

## Smallholder farmers toward the dual transition: where do we stand?

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# Outline

- Few thoughts on dual transition and small farming
- The empirical evidence from Tuscany
  - The survey
  - Profiling farming
  - At the heart of a transition: Traditional vs. complex investments
  - On the way towards dual transition
- Concluding remarks

# Few thoughts on dual transition and small farming- 1

- **Smart farming** will support the **green transition** through the optimization in the use of inputs - with both individual and collective benefits – and the automation of some processes (JRC, 2022)
- Smart farming has to do not only with the introduction of new types of machinery and robotics but also with **data collection and management and previsions based on time series** (Klerkx et al., 2019)
- It is designed as a ***Decision Support System (DSS)***, keeping farmers' knowledge and control of their work central, opposite to the GR (Vieri e Titomanlio, 2014).

# Few thoughts on dual transition and small farming- 2

- However, the debate is lively because it will bring huge and profound changes to the rural world, with farmers adapting to entirely new routines (Brunori, 2022; Rolandi et al., 2021) → **Investments on both physical and human capital**
- **Effects on labor**: displacement or creation of new (better or maybe not) jobs (Rotz et al., 2019)?
- Limits to the use of information due to (Carolan, 2018; 2017):
  - **Intellectual property rights** related to the use of software;
  - Technical constraints related to the effective **usability of data** (in-house absorptive capacity or the ability to buy in skills from outside)

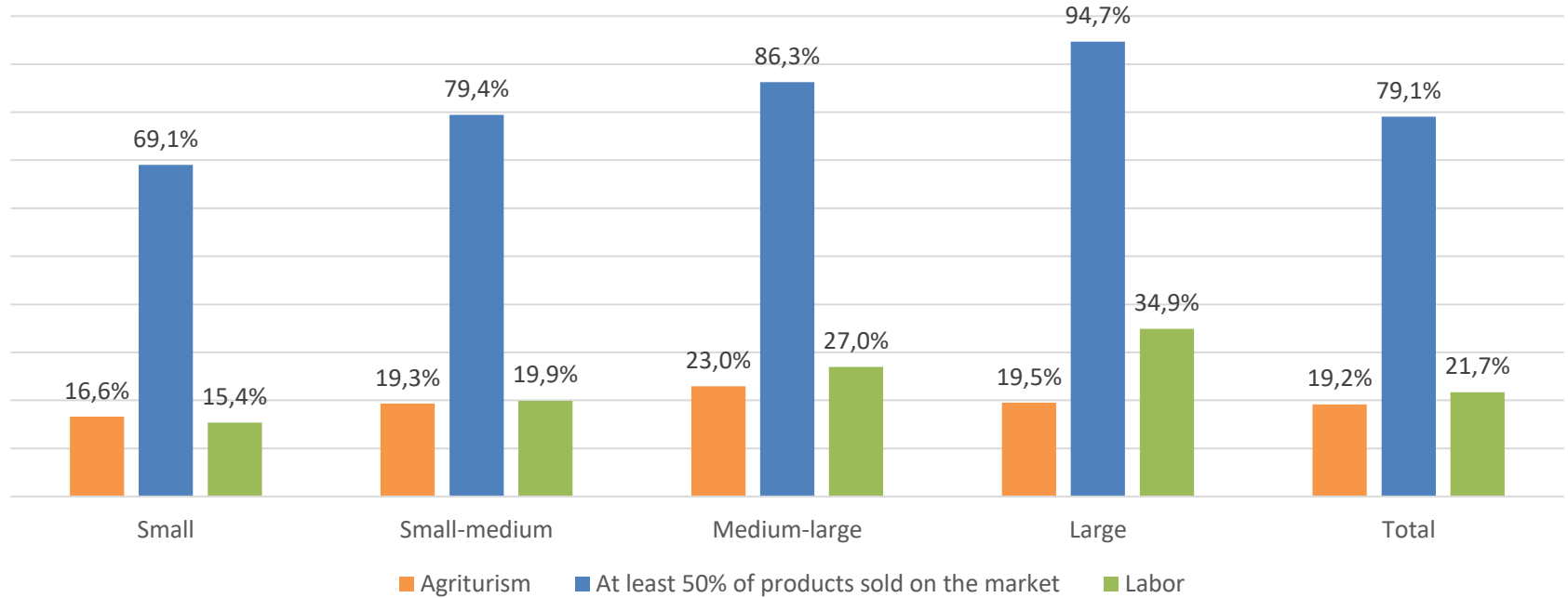
# The survey

- The aim is to identify the characteristics of farmers most likely to be key players in the **dual transition**
- 1300 interviews to individual farmers stratified by:
  - 8 types of crops: cereals, other field crops, floriculture, wining, olives, fruits, livestock, mixed crops.
  - Sex (m/f)
- Computer Assisted Telephone Interview (CATI)
- The interest is to estimate, from the sample above, certain quantities relating to the population of farmer

