MIXED
EFFICIENT AND RESILIENT
MIXED FARMING & AGROFORESTRY

Economic Aspects of Mixed Farming

Frederic Ang (Wageningen University)

Overview

- Stylized facts of mixed farming
- Economic aspects
- Concluding discussion

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 862357

1. Stylized facts of mixed farming

- Lots of definitions!
- Here, we focus on the definition of the Farm Accountancy Data Network (FADN): 33.3%-66.7% crops/livestock output, mixed cropping, mixed livestock
- No agroforestry

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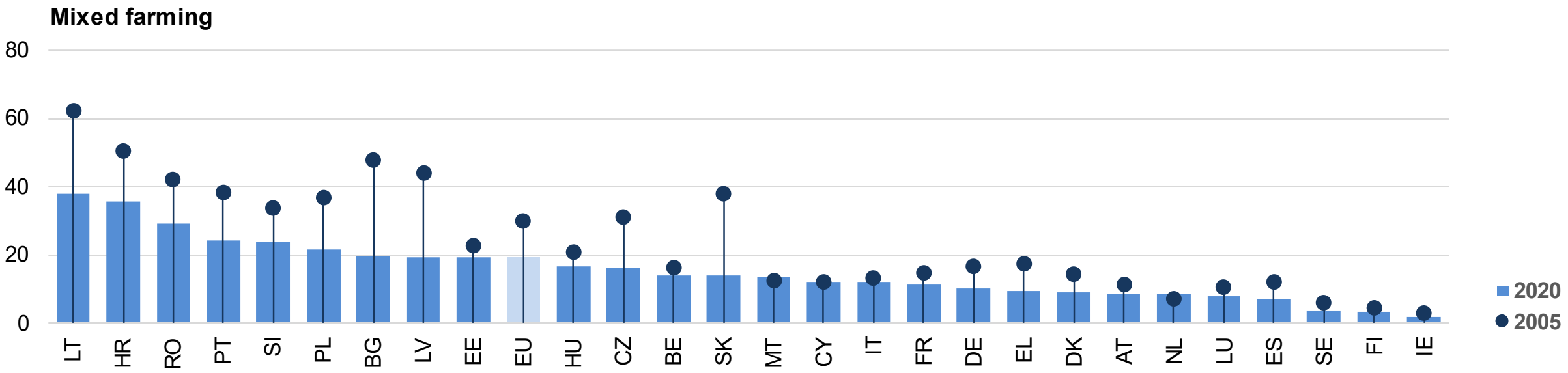
1. Stylized facts of mixed farming

- Share of mixed farms is decreasing over time.



