Farmers input price risk management

Literature Insights and Research Agenda on Input Contract Adjustment

Riccardo Spada

Business Economics Group

Wageningen University & Research

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Literature review

Behavioral Preferences and Price Risk Management: A Systematic Literature Review

Riccardo Spada[1], Laura Moritz[2], Jens Rommel[3], Simone Cerroni[2], Miranda Meuwissen[1], Tobias Dalhaus[1]

[1] Wageningen University and Research

[2] University of Trento

[3] Swedish University of Agricultural Science

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Literature review

- Recent geopolitical crises have caused substantial volatility on agricultural markets (Vigani et al., 2024)
- **Risk management tools** can be used for price risk (Hardaker et al., 2004)
- Previous research argues that farmers' decisions are in general influenced by **behavioral factors** (Dessart et al., 2019; Palm-Forster et al., 2019; Wuepper et al., 2023)
- Conduct a **systematic literature review** to identify behavioral factors that influence the adoption of financial tools for price risk management in agriculture

Literature review

Conceptual framework

Behavioral preferences

- formally recognized in economic models

(e.g. risk, uncertainty, time preferences and hyperbolic discounting, loss aversion, or probability weighting)

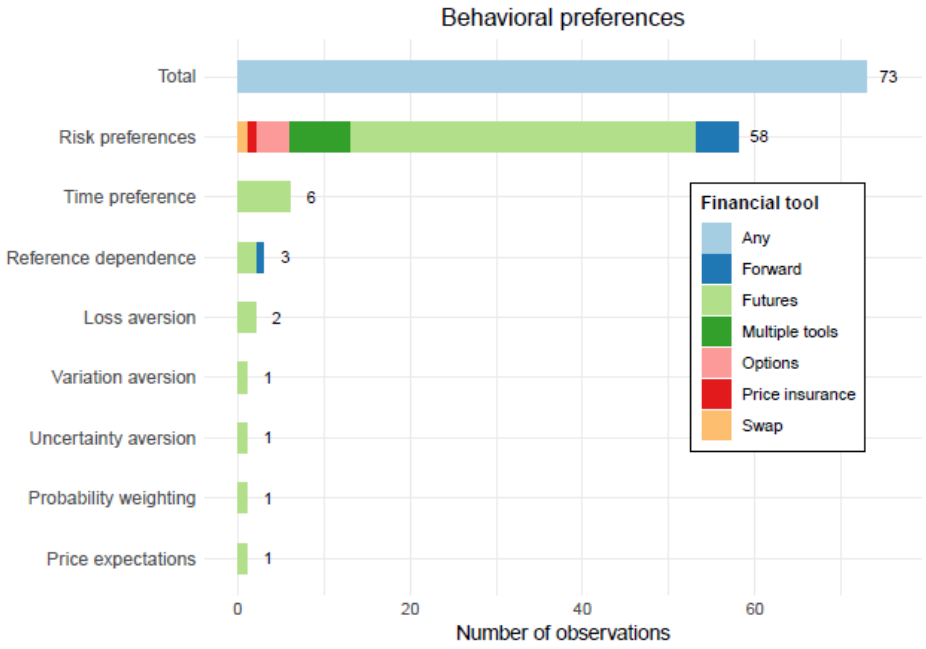
Psychological factors

- describe farmer preferences but are not mathematically implemented into a theoretical economic model

(e.g. social interaction, culture, and personality traits)

