DISTRIBUTION OF BEEF CATTLE IN SCOTLAND: HOW IMPORTANT IS AGRICULTURAL POLICY?

SAC

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Presentation to

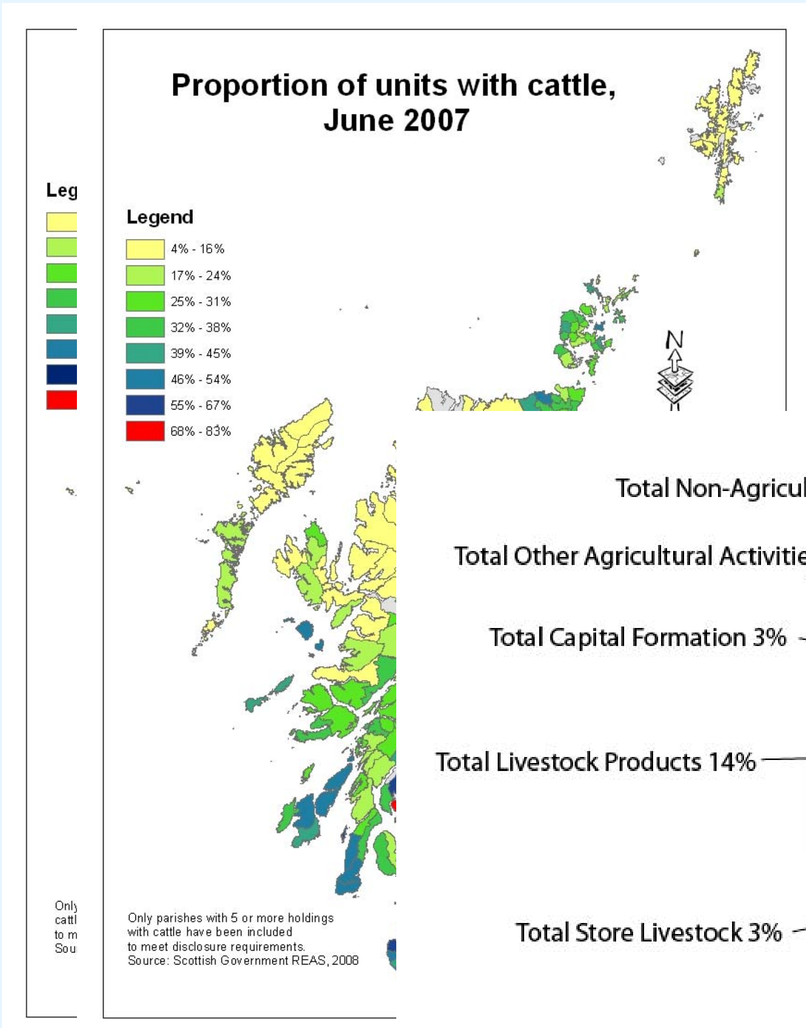
Outline

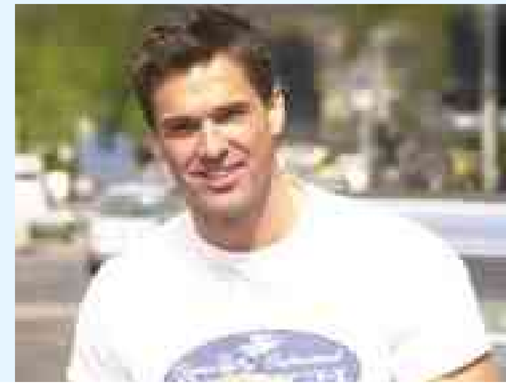
- Motivation
- Background
- Methods
- Results
- Further Developments