Source: Eurostat

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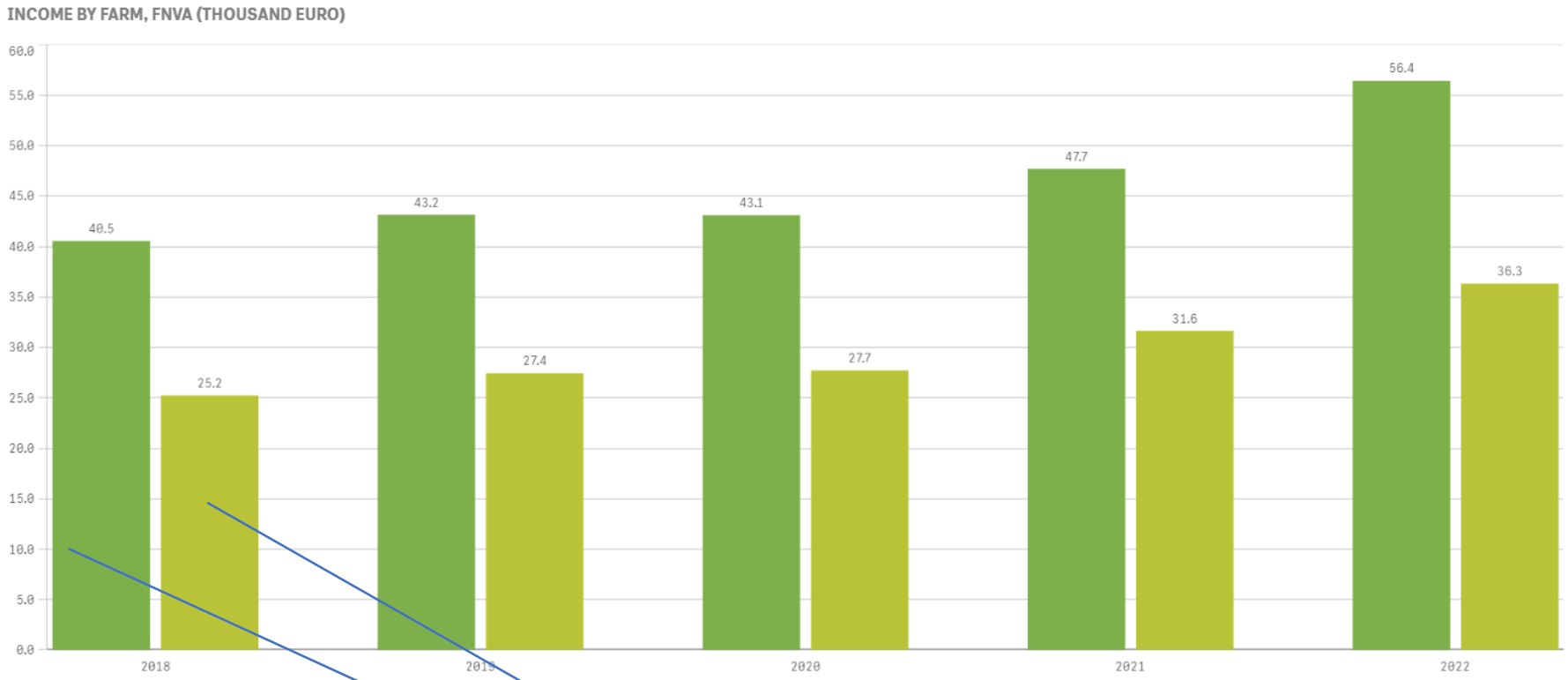
1. Stylized facts of mixed farming

Income of mixed farms is generally lower.



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2. Economic aspects

- Economic reasons for mixed farming:
  - Risk reduction → better resilience
  - Potential efficiency increases through circularity (crop residue as feed for livestock and manure as input for crops)
  - Economies of scope: synergies in input use for more diversified production
- However:
  - Economies of scale: easier management and lower input use for production in specialised farms
- Ultimately, this the economic pros and cons of mixed farming an empirical question. Here, we focus on 3 studies.

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2. Economic aspects

Ang and Kerstens (2016, Journal of Agricultural Economics): How should land use be allocated if one intends to remove inefficiencies?

Empirical application: English and Welsh farm for the years 2007-2013.

