in some instances, raket railways. The term ‘capacity’ describes a ski lift’s vertical transportation capacity (person-kilometers per hour).

³ Since the 2016/17 season, skiing demand has stabilized around 23 million annual skier days, based on 5-year averages (Vanat, 2023).

The goal of this paper is thus to close this research gap by estimating the effect of Swiss ski area investment on firm-level outcomes. In particular, we investigate (i) whether snowmaking investments help to overcome the operator firm's dependency on natural snow, (ii) how much ski lift investments increase the operator firm's demand and revenue in the short term, and (iii) whether and how much demand reacts to neighboring ski lift investment.

We answer these questions by combining novel data with a state-of-the-art empirical strategy to identify causal effects. Investment data was sourced from the online platform [bergbahnen.org](https://www.bergbahnen.org) and linked to firm-level outcomes from Seilbahnen Schweiz (SBS), the national cableways association. We added snowmaking data from SBS, natural snow, and weather data from the WSL Institute for Snow and Avalanche Research (SLF) and the Federal Office of Meteorology and Climatology (MeteoSwiss).

In the empirical part, we follow [Gonseth \(2013\)](#) and analyze the effect of natural snow variability on ski area demand and transportation revenue and test whether high snowmaking capability reduces these effects.⁴ We then employ a difference-in-differences (DiD) strategy using two-way fixed effect (TWFE) estimators or so-called event study specifications that allow for multiple treatments across time and varying treatment intensity (see, e.g., [Roller, 2023](#); [Schmidheiny & Sieglöckh, 2023](#)) for the Swiss market to study the events of new lift installations. The empirical strategy accounts for potential confounding factors such as skiing conditions as well as idiosyncratic firm strategies related to pricing, marketing, mergers and acquisitions. Finally, we add ski lift investments in neighboring ski areas to our empirical model and distinguish new ski lifts within concentric circles of 25 km travel distance by road and whether they expand a ski area extensively to new terrain. Crucially, the identified effect of ski lift investments always includes any accompanying infrastructure for the descent, such as snowmaking.

2. Background

2.1. Related literature

The Alps and their snowy mountain landscape represent the primary resources of skiing tourism. According to [Leiper \(1990\)](#), supporting infrastructure such as ski lifts is essential for enabling access to these primary attractions. Other examples of such access-enhancing infrastructure are airports or high-speed rail, which are well-documented to positively affect the number of tourists ([Albalade et al., 2023](#); [Chow et al., 2021](#); [Doerr et al., 2020](#); [Eugenio-Martin, 2016](#); [Lahura & Sabrera, 2023](#); [Shu et al., 2023](#)). Beyond access, infrastructure can also increase a destination's attractiveness by improving services that are typically demanded by tourists ([Deng et al., 2019](#); [Khadaroo & Seetanah, 2007](#); [Lahura & Sabrera, 2023](#); [Paramati et al., 2018](#)).

Contrary to other infrastructure, ski area infrastructure can be viewed as support and part of the primary attraction. It simultaneously enables access and generates additional demand by adapting the landscape to the needs of skiers. For example, investments in snowmaking technology can extend the winter season, thereby enhancing demand. In Switzerland, most ski area infrastructure had been established by 1980 ([Troxler et al., 2024](#)). Thus, any recent investment by the operators intends to rejuvenate their destination's primary attractions through technological innovation and upgrading their tourism products ([Butler, 1980](#); [Zuo & Huang, 2018](#)) and does not create new primary attractions.

In line with this reasoning, research indicates a positive correlation

between snowmaking and ski area outcomes in Australia, France, Canada, and the USA ([Bark et al., 2010](#); [Berard-Chenu et al., 2021](#); [Falk & Vanat, 2016](#); [Pickering, 2011](#); [Scott et al., 2019](#)). Regarding Switzerland, [Gonseth \(2013\)](#) finds that an increase in snowmaking facilities from zero to 30 % of the slopes' length reduces the natural snow sensitivity of skier visits from 0.41 % to 0.25 % per day. In addition to snowmaking coverage, the quantity and quality of ski lifts are positively related to operator outcomes ([Alessandrini, 2013](#); [Falk, 2008](#); [Falk & Steiger, 2020](#); [Falk & Tveteraas, 2020](#); [Malasevska, 2018](#)). Several studies that looked at the correlation between the size and outcome of ski areas have shown that larger ski areas tend to be more profitable (see, e.g., [Falk & Steiger, 2020](#)), but the authors refrain from identifying causal effects. In this regard, the most similar work to ours is by [Falk and Tveteraas \(2020\)](#). Using data from South Tyrol, they estimate that a lift investment increases demand by between 6 % and 10 % in the following winter season before returning to baseline two years later. Furthermore, they find ski lift investments cannibalize demand from within the wider ski area because the effect is smaller and insignificant when investment effects cover the whole ski destination.

As skiing demand rises, additional tourists seek accommodation and indulge in the local gastronomy. This can create more productive employment opportunities in tourism-related services for alpine farmers, either by substituting or complementing their previous jobs ([Troxler et al., 2024](#)). Additionally, the increased income can stimulate the broader economy, as suggested by the tourism-led growth hypothesis ([Faber & Gaubert, 2019](#); [Nocito et al., 2023](#); [Zuo & Huang, 2018](#)). However, while induced demand is a necessary condition for infrastructure to promote further economic growth, it is not a sufficient condition. For established ski areas facing stagnation, it remains uncertain whether investments in ski area infrastructure can rejuvenate a destination by generating demand that exceeds the contributions of existing attractions and ultimately fosters growth in the broader economy. Therefore, evaluating the effect of infrastructure investment on tourism activity is crucial.

Estimating the causal effects of investments on the tourism economy is challenging because the latter may be targeted at relieving touristic bottlenecks. This implies that the tourism economy affects infrastructure choice and that destinations with more infrastructure are, by design, more economically successful. In such a setting, comparing outcomes with investment using simple linear regression techniques delivers biased results ([Angrist & Pischke, 2009](#); [Cunningham, 2021](#)). Therefore, a growing body of tourism research applies causal inference methods from the micro-econometric literature that uses quasi-natural experiments or exogenous variation associated with the timing of an event. For example, [Deng et al. \(2019\)](#) exploited jurisdictional borders with a regression discontinuity design, and [Lahura and Sabrera \(2023\)](#) and [Doerr et al. \(2020\)](#) used synthetic controls to establish their effects. Most scholars, however, employ a difference-in-differences strategy to identify the effect of events with exogenous timing on outcomes where either the event or the outcome of interest is related to tourism ([Gao & Su, 2019](#); [Nocito et al., 2023](#); [Yeon et al., 2020](#)). From a methodological point of view, our paper is closest to that of [Roller \(2023\)](#), who developed a dynamic difference-in-differences strategy (in the literature typically called an event study)⁵ to exploit the timing of different events based on [Schmidheiny and Sieglöckh \(2023\)](#). Likewise, we capture the net effects of multiple events (i.e., investments) across time and space by comparing them to counterfactual situations without such events.

Our empirical contribution to the literature is threefold: First, we show comprehensively how ski lift investment affects tourism demand

⁴ We believe that the approach of [Gonseth \(2013\)](#) and [Berard-Chenu et al. \(2022\)](#) involving the use of snowmaking investments as a moderating variable on the relationship between natural snow variability and outcomes is more valid than investigating the direct effect of snowmaking investments on outcomes, mainly because the latter relationship is endogenous.

