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Effects of mean temperature on output in diversified Swedish dairy farms.

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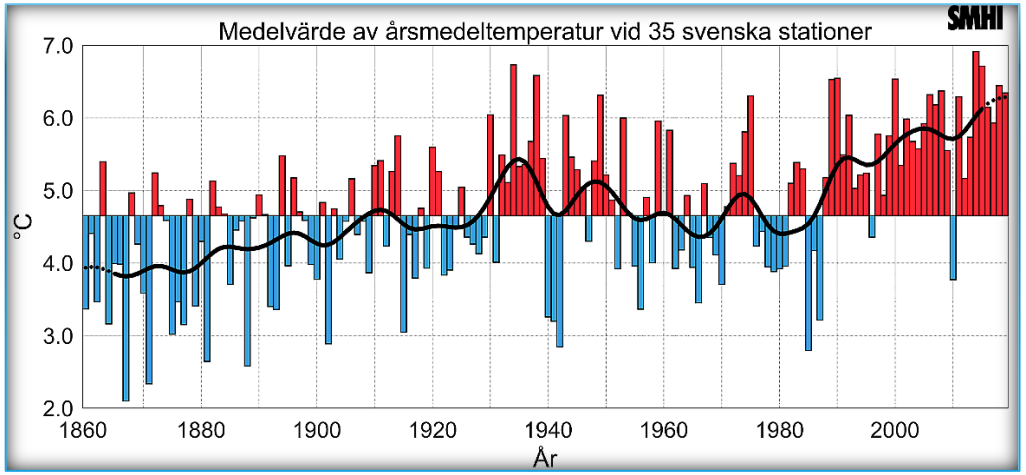
Introduction

- Increased global temperature and its effects
- Heat and cold stress of dairy cows



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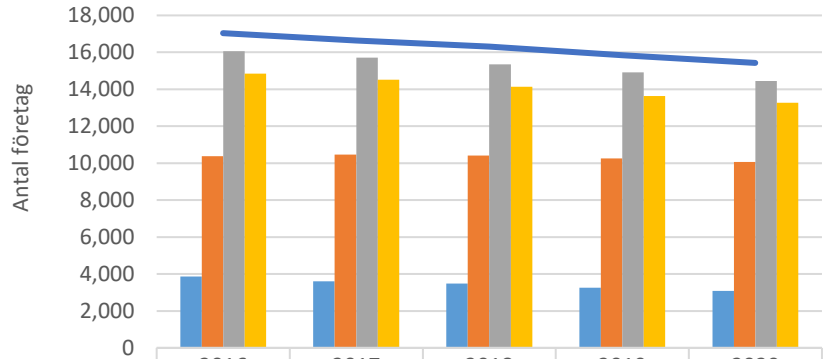
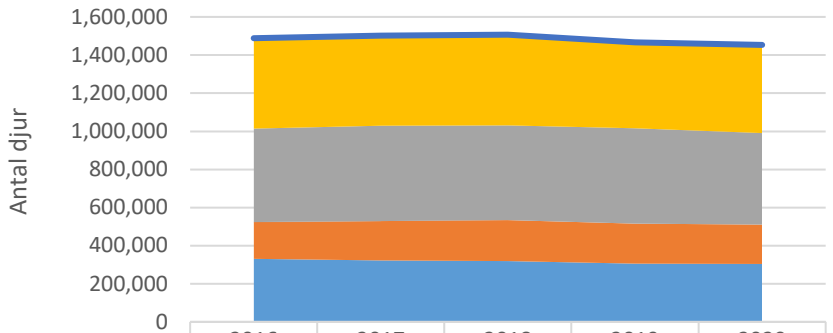
Swedish dairy farms
Diversification
→Under development



	2016	2017	2018	2019	2020
Kor för mjölkproduktion	3,872	3,614	3,477	3,253	3,087
Dikor	10,379	10,471	10,418	10,266	10,063
Kvigor, tjurar och stutar	16,060	15,722	15,343	14,925	14,444
Kalvar under 1 år	14,839	14,517	14,139	13,630	13,266
Totalt	17,046	16,647	16,317	15,851	15,426



	2016	2017	2018	2019	2020
Kalvar under 1 år	475,917	472,159	474,817	450,630	462,149
Kvigor, tjurar och stutar	489,217	499,556	498,176	500,009	480,493
Dikor	193,657	207,620	214,257	210,086	206,950
Kor för mjölkproduktion	330,833	322,010	319,387	305,570	303,390
Totalt	1,488,904	1,501,345	1,506,637	1,466,295	1,452,982

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Delimitation & Research question

- Sweden and Swedish dairy farms
- Years: 2005-2016
- Diversification

- *How does mean temperature and income diversification effect output in Swedish dairy farms?*
- *(What effect does income diversification have on possible negative effects on output caused by changes in the mean temperature in Swedish dairy farms?)*

Background

- Dairy production and the effect of temperature

Key et al. (2014)
Qi et al. (2015)
André et al. (2011)

- Diversification

Gardner et al. (2019)

Barbieri and Mahoney (2009)

Birthal & Hazrana (2019)

and more..

