Farmer's participation in the Income Stabilization Tool: Evidence from the Apple Sector in Italy

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Paper prepared for presentation at the ICAE 2021 International Conference of Agricultural Economists
August 2021

Acknowledgements

We thank the Consortium for the Defense of Agricultural Producers (CO.DI.PR.A) of the Autonomous Province of Trento (PAT) for the provision of the data and the helpful guidance.

Abstract

The European Common Agricultural Policy (CAP) proposes diverse tools to manage risk at farm level. However, their use across Member States is low on average. This is particularly true for the Income Stabilization Tool (IST), a mutual fund that aims to stabilize farmers' income. In the EU, only the Autonomous Province of Trento has operationalized two ISTs: one specific for the dairy sector and one for the apple sector. We empirically analyse and explore the drivers of farmers' participation in the IST-Apple. Our analysis is based on a theoretical framework rooted in the "Unified Theory of Use and Acceptance of Technology" (UTAUT) and the estimation of a binary logit model. The results show that higher insurance premiums as well as previous experience with mutual funds favour participation in the IST-Apple. However, access to the scheme is found to be heterogeneously influenced by the implementation of other on-farm risk management strategies. Our paper provides a grounded benchmark to understand farmers' decision to participate in the IST scheme, which may facilitate the implementation of the tool across Member States in the EU.

Keywords: Income stabilization tool, common agricultural policy, unified theory of acceptance and use of technology

JEL Codes: G22, Q18, D81

1. Introduction

Farmers can adopt a wide range of agricultural risk management tools and strategies to cope with risk and uncertainties related to production, market and financial outcomes (Moschini and Hennessy, 2001; Velandia et al., 2009). A relatively novel instrument offered to European farmers under the Common Agricultural Policy (CAP) is the Income Stabilization Tool (IST), which aims to stabilize farm income over time by providing compensation to farmers for a severe drop in their income due to any type of adverse event (e.g., production losses, market crisis or prices variations) (EC, 2011). In the whole European Union (EU), only one region has operationalized the IST to date: the Autonomous Province of Trento (hereafter, PAT) in Italy. This paper represents the first attempt at exploring the drivers affecting farmers' decisions to participate in an operating IST, by focusing on the scheme developed for the PAT apple producers in 2019. Our analysis builds on a modified version of the behavioral theoretical framework at the basis of the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003).

The IST is part of the EU risk management toolkit together with other two tools: (i) insurance for crops, livestock and plants, (ii) mutual funds for adverse climatic event and livestock or plant disease. These tools offer farmers protection in different ways. Insurance allows the farmer to transfer part of their risk to a third party (i.e., the insurance company) and covers losses due to crop failure or environmental damages (e.g. hail, frost). Mutual funds represent a form of organized savings which can be withdrawn by members to compensate production losses due to specific risks. The members are bounded by a principle of solidarity and a long-term nature of the commitment. The Income Stabilization Tool (IST), although similar to a mutual fund, is the only tool that focuses on farmers' income losses rather than production and it provides farmers with financial support due to any type of adverse event (Bardají and Garrido, 2016). The IST was introduced in the 2013 reform of the CAP and operates in compliance with the EU Regulation N. 1305/2013 and subsequent EU Regulation N. 2393/2017 (EC, 2013, 2011) and it operates through a mutual fund that collects farmers' contributions. When a member's income drops by more than 30% of the average annual income, the IST is activated and provides compensations for up to 70% of the income lost. The average annual income is based on in the three-year period, or five-year period excluding the highest and lowest year (Olympic average), prior to the IST enrolment. Later, the Omnibus Regulation

N.2393/2017 introduced the possibility to set up a sector-specific IST with a lower threshold of 20%, as it recognized that the economic risks do not affect all agricultural sectors equally (EC, 2017). The CAP Rural Development Policy allocates part of its budget to support the initial upfront cost of the IST in agreement with the World Trade Organization green-box requirements (Bardají and Garrido, 2016).