# Profiling farming - 1

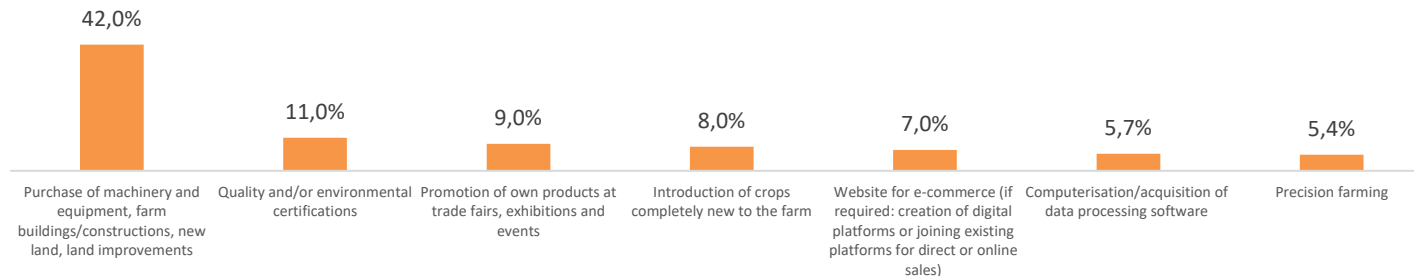
- Small dimensions of farms (medium size: 18ha) and decreasing utilised agricultural area (UAA) over time (-15% between 2010-2020);
- Ageing and lack of turnover (only 9,6% of farmers are under-40)
- About one third of farmers are female
- Most of farmers have basic education, while the share of graduates is about 15%
- 67,8% of farmers come from agrarian households, but only 40% of them will leave their business to their sons

# Profiling farming - 2

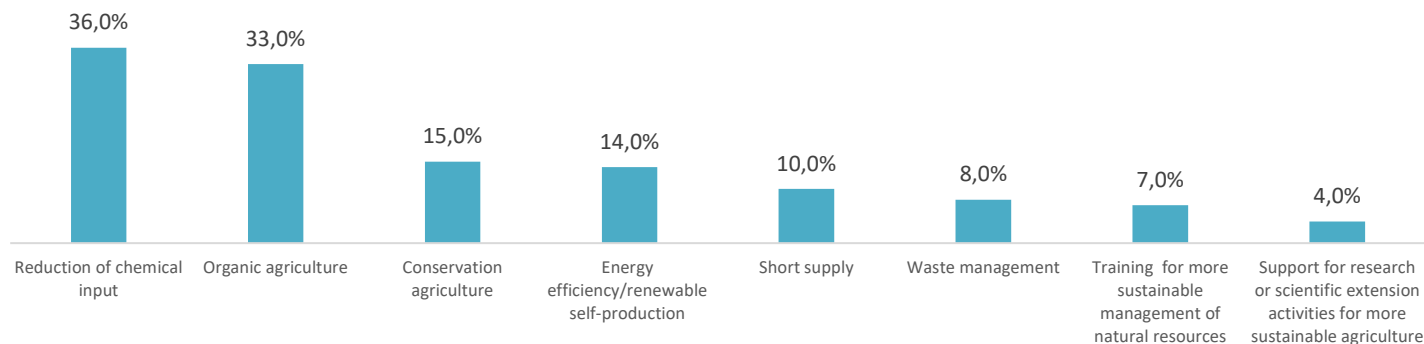


# Investments on digitalization and sustainability

In the last three years has your company invested in?



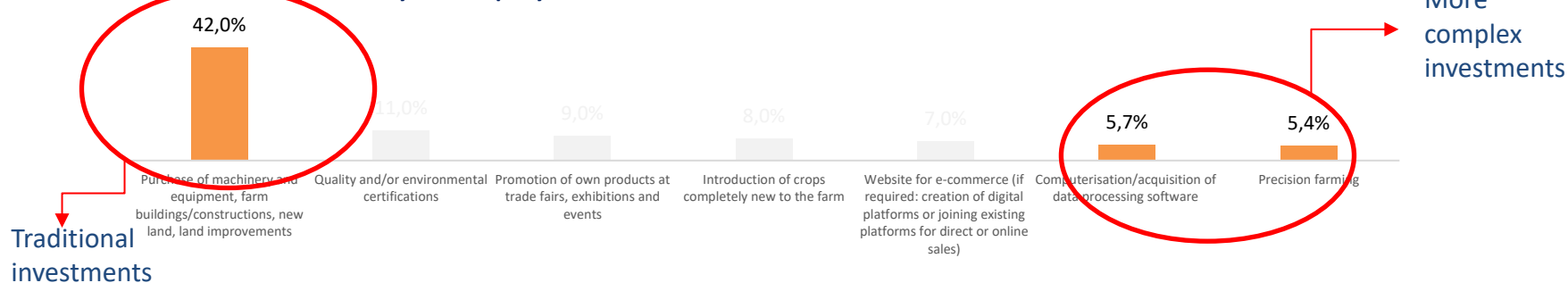
In the last three years, has your company adopted environmental sustainability solutions such as?



