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Importance of early snowfall for Swedish ski resorts: Evidence based on monthly data

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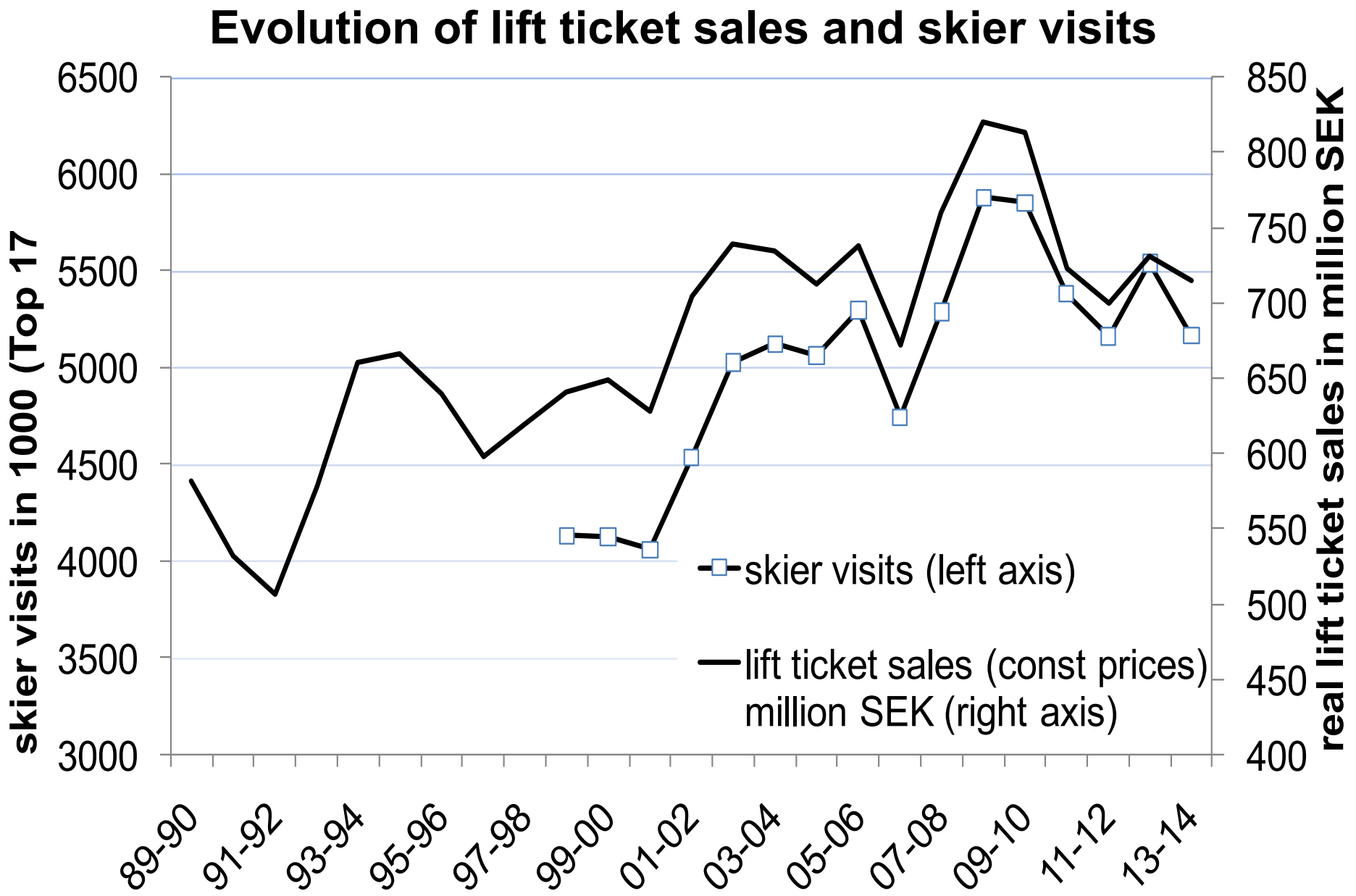
Motivation