⁵ It is crucial to distinguish this literature from event studies, which use data from securities markets to econometrically measure an event's impact on a firm's value. This method is widely used in the business administration and finance literature and has also found its place in tourism research (see [Nicolau & Sharma, 2022](#), for a broad discussion of the related literature).

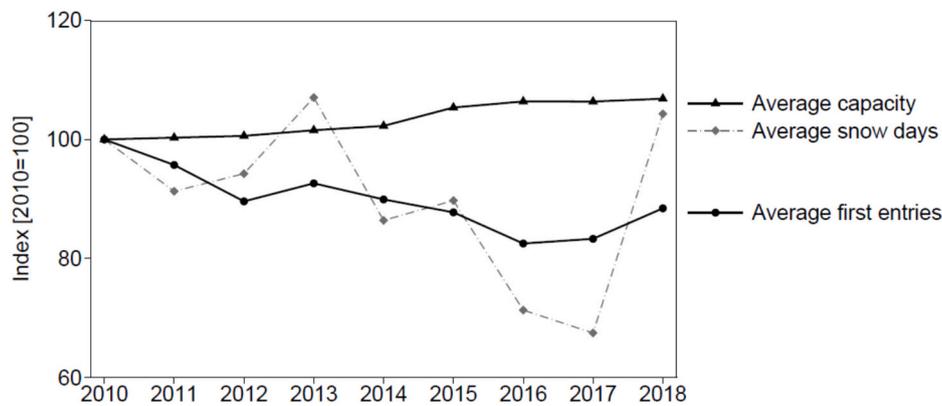


Fig. 1. Development of ski area supply and demand.

Figure Notes: Average ski area capacity (data from bergbahnen.org, measured as vertical person-kilometers per hour) and first entries (data from Seilbahnen Schweiz [SBS] and annual reports of ski area operator firms) of a balanced panel including 46 Swiss ski areas and their mean consecutive days with snow cover of ≥ 30 cm (data from the WSL Institute for Snow and Avalanche Research [SLF]). The averages are indexed to 100 in 2010. Snow days and first entries in year t correspond to the winter season $t - 1/t$ (e.g., first entries in 2018 correspond to the winter season 2017/18). The sample accounts for 24 % of all ski areas and 46 % of all ski lift capacity in Switzerland and is thus skewed towards larger ski areas about which more data is available.

in Switzerland. By doing this, we create a benchmark against which other tourism-related investments can be compared. Second, we complement the work of [Gonseth \(2013\)](#) and [Falk and Tveteraas \(2020\)](#) by showing the Swiss ski area's dependency on snow (natural or artificial), by estimating the causal effect of ski lift investment on demand and incorporating the spatial impact that permits an evaluation of regional policies, including substitution effects. Because the three federal tiers all support ski areas financially, we add a missing piece to the debate about the effectiveness of public involvement in the latter.⁶ Third, we contribute methodologically by improving [Falk and Tveteraas's \(2020\)](#) approach using a state-of-the-art empirical strategy to estimate causal effects and discussing all the pitfalls associated with identifying the effects.

Furthermore, we address two research gaps in tourism theory: First, we contribute to the theoretical foundation of the tourism-led growth hypothesis ([Song & Wu, 2022](#)) by investigating the underlying mechanisms. Specifically, we examine whether investments in physical capital and technological progress at the primary attraction alone meet the necessary condition to induce economic growth beyond tourism. Second, we quantitatively assess whether renewing the infrastructure at the primary attraction rejuvenates a destination, contributing to the life cycle assessment of Swiss ski areas in line with [Butler \(1980\)](#).

2.2. Firms' investment objectives

Faced with the decision of whether to invest in ski area infrastructure, we identify three possible investment objectives of operator firms:

1. Increase the attractiveness of the ski area ([Alessandrini, 2013](#); [Falk & Steiger, 2020](#); [Gonseth, 2013](#))
2. Reduce congestion ([Falk, 2008](#); [Pullman & Thompson, 2003](#))
3. Replace outdated lifts ([Falk & Tveteraas, 2020](#); [Federal Office of Transport, 2021](#))

The first objective is referred to as the *induced-demand effect*. An increase in investment is coupled with the belief that this will increase demand and revenue. Investment may create new demand (*business-*

creation effect), attract skiers away from competing areas (*business-stealing effect*) or have no effect. Further, seasons are tending to become shorter, and snowpack is decreasing ([Abegg et al., 2021](#); [Gonseth, 2013](#)). Thus, the longer a ski area is guaranteed to operate, the higher the demand it attracts and the greater the revenue it generates (see Section 5.1). The season can be prolonged by building new lifts at higher altitudes or investing in snowmaking facilities. In addition, the business-creation effect does not necessarily imply that investments will induce non-skiers to take up skiing. It is more likely to induce a behavioral change in skiers who already practice the sport to 'consume' more skiing days.

The second objective is referred to as the *induced-investment effect*: A change in demand induces investment. Supply reacts to changes in demand or expected changes in demand. This effect directly threatens the identification of the above-discussed *induced-demand effect*. However, we will show in Section 4.2.2 that this channel is barely a reason to invest in ski lifts any longer. Ski areas are only congested for a couple of days per season (e.g., during the Christmas holidays or on sunny weekends) at a few locations within the ski area. Thus, operator firms that are aiming to lessen congestion will fare better by allocating demand more efficiently across time ([Lütolf et al., 2020](#); [Malasevska et al., 2020](#)) and improving existing facilities than by increasing lift capacity ([Pullman & Thompson, 2003](#)).

The third objective becomes relevant when concessions are ending. Lifts in sufficiently attractive spots are often replaced by more comfortable and greater capacity lifts. Others might be renewed to the newest standards to extend a concession or are closed altogether. We show in Appendix C.2 that a switch in concession status is a good predictor of when ski lifts are replaced. The three objectives are not mutually exclusive: A new high-capacity lift built at the main junction in a ski area can meet all three objectives at the same time.

3. Data

3.1. Sample

We constructed an unbalanced sample regarding outcomes (revenue and demand) from 83 ski areas using data from SBS and the annual reports of individual firms. Further, we have data on the characteristics of all ski lifts from 186 ski areas within Switzerland from the online platform bergbahnen.org ([Gross, 2023](#)). We define a ski area as a cluster of lifts that consists, on average, of at least two lifts throughout its existence (see Appendix A.1 for details). Accordingly, we built the sample to retain as much information as possible about the outcomes. The data

⁶ The federal government and cantons together implement New Regional Policy (NRP), through which projects receive subsidies ([Hoff et al., 2021](#); [Lengwiler & Bumann, 2018](#)) and municipal governments act as owners of, or lenders to, investment projects in their local ski area ([Derungs et al., 2019](#); [Lengwiler & Bumann, 2018](#)).

is depicted on a map in Fig. 2. All circles indicate a ski area in Switzerland and correspond to the ski lift data from bergbahnen.org. The grey and black circles indicate the ski areas about which we have additional information on outcomes (grey circles only revenue; black circles also demand data) from SBS. White circles indicate data with no information on outcomes.