Literature review

Results



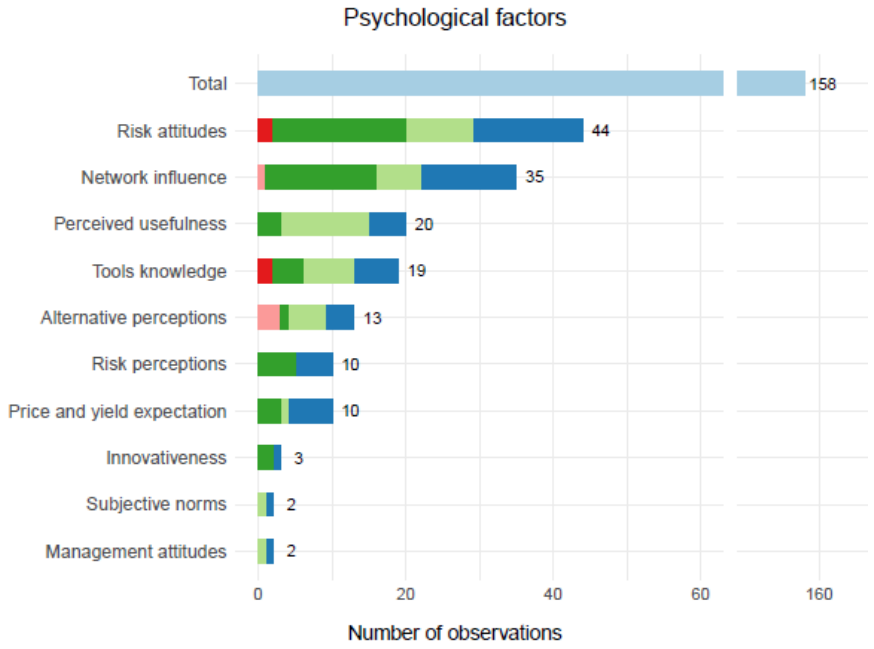


Figure 1. Overview of behavioural preferences and psychological factors

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Literature review

Conclusions

Behavioral preferences

- Risk aversion still the main paradigm
- Directional effect is mixed
- Only a handful of studies relate price risk management and reference dependence, loss aversion, and uncertainty preferences

Psychological factors

- Network influences and tools knowledge were found as an important factor in adoption decision
- Extension services, financial tools providers, and policy makers can have a role in providing training and education to improve farmers' decision-making ability regarding price risk

Research agenda

Behavioural finance tools for farmers' input price risk management

Riccardo Spada[1], Miranda Meuwissen[1], Tobias Dalhaus[1]

[1] Wageningen University and Research

Introduction

- (Nitrogen) **fertilizers** stand out as one of the most relevant agricultural inputs
    - Increase productivity
    - High share of input costs (crop farms)
    - Environmental concern
- **Fertilizer support** to agricultural producers in the EU during the 2020-2022 period almost doubled compared to the 2015-2019 average, reaching USD 27.1 billion in OECD countries (Jones & Deuss, 2024)

Introduction

- Farmers buy fertilizers at spot price or forward contract with suppliers

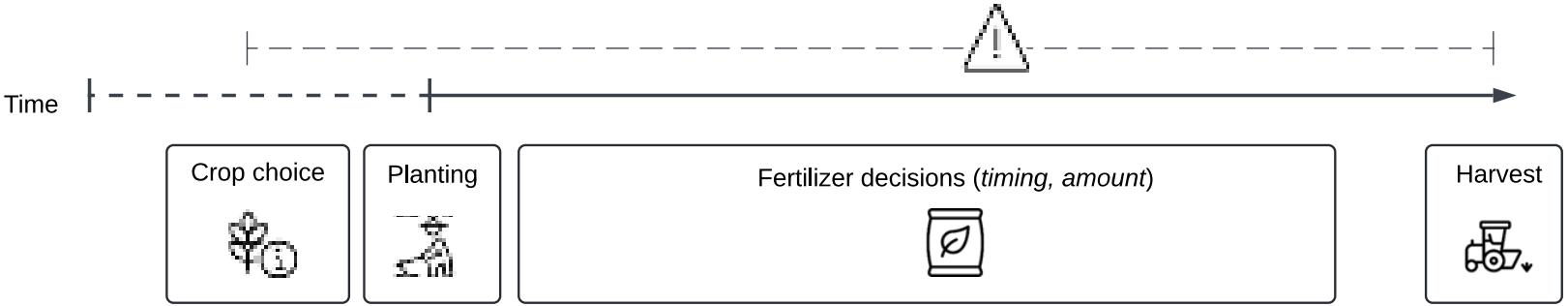

Figure 2. Simple production timeline

Objectives

- Adjust contract specifics of suppliers contracts for farmers’ input price risk management to better fit farmers' behavioural preferences
- Show how contract adjustments potentially affect farmers utility under different decision theories and different framing