- major ski markets are reaching a point of stagnation (=> tourism life cycle, Butler 1980)
- characteristics of SE downhill skiing market
  - long tradition
  - small market: 6.5 million skier visits
  - 70 downhill ski areas
  - high share of domestic visitors
  - from 2009/2010 onwards the number of skier visits declined
  - snow making widespread Sälen 62 out of 115 slopes covered
- possible factors for skiing demand
  - costs of skiing too high
  - low income elasticities combined low income growth
  - Increase in snow poor winter seasons
  - importance of snow fall in the early season
  - significant trend deciine

Motivation

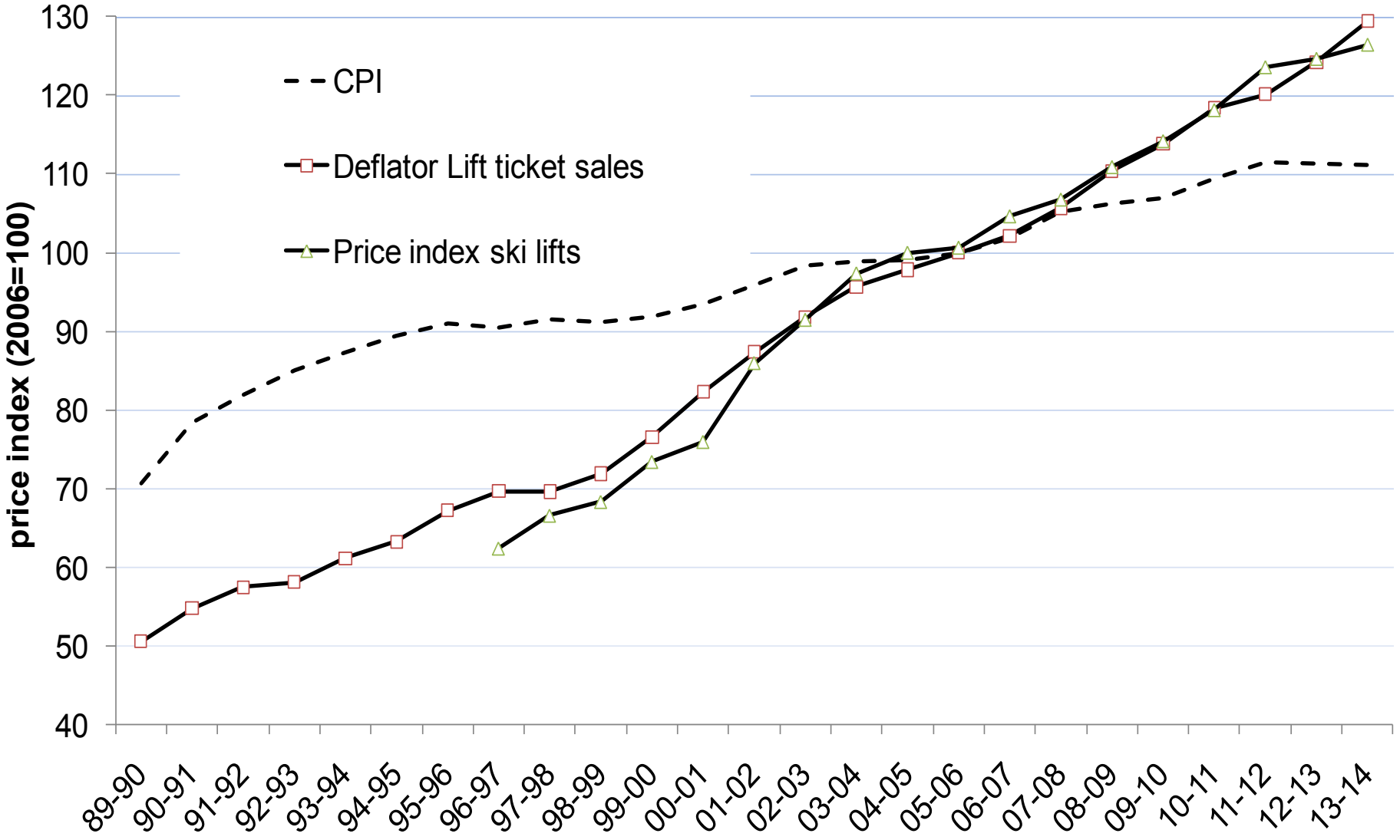
- Aim
  - relationship between the inter-annual variation of lift ticket sales and snow depth using monthly data
- contribution
  - First estimates using monthly data on output of ski lift operators
  - Precise information on lift ticket prices and lift ticket sales
- model
  - seemingly unrelated regression model (SUR) estimated jointly for five months for the winter seasons 93/94 to 13/14
  - economic factors are restricted to be identical across the winter months
  - snow conditions and calendar effects (early Easter holidays) are allowed to differ