Prior to the European experience, the US and Canada have already developed risk management tools that focus on income stabilization (EC, 2009). In Canada income support programs date back to the late 1930s. The Canadian Agricultural Income Stabilization (CAIS) program, for example, is a whole farm insurance program, where farmers' private contributions are matched by public support. The CAIS, which expired in 2007 and was replaced by the AgriStability and AgriInvest programs, was intended to help farmers who suffered large income declines with respect to a historical margin (Turvey, 2012). Mutual funds are no novelty in the EU (Meuwissen et al., 2013), and the introduction of the IST has renewed the interest of policy makers in such schemes for multiple reasons. First, the IST has the prerogative to stabilize farmers' income that represents the economic well-being of a farm household more appropriately than revenues from a single commodity. Second, the new scheme accounts for various correlations between prices, yields and profits of different farm activities (Severini et al., 2019a). Third, the IST could potentially also cover systemic risk (i.e., trade-related risks) that are not covered by purely commercial insurance (Meuwissen et al., 2003). Fourth, a few studies argue that the IST could mitigate moral hazard and adverse selection (Pigeon et al., 2014; Severini et al., 2019b). Finally, reaching a greater income stability could help equilibrate the balance between the economic profitability and the environmental sustainability of the agricultural sector (FAO, 2009).

There are also some limits associated with the IST. First, Meuwissen et al. (2003) suggests that the IST may generate asymmetric information, inducing farmers to manipulate factors affecting farm income (e.g., operating cost and inventories). Second, since the IST covers systemic market risk (i.e. price fluctuation) it could fall short at achieving a heterogenous risk pool (Meuwissen et al., 2003). Third, limits could be associated to the lack of trust in the financial robustness of the mutual fund (Meuwissen et al., 2013). Finally, farmers may fail to understand the complementarity between classic commercial insurance products and the IST, misperceiving these risk management tools as substitutes.

Despite its potential and the EU financial support to the IST upfront costs, EU Member States' interest regarding the IST seems very limited. Two Member States (Italy, Hungary) and one region (Castilla y Lèon in Spain) had shown initially interest in implementing the IST (EPRS, 2016). In Spain and Hungary, the implementation of the IST was hindered by some difficulties in the preliminary design of the instrument, like the reference income measurement (Cordier and Santeramo, 2020). In Italy, the Ministry of Agricultural, Food and Forestry Policy (MIPAAF) issued the Decree N. 10158/2016 that regulates the implementation and the management of the IST. In 2019, the PAT created two sector specific IST: one for the apple sector and one for the dairy sector, which together represent the first experience of operating IST in the whole EU to date.

In the existing literature, studies on the IST have adopted an explorative and preliminary approach. The limited amount of works available provide an ex-ante assessment of IST schemes in different countries using available data at farm level (for example, FADN) and simulation procedures. Few studies have simply simulated the setup costs of the IST and its economic viability in specific regions and countries (e.g. Capitanio et al., 2016). Scholars have investigated whether the probability and the level of indemnification were a function of farm profiles and farmers' characteristics. Trestini et al. (2018) focused on the dairy sector in two Italian regions (Veneto and Lombardy), while El Benni et al. (2016) conducted a multi-sector analysis in Switzerland. Other studies have examined the potential effects of the IST on income inequalities. Finger and El Benni (2014) showed that within the Swiss farming community the IST can potentially reduce income inequalities. Similarly, Severini et al. (2019a, 2019b) found, by means of stochastic simulation procedures, that nationwide in Italy the IST can stabilize farm income, reduce income inequalities and also enhance its level under different policy scenarios. More recently, Giampietri et al. (2020) have analyzed farmers' intentions and barriers toward the use of mutual funds and, more specifically, toward the IST scheme in the Veneto region (Italy), by using a questionnaire administered to 127 farmers. However, behavioral economics and psychology teach us that economic agents' intentions are not necessarily good predictors of observed behavior due to the attitude-action gap (Cummings et al., 1995; Ariely and Wertenbroch, 2002).