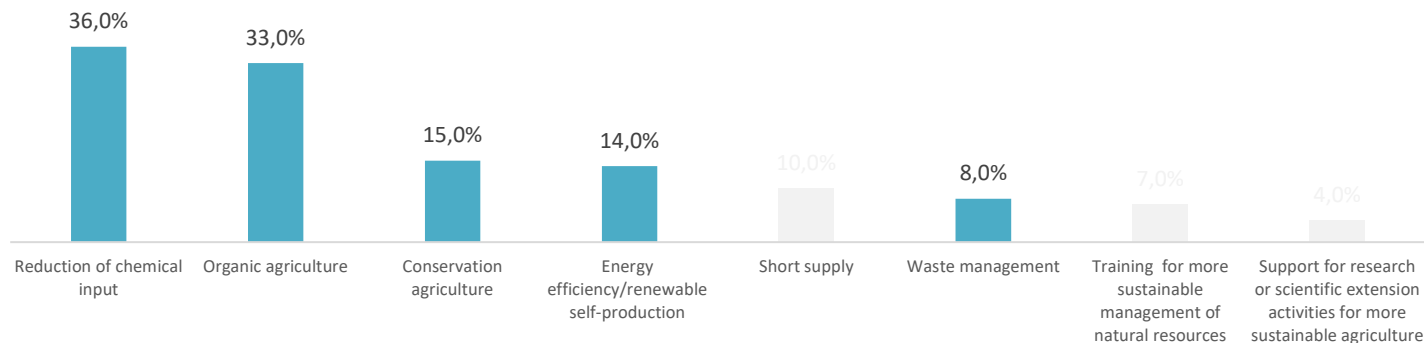


# Investments on digitalization and sustainability

In the last three years has your company invested in?



In the last three years, has your company adopted environmental sustainability solutions such as?



# Traditional vs. complex investments

We estimate a **ordered logit model** in order to better understand the propensity to investment of farmers:

$$\Pr(y = i) = \Pr(\kappa_{i-1} < \beta_1 x_{1j} + \beta_2 x_{2j} + \dots + \beta_k x_{kj} + u_j \leq \kappa_i)$$

*with:*

- $\kappa_1 \dots \kappa_i$  are the possible outcome (*cutpoints*)
- $u_j$  is the random error

We have three possible outcomes:

- $\kappa_0$ : no investments at all
- $\kappa_1$ : traditional investments
- $\kappa_2$ : complex investments