Table 1 shows the data coverage of the main sample. On the supply side, we count 186 ski areas in Switzerland, where 156 new ski lifts have been built between 2009 and 2018. The new ski lifts involve 146 investments in the intensive margin (within the original terrain of the ski area; mainly replacement lifts) and 10 at the extensive margin (expanding the ski area to new terrain, including ski lifts that link two ski areas). We narrowed down the observations to our main sample according to two objectives. First, to obtain the most comprehensive coverage of firm data and second, to ensure comparability across the two firm outcomes. Thus, the main sample comprises all observations with non-missing revenue and demand data. This covers around 64 % of all ski area capacity, including 72 ski areas and 83 ski lift investments, of which 9 are extensive, and 74 are intensive.⁷ To ensure that our results are not driven by sample selection, we used other samples (e.g., balanced samples) for sensitivity checks. These are described in Appendix C.5.

3.2. Ski lift investment

Data on ski lift investment is taken from the online platform bergbahnen.org (Gross, 2023). The latter contains geo-referenced data on lift characteristics such as the type, length and capacity of all ever-built ski lifts associated with ski areas in Switzerland until 2020. We use investment data from 2005 to 2020, which allows us to assess leads of up to three years and lags of up to five years beyond the observation period of the outcome variables. Because we are interested in local competition, we identify ski lift investment in neighboring ski areas using road distances between ski area access points. First, we identified the access points in the surrounding municipalities in a related project (see Troxler et al., 2024 for details). Then, using the access points, we computed the shortest road distances between all pairs of ski areas using the Here Application Programming Interface (API) and identified the number of new ski lifts built within concentric road-distance circles of 25 km for each ski area. We computed the road distances with the Stata command *georoute* (Weber & Péclat, 2017). Finally, we only retained ski lifts from ski areas that conformed to the definition above.

3.3. Ski area operator firms

The firm data on ski area operators is provided by SBS and includes self-reported figures from annual reports. Similar to the ski lift data, we excluded excursion lifts that operate only in summer and small ski lifts outside of ski areas. Sometimes, firms did not permit us to match their data with other information. We omitted these observations. Finally, we filled in the gaps in winter first entries and transportation revenues and validated the data for as many firms as possible with annual reports from the web (see Appendix A.4 for a comprehensive list of all reports that were used).

The self-reported information on snowmaking capabilities (the share of slopes that can be prepared with artificial snow) is not typically stated in annual reports. Thus, we could not perform plausibility checks and had no means of filling the gaps. Moreover, as the snowmaking variable barely varies over time, is often incomplete, and contains a few

⁷ The extensive investments are one ski lift in Aletschregion (2010), two ski lifts in Flumserberg (2013), two lifts linking Arosa-Lenzerheide (2013, 2015), three lifts linking Andermatt-Sedrun (2017, 2018), and one lift linking Grimentz-Zinal (2013). Not in our sample is one extensive ski lift investment in Sörenberg (2018).

contradictory values, we took the average of the first and last plausible value for each ski area as a proxy for the area's snowmaking capabilities.

We then matched all firm-level data to the ski lift data. For two or more firms operating in the same area, we aggregated the variables to the ski area level. For one firm operating across more than one ski area, we either took figures from the subsidiary operating in that ski area or matched them to the largest ski area. Ski area linkages that occurred during the observation period are left as separate entities (see Appendix A.3).

In the last step, we split demand at ski areas into two groups: over-nighters and daytrippers. For this, we first linked the first entries of ski areas to hotel demand data from the Federal Statistical Office (FSO) at the ski area locations. Then, we estimated the travel time for each ski area to all Swiss agglomerations and computed a gravity-based average travel time (as is commonly done in the economic geography literature – see Gutiérrez et al., 2010, for an overview and Appendix A.7 for details of how we implemented this). The population data is drawn from Francelet et al. (2020), and the travel times are computed using the Here API. The resulting remoteness measure captures the daytripper potential for each ski area. Together with changes in overnight stays and first entries across time, we estimated the demand composition of these two types for each ski area (see Appendix A.8 for details on the construction of the composition).

3.4. Snow and weather

Snow data are from an ongoing research project by SLF and MeteoSwiss. In this project, the researchers estimate the snowpack at a detailed spatial and temporal resolution using historical snow, precipitation, and temperature measurements (see Michel et al., 2024). They provided us with their most recent estimates, which have not been published. The data are modeled as the water equivalent of the snowpack in meters for each day from 1961 to 2021 using a spatial resolution of 1000 by 1000 m. Then, we matched the snowpack data to all ski area centroids and counted the number of consecutive days with a snowpack above 30 cm (we followed Vorkauf et al., 2024, and assumed 120 mm snow water equivalent with a snow density of 400 kg/m³ for a 30 cm thickness of groomed slope) for each ski area centroid (see Appendix A.5 for details on the construction of the centroid) and winter season (typically between the first Saturday in December and the last Sunday in April). We computed the ski area centroids as of 2009 and kept them constant to avoid endogeneity issues (i.e., ski lifts at higher altitudes might be built to reach better snow conditions).

Furthermore, we exploited solely the within ski area variation of the snowpack in our empirical strategy. Using ski area fixed effects, we purged all time-invariant characteristics, such as the ski area centroid and snow density. Changing these assumptions, therefore, has little to no impact on our final estimates (e.g., see the results in Appendix C.3).

We combined daily weather data from MeteoSwiss and daily first entries from three ski areas to construct a weather index. The index consists of daily variation in relative sunshine duration and minimum temperature. We refrained from adding precipitation to the index as it is strongly correlated with our snowpack data. The data is drawn from 190 weather stations and spatially aggregated to the centroid of each ski area using inverse distance weighted averaging (a method widely used in geography-related sciences to interpolate spatial data – see, e.g., Burrough et al., 1998). Then, we constructed a weighted average of the weather, whereby the days are weighted based on season-day fixed effects from a regression of daily skiing demand on the weather variables. Thus, the more favorable the weather is for skiing throughout the season, the higher the weather index – and more so when the weather is good on high-season days (see Appendix A.6 for further details).

3.5. Summary statistics

Table 2 provides a summary of the statistics associated with variables

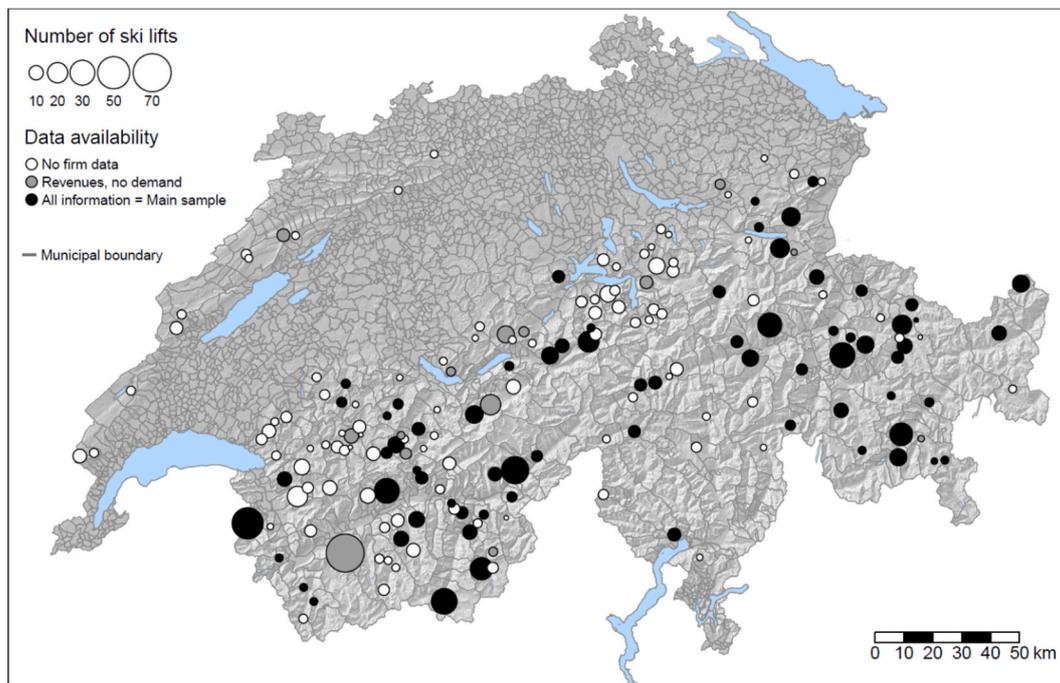


Fig. 2. Ski areas in Switzerland and coverage of samples.