Method: data envelopment analysis

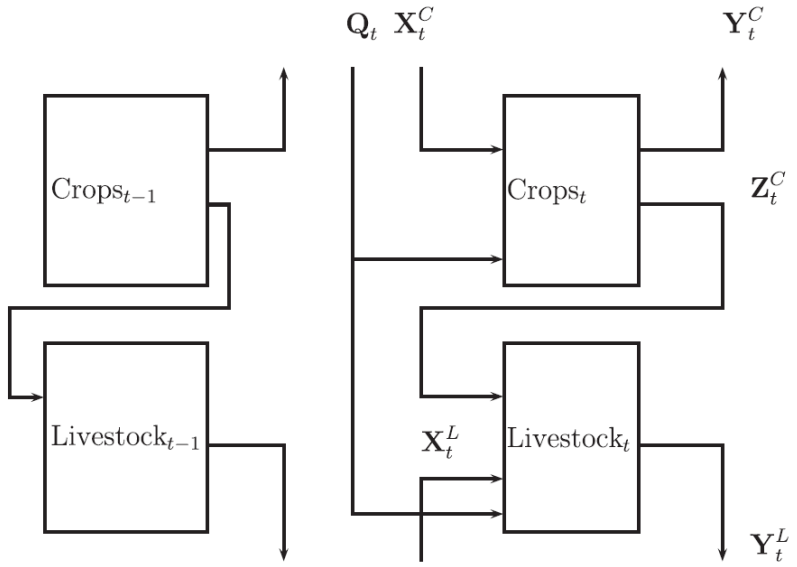

Figure 1. Network structure of the model

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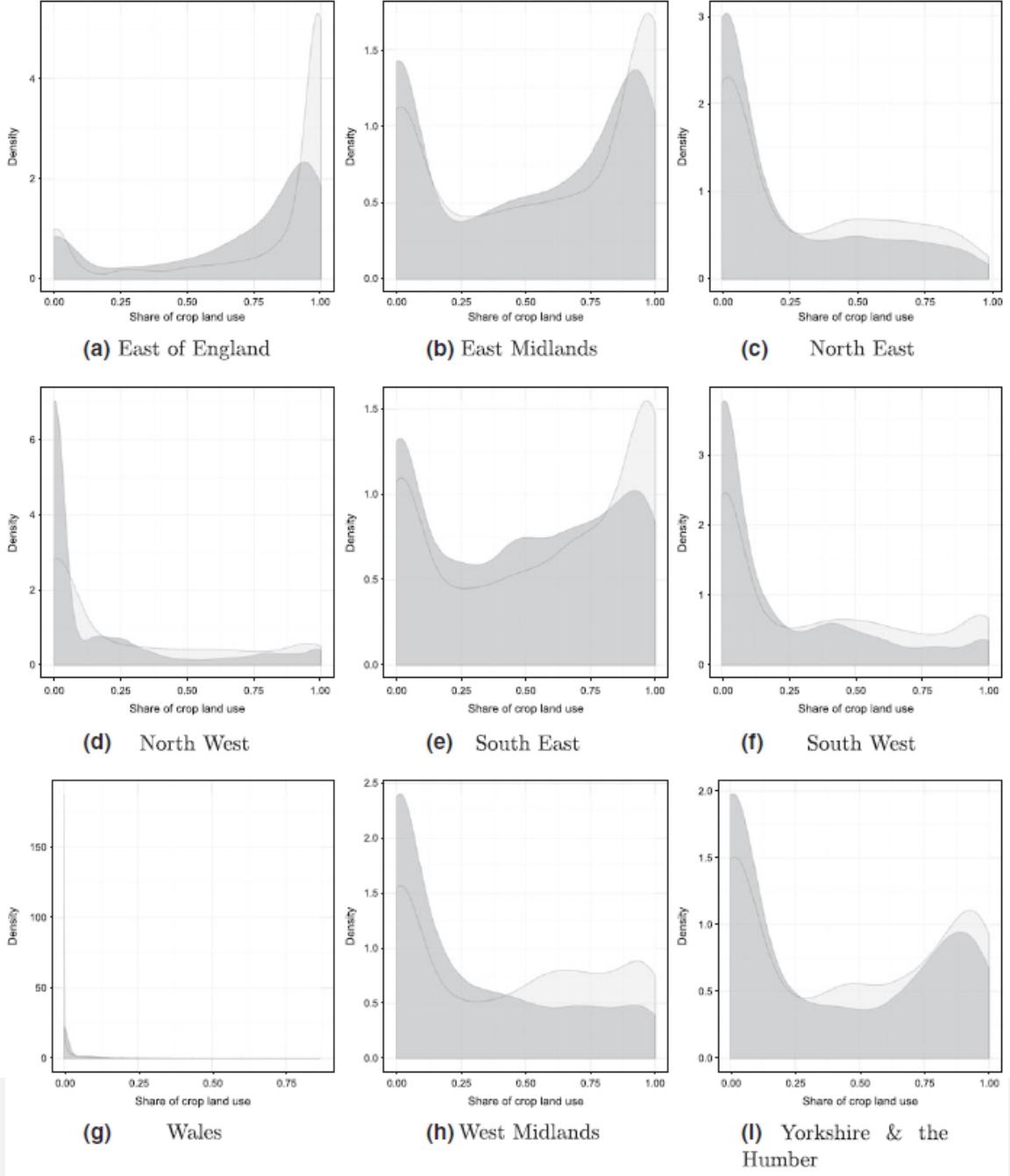