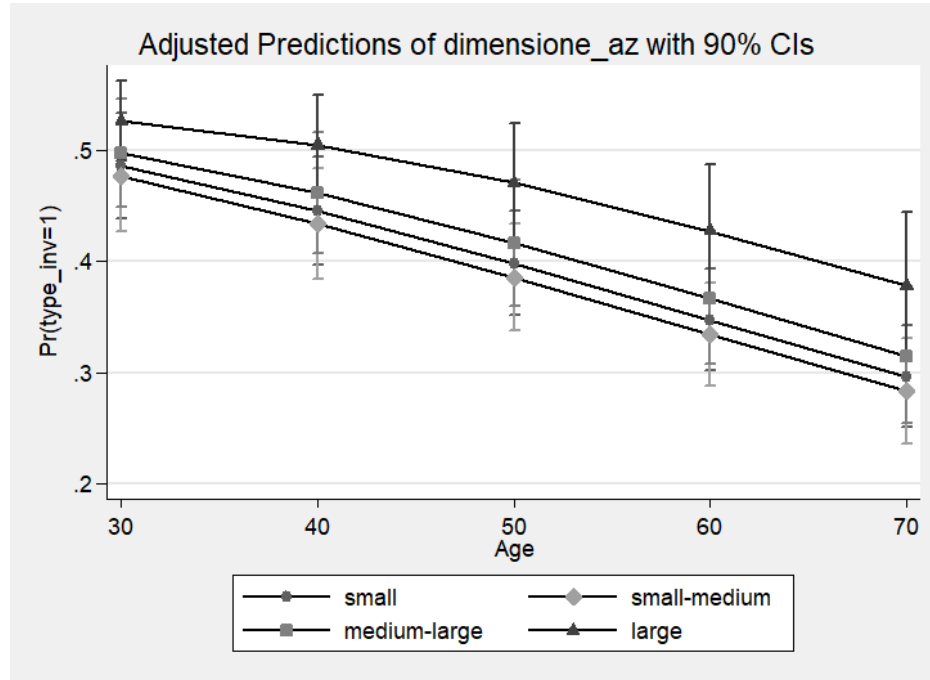
# Independent variables

Variables	Definition	Description
X <sup>(1)</sup>	Sex	Binary M/F
X <sup>(2)</sup>	Age	Continuous var
X <sup>(3)</sup>	Education	Categorical, 1= compulsory schooling only; 2 = agricultural diploma and/or degree; 3= other diploma and/or degree
X <sup>(4)</sup>	Type of farming	Categorical, 1 = Cereals; =2 if Other arable crops; 3=Floriculture; 4=wining; 5= Olive; 6 Fruits; =7=Livestock; 8=Mixed crops
X <sup>(5)</sup>	Family background	Binary : 0 if not from a farming family/1 otherwise
X <sup>(7)</sup>	Future	Binary, 0 if current holder does not plan to pass the holding to children or relatives/ 1 otherwise
X <sup>(6)</sup>	Structure of the farm: labor	Binary, 0 no employees/1 otherwise
X <sup>(8)</sup>	Structure of the farm: agriturism	Binary, 0 no agriturism/1 otherwise
X <sup>(9)</sup>	Structure of the farm: market orientation	Binary, 0 more than 50% of the production is self-consumed /1 otherwise
X <sup>(10)</sup>	Structure of the farm: dimension	Discrete, 1 <5 (small); 2 >4.9-<15 (small-medium); 3 >14.9-<50 (medium-large); >40.9 (large)

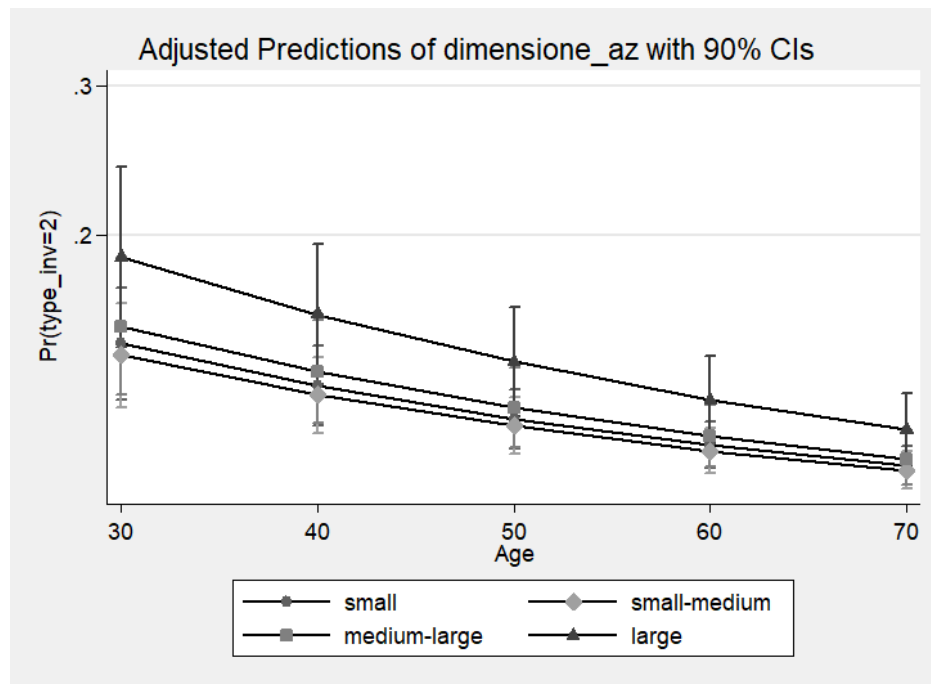
# Results- 1

CHARACTERISTICS OF FARMERS	
sex	
age	(-)***
sex#age	
Education: noagr	(+)**
Education: agr	(+)***
TYPES OF FARMING	
other fieldcrops	
floriculture	
wining	(+)*
olives	
fruits	
livestock	
mixed crops	
FAMILY BACKGROUND AND THE FUTURE	
0b.parents#0b.tosons	
0b.parents#1b.tosons	
1b.parents#0b.tosons	
1b.parents#1b.tosons	(+)***
STRUCTURE OF THE FARMS	
Labor	(+)***
Agritourism	(+)***
Market	(+)***
1.dimension: small	(-)*
2.dimension: small-medium	(-)*
3.dimension: medium-large	(-)**
1o.dimension#labor	