Figure Notes: Circles indicate the centroid (in 2009) of Swiss ski areas. Circle size depicts the number of ski lifts per ski area in 2018. Black circles show ski areas about which all data is available (including revenue and demand data from SBS) and correspond to the main sample. Grey circles show areas from which all data except demand is available, and white circles show all other areas from which firm data is missing.

Table 1
Data coverage of the samples.

| [Period] Sample | N | n | T | New | Ext | Int | Capc 2009 [%] | Capc 2018 [%] |
|---------------------------|------|-----|-----|-----|-----|-----|---------------|---------------|
| [2009 – 2018] Overall | 1849 | 186 | 9.9 | 156 | 10 | 146 | 100 | 100 |
| [2009 – 2018] Main sample | 581 | 72 | 8.1 | 83 | 9 | 74 | 63.2 | 64.9 |

Table Notes: The table shows the number of observations (N), the number of panels (n) (= ski areas), the average time periods (T), the number of new ski lifts (New) distinguished by lifts that expand the ski area’s terrain extensively (Ext) and those that affect the intensive margin of ski area supply (Int). The last two columns show the share of aggregate capacity that the sample covers from all Swiss ski areas in 2009 and 2018 (Capc). Notice that the overall data is also unbalanced due to ski areas that stopped operating during those years.

in the main sample, with a mean comparison in the last column that helps assess the sample’s representativeness.

The sample consists of 72 ski areas and 8.1 time periods on average (unbalanced sample). Of these, 33 did not invest in a ski lift, 18 invested once in a ski lift, and another 21 invested in two or more ski lifts over the observed period. The sample is not representative in terms of ski area size and altitude. Sampled ski areas, on average, operate 42 % more lifts, provide 76 % greater vertical capacity, invest in around 56 % more lifts, and are located about 200 m higher than the average Swiss ski area. Connected to the higher altitude, the sampled ski areas have better snow and weather conditions. Also, larger ski areas naturally require more lift replacements and, thus, investment. This selection bias means that the results are more valid for relatively large and higher-lying ski areas that invest considerably more than the average ski area in Switzerland.

4. Method

4.1. Natural snow dependency

This section describes the empirical strategy used to estimate the firm’s ability to reduce natural snow dependency by investing in snowmaking facilities. Before adding variation in snowmaking capability, we model the natural snow and weather dependency of ski areas using a two-way fixed effect model. More precisely, we estimate the

following specification:

$$\ln Y_{it} = \alpha_i + \delta S_{it} + \eta W_{it} + \theta_t + \varepsilon_{it}, \tag{1}$$

where Y_{it} is either demand or revenue at time t in ski area i , α_i and θ_t are ski area and time fixed effects, respectively. S_{it} are the consecutive days with snow cover above 30 cm at t in area i and W_{it} is the weather index. As both weather and snow conditions are exogenous to the outcome, the coefficients δ and η identify causal effects of the two variables conditional on keeping the other variable constant.

We add an interaction to specification (1) to estimate whether ski areas with a high snowmaking capability can reduce their dependency on natural snow. Specifically, we estimate

$$\ln Y_{it} = \alpha_i + \delta_0 S_{it} + \sum_{g=1}^G \delta_g D_g S_{it} + \eta W_{it} + \theta_t + \varepsilon_{it}, \tag{2}$$

where all parameters and variables are defined as in (1) except the interactions between the consecutive snow days S_{it} and the indicators D_g that equal one if the ski area operator firm has a snowmaking capability between the g^{th} and $(g + 1)^{\text{th}}$ quartile of snowmaking capability and zero otherwise. Accordingly, we identify three group effects ($G = 3$) relative to the reference group below the first quartile.

The snowmaking capability variable remains constant over time due to data restrictions. Furthermore, we do not identify a causal effect of

Table 2
Summary statistics of the sample versus all data.

| | Overall | | Sample | | | | | Diff |
|--|---------|------|--------|------|------|------|--------|---------|
| | N | Mean | N | Mean | SD | Min | Max | |
| <i>bergbahnen.org</i> | | | | | | | | |
| Number of lifts [#] | 1849 | 7.6 | 581 | 10.8 | 8.7 | 2.0 | 49.0 | 3.2*** |
| Aggregate capacity [(pers./h) × km] | 1849 | 2678 | 581 | 4703 | 4672 | 214 | 22,704 | 2025*** |
| Lift investments [#] | 1849 | 0.08 | 581 | 0.14 | 0.45 | 0.00 | 3.00 | 0.06** |
| Neighboring ext. investments, 0-25 km [#] | 1849 | 0.02 | 581 | 0.02 | 0.17 | 0.00 | 2.00 | 0.01 |
| Neighboring ext. investments, 25-50 km [#] | 1849 | 0.06 | 581 | 0.08 | 0.31 | 0.00 | 3.00 | 0.02 |
| Neighboring int. investments, 0-25 km [#] | 1849 | 0.32 | 581 | 0.32 | 0.69 | 0.00 | 4.00 | 0.00 |
| Neighboring int. investments, 25-50 km [#] | 1849 | 0.83 | 581 | 0.98 | 1.36 | 0.00 | 11.00 | 0.15** |
| Capacity-weighted average altitude [masl] | 1849 | 1676 | 581 | 1881 | 340 | 1106 | 2764 | 205*** |
| <i>SBS</i> | | | | | | | | |
| Winter first entries [1,000 pers.] | – | – | 581 | 261 | 342 | 5 | 2950 | – |
| Winter transportation revenue [CHF 1,000] | – | – | 581 | 7648 | 9938 | 30 | 50,214 | – |
| Artificial snowmaking [%] | – | – | 545 | 35 | 25 | 0 | 98 | – |
| <i>SLF, MeteoSwiss</i> | | | | | | | | |
| Consecutive snow days [#] | 1849 | 82 | 581 | 97 | 46 | 0 | 149 | 15*** |
| Weather index | 1849 | 44 | 581 | 45 | 12 | 17 | 74 | 1* |

Table Notes: The table shows summary statistics for the sample and compares these to all ski areas in Switzerland (columns under Overall). The last column (Diff) indicates the difference in means of all ski areas and the sample. A two-sided t-test is performed to test whether the differences are statistically distinguishable from zero.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

single snowmaking facilities on the outcome due to the difficulties in excluding reverse causality and selection into treatment bias. Ski area operator firms are likely to react to winter seasons with poor snow coverage by investing in snowmaking capabilities (see [Berard-Chenu et al., 2021](#)). At the same time, firms probably invest more in snowmaking facilities when they have a high chance of reducing natural snow dependency. Therefore, we merely compare ski areas with a strong tendency to produce snow with areas with a weak tendency and examine whether this reduces natural snow dependency.