Figure 3. Distribution of optimal (□) and actual (▨) land allocation as a function of the proportion of land allocated to crops.

- More land should be allocated to crops.
- Livestock farms should become more mixed.
- Crop farms should become more specialised.

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2. Economic aspects

De Almeida-Furtado, Ang and Meuwissen (ongoing):

- Specialised practices are more efficient than mixed practices.
- Mixed practices are more resilient (in terms of robustness, adaptability and transformability) than specialised practices.
- Empirical application: 800,000 observations from 25 countries across 11 environmental zones, for the years 2004-2017.
- Method: benchmarking using data envelopment analysis

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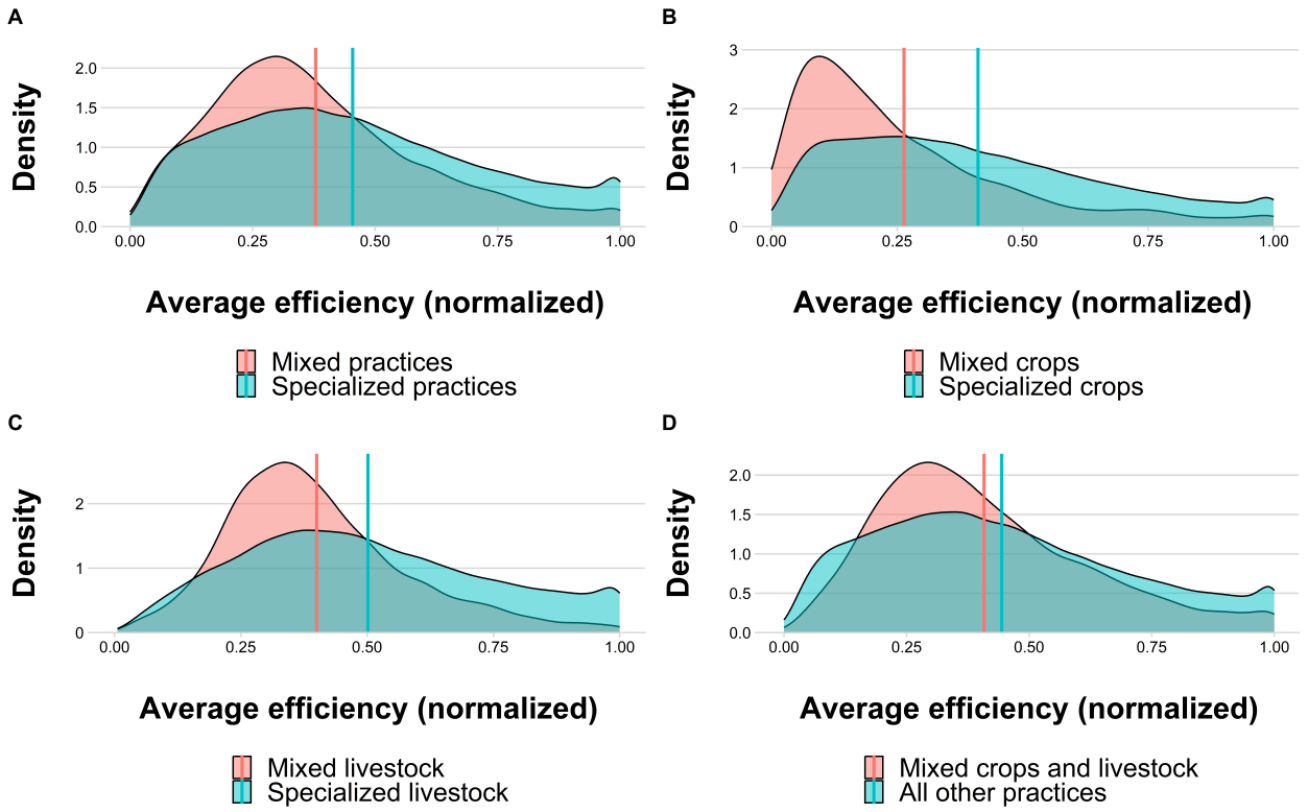
2. Economic aspects