# Results- traditional investments



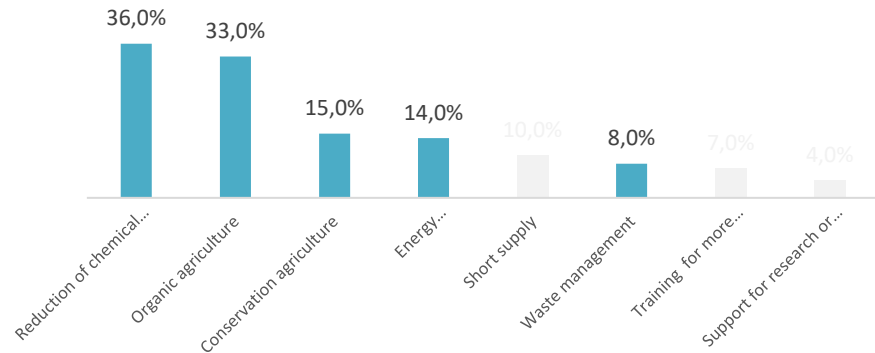
# Results- complex investments



# Towards dual transition...

We **logit-estimate** the probability of adoption  $\Pr(y=1|x_i)$  of 5 environmental-friendly solutions for sustainable agriculture, as a function not only of farm characteristics but also of the type of physical investment done (none/traditional/complex):

- Organic agriculture
- Reduction of chemical inputs
- Conservation agriculture
- Energy selfproduction/efficiency
- Waste management



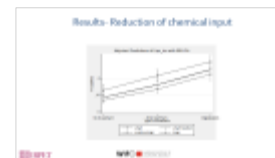
	ORGANIC	REDUCTION OF CHEMICAL INPUTS	CONSERVATION	ENERGY SELFPRODUCTION/EFFICIENCY	WASTE MANAGEMENT
<b>CHARACTERISTICS OF FARMERS</b>					
sex					
age					
sex#age					
Education: noagr	(+)***	(+)***	(+)***	(+)***	
Education: agr			(+)***		(+)***
<b>TYPES OF FARMING</b>					
other fieldcrops		(+)***			
floriculture		(+)***			
wining					
olives	(+)***				(+)**
fruits		(+)***			
livestock		(+)***			
mixed crops		(+)**			
<b>FAMILY BACKGROUND AND THE FUTURE</b>					
0b.parents#0b.tosons					
0b.parents#1b.tosons					
1b.parents#0b.tosons					
1b.parents#1b.tosons					
<b>STRUCTURE OF THE FARM</b>					
Labor				(-)***	
Agritourism	(+)***			(+)**	(+)***
Market				(+)***	(+)**
1.dimension: small	(-)**	(-)***		(-)***	
2.dimension: small-medium	(-)***	(-)***		(-)***	
3.dimension: medium-large	(-)***	(-)***		(-)**	
1o.dimension#labor					
1.small#labor					
2.small-medium#labor	(-)***				
3.medium-large#labor					
<b>TYPE OF INVESTMENTS</b>					
Traditional	(+)***	(+)***	(+)***	(+)***	(+)***
Complex	(+)***	(+)***	(+)***	(+)***	(+)***



	ORGANIC
CHARACTERISTICS OF FARMERS	
sex	
age	
sex#age	
Education: noagr	(+)***
Education: agr	
TYPES OF FARMING	
other fieldcrops	
floriculture	
wining	
olives	(+)***
fruits	
livestock	
mixed crops	
FAMILY BACKGROUND AND THE FUTURE	
0b.parents#0b.tosons	
0b.parents#1b.tosons	
1b.parents#0b.tosons	
1b.parents#1b.tosons	
STRUCTURE OF THE FARM	
Labor	
Agritourism	(+)***
Market	
1.dimension: small	(-)**
2.dimension: small-medium	(-)***
3.dimension: medium-large	(-)***
1o.dimension#labor	
1.small#labor	
2.small-medium#labor	(-)***
3.medium-large#labor	
TYPE OF INVESTMENTS	
Traditional	(+)***
Complex	(+)***