Decision-making theories

- Expected Utility Theory

$$max\ \mathrm{CE} = E(x) - \frac{\lambda}{2} Var(x)$$

- Cumulative Prospect Theory (Tversky and Kahneman, 1992)

$$max\ V = \sum_{i=1}^{n} \vartheta_i v(x_i)$$

- Decision-making under uncertainty (Knight, 1921)

$$max\ EU = \alpha E_{p_{max}} U(x) + (1 - \alpha) E_{p_{min}} U(x)$$

Economic model and contract design

$$\pi = p_y y(N) - p_N N$$

- When farmers buy fertilisers they pay the market price
- When forward contracting, the input costs become fixed, with the forward price calculated as:

$$F = S_0 e^{-rT}$$

- introducing an “insurance” mechanism to the contract:

$$\pi = p_y y(N) - p_N N + \Pi - P$$

$$\Pi = \max[S(T) - K, 0]$$

Framing

Traditional (broad) framing → risky choices are considered broadly in conjunction with other risks, by defining the utility of total wealth or profits.

Narrow framing → farmers consider contracts decisions as a stand-alone investment:

- for a forward contract:

$$\sigma_F = S(T) - F$$

- for the adjusted contract:

$$\sigma_A = \Pi - P$$

Data and Empirical strategy

Fertilizer prices

- World Bank Commodity prices (urea), monthly data
- Farm input prices (?)

Relationship fertilizer-yield

- Moment-based approach (Antle, 1983)

Contract pricing

- Black-Scholes

Next steps

- Decision model:
    - Winter wheat case
    - Other costs
- Extend to multi-year contracts
- Experimental investigation on farmer acceptance of adjusted contracts

Thank you

Riccardo Spada

riccardo.spada@wur.nl

AgEnRes project

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Appendix

Behavioral Preferences and Price Risk Management: A Systematic Literature Review

Riccardo Spada[1], Laura Moritz[2], Jens Rommel[3], Simone Cerroni[2], Miranda Meuwissen[1], Tobias Dalhaus[1]

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Conceptual framework

- **Behavioral economists** developed extensions of Expected Utility Theory and relax some of its assumption by incorporating new behavioral preferences

- **Social-psychological** factors not yet considered formally in economic models, play an increasing role in applied agricultural economics research

Conceptual framework

Behavioral preferences

- formally recognized in economic models

(e.g. risk, uncertainty, time preferences and hyperbolic discounting, loss aversion, or probability weighting)

Psychological factors

- describe farmer preferences but are not mathematically implemented into a theoretical economic model

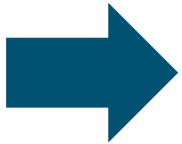
(e.g. social interaction, culture, and personality traits).

Conceptual framework

Behavioral preferences

Decision-making theories:

- Expected Utility Theory
- Cumulative Prospect Theory (Tversky & Kahneman, 1992)
- Theories under uncertainty and ambiguity (Savage, 1954; Klibanoff et al., 2005)



- risk preferences
- loss aversion
- probability weighting
- time preferences
- uncertainty aversion
- subjective probabilities

Conceptual framework

Psychological factors

Following the approach proposed by Dessart et al. (2019):

- **Dispositional factors**
  - rather stable internal factors of a given individual
- **Social factors**
  - relate to the network and social environment
- **Cognitive factors**
  - related to learning and reasoning and are more closely dependent on the specific decision-making process

Methods

Systematic Literature Review

- Pre-registration plan (Spada et al., 2024)
- PRISMA guidelines (Page et al., 2021)

Databases: Scopus; Web Of Science

Search string:

1. Farmers
2. Financial tools
3. Behavioral factors
    I. Behavioral preferences
    II. Psychological factors

1 Research question

2 Search strategy

3 Eligibility criteria

4 Screening and selection

5 Data extraction

6 Data analysis

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Methods

Eligibility

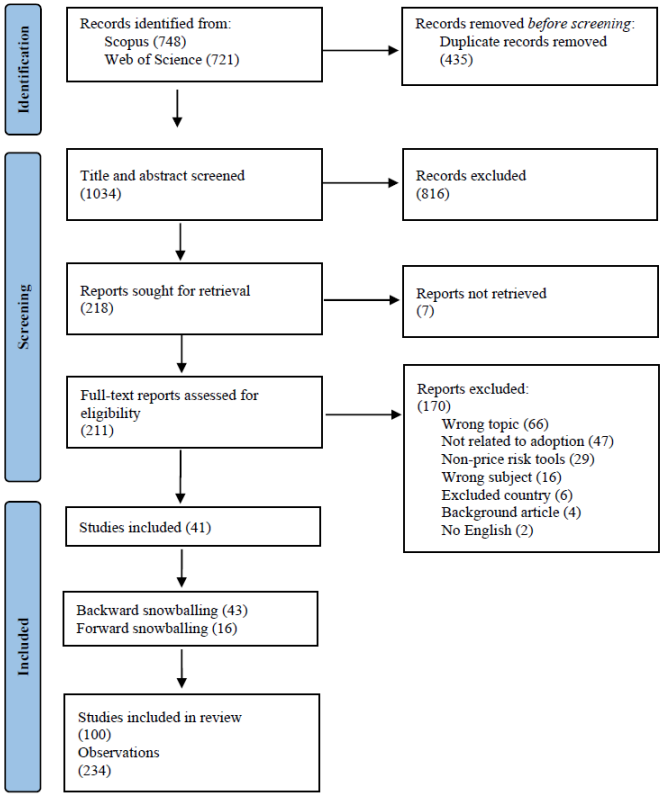
Inclusion criteria	
Subject	Farmers
Decision making	• Adoption of financial price risk management tools: - Forward contracts - Futures contracts - Options contracts - Price insurances - Other price tools • Impact of behavioral preferences and psychological factors on adoption
Geography	Agricultural systems in countries classified as "advanced economies"[1]
Type of report	Peer-reviewed literature
Year of publication	No limit
Language	English

[1] Following the International Monetary Fund “advanced economies” classification.

Methods

Screening

- 1469 entries obtained through the search process
- To ensure literature saturation, a snowballing method was implemented



Results

Categorization

Behavioral preferences	Psychological factors
- Risk preferences - Time preferences - Uncertainty and Variation aversion - Probability weighting - Loss aversion - Reference dependence - Price expectations	**Dispositional factors** - Risk attitudes - Innovativeness - Management attitudes **Social factors** - Network influence - Social norms **Cognitive factors** - Tool knowledge and perceived ease of use - Alternative perceptions - Perceived usefulness - Risk perceptions - Price and yield expectations