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Model

- Base in production economics (Cobb-Douglas vs. Translog)

$$lny = \beta_0 + \theta_1 t + \theta_2 t^2 + \sum_{n=1}^{N} \beta_n \, lnx_n + \frac{1}{2} \sum_{n=1}^{N} \sum_{m=1}^{N} \beta_{nm} \, lnx_n lnx_m$$

$$\frac{\partial lny}{\partial t} = \theta_1 + 2\theta_2 t$$

- Stochastic frontier analysis

- Simpsons Index

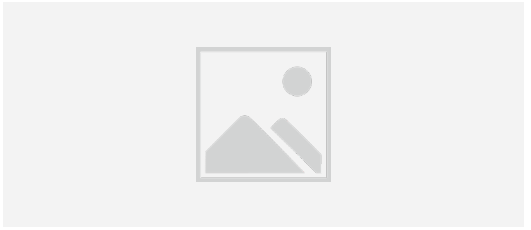
$$SID = 1 - \sum_{i=1}^{n} P_i^2$$

Data

Temperature

- The temperature data used in the regressions are from Swedish Metrological and Hydrological Institute between 2000-2016.
- The data are in means and divided into seasons of winter (December, January, February), spring (March, April, May), summer (June, July, August) and autumn (September, October, November).
- The collected data are from 35 weather stations spread all over Sweden.

Winter



Summer

Autumn

Spring

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FADN-Data

- The data used for all variables besides temperature, originates from the Farm Accountancy Data Network (FADN)
- Between 2005 – 2016
- 684 dairy farms

VARIABLES	Number of obs.	Mean
Output milk *(y)*	3,947	5635
Cows *(x1)*	3,947	65.46
Land *(x2)*	3,947	116.9
Labor *(x3)*	3,947	2.961
Intermediate cost *(x4)*	3,947	237,470
Fixed cost *(x5)*	3,947	795,546
SID	3,947	0.0356
MTempWinter	3,947	-3.008
MTempSpring	3,947	4.596
MTempSummer	3,947	15.44
MTempAutumn	3,947	6.660

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Variables

- **Dependent variable:**

- Milk production

- **Conventional inputs:**

- Cows
- Land
- Labour
- Intermediate cost
- Fixed costs

- **Simpsons index (SID)**

- Tourism (from 2014)
- Other products and incomes
- Renewable energy (from 2014)
- Sales of dairy
- Processing of dairy

- **Other explanatory variables:**

- Temperature
- Organic production
- Less favoured areas

- **Interaction term**

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Results

VARIABLES	Elasticities Coff.	SE
MTempAutumn	0.0688*	(0.0352)
MTempWinter	-0.0118*	(0.00716)
MTempSpring	-0.0533**	(0.0216)
MTempSummer	-0.139	(0.140)
MTempAutumnSID	-0.0396***	(0.0151)
MTempWinterSID	-0.00372	(0.00328)
MTempSpringSID	0.00182	(0.00886)
MTempSummerSID	0.0141	(0.0564)
SID	0.00930	(0.0555)
Observations	3,947	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

$$
\begin{aligned}
&lny_i \\
&= \beta_0 + \sum_{n=1}^{5} \beta_n \, lnx_{ni} + \frac{1}{2}\sum_{n=1}^{5}\sum_{m=1}^{5} \beta_{nm} \, lnx_{ni} lnx_{mi} + \delta_1 (MTempAutumn) \\
&+ \delta_2 (MTempSpring) + \delta_3 (MTempSummer)_i + \delta_4 \, (MTempWinter)_i \\
&+ \delta_5 (MTempAutumnSID)_i + \delta_6 (MTempSpringSID)_i + \delta_7 (MTempSummerSID)_i \\
&+ \delta_8 (MTempWinterSID)_i + \delta_9 (SID)_i + \gamma_1 (DummyLFA)_i + \gamma_2 (DummyOrganic)_i \\
&+ \theta_1 \ln t_i + \theta_2 \ln t_i{}^2 + v_i - u_i
\end{aligned}
$$

$i = entity, in\ this\ case\ farms$

VARIABLES	MODEL I Coff.	SE
lnx1(Cows)	0.842***	(0.0153)
lnx2 (Land)	0.00656	(0.0123)
lnx3 (Labor)	0.0226*	(0.0129)
lnx4 (Intermidiatecost)	0.0788***	(0.0102)
lnx5 (Fixedcost)	0.0917***	(0.0110)
lnx1Sq	0.244***	(0.0259)
lnx2Sq	-0.0215***	(0.00631)
lnx3Sq	-0.00166	(0.0258)
lnx4Sq	0.0472***	(0.0153)
lnx5Sq	0.0135	(0.0149)
lnx1x2	-0.175***	(0.0254)
lnx1x3	0.0295	(0.0348)
lnx1x4	-0.101***	(0.0194)
lnx1x5	0.0133	(0.0191)
lnx2x3	0.0203	(0.0257)
lnx2x4	0.0587***	(0.0158)
lnx2x5	0.0529***	(0.0144)
lnx3x4	-0.0123	(0.0187)
lnx3x5	-0.0425**	(0.0169)
lnx4x5	-0.0254**	(0.0108)
MTempAutumn	0.0688*	(0.0352)
MTempWinter	-0.0118*	(0.00716)
MTempSpring	-0.0533**	(0.0216)
MTempSummer	-0.139	(0.140)
MTempAutumnSID	-0.0396***	(0.0151)
MTempWinterSID	-0.00372	(0.00328)
MTempSpringSID	0.00182	(0.00886)
MTempSummerSID	0.0141	(0.0564)
SID	0.00930	(0.0555)
DummyLFA	0.0228**	(0.00917)
DummyOrganic	-0.0987***	(0.00949)
lnt	0.135***	(0.0244)
lntSQ	-0.0492***	(0.00914)
Usigma	-2.451***	(0.0440)
Vsigma	4.175***	(0.0567)
Constant	0.322**	(0.130)
Observations	3,947	

Standard errors in parentheses
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Weaknesses

- More data is needed
- Further development

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Thank you!

Questions?