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The choices of the Swiss ski lift companies towards artificial snow cover use: a statistical analysis

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Wengen Workshop

04/10/06

Outline

- Snowmaking in Switzerland
- Objectives
- Financing ability of the companies
    - Financial situation of the companies
    - Assessment of the public support
- The statistical analysis
    - Collected data
    - Description of the model
    - Results from the multiple logistic regression model
- Conclusions

Snowmaking in Switzerland

- Snowmaking is often presented as the adaptation measure to climate change *par excellence*.
- In Switzerland, potential for adaptation through snowmaking seems high in view of the low amounts of investments that have been yet undertaken:

1/ Snowmaking concerns 15% to 19% of the total prepared ski runs' length (i.e. between 1700 and 2200 km)

2/ 20 to 30% of the Swiss ski lift companies without snowmaking facilities

Questions to be asked:

- Massive investments in the medium term future? Which companies are concerned with these future investments?
- Can we somehow answer these questions looking at the current pattern of investments in snowmaking and at the current financing ability of the companies?

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Objectives

- Financing ability of the companies: 1/ Discuss the financial situation of the firms and 2/ Assess the public authorities support towards snowmaking.

- Define the profiles of the companies that have invested in snowmaking and the profiles of those that have not yet invested using statistical models.

- Draw conclusions for the whole sector on what is going to be the possible role of snowmaking as a measure to cope with the impacts of future climate change.

Financing ability of the companies

- Why does the financing ability matter? High investments costs (0.75 to 1 Mio CHF/km) and withstand greater operating expenditures (50'000 to 75'000 CHF/km and sometimes up to 90'000 CHF/km) need to be financed.
- Sources for financing new investments: free cash flows, new issuing of shares, bank's loans, leasing, authorities' support.
- I will focus my presentation on:

Free cash flows →
- Most important source of finance
- Depends on the financial health of the companies

Authorities support →
- Its importance stresses the economic relevance of the sector
- Important for companies in financial difficulties

Financial situation of the companies

A high total debt ratio and a low operating margin both adversely affect the financing ability of a given company in terms of its free cash flow:

- Operating margin: 40% of the companies rated “Good to very good”
- Total debt ratio: 56% of the companies rated “Good to very good”

But the sector’s revenues are mainly generated by healthy companies:

- VS: 80% of the revenues are generated by companies having good operating margins (*Vikuna*).
- GR: 90% of the revenues are generated by good rated companies (*GKB*).

Assessment of the public support *forms of support*

Financial forms of support at the communal, cantonal and federal levels

• Communes: *subsidies, loan's guarantees, increased shareholding in the companies.*

• Cantons: *LIM loans, other interest-free loans, subsidies*, *loan's guarantees.*

• Confederation: *LIM loans.*

Non financial forms of support

• *facilitated and accelerated administrative procedures, rights on some water resources, etc*.

Assessment of the public support *quantitative assessment*

Cumulated value of the financial support provided at the cantonal and federal levels:

interest-free loans=35 Mio CHF
(30 Mio of LIM loans and 5 Mio of other loans)
\+ Subsidies=3.5 Mio CHF
= Roughly 40 Mio CHF shared between 40 companies since the mid-nineties

Appreciation of the financial support provided at the communal level:

- 78% of the companies that have been financially supported when investing in snowmaking facilities have received support at the communal level (*Grishconsulta*): subsidies are common.
- On average, communes have a shareholding of 20% in the companies (*SBS*).

Assessment of the public support
Main features

- **The financial support has been limited up to now:**
- The supported projects (around 125 Mio CHF of investments) only represent 5 to 10% of the overall amount of investments towards snowmaking in Switzerland.
- **The financial support varies greatly from one canton to the other but comparisons remain difficult.**
- The cumulated support in GR is 50% less than in VS but 20% of the support is constituted of subsidies!
- **LIM loans represent 75% of the financial support at the cantonal and federal level.**
- **Support from the communes is hard to valuate but is surely important.**

Assessment of the public support
LIM loans

General characteristics:

- LIM loans are granted at advantageous rates or at zero rates and must be repaid within 30 years at most. In case of interest-free loans (i.e. the rule), the debtor must refrain from paying dividends. Debtors commit themselves to respect this clause.

LIM loans beneficiaries:

- The beneficiaries are currently defined on the basis of the new cantonal strategies (these are the consequences of the moratorium launched by the Seco that intended to put an end to the so-called “principe de l’arrosoir”)

Attitude towards snowmaking projects:

- No particular ceiling placed on the financial support brought to the snowmaking projects.
- Federal guidelines published in 1991: snowmaking facilities located below 1300 to 1500m should not in general be financially supported by the Confederation.

Statistical analysis: collected data

A database of the Swiss ski lift companies has been built:

Included variables:

• (total and mean) transport capacity, ski runs' length, relevant altitudes of the ski area, key financial variables and snowmaking in km.