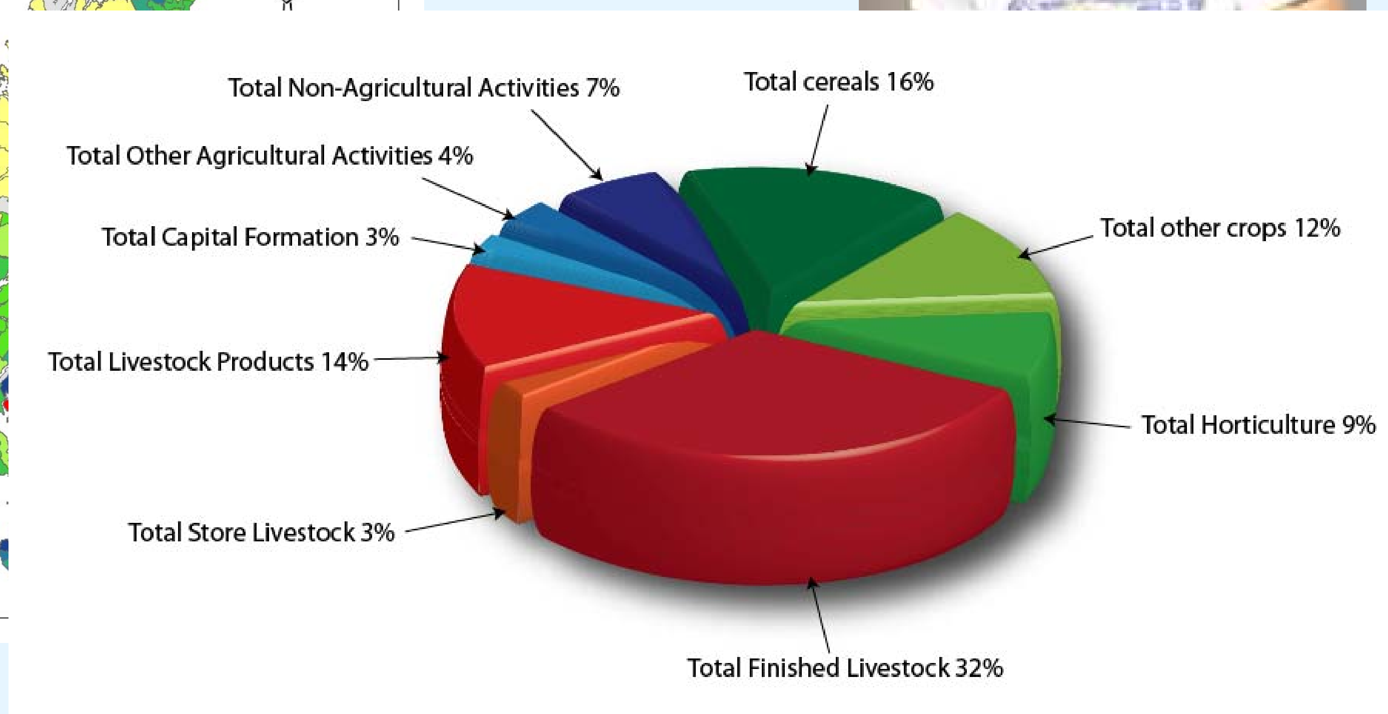
Motivation

- Interest in sustainability of farming systems in Scotland but also their resilience – particular interest in food security debate
- Extensive discussion about impact of 2005 reforms on Scottish agriculture but also looking ahead to further reforms post 2013
- Interesting exercise to look back over time and examine impact of policy changes as may give us some indication of future impacts