Motivation


Evolution of lift ticket sales and skier visits
skier visits in 1000 (Top 17
real lift ticket sales in million SEK
6500
6000
5500
5000
4500
4000
3500
3000
850
800
750
700
650
600
550
500
450
400
89-90
91-92
93-94
95-96
97-98
99-00
01-02
03-04
05-06
07-08
09-10
11-12
13-14
skier visits (left axis)
lift ticket sales (const prices) million SEK (right axis)

Motivation

Evolution of the price index for ski lifts and total CPI



Theoretical background

- Recreational demand
- Indirect utility function n number of skier days, d # ski trips

$$V(\mathrm{n}, \mathrm{d}, \mathrm{z}, p_m^t, p_i^l, z, T, \tau) = u(\mathrm{n}, \mathrm{d}, \mathrm{z}) +$$

$$\lambda\left[y - \sum_{i=1}^{m} n_i p_m^t - p_i^l d_i - z\right] + \mu\left[T - \tau - n t_i^t - \sum_{i=1}^{m} d_i\right]$$

- Budget and time constraints, costs of travelling and costs of stay
- Demand function, first order condition:

$$n_i = n_i(\mathrm{p}^{\mathrm{t}}, \mathrm{p}^{\mathrm{l}}, \mathrm{t}^{\mathrm{t}}, y, T)$$

- effects

$$\partial n_i / \partial y > 0, \partial n_i / \partial p_i^t < 0, \partial n_i / \partial p_i^l < 0, \partial n_i / \partial T > 0$$

Theoretical background and previous literature

- Cost factors are main determinants of skiing demand (Tuppen, 2000)
- Gilbert and Hudson (2000) : high costs are the major constraints for skiing participation
- Priporas et al. (2014) : financial costs and interpersonal constraints are the main factors
- However: lack of snow and congestion on the slopes play a minor role
- winter sport destinations in the mature phase: income elasticities can be expected to be low

Theoretical background and previous literature

- skier visits strongly depend on natural snow depth (Gonseth 2013, Falk 2014; Steiger 2011)
- despite large investments in snow making facilities
- distribution of snowfall during the winter is of high importance (Burroughs, 2000).
- poor start to the winter season may have a disproportionately negative impact on output and profits
- =>choice of the time scale of the weather data (e.g. monthly, daily or for total season) is crucial when modelling the relationship between weather and tourism demand
- Gómez Martín (2005): weather conditions can cause major variations in visitor flow on the same days or on successive days (Hamilton et al., 2007, Shih et al. 2009)
- However, studies based on daily data have not accounted for price and income effects

Empirical model

- Recreation/tourism demand model:

$$\ln YCP_{mt} = \alpha_{0m} + \alpha_{1m} \ln PS / CPI_t + \alpha_{2m} \ln GDPcp_t + \alpha_{3m} SNOW_{mt} + \alpha_{4m} t_t + \varepsilon_{mt},$$

- m=1,..,5 months: Nov-Dec, Jan, Feb, Mar, and April-May
- t=seasons 1992/1993 to 2013/2014
- YCP: lift ticket sales (net of value added tax) in constant prices
- PS: price index of ski lift tickets
- CPI: consumer prices index
- GDPcp: Swedish GDP in constant prices
- prices and GDP refer to the year when the season starts (season 2013/14 uses 2013 values)
- SNOW: average monthly snow depth

Empirical model

- dependent and explanatory variables are both I(1) and I(0)
  => model in first differences (to the same month previous yr)