	REDUCTION OF CHEMICAL INPUTS
CHARACTERISTICS OF FARMERS	
sex	
age	
sex#age	
Education: noagr	(+) <sup>***</sup>
Education: agr	
TYPES OF FARMING	
other fieldcrops	(+) <sup>***</sup>
floriculture	(+) <sup>***</sup>
wining	
olives	
fruits	(+) <sup>***</sup>
livestock	(+) <sup>***</sup>
mixed crops	(+) <sup>**</sup>
FAMILY BACKGROUND AND THE FUTURE	
0b.parents#0b.tosons	
0b.parents#1b.tosons	
1b.parents#0b.tosons	
1b.parents#1b.tosons	
STRUCTURE OF THE FARM	
Labor	
Agritourism	
Market	
1.dimension: small	(-) <sup>***</sup>
2.dimension: small-medium	(-) <sup>***</sup>
3.dimension: medium-large	(-) <sup>***</sup>
1o.dimension#labor	
1.small#labor	
2.small-medium#labor	
3.medium-large#labor	
TYPE OF INVESTMENTS	
Traditional	(+) <sup>***</sup>
Complex	(+) <sup>***</sup>



CONSERVATION

CHARACTERISTICS OF FARMERS

sex	
age	
sex#age	
Education: noagr	(+)**
Education: agr	(+)**

TYPES OF FARMING

other fieldcrops	
floriculture	
wining	
olives	
fruits	
livestock	
mixed crops	

FAMILY BACKGROUND AND THE FUTURE

0b.parents#0b.tosons	
0b.parents#1b.tosons	
1b.parents#0b.tosons	
1b.parents#1b.tosons	

STRUCTURE OF THE FARM

Labor	(-)**
Agritourism	(+)**
Market	(+)**
1.dimension: small	(-)**
2.dimension: small-medium	(-)**
3.dimension: medium-large	(-)**
1o.dimension#labor	
1.small#labor	
2.small-medium#labor	
3.medium-large#labor	

TYPE OF INVESTMENTS

Traditional	(+)**
Complex	(+)**

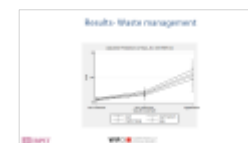


ENERGY  
SELFPRODUCTION/EFFICIENCY

CHARACTERISTICS OF FARMERS	
sex	
age	
sex#age	
Education: noagr	(+)***
Education: agr	
TYPES OF FARMING	
other fieldcrops	
floriculture	
wining	
olives	
fruits	
livestock	
mixed crops	
FAMILY BACKGROUND AND THE FUTURE	
0b.parents#0b.tosons	
0b.parents#1b.tosons	
1b.parents#0b.tosons	
1b.parents#1b.tosons	
STRUCTURE OF THE FARM	
Labor	
Agritourism	(+)***
Market	(+)**
1.dimension: small	
2.dimension: small-medium	
3.dimension: medium-large	
1o.dimension#labor	
1.small#labor	
2.small-medium#labor	
3.medium-large#labor	
TYPE OF INVESTMENTS	
Traditional	(+)***
Complex	(+)***



	WASTE MANAGEMENT
<b>CHARACTERISTICS OF FARMERS</b>	
sex	
age	
sex#age	
Education: noagr	
Education: agr	(+)***
<b>TYPES OF FARMING</b>	
other fieldcrops	
floriculture	
wining	
olives	(+)**
fruits	
livestock	
mixed crops	
<b>FAMILY BACKGROUND AND THE FUTURE</b>	
0b.parents#0b.tosons	
0b.parents#1b.tosons	
1b.parents#0b.tosons	
1b.parents#1b.tosons	
<b>STRUCTURE OF THE FARM</b>	
Labor	
Agritourism	
Market	
1.dimension: small	
2.dimension: small-medium	
3.dimension: medium-large	
1o.dimension#labor	
1.small#labor	
2.small-medium#labor	
3.medium-large#labor	
<b>TYPE OF INVESTMENTS</b>	
Traditional	(+)***
Complex	(+)***



# Concluding remarks - 1

- This research aims to identify the main drivers of the dual transition, which is a complex but crucial process
- We carried out a large survey among farmers in Tuscany to assess where we stand along the way and what factors are driving the process
- Distinguishing between traditional and complex investments, we found that about 40% of the farmers made at least one traditional investments in the last three years, while farmers investing on digitalization are still a small share ( 11%)
- Younger and larger farms are more likely to invest on innovation (as expected), while the type of farming do not seem to affect the choice of investing (slightly higher for wining)

## Concluding remarks - 2

- Both education (especially agrarian) and generational continuity – including positive expectations about the future – increase the probability of adoption
- However, dimension matters as well as the overall structure of the farms: hiring labour, diversifying and being market-oriented increase the probability of adoption → **complex investments require organizational upgrading**
- Coherently, investments in eco-friendly solutions are strongly associated to technological investments, especially more complex ones