Scottish cattle industry



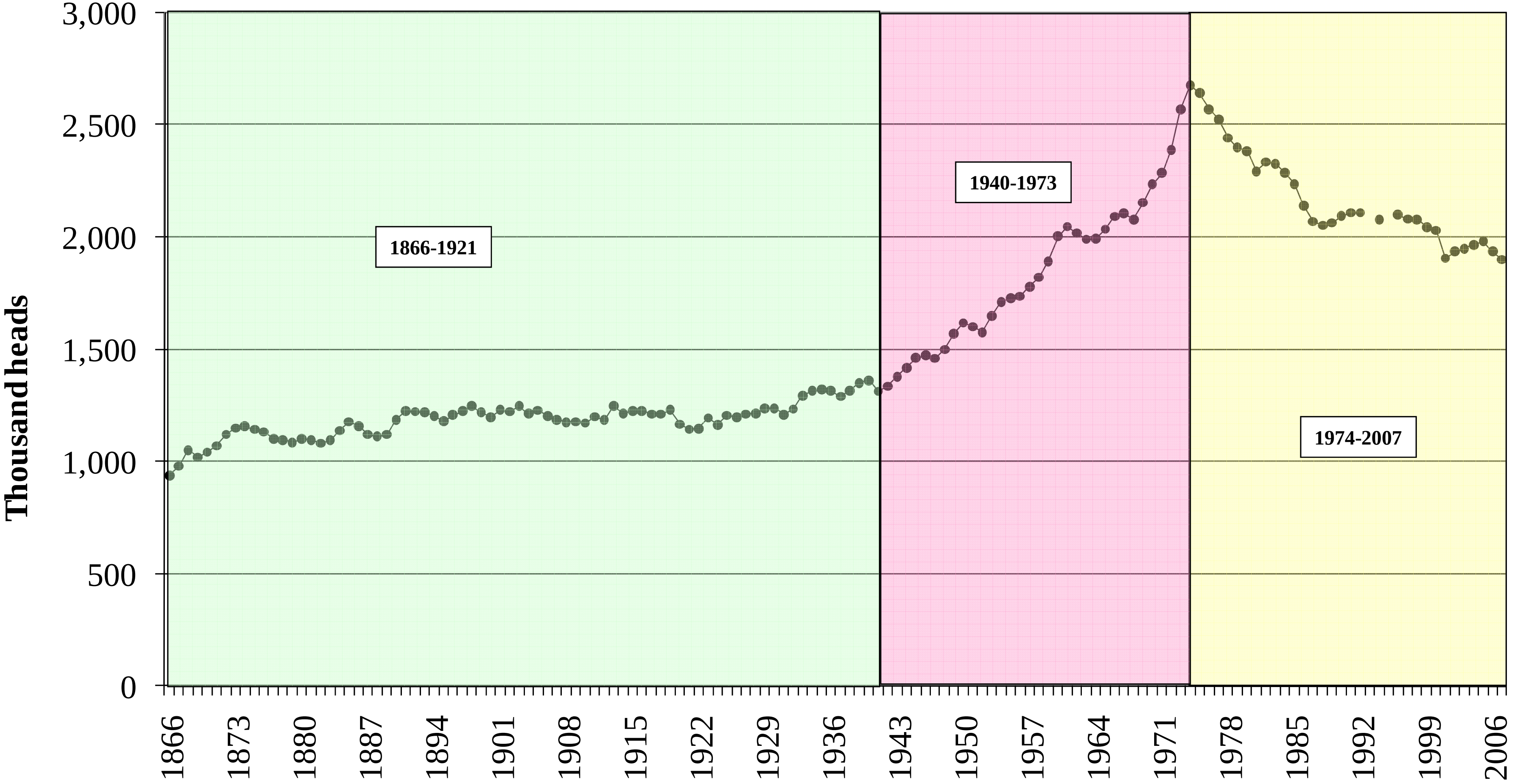




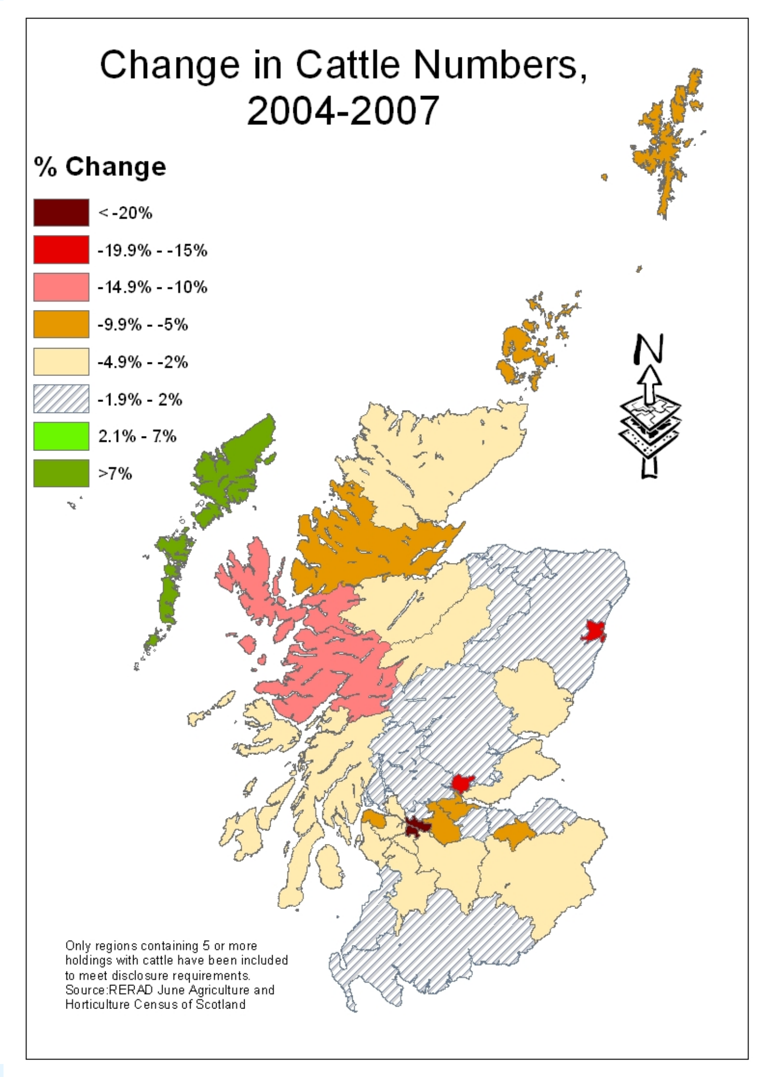
- Considerable discussion in Scotland about need to maintain capacity
  - Raises a number of questions but if livestock disappear will the capacity disappear too?
    - Loss of stock
    - Loss of skills
    - etc

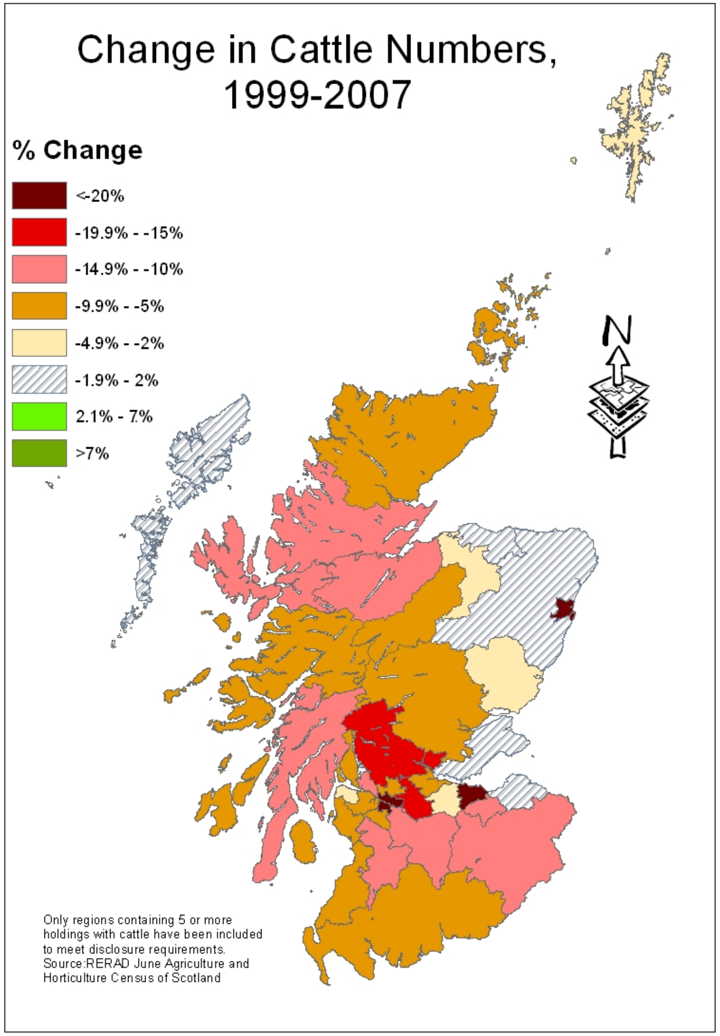
- Therefore interest in the resilience of the Scottish livestock sector
  - Various definitions of resilience
- Also interest particularly since decoupling on impact on environment and possible land abandonment
  - Greater interest in spatial impacts of policy in Scotland