To the best of our knowledge, there has been no detailed investigation of farmers' acceptance of the IST and of factors affecting participation in the scheme using secondary data, which reveal real farmers' decisions to join an existing and operating IST. It should be noted that a large part of the former studies assumed famers' participation to the IST as mandatory, ignoring completely the issue of participation. This paper fills this gap using a unique dataset which contains information on farmers' decision regarding entry into the Apple-IST implemented in the PAT. The data refer to the first year of application of the scheme (2019). By means of a logit regression, we investigate the factors influencing farmers' participation in the IST-Apple based on real farmers' actions.

The novelty of this paper also generates relevant policy contributions. Firstly, it offers evidence on the acceptance of the latest EU risk management tool, the IST. Information on the rate of acceptance in the PAT can be used as an indicator of farmers' attitudes regarding this new scheme and can be interpreted as a very first test of its acceptance. Lessons learnt from this region will be useful for other EU Member States that are planning to operationalize the IST at country or regional level. Secondly, this study sheds light on the main factors driving participation in the IST. A better understanding of the typology of farmers and farms joining the IST can be useful to forecast more precisely the cost of indemnification as well as the national or the regional budgets needed to operationalize the new scheme in the future, not only in the PAT but also in other European countries and regions. Not to mention that knowledge and understanding of factors driving participation can help policy makers to design strategies and campaigns to reach out to farmers who were more reluctant to accept the new risk management tool. The design of such strategies and campaigns can be supported by theories of behavioral change and technology acceptance.

The paper proceeds as follows: Section 2 describes the study settings and the data set. In Section 3 we review the major aspects of the agricultural innovation adoption process and present the theoretical framework. Section 4 lays out the econometric approach and the estimation strategy, and Section 5 reports the results and the findings. Section 6 offers our conclusions and a discussion on the relevant policy implications of our study.

2. Empirical application

1.1. The Apple Income Stabilization Tool in the PAT

The Autonomous Province of Trento is located in the northeast of Italy. The apple production, for the Trentino farmers, is a relevant source of income and its value is over € 200 million, representing 25% of the PAT gross marketable agricultural production (Williams et al., 2015). The production system is characterized by small producers with a farm size generally below 0.5 hectares. In addition, the territory presents an high business fragmentation linked to the complex morphology with numerous Alpine valleys and mountainous areas (Laiti et al., 2016). To overcome these environmental challenges, the Trentino farmers have found an ally in the cooperative system (Fontanari and Sacchetti, 2020). Indeed, the PAT has a long-standing cooperative tradition within the agricultural sector, and today, more than 75% of the agricultural gross product can be traced back to farmers who are members of agricultural cooperatives (Fontanari, 2018). The cooperation tradition has certainly played a major role in the implementation of the IST as well.

Since 2019, PAT apple producers have the possibility to join the Apple-IST scheme. The Consortium for the Defense of Agricultural Produces (Co.Di.Pr.A.) is the main consortium in the area, accounting for 11,783 associates (i.e. 90% of the farmers in the PAT), and it is the administrative body of the IST. The Apple-IST in 2019 counted 1,995 enrolled apple growers (i.e. 50% of PAT total apple growers), and a total fund of € 8,686,71.70. The total apple area involved in the IST for the 2019 is of 5,382.38 hectares. To join the Apple-IST farmers pay a three-years € 10 membership fee, and buy the annual IST income coverage. The cost of the coverage depends on: i) the apple area, for which the farmer pays a fixed sum of €150 per hectare, ii) the apple insured value (in €) referred to the subscription year and iii) the annual premium of the multi-perils insurance for the apple production. Therefore, a farmer buying the IST coverage pays 150€ for each apple hectare, 4% of the annual apple insurance premium value plus 0.5% of the apple insured value. The farmers' quotas represent the 30% of the contributions to the fund, as the public support (i.e. the EU) adds a financial support for the 70%. Farmers who want to participate in the IST must provide detailed information regarding their apple activities (e.g. revenues, operating costs, sales). Based on the documentation, the threshold income is calculated as the preceding three years farmer's apple income

average. If in the year for which the farmer has bought the IST coverage, her/his apple-income is at least 20% lower than the threshold, the IST triggers compensations for up to 70% of this loss.