SUR model:

$$\Delta \ln YCP_{1t} = \alpha_1 + \alpha_1 \Delta \ln PS/CPI_t + \alpha_2 \Delta \ln GDPcp_t + \alpha_{31} \Delta SNOW_{1t} + \alpha_4 D_t + \varepsilon_{1t}$$

$$\Delta \ln YCP_{2t} = \alpha_2 + \alpha_1 \Delta \ln PS/CPI_t + \alpha_2 \Delta \ln GDPcp_t + \alpha_{32} \Delta SNOW_{2t} + \alpha_4 D_t + \varepsilon_{2t}$$

$$\Delta \ln YCP_{3t} = \alpha_3 + \alpha_1 \Delta \ln PS/CPI_t + \alpha_2 \Delta \ln GDPcp_t + \alpha_{33} \Delta SNOW_{3t} + \alpha_4 D_t + \varepsilon_{3t}$$

$$\Delta \ln YCP_{4t} = \alpha_4 + \alpha_1 \Delta \ln PS/CPI_t + \alpha_2 \Delta \ln GDPcp_t + \alpha_{34} \Delta SNOW_{4t} + \alpha_4 D_t + \alpha_{54} EARLYEASTER_t + \varepsilon_{4t}$$

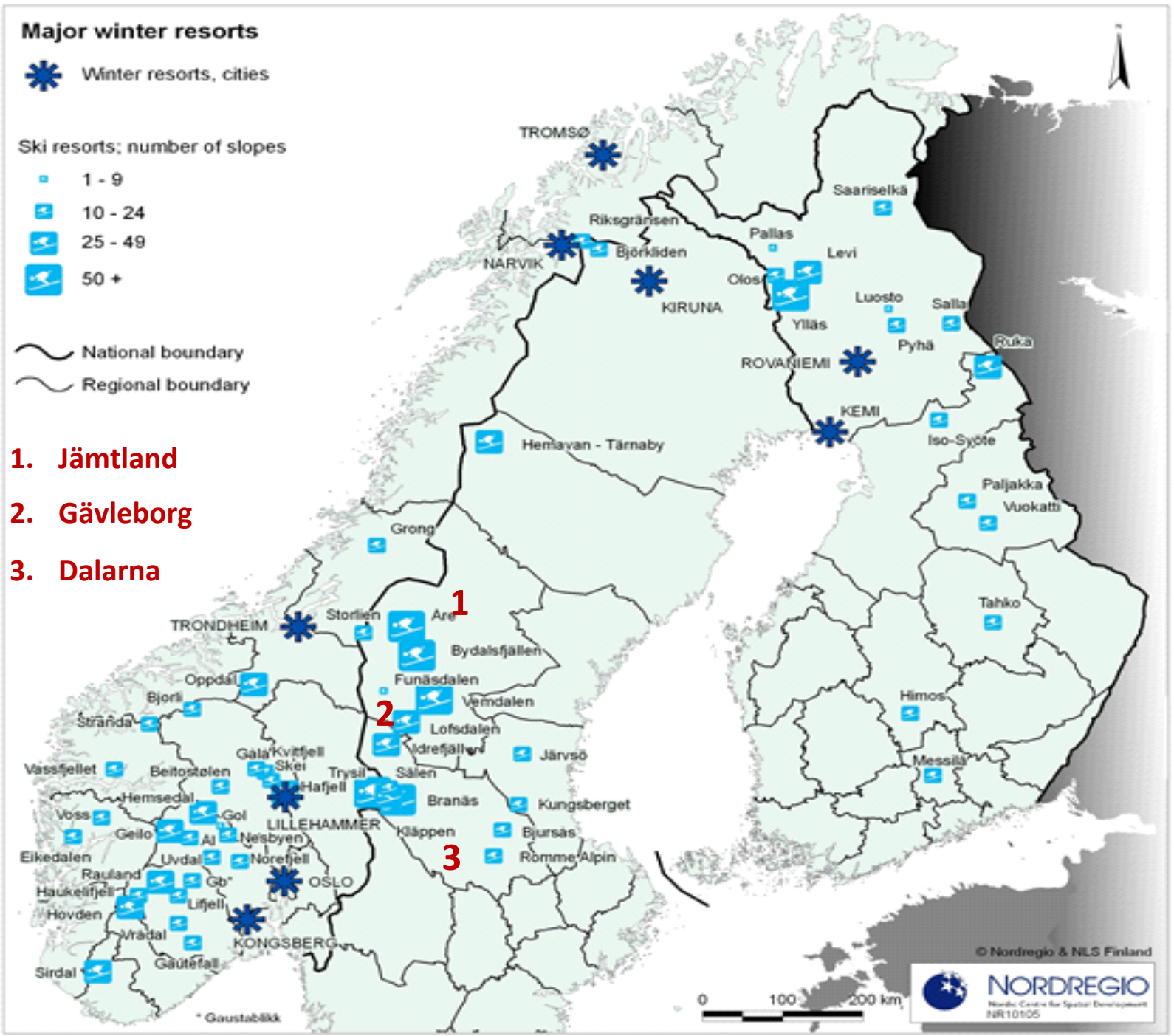
$$\Delta \ln YCP_{5t} = \alpha_5 + \alpha_1 \Delta \ln PS/CPI_t + \alpha_2 \Delta \ln GDPcp_t + \alpha_{35} \Delta SNOW_{5t} + \alpha_4 D_t + \alpha_{55} EARLYEASTER_t + \varepsilon_{5t}$$