Cattle numbers 1866-2007



Variations in Time and Space



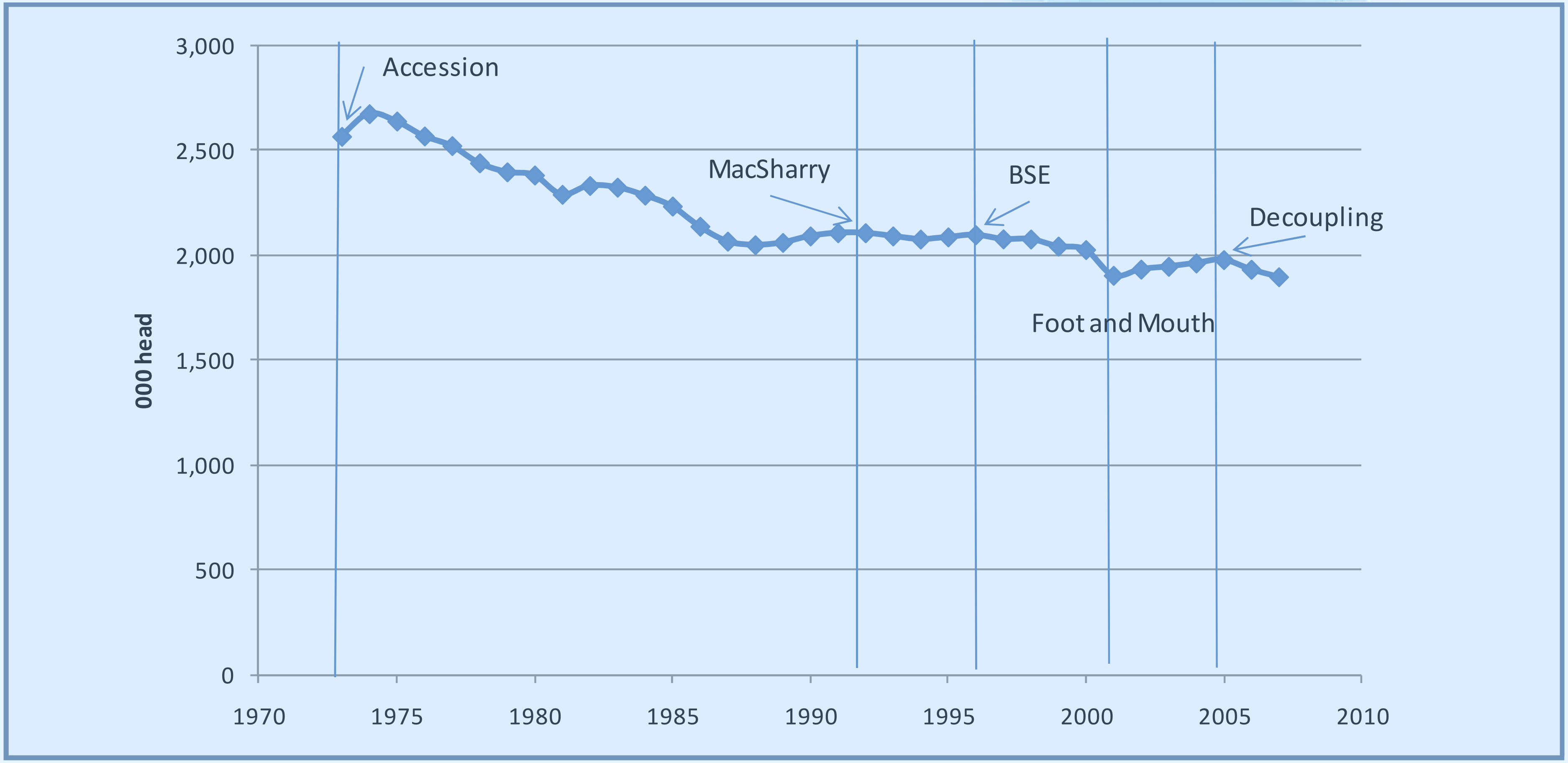

Change in Cattle Numbers, 1999-2007
% Change
<-20%
-19.9% - -15%
-14.9% - -10%
-9.9% - -5%
-4.9% - -2%
-1.9% - 2%
2.1% - 7%
>7%
N
Only regions containing 5 or more holdings with cattle have been included to meet disclosure requirements.
Source:RERAD June Agriculture and Horticulture Census of Scotland

