Functional regression to explain the evolution of livestock farms' performances

Ecole doctorale Sciences Pour l'Ingénieur

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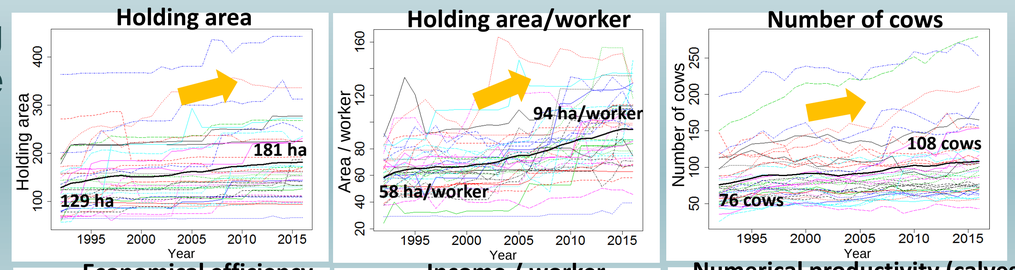
Introduction

French beef farmers have extended their holdings (area and herd) for 30 years whereas their income per worker stagnate (Veysset & al 2014) and their technical efficiency decrease (Veysset & al 2017).

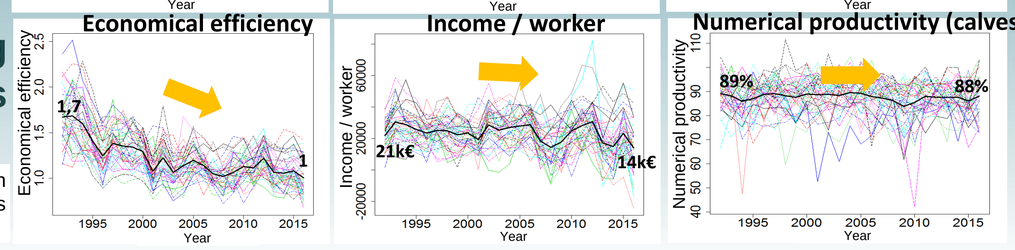
What we observe on 38 holdings from the center of France surveyed between 1992 and 2016 (see figures) :

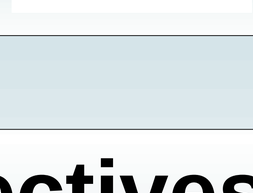
What factors explain the holdings' performances stagnation or decrease ?

Holding size



Holding performances



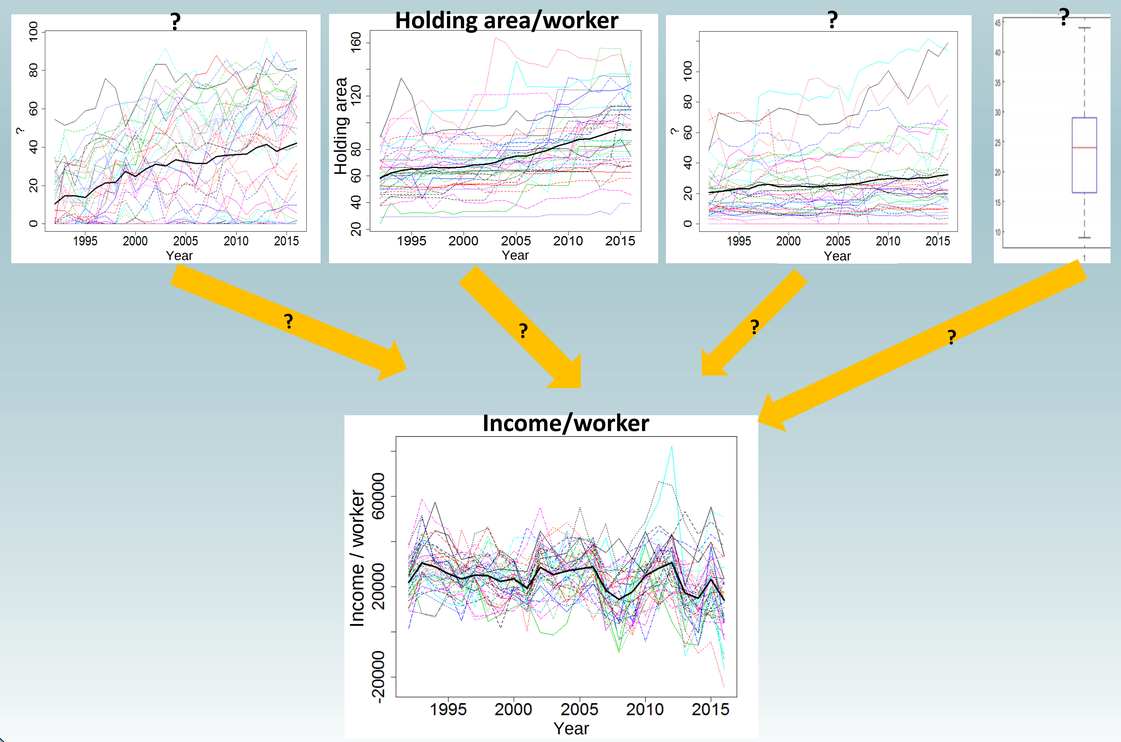


Objectives

Application

Explain the holdings' performances evolution

with the most relevant structural technical or economical static or dynamic characteristics



Modelling

1. **Interpret regression coefficients β(t,s)** in equation

$$Y_i(s) = \int_t \beta(t,s)X_i(t)dt + \varepsilon(s)$$

$\forall\, s \in \{1992, \dots 2016\},\quad i \in \{1, \dots 38\}$ with

- i : holding index
- Y_i : performance evolution for holding i (income/worker) $\rightarrow$ functional response
- X_i : evolution of a characteristic for holding h (area/worker) $\rightarrow$ functional predictor

so that the least squares criteria be penalized while maximizing covariance :

$$\max_{\substack{w,\|w\|=1 \\ c,\|c\|=1}} cov^2\left(\int_t X(t)w(t)dt, \int_t Y(t)c(t)dt\right)$$

with c(t) and w(t) the model's PLS components

2. **Extend to a model with several functional or scalar predictors**

3. **Define criteria for the selection of the best model**

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