1.2. Data

Our data have been collected during the 2019 Co.Di.Pr.A. insurance campaign, in the course of which the farmers subscribed the multi-perils insurance to hedge against adverse climatic conditions (i.e. flood, frost, hailstorm and drought) and plant diseases. All the farmers in our sample have insured against these events. Farmers may have more than one insurance certificate at their name, because the certificate refers to a specific apple plot within the farm. The certificate, by considering the specific plot characteristics like the location, the on-farms protection strategies (i.e. anti-hailstorm nets, anti-frost system), the apple production value in €, calculates the insurance premium for the parcel of the farm. Each data point in our set refers to the single certificates and in total we have collected 5,701 insurance certificates corresponding to 3,662 apple producers, almost half of which joined the IST scheme in 2019. Table 1 presents the summary statistics.

We clustered farmer's characteristics related variables as they are constant across the multiple certificates the farmer may have. These are socioeconomic variables (*AGE* and *GENDER*), farm legal status (*SOLE_TRADER*, either sole trader or a company), information regarding farmers' subscription to other mutual funds other than the IST (*MF_PART*) as, in addition to the IST, Co.Di.Pr.A. offers to its associates other mutual funds that cover specific direct and indirect farm damages (Co.Di.Pr.A., 2020). The farmers involved in our study could adhere to up to four mutual funds in 2019: i) the mutual fund for damages due to fruit diseases (i.e apple), ii) the mutual fund for municipalities at high climatic risk[1], iii) the mutual fund "*per rischio sotto soglia*"[2], and iv) the mutual fund for damages due to plant diseases (i.e. apple tree).[3] We also clustered information about the insurance frequency (*YEARS_INS*), which indicates the number of years in which the farmer has signed an insurance contract in the period 2015-2019.

[1] The mutual fund provides indemnities to farmers in area at high climatic risk, where the insurance deductible is generally higher than usual.
[2] The mutual fund provides indemnities for those damages below the insurance deductible threshold.
[3] For more information regarding the Co.Di.Pr.A. mutual funds see www.codipratn.it/fondi-mutualistici/

Table 1
Data description of variables used in the logit model (n = 5,701)[4]

Variable	Description	%	Mean	SD
Farmer's level information 2019				
IST*	= 1 if the farmer participates in the in IST 2019	53.67		
	= 0 otherwise	46.33		
FEMALE*	= 1 if farmer female	10.35		
	= 0 otherwise	89.65		
AGE_YOUNG*	= 0 if farmer's age below or equal to 35 years	11.09		
AGE_MID*	= 1 if farmer's age between 35 and 70 years	73.34		
AGE_OLD*	= 2 otherwise	15.58		
SOLE_TRADER*	= 0 if farm is run as a company	2.81		
	= 1 if farm is run as a sole trader	97.19		
MF_PART*	= 1 if farm participate to other mutual funds in 2019	94.09		
	= 0 otherwise	5.91		
YEARS_INS	N° years with multi-peril insurance subscription 2015- 2019		4.56	1.01
Certificate's level information 2019				
AREA_TSR*	= 0 if the farm area Val di Non – Val di Sole	72.83		
AREA_VAL*	= 1 if the farm area Valsugana	5.28		
AREA_VNS*	= 2 if farm area Trento Sud – Rotaliana	14.21		
AREA_BVL*	= 3 if farm area Bleggio – Valle dei Laghi	7.68		
RP_NO*	= 0 if no on farm protection applied	79.27		
RP_NETS*	= 1 if farm uses net	15.17		
RP_FROST*	= 2 if farm uses anti-frost system	4.63		
RP_MIX*	= 3 if farm use nets with anti-frost system	0.93		
INSPR_LOW*	= 0 if 2019 insurance premium up to €1,000/ha	11.98		
INSPR_MED*	= 1if 2019 insurance premium €1,000/ha - €5,000/ha	87,74		
INSPR_HIGH*	= 2 if 2019 insurance premium above €5,000/ha	0,28		
INDEM	Indemnities received in 2019 in €1,000		5.11	14.70