4.2. Lift investments

4.2.1. Estimation

In this section, we describe the empirical strategy used to estimate the effect of ski lift investments on ski area outcomes and the effect of neighboring investments on ski area outcomes. To this end, we use an event study approach based on [Schmidheiny and Sieglöcher \(2023\)](#) with multiple treatments and varying treatment intensity. We allow for multiple investments across the observation period and (neighboring) investments of several lifts per year. The empirical model is

$$\ln Y_{it} = \alpha_i + \sum_{k=-3}^5 \beta_k C_{i,t-k} + \delta S_{it} + \eta W_{it} + \theta_t + \varepsilon_{it}, \quad (3)$$

where $C_{i,t-k}$ are a set of binned event variables that indicate the number of ski lifts built $k \in [-3, \dots, 5]$ years ago at time t in ski area i . All other parameters and variables are defined as in (1). The binning at the endpoints is crucial because we assume that treatment effects remain constant beyond the event window. The maximum lag reflects all observable past events before the event window and the maximum lead reflects all observable future events after the event window ([Schmidheiny & Sieglöcher, 2023](#)). Formally,

$$C_{i,t-k} = \begin{cases} \sum_{s=-\infty}^{-3} c_{i,t-s}, & \text{if } k = -3 \\ c_{i,t-s}, & \text{if } -3 < k < 5 \\ \sum_{s=5}^{\infty} c_{i,t-s} & \text{if } k = 5, \end{cases} \quad (4)$$

where $c_{i,t}$ equals the number of new lifts at t in area i . In a year with no

lift investments, $c_{i,t}$ equals zero. An example of the data with binned endpoints is in Appendix A.9. To achieve our last objective, the effect of neighboring investments on ski area outcomes, we add investments at neighboring ski areas to (3) using four concentric road-distance circles r . This yields

$$\ln Y_{it} = \alpha_i + \sum_{k=-3}^5 \beta_k C_{i,t-k} + \sum_{r=1}^4 \sum_{k=-3}^5 \gamma_{rk} \tilde{C}_{ir,t-k} + \delta S_{it} + \eta W_{it} + \theta_t + \varepsilon_{it}, \quad (5)$$

where all coefficients and variables are defined as in (3) except $\tilde{C}_{ir,t-k}$ are a set of binned event variables that indicate the number of ski lifts built $k \in [-3, \dots, 5]$ years ago in neighboring ski areas at a concentric road-distance circle r from ski area i . The binned variables are defined as in (4) with \tilde{c}_{ir} and all its leads and lags instead of c_{it} as inputs. \tilde{c}_{ir} denotes all new ski lifts that are built in ski areas $j \neq i$ in concentric road-distance circles of (0,25], (25,50], (50,75] and (75,100] kilometers from ski area i at t . The circles are calculated using the closest access points between ski area i and neighboring ski areas j . In the final step, we separate \tilde{C}_{ir} into two sets of binned event variables (and corresponding coefficients) of new ski lifts that expand the ski area's slopes extensively (\tilde{C}_{ir}^{ext}) and new ski lifts without such expansion (\tilde{C}_{ir}^{int}).

All estimates in (3) and (5) are interpreted relative to the year of the lift construction at $t = 0$. Therefore, we normalize at $t = 0$ by dropping $C_{i,t-0}$ or $\tilde{C}_{ir,t-0}$. The normalization is at the year of the lift construction because it affects demand at the earliest in the winter after construction, which is at $t + 1$.⁸ In this regard, the normalization is quite standard as we drop the variable one period before the impact of the event unfolds.

Notice that the coefficients of interest (β_k and γ_k in (3) and (5)) include effects of changes at the ski area that happened over the same summer. We assume that the new ski lift is the most salient change to be recognized by the skiers and thus primarily induces the effects. In many cases, a new ski lift is only built when the connected slopes can be supported by additional snowmaking facilities ([Falk & Tveteraas, 2020](#)). The resulting estimates are thus valid for overall changes occurring

⁸ We denote a winter season that typically starts in mid-December of year t and ends in April of year $t + 1$ as being in the year $t + 1$ for simplicity.

simultaneously at the ski area, including accompanying snowmaking facilities, related price changes or marketing efforts, and need to be interpreted as such.

4.2.2. Identification

In this section, we address the assumptions for the identification of β_k in specification (3) as the average treatment effect on the treated (ATT). These are (i) no reverse causality, (ii) no effect on the pre-treatment population, (iii) parallel trends, (iv) stable unit treatment value assumption (see, e.g., Lechner, 2010), and (v) treatment homogeneity (Schmidheiny & Siegloch, 2023).

4.2.2.1. No reverse causality. First, we have to be certain that a change in demand does not induce ski lift investments. It might very well be that investment is demand-driven, aimed at resolving congestion (see *induced-investment effect* in Section 2.2). To test this hypothesis, we use historical natural snow variation as a proxy for winter revenues (and demand) over almost 60 years. This is effective because ski areas are dependent on variations in natural snowfall—and the fewer snowmaking capabilities they possess, the greater this dependence becomes. (see Section 5.1). The results in Appendix C.2 show that it is not the snow conditions but the concession status alone that predicts when ski lifts are replaced, ruling out reverse causality.

4.2.2.2. No effect on the pre-treatment population. This assumption is violated when skiers anticipate the opening of a ski lift and change their behavior before the event because of it. As most ski area operators replace their lifts when concessions end and often communicate such changes beforehand, skiers anticipating this is plausible. However, the bureaucratic obstacles that operators face when new lifts are planned imply that the exact timing of a lift opening is somewhat random because the formal process of building a ski lift takes around 19 months (Federal Office of Transport, 2021). Furthermore, such anticipation would lead only to biased estimates when the skiers change their behavior before the event. Including all our sensitivity checks, we estimated more than twenty event studies and found no pre-treatment coefficients significantly different from zero (single and jointly tested).

4.2.2.3. Parallel trends. The third assumption to address is the parallel trends assumption that requires outcomes to evolve in parallel absent any treatment. In our dynamic setting, the assumption must hold for all combinations of periods and groups (Roth et al., 2023), and there is no formal way to test this assumption (Lechner, 2010). Clearly, all operators pursue different approaches to running their businesses with differing marketing, pricing, and horizontal or vertical acquisition strategies. Therefore, the outcomes of operators that invest regularly in infrastructure might diverge from those who do not.

We state three reasons we still expect the assumption of parallel trends to hold according to our setup: First, the trends are, on average, parallel before new lifts are built (as discussed in the previous point). Second, the public support for lift investments, as well as no evidence of revenue-induced investment (on average), shows that it is not only successful operators that invest but also those with significant public support (i.e., selection into treatment is mitigated through large public involvement). Third, removing cases of horizontal acquisition, such as ski area linkages, does not affect our results (see Appendix C.9). Fourth, innovative pricing strategies and related marketing strategies influence outcomes (Lütolf et al., 2020; Wallimann, 2022) and might thus violate parallel trends. However, our results are not sensitive to including ski areas that implemented substantial season-pass discounts or dynamic pricing (see Appendix C.6).