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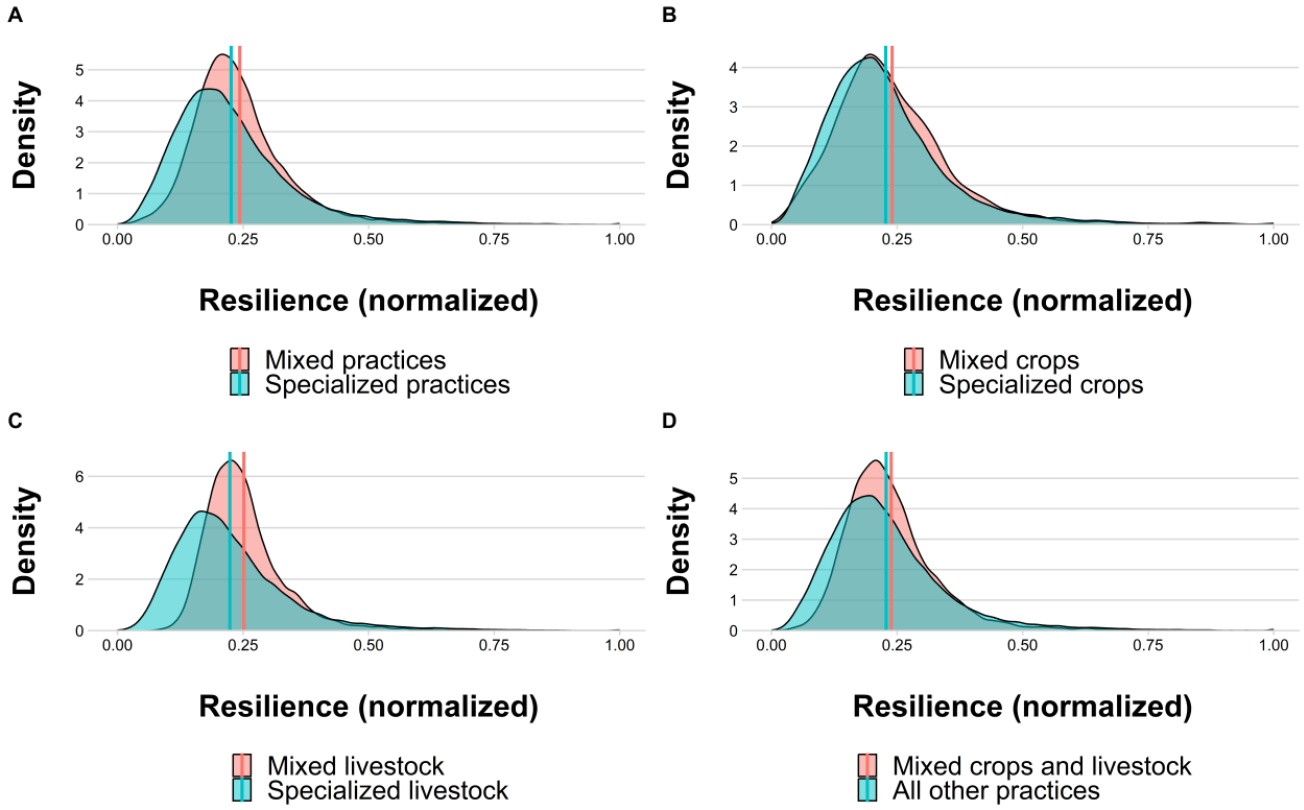

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2. Economic aspects

Low, Dalhaus, Meuwissen and de Mey (ongoing):

- Investigation of the causal effects of switching from specialised farming to mixed crop-livestock farming on farm-level economic indicators.
- Method: DiD model with differential timing and treatment-effect heterogeneity.
- Empirical application: EU data for 2004-2018.