Size of the sample:

• 95 cases distributed into 12 cantons.

• 20% of the Swiss ski lift companies' global offer in terms of km of prepared ski trails.

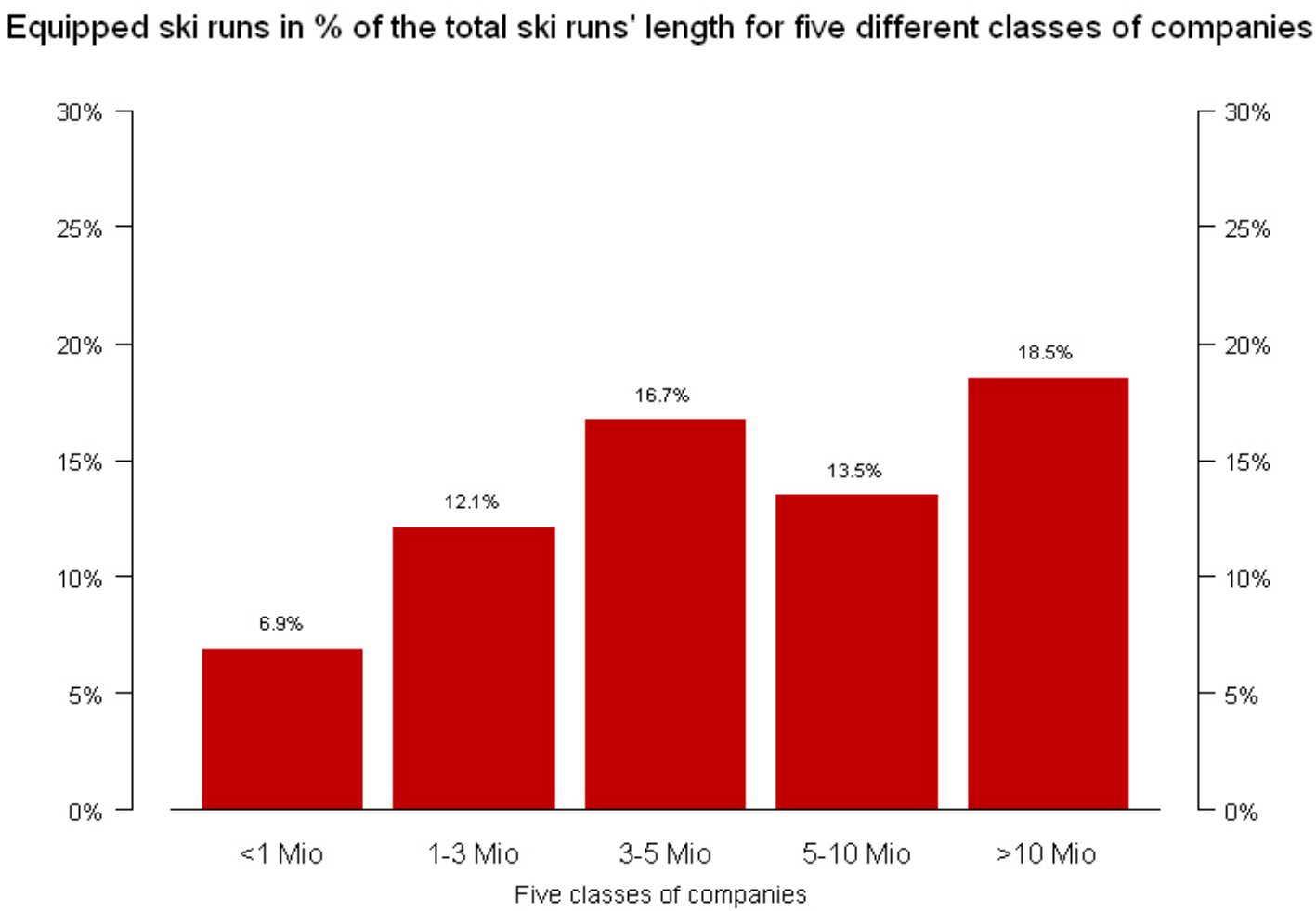
Representativity of the sample:

• *In terms of companies' size*: 60% of the companies with transport revenues <3 Mio CHF and less than 10% of the companies with revenues >10 Mio CHF.

• *In terms of artificial snow cover use*: for companies with total revenues>1 Mio CHF, the value of the equipped ski runs in % of the total ski runs' length lie in the range of 15%.

Statistical analysis: collected data

- Link between the size of the sample's companies and their recourse to artificial snow cover



Statistical analysis: the models

Two statistical models are used to analyze the current pattern of investments:

→ The multiple logistic regression model (binary responses)

- Y_i=1 means that the company i has recourse to artificial snow cover.
- Predict whether or not artificial snow cover use from a set of explanatory variables.