$$\text{cov}(\varepsilon_{mt}\varepsilon_{jt}) = E(\varepsilon_{mt}\varepsilon_{jt}) = \sigma_{mj} \text{ , for all t} = 1,2..\text{T} \qquad \text{cov}(\varepsilon_{mt}\varepsilon_{js}) = E(\varepsilon_{mt}\varepsilon_{ms}) = 0 \qquad \text{for t} \neq \text{s}.$$

Empirical model

- Parameters are short-run elasticities
- When all regressors are the same => OLS and SUR are identical
- SUR model is estimated by two-step feasible generalized Least squares (FGLS) estimator

data


Major winter resorts
Winter resorts, cities
Ski resorts; number of slopes
1 - 9
10 - 24
25 - 49
50 +
National boundary
Regional boundary
1. Jämtland
2. Gävleborg
3. Dalarna
TROMSØ
NARVIK
Riksgränsen
Björkliden
KIRUNA
Saariselkä
Pallas
Levi
Olos
Luosto
Salla
Ylläs
Pyhä
Ruka
ROVANIEMI
KEMI
Iso-Syöte
Hemavan - Tärnaby
Paljakka
Vuokatti
Grong
Storlien
Are
TRONDHEIM
Bydalsfjällen
Funäsdalen
Oppdal
Björli
Vemdalen
Stranda
Lofsdalen
Idrefjällen
Järvsö
Tahko
Himos
Messilä
Gala
Kvitfjell
Skei
Vassfjellet
Beitostølen
Trysil
Sälen
Hafjell
Hemsedal
Branäs
Kungsberget
Voss
Gol
LILLEHAMMER
Kläppen
Bjursås
Geilo
Al
Nesbyen
Romme Alpin
Eikedalen
Uvdal
Norefjell
Rauland
Gb*
OSLO
Haukelifjell
Lifjell
Hovden
Vrådal
KONGSBERG
Gautefall
Sirdal
* Gaustabåkk
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200 km
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Data

- monthly data on lift ticket sales (net of value added tax) in constant prices: SLAO
- GDP in constant prices and CPI: Statistics Sweden
- deflator for lift ticket sales: lift ticket sales in nominal prices/lift ticket sales in constant prices
- snow depth based on three weather stations from SMHI (Storlien-Visjövalen, Särna and Nornas)
- ski lift ticket sales for March and April-May are heavily influenced by timing of Easter holidays
- sample period starts with the 1993/1994 season
- Ski resorts in provinces (counties) of Dalarna, Gävleborg and Jämtland 80 per cent of market and of major importance for local economy