- This paper presents preliminary analysis of whether the reaction to policy changes is similar across Scotland
- By undertaking a regional analysis

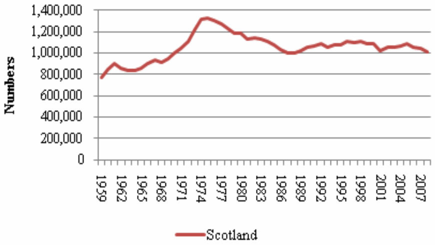
Methods

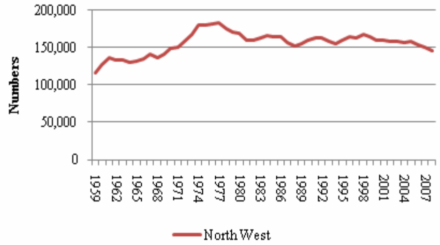
- Data collected from various government sources from 1959
- Definitions of regions and cattle classifications have changed over time
  - 11 regions were used
  - Certain categories were taken out

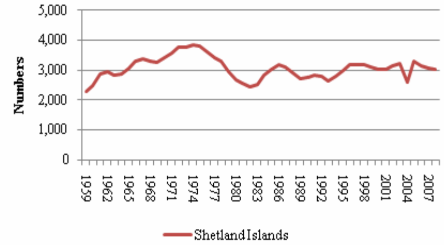
Policy Variables added

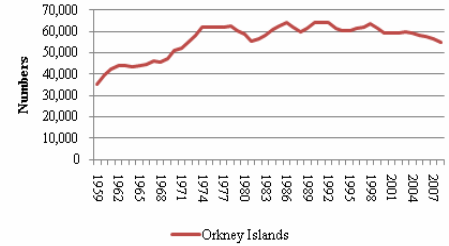


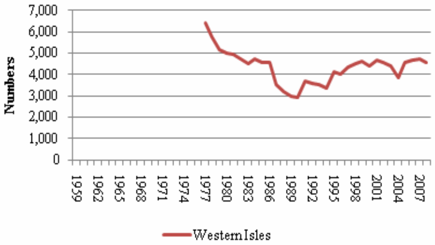
What does our data look like?