4.2.2.4. Stable unit treatment value assumption. The stable unit treatment value assumption (SUTVA) requires no treatment interactions between the ski areas (Lechner, 2010). Therefore, evidence of business

stealing violates SUTVA. We show in Section 5.3 that neighboring ski lift investments do not affect ski area outcomes on average. However, when we distinguish neighboring investments according to whether a new lift expands the ski area or only increases capacity within the area, we find business-stealing effects in the former scenario. In this specification, the effect of own ski lift investments is, as expected, smaller compared to estimates without neighboring interference (the effect is smaller when the control group is no longer negatively affected by business stealing). Nonetheless, the small size of the bias indicates that the SUTVA violation does not alter the results substantially.

4.2.2.5. Treatment homogeneity. In our main specification (3), we get unbiased estimates when we assume treatment homogeneity across different years (Schmidheiny & Siegloch, 2023). However, recent advances in the econometric literature have highlighted that event study designs produce biased estimates when treatments are heterogeneous across time (Callaway & Sant'Anna, 2021; de Chaisemartin & D'Haultfœuille, 2020, 2024; Sun & Abraham, 2021). To our knowledge, only de Chaisemartin and D'Haultfœuille (2024) have examined treatment heterogeneity with multiple events in the same unit, and we accordingly use their estimator. This leads to similar results to our baseline estimates, and we conclude that our results are not driven by treatment effect heterogeneity across time (see Appendix C.7).

In addition, treatment effects may not be homogeneous across ski area sizes or lift types. A new chairlift could have a much broader effect on demand when only three T-bar lifts are in place compared to a ski area with twenty chairlifts. On the contrary, smaller ski areas are liable to invest in smaller lifts in accordance with their legal and economic capabilities (since the 1980s, most ski areas have not been allowed to expand extensively; see Troxler et al., 2024). One way to examine effects across ski area size and lift type is by defining the treatment variable as relative treatment intensity. An investment is then formulated as the relative capacity change from one year to the next. Results are included in Appendix C.8, but we avoid interpreting these too much due to data constraints and a parallel trend violation.

5. Results

5.1. Natural snow dependency

Table 3 shows TWFE estimates of specification (1). Increasing the number of consecutive days with a natural snow coverage of above 30 cm by one day leads, on average, to 0.16 % higher skier demand, all else being equal (column 1).⁹ As a typical year-to-year change in natural snow days within a ski area is 25 days (i.e., within-ski-area standard deviation), skiing demand varies by 4 % from one year to the next due to natural snow conditions, on average.

In column 2, Table 3, we show TWFE estimates from (1) using winter transportation revenue as the outcome and find qualitatively the same results as with demand. We find that an increase of one day in natural snow days leads, on average, to a 0.12 % increase in winter transportation revenue.

To differentiate the effect of snow days across the quartiles of artificial snowmaking capabilities, we estimate (2) and recover partial effects for each group g .¹⁰ The group estimates are depicted in Fig. 3. Each point depicts the effect of natural snow days on outcomes across the four groups between the quartiles indicated by $q1$ to $q4$. The first point (from

⁹ This estimate and all of the following results are computed in exact percentages. Formally, for the coefficient on the snow days ΔS and the change in snow days $\Delta S = 1$, we get $\% \Delta Y = \exp(\hat{\delta} \cdot \Delta S) - 1$.

¹⁰ The partial effect is the partial derivative of the expected value of (2) with respect to the snowmaking variable. Formally, $\partial E[\ln Y_{it} | S_{it}, W_{it}, D_g] / \partial S_{it} = \delta_0 + \delta_g D_g$. Therefore, $\hat{\delta}_0 + \hat{\delta}_1$ is the respective partial effect for group $g = 1$.

Table 3
Estimated effect of natural snow coverage and weather on ski demand.

| Dependent variable: | Log winter first entries | Log winter transportation revenue |
|------------------------|--------------------------|-----------------------------------|
| | (1) | (2) |
| Snow days | 0.0016*** (0.0003) | 0.0012** (0.0004) |
| Weather index | -0.0004 (0.0023) | -0.0019 (0.0021) |
| Intercept | 6.1481*** (0.0983) | 9.9608*** (0.0924) |
| Year fixed effects | Yes | Yes |
| Ski area fixed effects | Yes | Yes |
| N | 581 | 581 |
| R ² | 0.9911 | 0.9934 |

Table Notes: The Table shows TWFE estimates of specification (1). Column (1) shows estimates with the log of winter first entries as the outcome. Column (2) shows estimates with the log of winter transportation revenue as the outcome. Snow days are consecutive days with natural snow cover above 30 cm, and the weather index is a weighted average of favorable skiing weather scaled from 0 to 100. Standard errors are in parentheses and clustered at the ski area level.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

the left) shows the effect of the reference group, and the other three points show the partial effect of each group (g). For example, the point between q_1 and q_2 in panel (a) shows that an increase of one day in natural snow days leads, on average, to 0.17 % more first entries to ski areas with a snowmaking capability between the first and second quartile. The effect of natural snow days becomes statistically insignificant for the ski areas around the third quartile. Thus, variation in natural snow days still positively affects more than half of the sampled ski areas.

Panel (b) in Fig. 3, with revenues as the outcome, shows similar results. Therefore, we conclude that only ski areas above the third quartile in terms of snowmaking capability show independence of variation in days with natural snow cover. Nonetheless, ski areas above the median in snowmaking capability can reduce demand dependency to approximately a third compared to those below the median (from the four groups, we get an average effect of 0.06 % above vs. 0.19 % below the median). Considering again how much natural snow days vary from year to year, the demand associated with the above median groups varies on average by 1.4 %, whereas the demand of the below median groups varies by 4.8 % due to natural snow conditions.

5.2. Lift investments

Fig. 4 depicts the results of specification (3). Panel (a) shows that demand increases on average by 4.1 % in the winter after construction for each built lift. There is no pretrend visible, and a joint F-test of the three leads is statistically not distinguishable from zero at the 5 % confidence level. At the same time, the effect drops to 2.0 % for the next four winters and is no longer statistically significantly different from zero at the 5 % confidence level.

In panel (b) of Fig. 4, we depict how a lift opening translates to 1.9 % higher transportation revenue in the winter of the opening with no statistical significance at the 5 % level and drops to zero in the fifth winter after the investment. Although the point estimate for revenue is considerably smaller than the effect on demand, we infer that ski areas increase their transportation revenue after a lift investment.

When we estimate (3) using the decomposition into daytrippers and overnighters, we find that the demand effect is entirely driven by daytrippers. To see this, consider the estimates in Fig. 5. A new lift opening increases the number of daytrippers by 6.2 % in the short term on average but has virtually no effect on the number of overnight stays in the access municipalities of the ski areas. Considering the large confidence intervals in panel (a), we estimate that the actual effect on

daytrippers is roughly the same as on overall demand.

As the lift investments mainly affect skiing demand from daytrippers, in the next section we continue to investigate whether and by how much these short-term demand shifts happen at the expense of neighboring ski areas.

5.3. Neighboring lift investments

We estimate specification (5), including neighboring ski lift investments distinguished by concentric road-distance circles of 25 km. Fig. 6 depicts the results. Panel (a) shows the point estimates and 95 % confidence intervals of the first lags across the four circles using all neighboring ski lift investments. Similar to our previous results, a new lift increases first entries on average by 4.1 %, all else being equal. Furthermore, on average, neighboring ski lift investments do not affect skiing demand across any road distance up to 100 km.