Note *Variable is coded as dummy

At certificate level, we have information regarding the premium per hectare to insure the apple production (*INS_PR*) and the amount (in €) of indemnities from the multi-peril insurance in 2019 due to damages to the apples' orchard (*INDEM*). The dummies *AREA* refers to where the plot is located. We have four macro areas denominated as follow: *Val di Non - Val di Sole (AREA_VNS)*, *Valsugana (AREA_VAL)*, *Trento Sud – Rotaliana* (*AREA_TSR*), and *Bleggio - Valle dei Laghi (AREA_BVL)*. The partition shall be considered as a proxy of the different production system in place and the relevance of the apple production among other agricultural activities for the area. For example, the apple production is the predominant activity in *Val di Non-Val di Sole* and this area represents 73% of the total insured apple value in our sample.

[4] Summary statistic of our original datasets is available. Some variables were drop due to correlation issues.

Indeed, in 2018, 84% of the farms in *Val di Non -Val di Sole* were apple-oriented, whereas the agricultural production is more diversified in the other areas, where farmers cultivate apples along with other products (e.g. wine, other fruits and vegetable). Altogether, the 2,241 fruit-oriented farm businesses in this area represented the 71% of the fruit-oriented farms in the whole PAT (ISPAT, 2020).

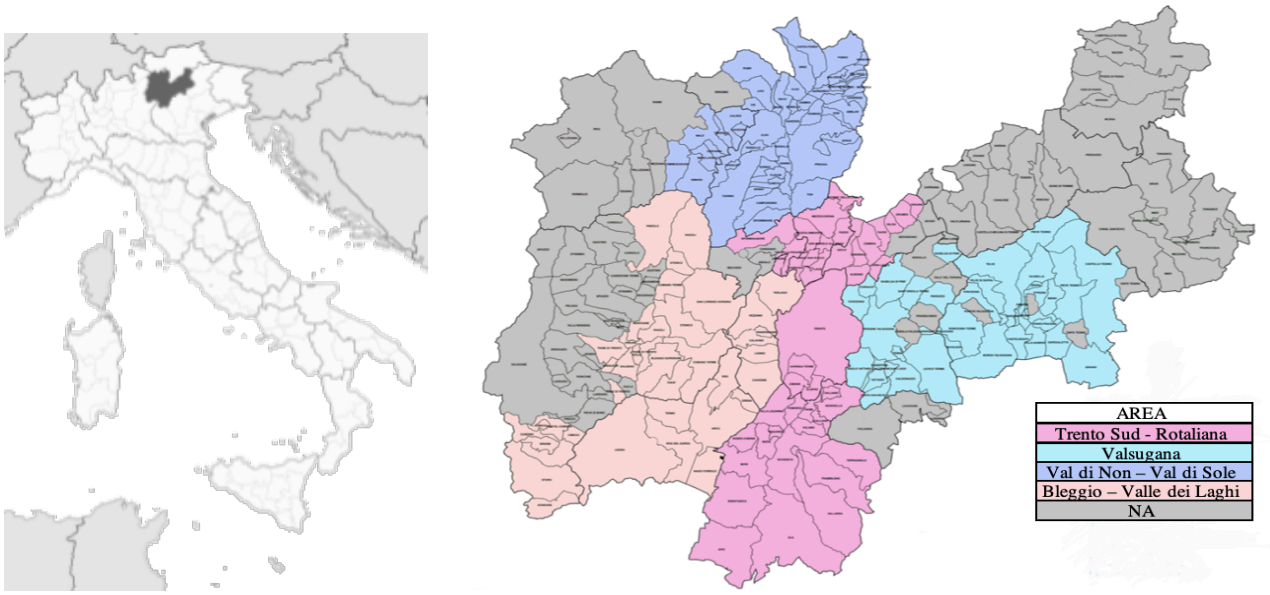

Fig. 2. PAT Territory and the four macro areas considered. The grey-area is out of the scope of our analysis Source: Author's illustration based on Map of Autonomous Province of Trento (2020)