# Concluding remarks - 3

- Most of the farms have invested in organic farming and the reduction of chemical input, while the shares of farms investing in conservation agriculture, energy self-production/efficiency, waste management are smaller
- Larger farmers are more likely to adopt organic farming, reduction of chemical input and conservation, while dimension does not seem to matter neither for energy self-production/efficiency nor for waste management
- Conservation agriculture is also associated with specific skills and highly structured farms



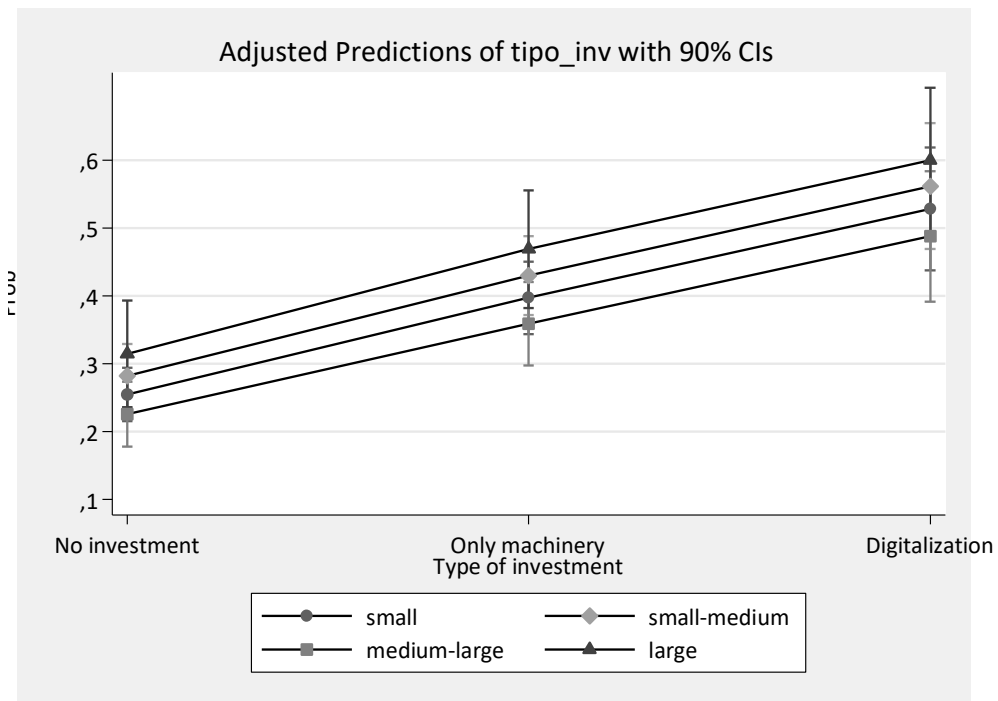
Thank you!