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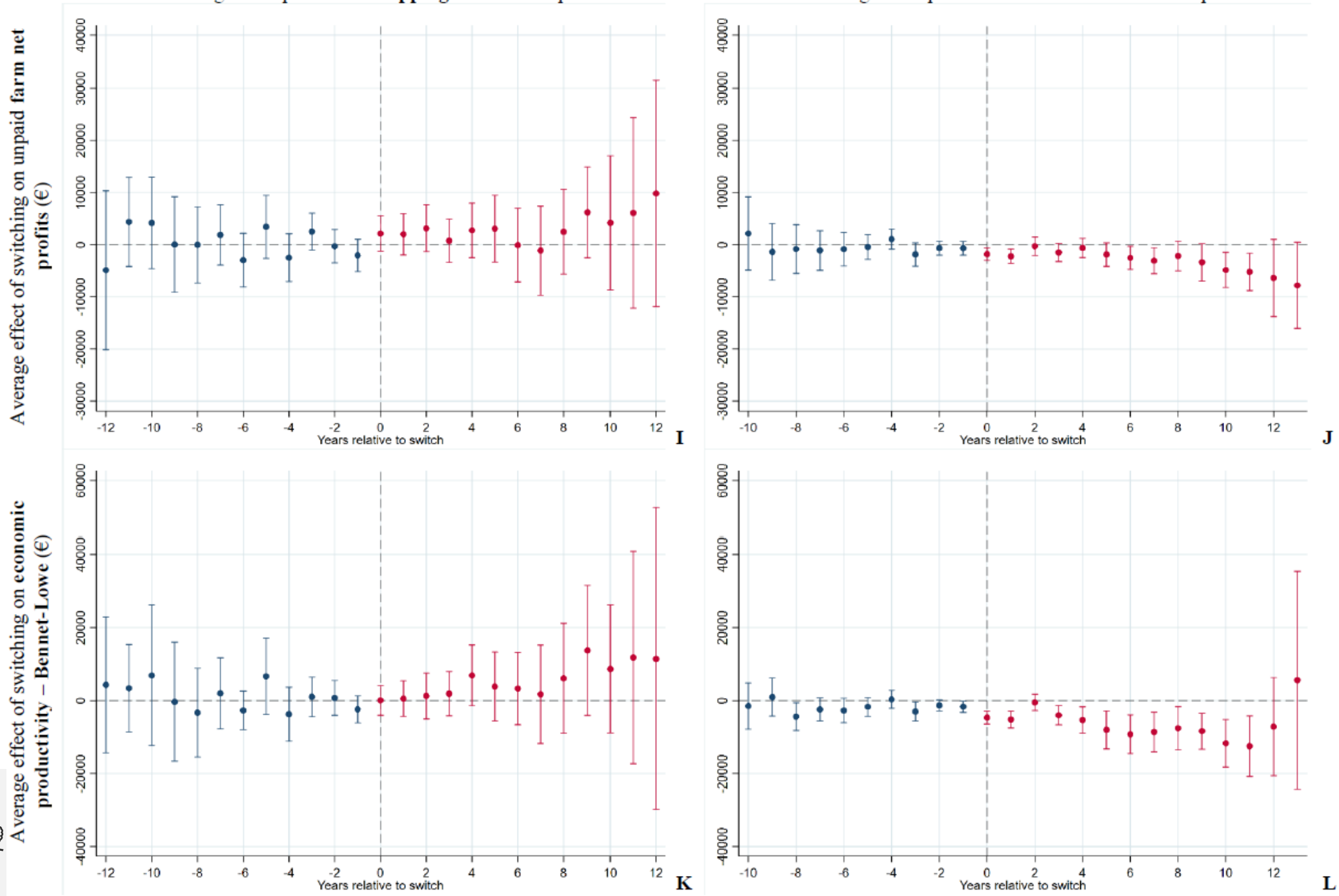
Effect of switching from specialised **cropping** to mixed crop-livestock