The variables *RP* provide information regarding the preventive measures (or risk management practices) that are implemented on-farm. The largest share of apple-growers in our sample do not use any protection (RP_NO = 79.27%). Approximately 15% of the farmers cover the apple with nets (*RP_NETS*), preventing damages from hail, the 5% use anti-frost systems (*RP_FROST*) and almost 1% implement both nets and anti-frost (*RP _MIX)*. The fact that the large majority of the sample does not implement any protection is not surprising as over 70% of the production is insured in the PAT (ISMEA, 2020).[5] Agricultural insurances are commonly perceived as substitutes to on-farm protection strategies (e.g. Enjolras and Sentis, 2011b; Di Falco et al., 2014).

3. Farmers' adoption of risk management tools

The adoption of innovative practices or risk management tools in agriculture has been extensively investigated, and it is still today a relevant topic in the literature. Insurance coverage choices and

[5] In 2019 insurance campaign, 80% of the insured apple did not implemented any type of protection, 15% used nets, 4% anti-frost system, and 1% the combined option. Our dataset shows similar figures.

participation in mutual funds have been object of empirical, experimental and theoretical research (Harrison and Ng, 2019). A large part of this literature looked at the crop insurance market in the USA (e.g., Goodwin, 1993; Sherrick et al., 2004; Velandia et al., 2009) and EU (e.g. Vanslembrouck et al., 2002; Defrancesco et al., 2008; Hynes and Garvey, 2009; Enjolras and Sentis, 2011; Lastra-Bravo et al., 2015). There is also an increasing interest regarding the uptake of index-based insurance products, especially in developing countries (e.g. Jensen et al., 2018; King and Singh, 2020; Takahashi et al., 2020).

Provided that farm-related characteristics (e.g. farm size, crop type) as well as farmers' specific attributes (e.g. gender, age, education) are generally considered as factors explaining the demand for agricultural insurance in the above empirical analyses, innovation characteristics and behavioral factors have also shown a good potential to improve adoption studies (Streletskaya et al., 2020), but they are often omitted from the explanatory variables set (Oca Munguia and Llewellyn, 2020). An increasing number of adoption studies now opt for the use of more complex behavioral decision-making models that depart from the standard expected utility theory (EUT) (e.g. Cao et al., 2019; Doherty and Eeckhoudt, 1995; Richter et al., 2014; Dalhaus et al., 2020). Moreover, the profit maximization assumption has been recognized to be limiting in explaining the adoption process (Weersink and Fulton, 2020). Studies have stressed the importance of behavioral and psychological factors in influencing behavioral patterns of farmers' risk management strategies and technology adoption (Bergevoet et al., 2004; Aziz et al., 2015; Santeramo, 2019; Sok et al., 2020).

In our analysis, we modelled the famers' decision to adopt the Apple-IST after the Unified Theory of Acceptance and Use of Technology (UTAUT) framework proposed by Venkatesh et al. (2003). The UTAUT is the synthesis of eight prominent models of individual acceptance and use: the theory of reasoned action (Fishbein and Ajzen, 1975); the technology acceptance model (Davis, 1989); the motivational model (Vallerand, 1997); the theory of planned behavior (Ajzen, 1991); a model combining the technology acceptance model and the theory of planned behavior (Taylor and Todd, 1995); the model of PC utilization (Thompson et al., 1991); the innovation diffusion theory (Rogers, 1995); the social cognitive theory (Bandura, 1986). Venkatesh et al. (2003) validated the UTAUT model empirically by showing that it would outperform any of the above models in explaining an individual's intention and usage of a new technology

or of a new system. The UTAUT assumes that four major constructs determine an individual's behavior: the performance expectancy, the effort expectancy, the social influence and the facilitating conditions. The core construct can be thought as latent variables that need to be identified. The original model was later updated to UTAUT 2, which incorporates additional constructs and it introduces some moderating factors related to the user: age, gender and experience. The UTAUT model has been extended and adapted to different kind of contexts, such as education, food service, medical service and healthcare (for extensive review see Williams et al., 2015). In the next section we present how we adapted the UTAUT model to the IST acceptance context, describe the major constructs and show the corresponding identifying variables from our dataset.