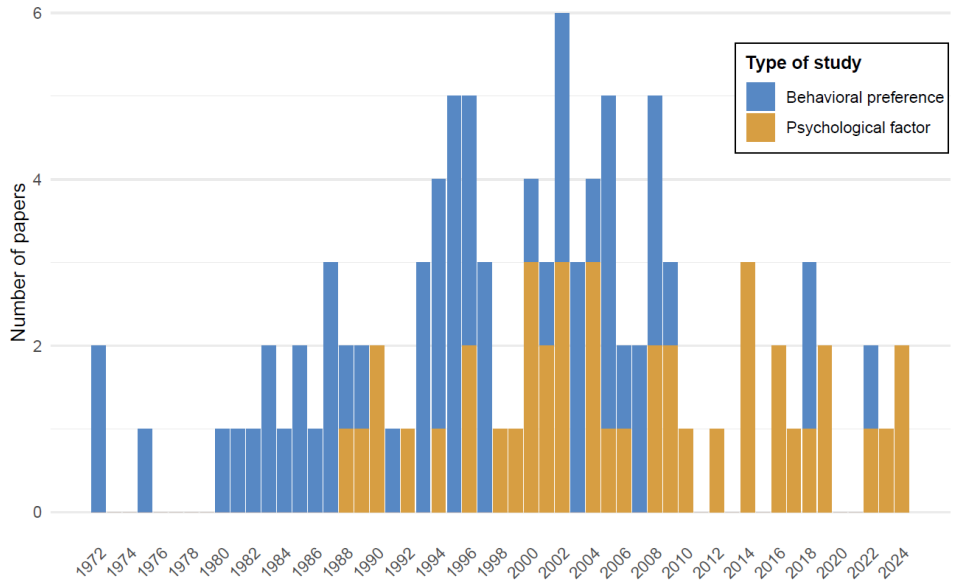
Results

Methodological categorization

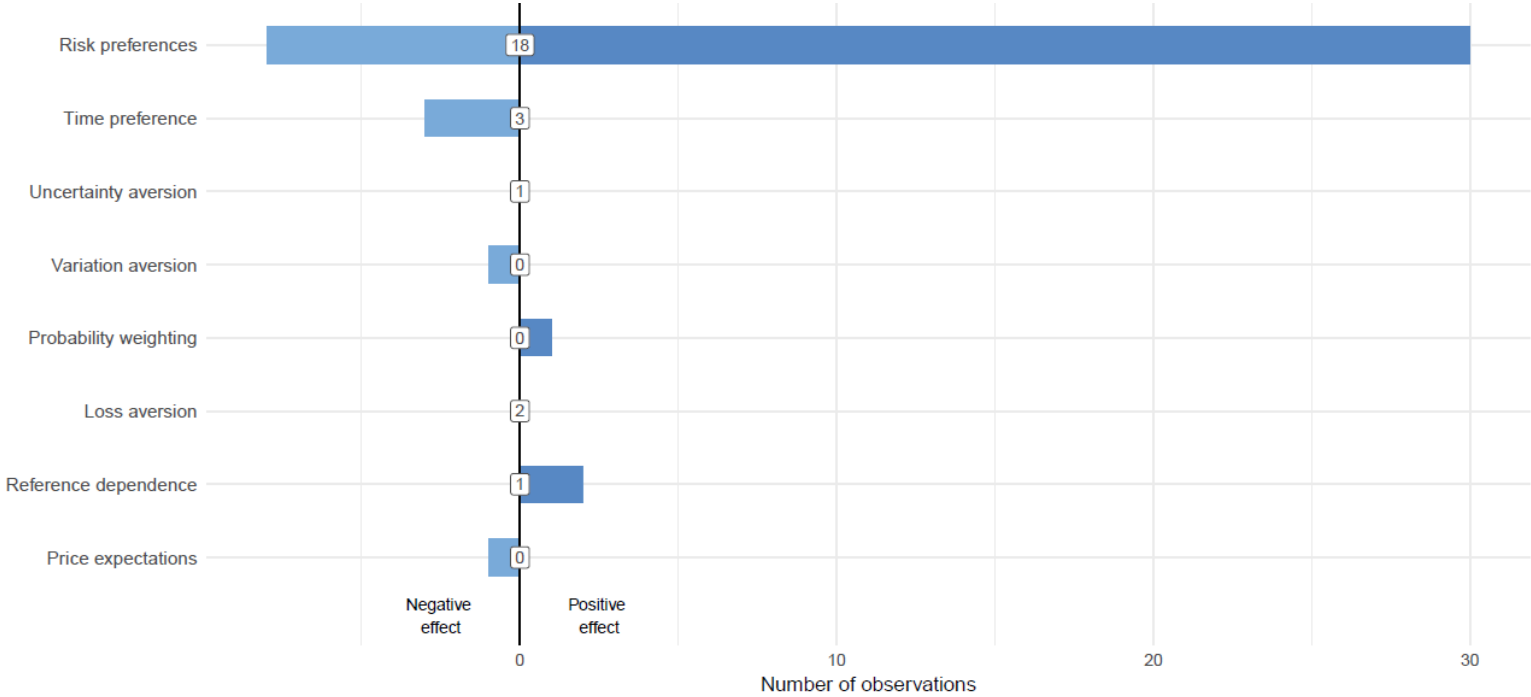
Behavioral preferences	Number of papers	**Psychological factors**	Number of papers
- Theoretical models	15	- Experiments	40
- Optimizations	42	- Econometric methods	3
- Stochastic dominance	2		
Total	**57**	**Total**	**43**