Effect of switching from specialised **livestock** to mixed crop-livestock



2. Economic aspects

- Specialised crop switchers: no overall economic effect, more unpaid labour required.
- Specialised livestock switchers: negative overall economic effect (variable costs decrease, but revenues decrease even more).

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3. Concluding discussion

- Economic benefits of mixed agriculture are mixed.
- No consideration of agroforestry.
- No consideration of environmental indicators. However, mixed farming may improve circularity. For instance, Wang, Ang and Oude Lansink (2023, Agricultural Economics) show that there is some potential for Dutch dairy farms to simultaneously increase production and reduce greenhouse gas emissions by becoming more mixed.
- Mixing at higher scales?

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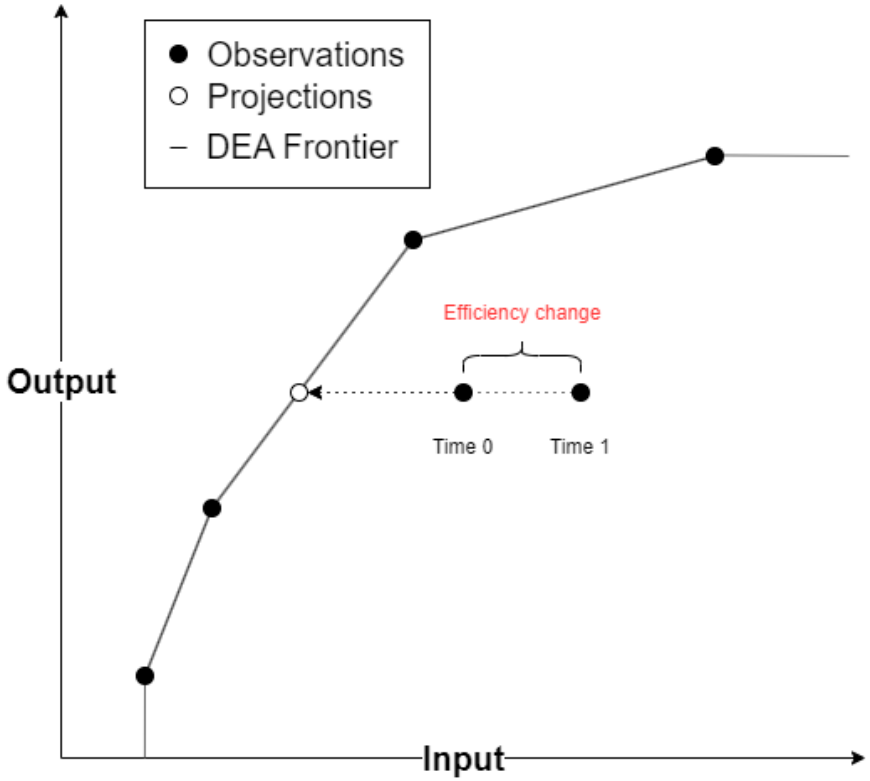
Robustness

- Maintain high levels of efficiency and withstand stresses
- Adapted from Zampieri (2021)

$$\frac{\overline{EFF_{EnZ}}^{2}}{1+\sigma^{2}}$$

a. Robustness



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Adaptability

- Changes that do not affect the main structure and functions of a production system
- Inputs αX