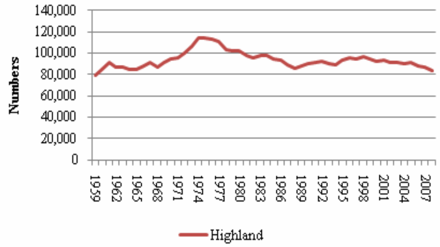


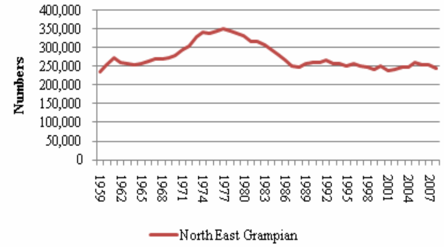


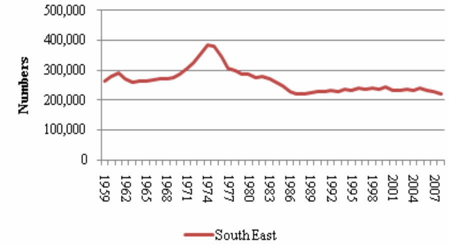


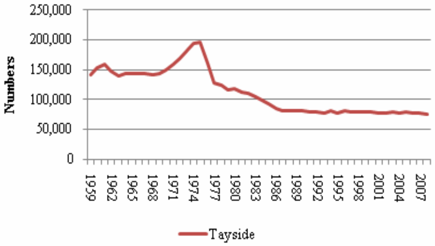


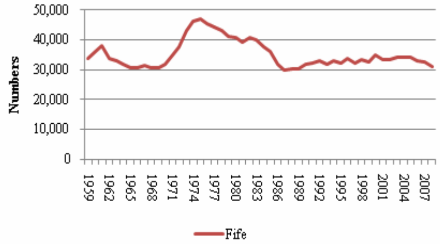


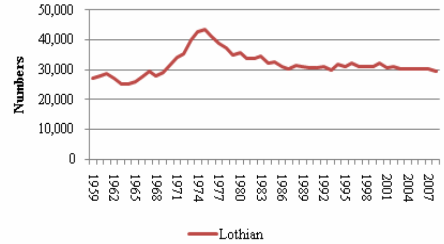


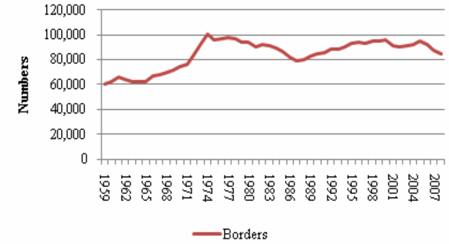


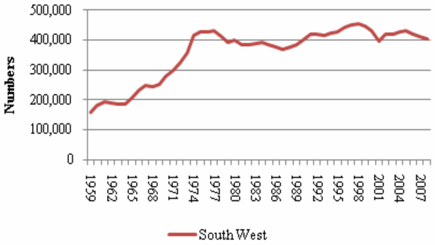


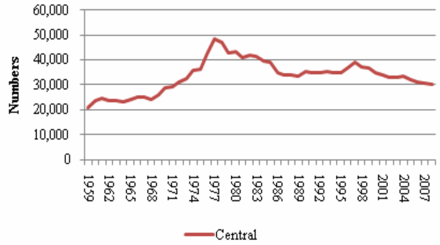


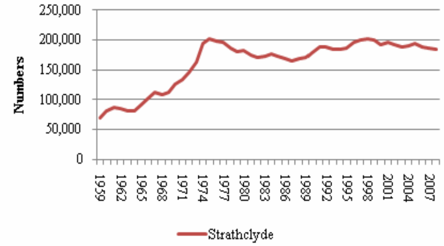


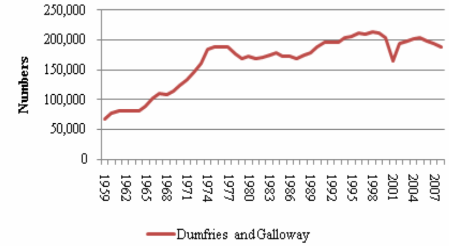












- Simple regression techniques used
- Given the issues of interest chose two models
  - First really to examine whether or not the shares of the cattle numbers across regions has changed as policy has changed
  - Second allows us to consider long term trends and assesses the degree of similarity in way regions evolve over time

Herath et al (2005)

$$(1) \qquad Y_{it} = \sum_{k=1}^{K} \beta_k X_{k,it} + V_i + U_t + \varepsilon_{it}$$

$$i = 1,....,11; t = 1,....,50$$

Where

Y_{it} is the share of beef cattle in region i in year t,

$X_{k,it}$ represent k exogenous variables affecting the share of cattle in region i.

β_k are the coefficients associate with the explanatory variables.

V_i is the time-invariant, unobserved region-specific effect;

U_t is the region-invariant, unobserved time-specific effect and

ε_{it} is the random disturbance term.

Based on Barra and Xala-i-Martin (2001,2002)

$$(2) \qquad y_{it+1} = x_i + (1-\beta) y_{it} + \varepsilon_{it}$$

Where

$y_{it} = \ln\left(Q_{it} / Q_t \right)$ is the natural logarithm of the beef cattle stock in region i at time t normalised by the mean of the variable in the period.

x_i summarises the determinants of the growth in beef cattle in region i and

ε_{it} is the independent and identically distributed random disturbance term.

Equation (2) can also be written in terms of first differences as in (3)

$$(3) \qquad \Delta y_{it} = x_i + \beta y_{it} + \varepsilon_{it}$$

Where $\Delta y_{it} = y_{it+1} - y_{it}$ is approximately equal to the growth rate of the beef cattle stock in region i, measured in deviation from the average growth of the sample.

$$(4) \qquad y^*{}_i = \frac{x_i}{\beta}$$

Steady state value is given by (4):

Taking expectations for both sides of (2), given initial conditions y_{i0} we get the non-stochastic equation in expected beef cattle stock $y^e{}_{it}$ as in (5)

$$(5) \qquad y^e{}_{it} = y^*{}_i + \left(y_{i0} - y^*{}_i\right)(1-\beta)^t$$

Results (1)

Region	Regional Share	Change after Accession
Shetland islands	0.003	-0.001
Orkney islands	0.05	0.005
Highland	0.097	-0.01
North East Grampian	0.292	-0.038
Tayside	0.159	-0.07
Fife	0.037	-0.004
Lothian	0.032	-0.002
Borders	0.075	0.007
Central	0.028	0.005
Strathclyde	0.115	0.051
Dumfries and Galloway	0.113	0.056

	t - stat over 1.5
	t-stat over 2
	t-stat over - 2

550 Observations
$R^2 = 0.9793$
R^2 adj. = 0.9785

Results (2)

- Effectively four sets of results
  - Allowing for fixed effects only
  - Allowing for differences pre and post accession
  - Allowing for differences between regions
  - Allowing for differences between regions and pre and post accession

Region	Deviation	Change after Accession	Convergence
Shetland islands	-0.915	-0.06	0.721
Orkney islands	-0.067	0.01	0.882
Highland	-0.004	-0.003	0.901
North East Grampian	0.028	0.002	0.968
Tayside	0.041	-0.064	0.899
Fife	-0.139	-0.006	0.864
Lothian	-0.363	-0.017	0.662
Borders	-0.026	0.015	0.874
Central	-0.242	0.035	0.794
Strathclyde	0.045	0.011	0.919
Dumfries and Galloway	0.044	0.009	0.93

Steady state values

	2008	Steady state values			
		Model 1	Model 2	Model 3	Model 4
Shetland island	0.033	0.032	0.030	0.032	0.030
Orkney island	0.596	0.624	0.616	0.609	0.616
Highland	0.909	0.911	0.941	0.935	0.937
North East Grampian	2.680	2.658	2.717	2.563	2.538
Tayside	0.808	0.808	0.824	0.565	0.799
Fife	0.339	0.322	0.344	0.347	0.345
Lothian	0.322	0.311	0.320	0.328	0.325
Borders	0.926	0.904	0.920	0.908	0.919
Central	0.329	0.360	0.369	0.353	0.366
Strathclyde	2.002	2.120	1.945	2.086	2.020
Dumfries and Galloway	2.055	2.182	1.988	2.166	2.111

Note: Values are ratios with respect to the mean.