Results

Distribution of publication over time

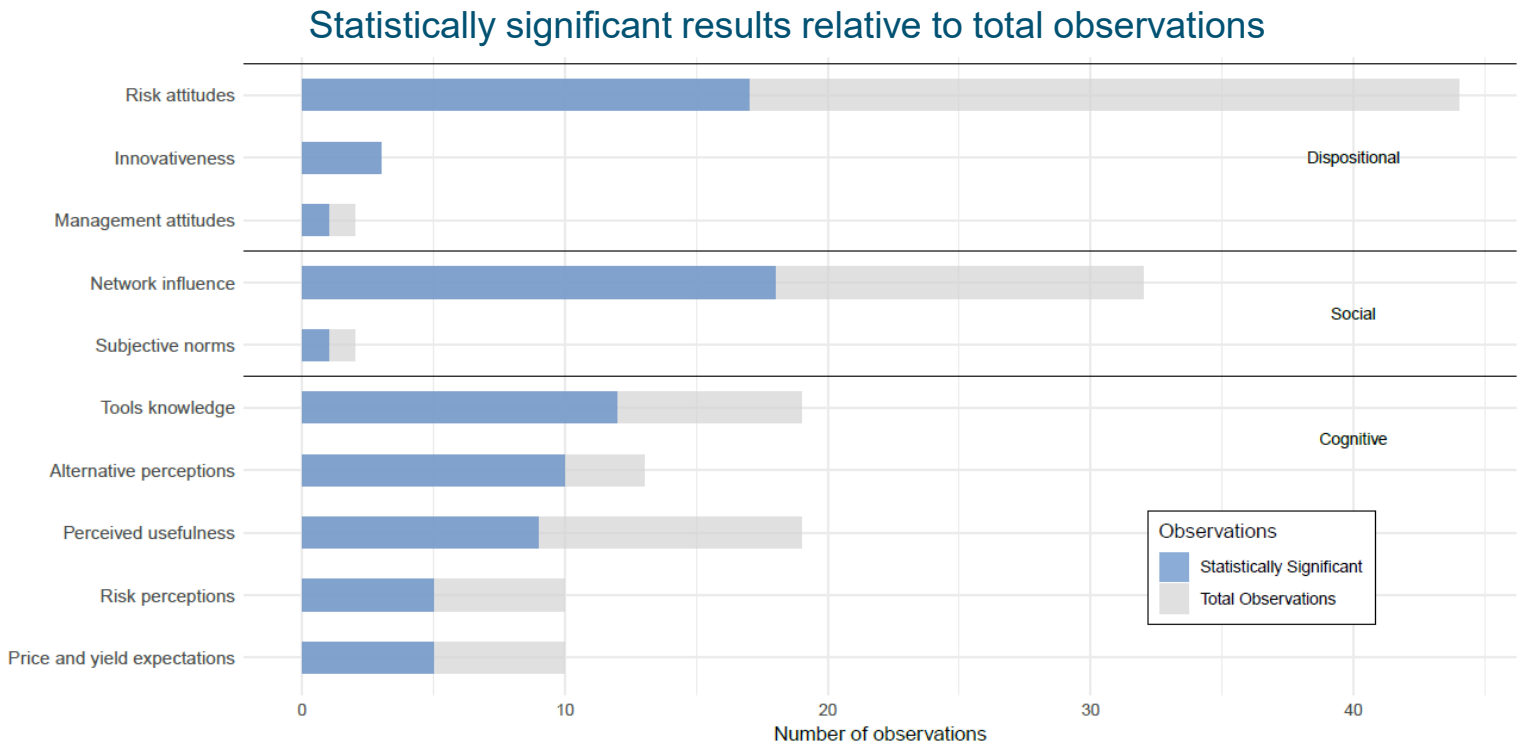


Behavioral preferences



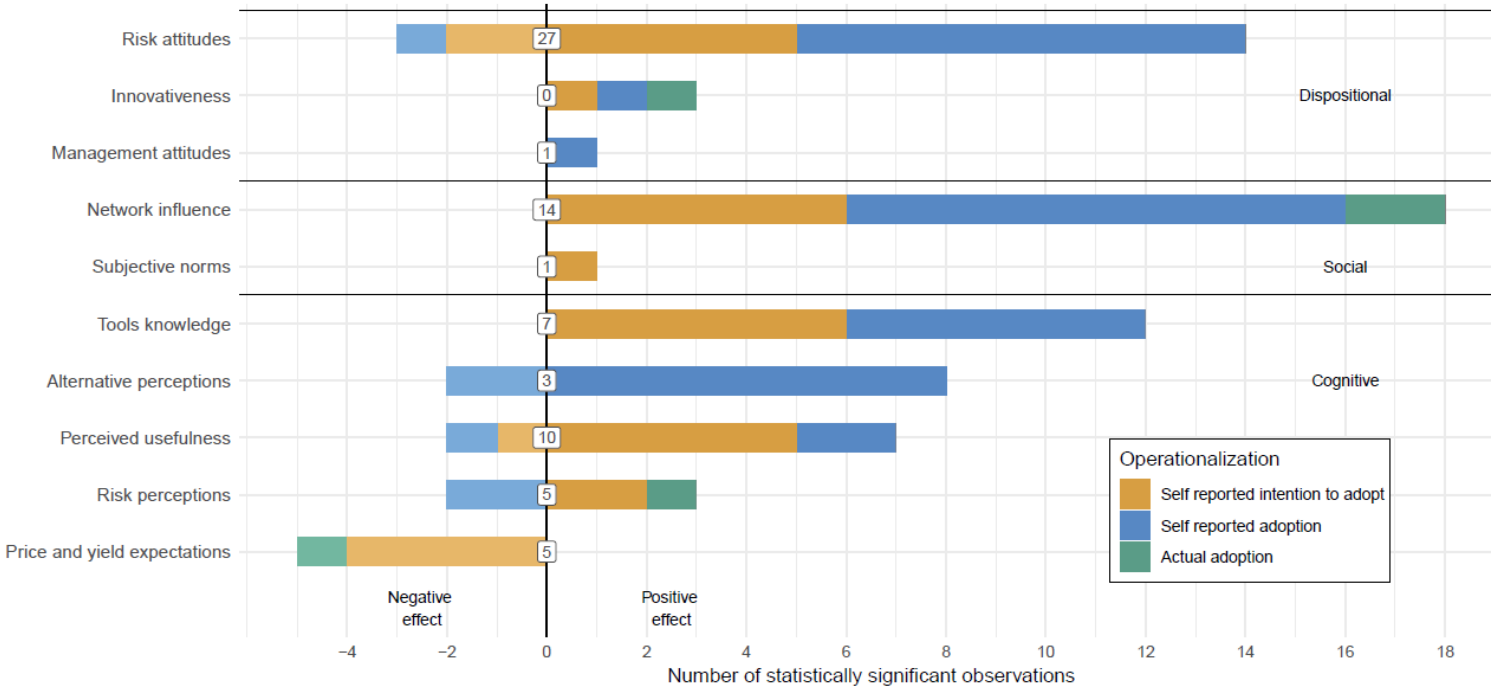
Notes: Numbers inside the boxes indicate the number of statistically insignificant observations.

Psychological factors



Psychological factors

Effect and direction of statistically significant results



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