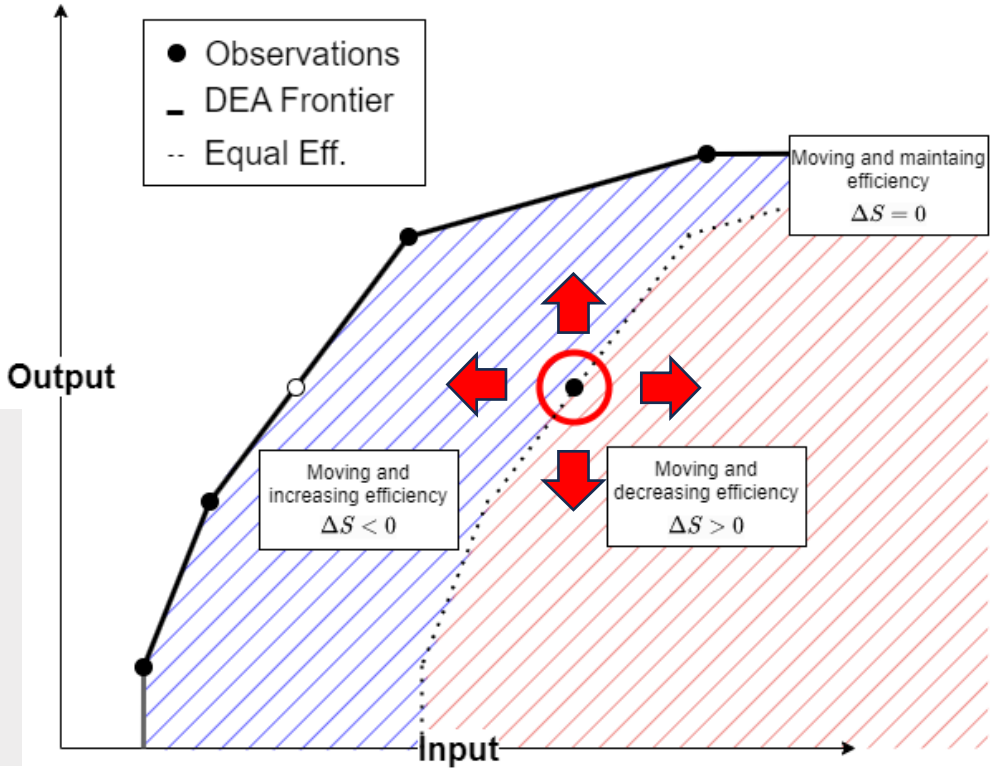
$$\frac{2}{N+E} \times \left(\sum_{n=1}^{N} \frac{|\Delta x_{t,n,k}| - \Delta s_{t,n,k}}{x_{t,n,k} + x_{t-1,n,k}} + \sum_{e=1}^{E} \frac{|\Delta x_{t,e,k}|}{x_{t,e,k} + x_{t-1,e,k}} \right)$$

- Outputs αY

$$\frac{1}{2} \exp\left(- \sum_{s=1}^{S} |\Delta\%L_s| \cdot \ln|\Delta\%L_s| \right)$$

- Relative values to the yearly average
- Combined into one indicator with BoD

b. Adaptability



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Transformability

c. Transformability

- Substantial changes in production characteristics
- New Ys - mean

$$\begin{cases} \exp\left(-\sum_{s=1}^{Y} \Delta\%L_s \times \ln \Delta\%L_s\right), & \%L_{s,t-1} = 0 \; and \; \%L_{s,t} > 0 \\ 0\ , & \%L_{s,t-1} > 0 \end{cases}$$

- Organic transformation – max

$$\begin{cases} 1, & not\ organic \\ 2, & in\ transition\ or\ partial\ production \\ 3, & fully\ organic \end{cases}$$

- Other gainful activities - mean

$$\begin{cases} 1, & no\ other\ gainful\ activities \\ 2, & marginal\ (\leq\ 10\ \%\ of\ turnover) \\ 3, & medium\ (>\ 10\ \%\ to\ \leq\ 50\ \%\ of\ turnover) \\ 4, & important\ (>\ 50\ \%\ to\ <\ 100\ \%\ of\ turnover) \end{cases}$$

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