Descriptive statistics

	Mean	standard deviation	min.	max.
monthly data	percentage ch. in lift ticket sales in const. prices to the same month in the previous year			
Nov-Dec	2.4	22.1	-37.6	62.3
Jan	1.5	10.5	-16.1	25.9
Feb	1.6	7.6	-14.6	18.3
Mar	0.4	17.0	-25.6	28.8
Apr-May	-1.4	34.5	-57.4	73.5
	Change in log snow depth in percent to the same month in the previous year			
Nov-Dec	-3.5	71.4	-147.1	155.5
Jan	-1.8	37.1	-61.9	73.2
Feb	-1.3	30.0	-50.7	42.1
Mar	-4.0	37.2	-90.4	62.2
Apr-May	-7.0	68.9	-111.5	111.1
annual data:	oth. determinants (percentage ch. to previous yr)			
change in real GDP in percent	2.2	2.7	-5.2	6.4
change in relative prices in percent	2.2	2.1	-2.6	5.5
early Easter multiplied by 100	38.1			

Empirical results

- Breusch–Pagan test of independence of the residuals: H0 is rejected=>SUR more efficient than OLS
- R2 of the equations ranges between 0.10 and 0.34 with an average of 0.25
- real GDP growth significant and positive
- relative prices of ski lift tickets are significant and negative
- average snow depth is significant and positive in the early winter months of November-December and January
- snow depth is not significant for the mid-season months and for the late season
- time scale of weather data is important
- short-run elasticities of lift ticket sales with respect to snow depth are 0.14 for November to December and 0.11 for January.

Empirical results

SUR estimates of the determinants of growth of lift ticket sales

dep. var.: year to year change in lift ticket sales (compared to the same month in the previous year

	Nov-Dec			January		
	coeff.		t	coeff.		t
change in log av. snow depth	0.14	**	2.50	0.11	***	2.95
change in log GDP in constant prices	0.88	***	3.37	0.88	***	3.37
change in (deflator lift ticket sales/CPI)	-0.68	**	-2.03	-0.68	**	-2.03
dummy time period 2010-11 to 2013-14	-0.08	***	-4.28	-0.08	***	-4.28
Constant	0.04		0.90	0.03		1.22
	February					
	coeff.		t			
change in log av. snow depth	0.05		1.07			
change in log GDP in constant prices	0.88	***	3.37			
change in (deflator lift ticket sales/CPI)	-0.68	**	-2.03			
dummy time period 2010-11 to 2013-14	-0.08	***	-4.28			
Constant	0.03		1.29			

Empirical results

SUR estimates of the determinants of growth of lift ticket sales

dep. var.: year to year change in lift ticket sales (compared to the same month in the previous year

	March			April-May		
	coeff.		t	coeff.		t
change in log av. snow depth	-0.03		-0.76	-0.04		-0.69
change in log GDP in constant prices	0.88	***	3.37	0.88	***	3.37
change in (deflator lift ticket sales/CPI)	-0.68	**	-2.03	-0.68	**	-2.03
dummy time period 2010-11 to 2013-14	-0.08	***	-4.28	-0.08	***	-4.28
early Easter	0.33	***	12.10	-0.49	***	-5.80
Constant	-0.11	***	-4.60	0.18	***	2.67

Empirical results

- effects are calculated in standard deviation units
- year-to-year variations in natural snow depth in the early winter season are much more important than economic factors

Effects of a change in one standard deviation of the main explanatory variables on the percentage change in lift ticket sales

explanatory variables	one standard deviation change X 100	elast-icity	effect of a one standard deviation increase, percentage p.
change in log snow depth Nov-Dec	68.6	0.14	9.3
change in log snow depth Jan	40.3	0.11	4.6
change in log GDP const. prices	2.7	0.88	2.3
change in log relative prices	2.3	-0.68	-1.5

Conclusions and implications

- lift ticket sales depend negatively on lift ticket prices and positively on real GDP
- income and price elasticities are quite low in absolute terms
- decline in snow depth in the early season has a strong negative impact on lift ticket sales
- effect is much more pronounced than the impact of economic factors
- strong trend decline in lift ticket sales from the season 2010/2011 onwards
- future prospects for Swedish ski lift operators are poor given
  - moderate growth in real domestic income
  - further price increases in lift tickets following huge investments in snow making and new lifts
  - expected increase in green early winter seasons

Conclusions and implications

- implications for stake holders and policy makers
  - attracting a larger group of international skiers
  - More direct flights
- Limitations
  - aggregate time series data
- Future work
  - Similar analysis at the individual ski area level
  - applying the same methodology to other countries
  - accounting for other factors