Generational Renewal and European agriculture: a resilience analysis from agent based simulations

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EAAE Bucharest 2019
Objective:

Analyzing farm and regional resilience using agent-based simulations

1. Resilience of what?
2. Resilience to what?
3. Resilience for what purpose?
4. What resilience capacities?
5. What enhances resilience?
Motivation

• Number of farms decreasing, size of farms increasing

• EU politicians concerned --> stimulate farm generational renewal

• Generational renewal (GR) is defined by the EU as the goal of not only reducing the “average age of farmers in the EU … [but] empowering a new generation of farmers…”

• Since 2007 18.3 billion euros have been dedicated by EU countries (EU Court of Auditors, 2017)

• Lack of tools for Ex Ante GR Policy assessment

• Predominant focus on family farm model despite diverse agricultural sector
Relevant Literature

Generational renewal of family farms
- Suess-Reyes & Feutsch (2016), Lobley and Baker (2012)

“European” farms are family farms

CAP excludes large farms
- Kostov et al. (2018), Gorton et al. (2009)

CAP effects on hired labour

Family labour vs hired labour

Gap: Generational renewal of European farming regions
Model Overview

• The Agricultural Policy Simulator (AgriPoliS) core version (Happe, 2004)

• Agent-based model used to observe and analyze the effects of policies and shocks on farm structural change over time

• Agents: heterogeneous typical farms of a region and auctioneer

• Inputs: Farm structural data, market data, investment options, globals

• Decision making: profit- / income- maximization

• Environment: farms, factor and product markets, and space

• Interactions: markets

• Random variables: farmer age, farm and plot locations, age of investments, managerial ability
Initialize:
Managerial ability
Investments
Farm and locations
Plots and locations
Age of farmer
Markets

Start

Land rental decision

Bid
Result

Investment decisions

Production decisions

Annual accountancy

Farm Future

Illiquid? No

Generational Change? No

Opportunity costs too high? Yes

No

Successor? Yes

No

Exit

Yes

Continue

Yes
Case Study: The Altmark

- Agricultural region located in the former East Germany

- Heterogeneous farms
  - large corporate and small family
  - Arable, grassland, bovine, granivore

- Dependent on qualified hired labour

- Farm Demographic changes:
  - Farm sizes increasing as number of farms decrease
  - Technology complexity increasing
  - Regional exodus
Focus Group Results

• Held November 2018 in the Altmark

• Mixed breadth of participants: corporate farmer, young family farmer, retired family farmer, farm succession consultant

• Semi-structured format: four topics ~1 hour per topic

• Main results: difficulty attracting workers to the sector and region, low pay, increasing demand for skilled workers, outward migration affecting family farms and hired labour
### Generational Renewal Extension

<table>
<thead>
<tr>
<th>Initialization:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Family Farmer’s age</td>
<td>minimum: 30 years</td>
<td>maximum: 70 years</td>
</tr>
<tr>
<td>Corporate Farmer’s age</td>
<td>minimum: 30 years</td>
<td>maximum: 66 years</td>
</tr>
<tr>
<td>Family farmer age distribution</td>
<td>average: 51.5 years</td>
<td>standard deviation: 11.83856</td>
</tr>
<tr>
<td>Corporate farmer age distribution</td>
<td>average: 50.1 years</td>
<td>standard deviation: 11.14596</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Generational Change:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of generational change</td>
<td>67 years</td>
<td></td>
</tr>
<tr>
<td>New farmer’s age</td>
<td>minimum: 30 years</td>
<td>maximum: 45 years</td>
</tr>
<tr>
<td>New farmer’s age distribution</td>
<td>average: 35 years</td>
<td>standard deviation: 1.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Probability of a Successor:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Family farms</td>
<td>75%</td>
</tr>
<tr>
<td>Corporate farms</td>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Farming without a Successor:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum age of farmer with no successor</td>
<td>75 years</td>
<td></td>
</tr>
<tr>
<td>Productivity decrease past generational change age</td>
<td>1%</td>
<td></td>
</tr>
</tbody>
</table>
## Simulation Scenarios

<table>
<thead>
<tr>
<th>Scenario Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference</td>
<td>- Core version of model</td>
</tr>
<tr>
<td></td>
<td>- No differentiation between corporate and family farm managers age distribution</td>
</tr>
<tr>
<td></td>
<td>- Normal distribution of manager ages (35 – 60)</td>
</tr>
<tr>
<td></td>
<td>- 100% presence of successor</td>
</tr>
<tr>
<td></td>
<td>- Generational change at 25 years of operating</td>
</tr>
<tr>
<td></td>
<td>- Farm wages increase at 1.9% annually</td>
</tr>
<tr>
<td></td>
<td>- Off farm wages increase at 2.7% annually</td>
</tr>
<tr>
<td>Wage</td>
<td>- Same as “Reference” except farm wages increase at 2.7% annually as well</td>
</tr>
<tr>
<td>Demographics</td>
<td>- Extended version of the model with demographics input file</td>
</tr>
<tr>
<td></td>
<td>- Wages same as in “Reference”</td>
</tr>
</tbody>
</table>
Number of farms

![Graph showing the number of farms from 2016 to 2040 with three lines representing different scenarios: Reference, Wage, Demographics. The graph indicates a decreasing trend over time.](image-url)
## Operational status

### Farms in 2026 per scenario in %

<table>
<thead>
<tr>
<th>Status</th>
<th>Reference</th>
<th>Wage</th>
<th>Demographics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating</td>
<td>82.3</td>
<td>82.1</td>
<td>79.5</td>
</tr>
<tr>
<td>Closed due to opportunity costs</td>
<td>9.5</td>
<td>9.8</td>
<td>9.8</td>
</tr>
<tr>
<td>Closed due to opportunity costs at generational change</td>
<td>3.5</td>
<td>3.5</td>
<td>0.6</td>
</tr>
<tr>
<td>Closed due to illiquidity</td>
<td>4.7</td>
<td>4.6</td>
<td>5</td>
</tr>
<tr>
<td>Closed due to lack of successor</td>
<td>-</td>
<td>-</td>
<td>5.1</td>
</tr>
</tbody>
</table>
Farms by size class 2026
Workers in region

Year

farm workers

Reference
Wage
Demographics
Workers per farm

Reference
Wage
Demographics
Production choices

Production in 2026

- Dairy cow
- Suckler cow
- Heifers
- Sows (1,000)
- Pigs (1,000)

- Maize
- Rape seed
- Grain
- Root crops
- Grass silage
- Meadows
- Fallow

Reference Wage Demographics
Resilience Analysis (Meuwissen et al., 2019)

Robustness:
Region withstands wage increases for ~8 years before adapting
Region maintains production levels in face of demographic change

Adaptation:
Individual farm level:
Failure to adapt to pressures of structural change: farm exit
  - Illiquidity & opp costs
Regional level:
  - Increasing wage costs: production shifts after ~8 years

Transformation:
No evidence; weakness of model
SURE Farm
Sustainable Resilient EU Farming Systems

Coordinated by:

Partners:

UNIVERSITY OF BERGEN
PRIFYSGOL ABERYSTWYTH UNIVERSITY
INSTITUTE OF KRAKOW AGRICULTURAL DEVELOPMENT
IRWIR PAN
GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN
ETH ZÜRICH

This project has received funds from the European Union’s Horizon 2020 research and innovation programme under Grant Agreement No 727520