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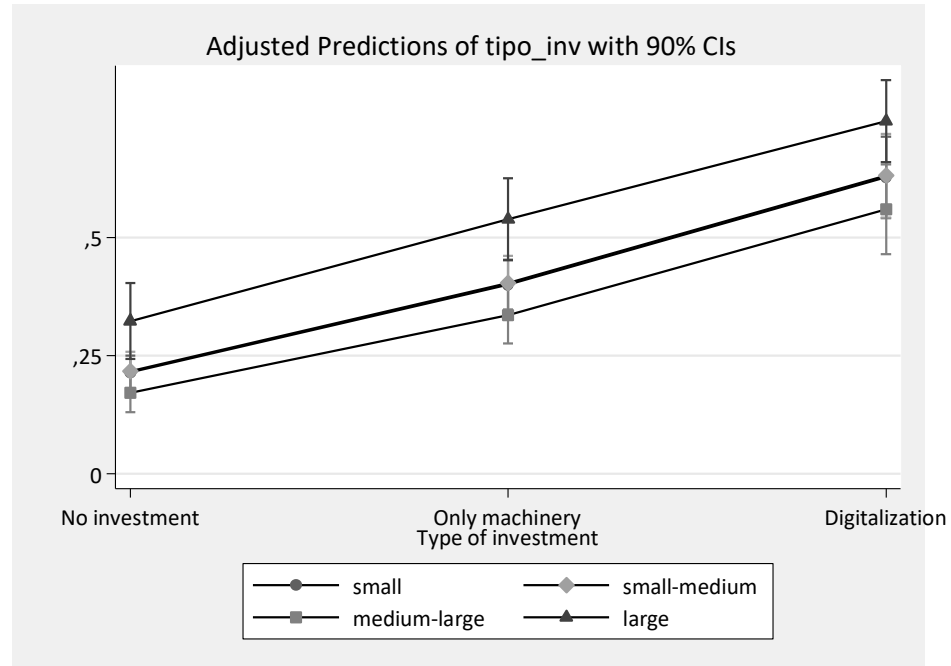
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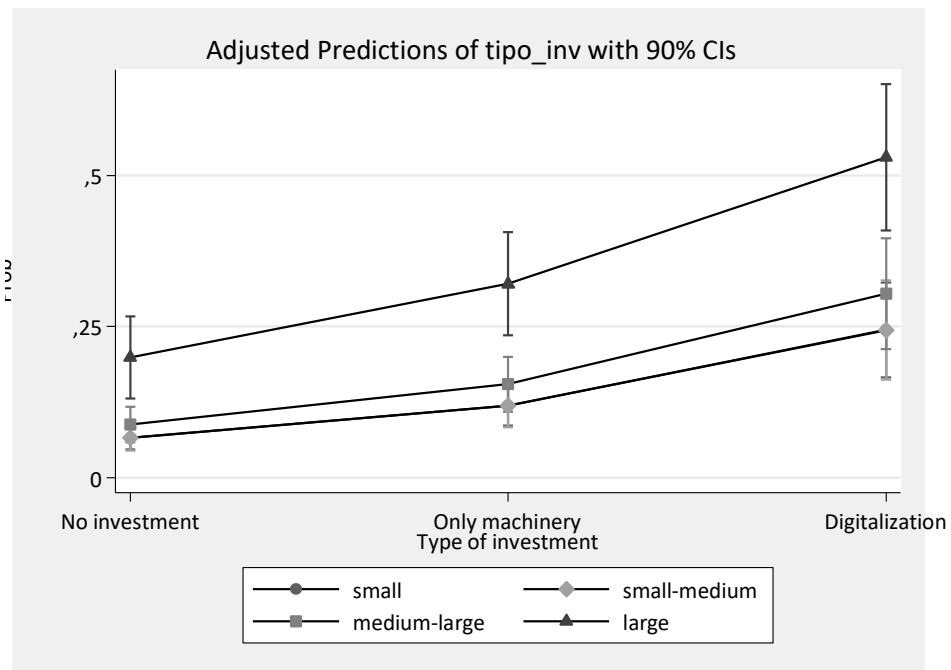
# Results- Organic farming



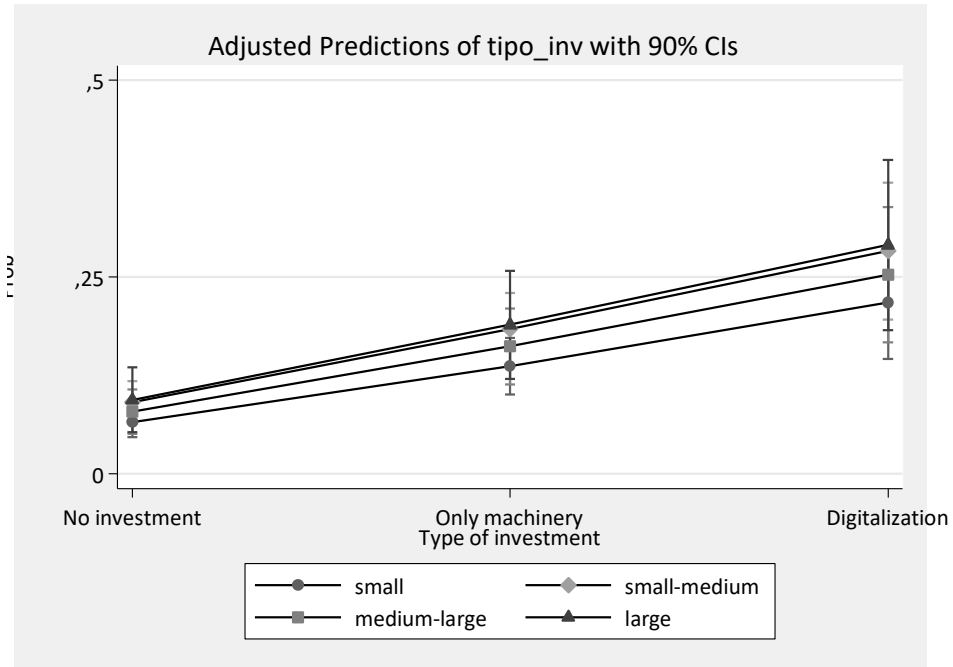
# Results- Reduction of chemical input



# Results- Conservation agriculture



# Results- Energy self-production/efficiency



# Results- Waste management