Finally, we distinguish neighboring investments by whether a new lift expands the ski area (extensive margin) or only increases capacity within the area (intensive margin). We find that neighboring ski area expansions within 25 km decrease skiing demand on average by 10.2 %, all else being equal. In contrast, we do not find any effect for intensive capacity increases, as panel (b) in Fig. 6 depicts. The latter also shows that expansions affect neighbors negatively up to 50 km before the point estimate decays to almost zero in the ring between 50 and 75 km. We estimate the effects of neighboring ski area expansions relatively imprecisely compared to those without expansions because we document only nine extensive ski lift investments between 2009 and 2018 in our main sample. In Appendix C.12, we address concerns about parallel trends violation using a counterfactual exercise in which we eliminate the spatial competition among ski areas.

The relatively large effect sizes of neighboring ski area expansions (-10.2 %) compared to own ski lift investments (+4.1 %) materialize for two reasons. First, the average increase in own demand in the first winter season after an extensive ski area expansion is estimated at 7.7 % (see Appendix C.11). Second, extensive expansions occur in relatively large ski areas typically surrounded by smaller ski areas. The smaller relative effects in large areas compensate for the larger relative effects in small areas. Taking these point estimates to the absolute values of the treated ski areas and their neighbors, we find that business-stealing effects account for 56 % of the absolute demand increase due to all ski area expansions. Business creation accounts for the other 44 % of the demand increase.¹¹

In summary, we find investment into new ski lifts at the intensive margin induce new business from daytrippers, whereas they partially steal and partially create business at the extensive margin.

6. Discussion

Our results suggest that demand reacts, on average, more to (standard deviation) changes in natural snow days than to single ski lift investments (with accompanied infrastructure). Regarding revenue, a ski lift investment has approximately the same impact as a standard deviation change in natural snow days when ski areas have relatively large snowmaking capability. For areas with low snowmaking capability, the natural snow effect is twice as large as making a single ski lift investment. These comparisons suggest that firms must make relatively large and costly infrastructure investments in order to generate new revenue comparable to the annual fluctuations caused by natural factors. Furthermore, the 5-year effects in all estimates are approximately half

¹¹ We first take the nine ski area expansions and calculate by how much the 7.7 % effect increases the demand for the treated ski areas in absolute terms. Then, we compute the same absolute figure for the 10.2 % decrease at the fourteen exposed neighbor-year cells and recover from both figures the estimate for the substitution effect.

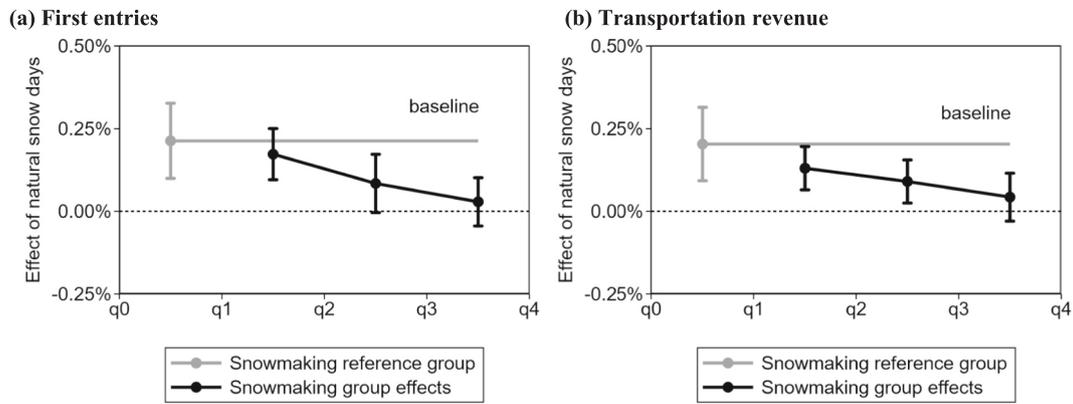


Fig. 3. Estimated effect of natural snow days on winter outcomes across snowmaking capability.
Figure Notes: Each point depicts group estimates of specification (2) across quartiles of snowmaking capability. Specifically, the first point from left (grey) depicts the point estimate of consecutive snow days for the reference group (below the first quartile), and the other points (black) depict the partial effects of consecutive snow days for ski areas between the respective quartiles in the horizontal axis. Panel (a) shows the estimates with the log of winter first entries as the outcome, and panel (b) shows the estimates with the log of winter transportation revenue as the outcome. The bars show 95 % confidence intervals and standard errors are clustered at the ski area level. The coefficient table with point estimates and standard errors is in Appendix B.1.

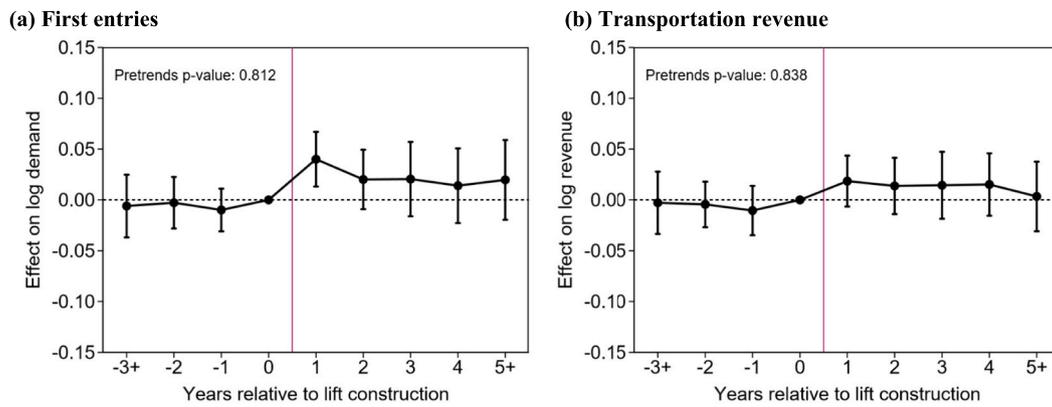


Fig. 4. Estimated effect of new ski lifts on first entries and transportation revenue.
Figure Notes: Both panels show estimates of specification (3) across time. Period 0 indicates the winter before the lift construction (in the same year), and period 1 indicates the winter of the lift opening. Panel (a) shows the estimates with the log of winter first entries as the outcome, and panel (b) shows the estimates with the log of winter transportation revenue as the outcome. The bars signify 95 % confidence intervals, and standard errors are clustered at the ski area level. Endpoints are binned and indicated by a plus. The p -values of the joint F-tests for pretrends are indicated in the plots. The coefficient table with point estimates and standard errors is in Appendix B.2.

the size of the immediate effect, which is not always clearly distinguishable from zero. This shows that firms can only mitigate (or enhance) the variation in demand from natural factors in the first winter. Further gains are much smaller and approach zero in terms of transportation revenue.

In addition, the point estimates for revenue are statistically insignificant and lower than those for demand for almost all results. We would, however, expect the exact opposite if ski area investments allowed operator firms to set higher prices and attract more daytrippers. Therefore, ski area investments no longer go hand in hand with higher price levels. Additionally, the coefficient on the weather index is small and statistically insignificant across all estimations. This confirms the observation of Wegelin et al. (2024) that the weather has, on average, no effect on seasonal outcomes because skiers intertemporally substitute their consumption. This shows that capacity constraints on peak days are no financial risk for most ski area operators. As with skiers deterred by bad weather, skiers deterred by congestion ski on another, less congested day.