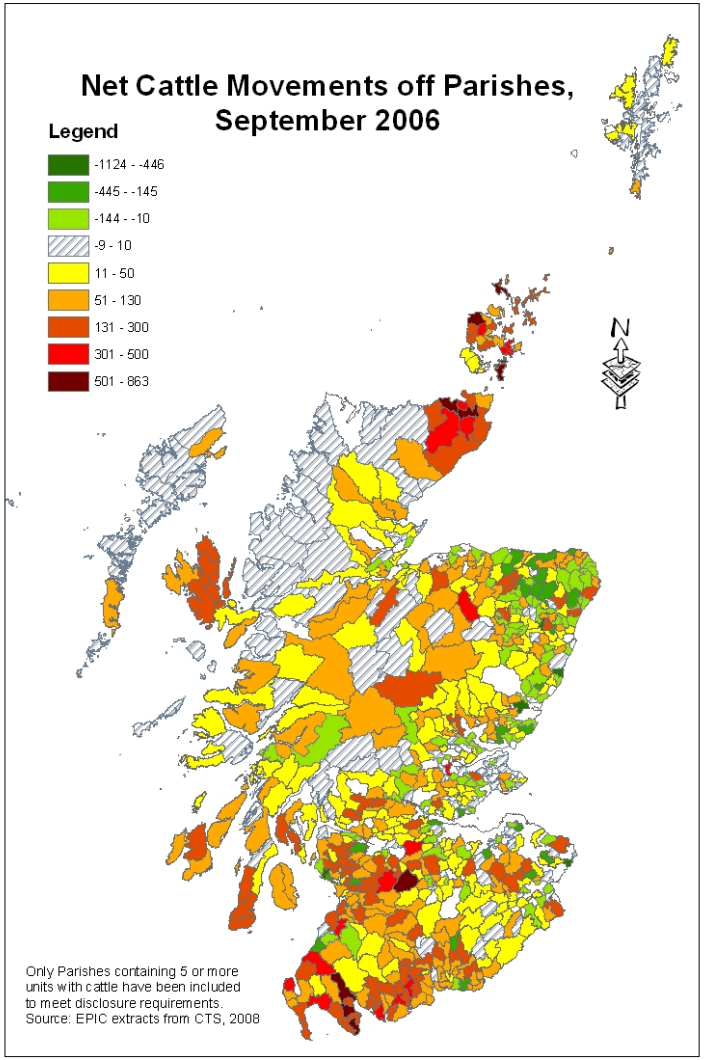
Initial findings

- Aggregated cattle figures for Scotland for more than a century show that cattle numbers react strongly to agricultural policy
- Agricultural policy is an important driver of both trends and structural change and also a source of divergence amongst regions.
- Two major periods: before and after the accession to the European Community. Further reforms not significant?
- Accession implied changes in the regional shares in regions
- In terms of the convergence analysis, accession to the EC affected the steady state values for beef cattle expected for the regions.

Developments

- Preliminary work has looked at changes in numbers
- Issue is the extent to which this has occurred through:
  - downsizing
  - exit from the industry
  - Change in breeds etc
  - Other policy changes – extensification; LFA; SBCS etc

Developments



Source Thomson (2008)

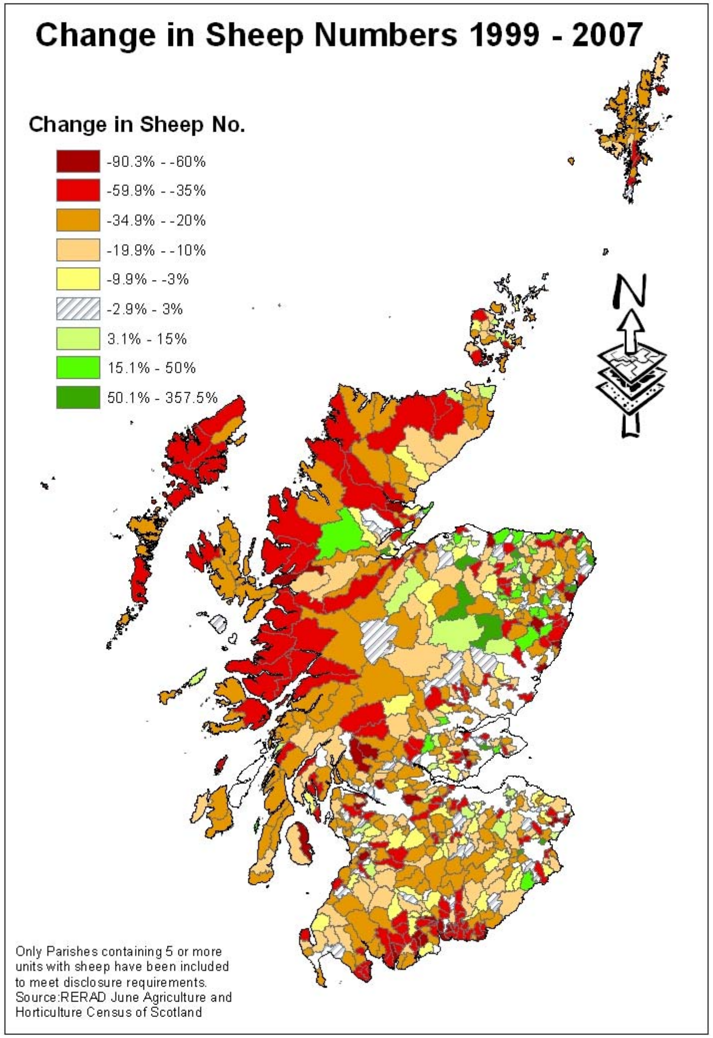
Analysis of change has concentrated on June census figures