→ The proportional odds model (responses fall in category 0/1/2/…/k)

- Y_i=r indicates that the ith response falls in category r.
- Assess how the ordinal responses (intensity of the recourse towards artificial snow cover) depend on a set of explanatory variables.

Results from the logistic regression model

The fitted linear predictor for the chosen model:

$$\ln\left(\frac{\hat{\pi}_i}{1-\hat{\pi}_i}\right) = -4.7194 + 0.0032\,DHM_i + 0.1804\,Trails_i + 2.5457\,ALT_i - 0.1601(Trails * ALT)_i$$

Interpretation of the model parameters:

- Taking the average values of *Trails* and *DHM* for the sample's cases with max alt.<1700m, the estimated probability would be 37.4%. The probability would increase by 110% given a 10km increase in *Trails* and by 20% given a 100 Pers./hour increase in *DHM*.
- Taking the average values of *Trails* and *DHM* for the sample's cases with max alt. ≥1700m, the estimated probability would be 85%. The probability would increase by 2.8% given a 10km increase in *Trails* and by 4.3% given a 100 Pers./hour increase in *DHM*.
- For the average values with max alt.<1700m, what is going to be the change in probability when ALT takes its higher value? The probability would increase by approximately 60%.

Results from the logistic regression model

The model predicts that two main families of companies have recourse to snowmaking with a high probability:

1/ A first broad family of companies is formed by the companies with max alt.>1700m (Alps) and some minimum values for the trails' length ($Trails_i \geq 30\,km$) and the mean transport capacity ($DHM_i \geq 800 Pers./hour$):

Estimated probabilities: $\hat{\pi}_i \geq 0.75$

Remark:

- Note that for $\hat{\pi}_i \geq 0.5$, it suffices to have for instance $Trails_i \geq 20km$ and $DHM_i \geq 550 Pers./hour$

Results from the logistic regression model

2/ Companies with max alt.<1700m (Jura and part of the Prealps) but with a trails' length higher or equal to 20 km (when the mean transport capacity is taken to be at least equal to 700 Pers./hour):

Estimated probabilities: $\hat{\pi}_i \geq 0.75$

Remarks:

Cases have been excluded from the analysis when the causes for non having recourse to artificial snow cover were the following:

- a lack of water resources (2% of my sample).
- environmental laws and nature preservation issues (3% of my sample).

Conclusion

In what we have seen of the financing aspects, there exists several brakes on medium term investments in snowmaking facilities at the sector level:

- Self-financing possibility in the sector will be still limited.
- More demanding conditions for accessing the federal and cantonal supports since the Seco's moratorium.
- LIM loans: no payments of dividends possible before the term of the loan.
- In general, no federal support for snowmaking facilities below 1300 to 1500m.

What are going to be the companies concerned with medium term investments in snowmaking facilities?

- We will expect that these companies be encompassed within the two families of companies defined previously because: 1/ they have already displayed their interest and need in having recourse to snowmaking and because 2/ they have generally proved to have the financial means to finance at least one snowmaking project.
- We will expect that the feature displayed previously concerning the equipped ski runs in % of the total ski runs' length will be accentuated in the years to come.

The multiple logistic regression model

Yi are independent Bernoulli random variables (0/1 responses) with expected values:

$$E(Y_i) = \pi_i \qquad \text{where}$$

$$E(Y_i) = \pi_i = \frac{\exp(x_i^T \beta)}{1 + \exp(x_i^T \beta)}$$

- Y_i=1 means that the company i has recourse to artificial snow cover
- $x_i^T\beta$ is called the **linear predictor** and β is a px1 vector of parameters
- The ratio $\frac{\pi_i}{1-\pi_i}$ is called the **odds of success** for company i.

The proportional odds model

There are k ordered categories defined by the cutpoints $\zeta_1,\ldots,\zeta_{k-1}$ and n independent companies whose ordinal responses are $I_1,\ldots,I_n$. The notation $I_j=r$ indicates that the jth response falls in category r:

$$\gamma_{jr} = \Pr(I_j \le r) = \frac{\exp\left(\zeta_r - x_j^T \beta\right)}{1+\exp\left(\zeta_r - x_j^T \beta\right)} \qquad \text{for r=1,…,k}$$

The odds ratio for appearing in category r or lower for two individuals with explanatory variables x_1 and x_2 is independent of r (the interpretation of the model parameters remains unchanged when adjacent categories are merged):

$$\frac{\Pr\left(I \le r; x_2\right)/\Pr\left(I > r; x_2\right)}{\Pr\left(I \le r; x_1\right)/\Pr\left(I > r; x_1\right)} = \frac{\exp\left(\zeta_r - x_2^T \beta\right)}{\exp\left(\zeta_r - x_1^T \beta\right)} = \exp\left(-\left(x_2 - x_1\right)^T \beta\right)$$