We find that ski area investments are, in relative terms, less effective at attracting demand than other investments into infrastructure described in the literature (Doerr et al., 2020; Eugenio-Martin, 2016; Lahura & Sabrera, 2023). However, the related studies do not explicitly incorporate substitution effects within and across destinations. In contrast, we provide such a perspective: At least in the case of ski lift replacements, nearby ski areas are unaffected, thus, public investment does not increase competition among Swiss ski areas. Therefore, we highlight the methodological importance of measuring net effects (as discussed in Roller, 2023), including substitution effects on neighboring jurisdictions, which may be crucial when evaluating a (public) infrastructure investment that is intended to affect overall tourism demand.

In light of the tourism-led growth hypothesis, the relatively small effect sizes imply that the average ski area investment fails to rejuvenate a destination in such a way that it leads to signs of economic growth. It neither creates sustainably higher revenues for the operators that could pay for new employment nor attracts over-nighters. Therefore, we must conclude that already the necessary condition for growth is not met. At

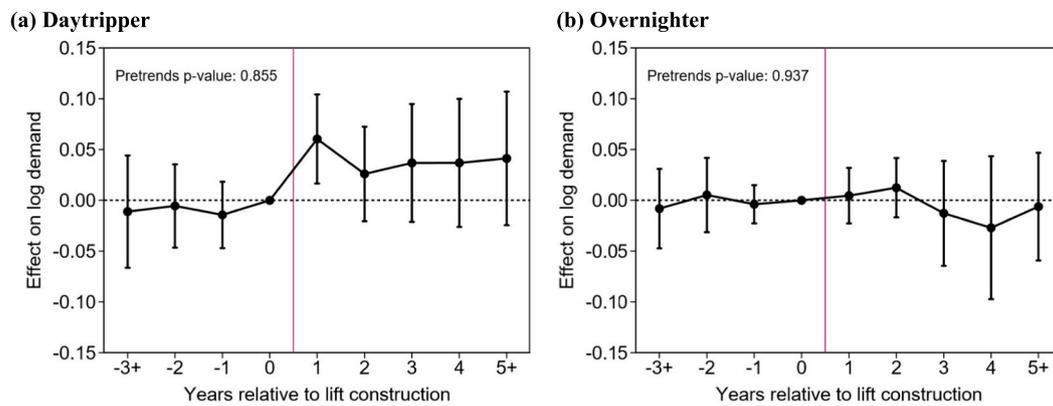


Fig. 5. Estimated effect of new ski lifts on first entries by guest type.

Figure Notes: Both panels show estimates of specification (3) across time. Period 0 indicates the winter before the lift construction (in the same year), and period 1 indicates the winter of the lift opening. Panel (a) shows the estimates with the log of winter first entries from daytrippers as the outcome and panel (b) shows the estimates with the log of winter first entries from overnighters as the outcome. The bars signify 95 % confidence intervals, and standard errors are clustered at the ski area level. Endpoints are binned and indicated by a plus. The p-values of the joint F-tests for pretrends are indicated in the plots. The coefficient table with point estimates and standard errors is in Appendix B.2.

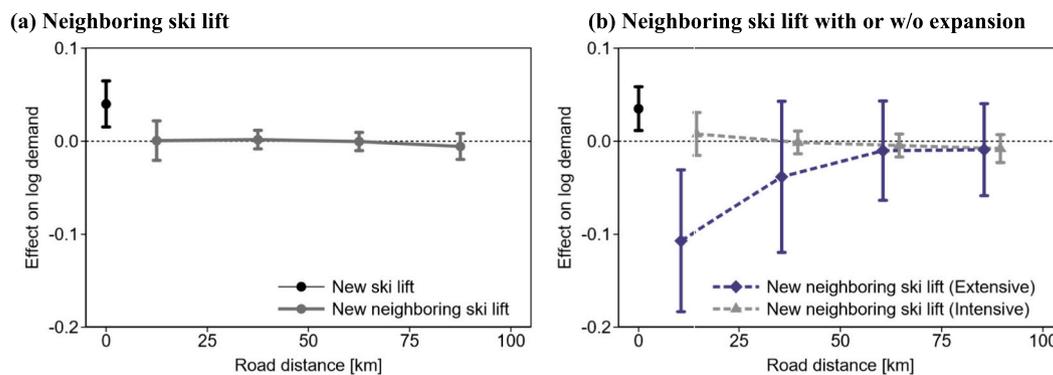


Fig. 6. Estimated effect of own and neighboring ski lifts on first entries in the first winter.

Figure Notes: The plots show point estimates and 95 % confidence intervals of the first lags in specification (5). The horizontal axis indicates the four concentric road-distance circles of 25 km each. Road distances are calculated using the closest two access points between each ski area pair. Panel (a) depicts the estimates using all new neighboring ski lifts, and panel (b) depicts the estimates for when new ski lifts are distinguished by whether they expand a ski area. Endpoints are binned, and the standard errors are clustered at the ski area level. The coefficient tables with point estimates and standard errors are in Appendix B.3.

best, it raises the operator firm’s short-term revenue and prolongs the destination’s stagnation phase.

7. Conclusion

We find that (i) snowmaking investments lessen the operator firm’s dependency on natural snow variation, (ii) ski lift investments increase short-term demand and revenue from daytrippers, and (iii) intensive ski lift investment creates short-term demand, whereas extensive investment creates and steals short-term demand from neighboring ski areas. Altogether, the effects of ski lift investments are of short-term nature and in some cases not statistically significant. We do not find long-term effects.

In line with the ongoing divergence of ski area supply and demand (see Fig. 1), our results show that investing in high-capacity lifts is a relatively ineffective means of retaining demand and sustaining revenue. Instead, it is crucial for decision-makers to carefully evaluate all the costs of ski lift investments (including operational costs, connected snowmaking facilities, and costs to neighboring ski areas) and consider whether the realistic demand expectation, pricing strategy, and year-round use of such investments justify their size and capacity. After all, most ski area operators do not primarily invest to raise immediate

demand. They may alternatively make use of innovative technologies to increase comfort, provide attractive slopes, increase summer use, and allocate skiers efficiently across time and space. Applied in combination, this should suffice to maintain operations and sustain the attractiveness of the ski area. These implications are of relevance to the policymakers who decide upon funding ski area investments, and particularly for ski area operators and tourism organizations that lobby in favor of new investments.

A limitation of the study is that the sample is not representative regarding ski area size and altitude. Broader data coverage would allow us to estimate the effects more precisely and draw additional conclusions about smaller ski areas. Related to this, our results are only externally valid to some extent. The situation with public involvement, regulations, road infrastructure and topography is unique to Switzerland. This means that our identification strategy may not entirely be translated to other contexts in terms of how it is implemented here. Nevertheless, at least in the Alps, many aspects are similar, and only slight adjustments to the modeling would be required to establish a causal link between ski area investment and outcomes elsewhere. The ongoing rise in global temperatures continues to reduce skiing demand, although decision-makers might still be tempted to invest in its supply. Thus, such research is relevant for the future.

CRedit authorship contribution statement

Pascal Troxler: Writing – review & editing, Writing – original draft, Visualization, Software, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Monika Bandi Tanner:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Conceptualization. **Marcus Roller:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Monika Bandi Tanner reports a relationship with Bergbahnen Destination Gstaad AG that includes: board membership. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.annale.2025.100191>.

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