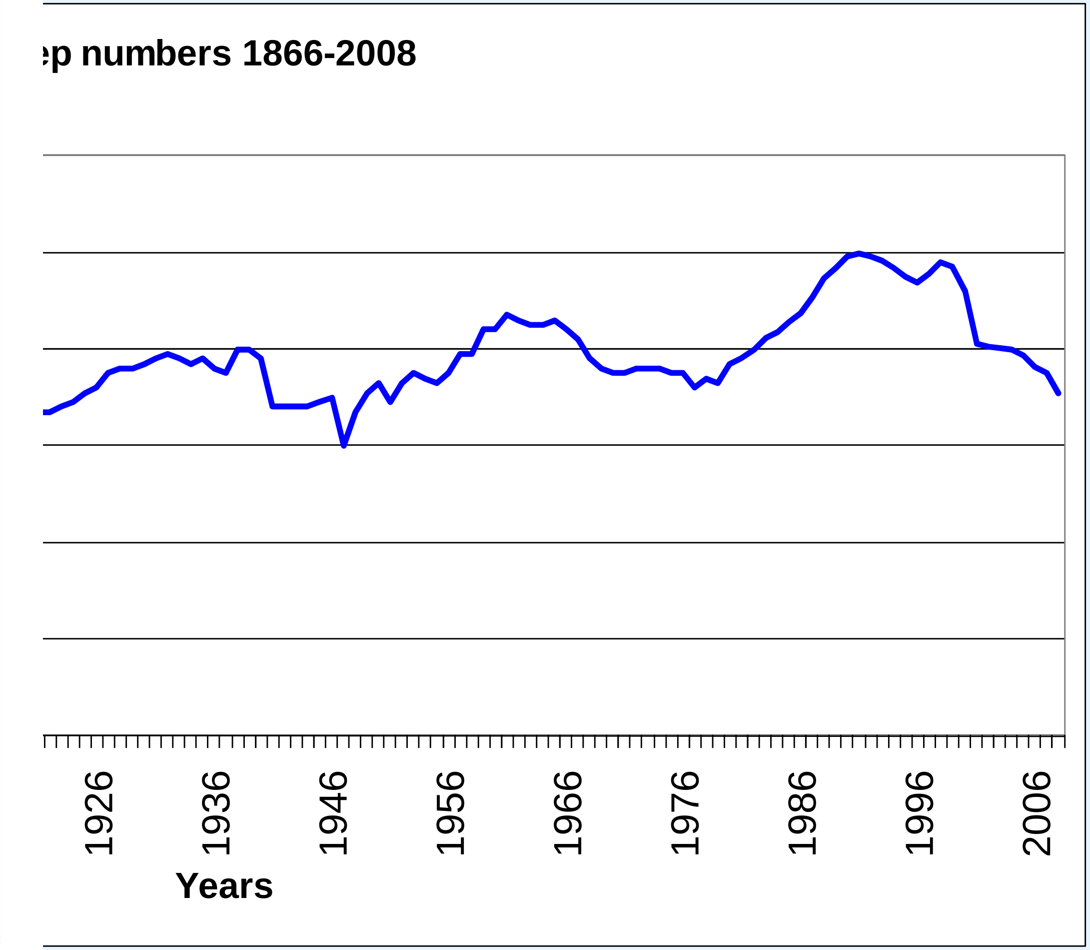
However marked variation within year

That is the cows are not in the same region during the year

How do changes in one region impact on the other?

Sheep and Interactions





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Resilience

- The **engineering** definition of resilience can be summarised as: Resilience is the reciprocal of the time taken for a system to return to its starting state if perturbed. That is, if the system is given a shock at time, *t* and returns to its initial state at time *t+dt*, engineering resilience can be defined as [*t*/(*t*+*dt*)]. Thus as the return time (*dt*) tends to zero the numerator and denominator of the ratio equal *t* and resilience equals 1. As *dt* grows the denominator exceeds *t* and the ratio falls below 1; for large values of *dt* relative to *t*, the ratio becomes very small.
-
- The **ecosystem-based** (or adaptive) definition of resilience can be summarised as follows: Resilience is the size of perturbation (or shock) a system can absorb without changing its internal functioning so that its structure and functions are qualitatively different from those present prior to the shock.