4. Theoretical framework and methodology

We propose a tailored version of the *UTAUT* model to investigate farmers' adoption of the IST, which is reflected by the farmer's choice to participate or not in the IST scheme (*IST*). We explain directly subjects' observed choices and not intentions as in the original model by mapping five key constructs (i.e, core factors): *performance expectancy*, *effort expectancy*, *facilitating condition*, *perceived vulnerability*, *habit*, and two modifying factors, gender and age. All these factors influence the farmers' adoption decision. We now clarify the details of the model which is represented in Figure 2.

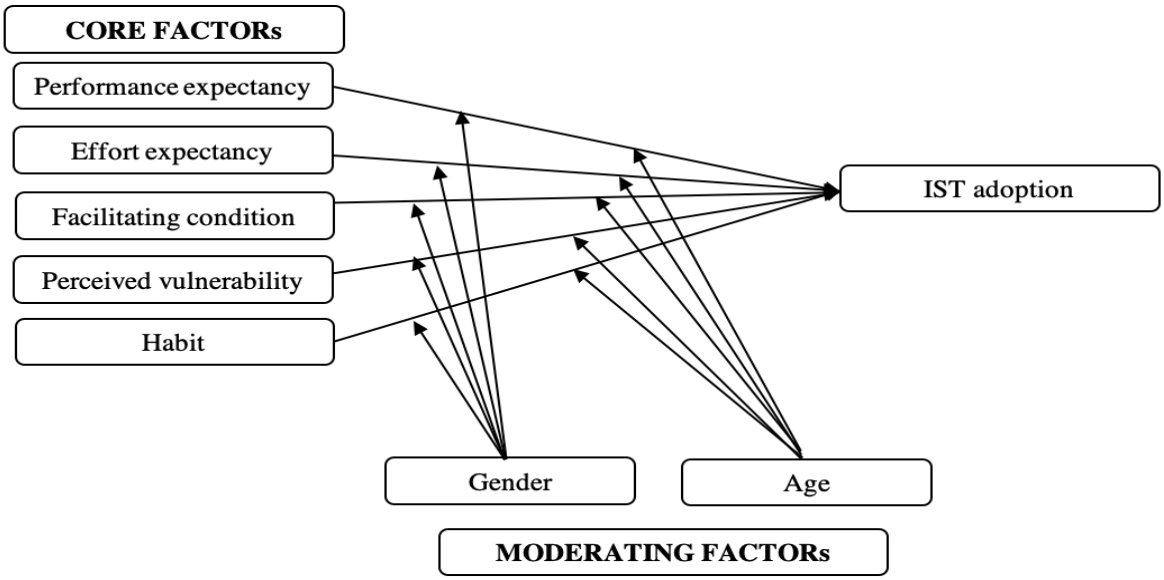

Fig.2. Model used in analysis, adapted from *UTAUT*. Source: Author's illustration

The *performance expectancy* construct is considered the strongest predictor of use among the core constructs. It refers to the farmer's belief that the adoption of the new system (i.e., IST) would provide

tangible benefits. Thus, we linked the farmer's expectation regarding the capacity of the IST to stabilize his/her apple income (*performance expectancy*) to the relevance of the apple production to the overall farm income. The expected added value of the tool is undoubtedly the major reason for farmers to accept the new scheme, as the IST has been proved to have the potential to smooth and stabilize farmers' apple-income, increasing the farm business resilience in face of risks not hedged by the standard crop insurance contract. Moreover, farmers who are more specialized in the apple's production may have a stronger incentive in using the apple-IST. In contrast, farmers with more complex crop portfolios may perceive the IST to be less beneficial because the apple-activities contribute to their final income marginally. The relevance of the apple production to the whole farm production is identified by the location of the farm. Farmers who operate in *Val di Non – Val di Sole (AREA_VNS)* where the apple production is very intensive are expected to be more willing to participate in the IST schemes with respect to farmers who operate in other areas with a lower apple intensity.

The *effort expectancy* is associated with the expected effort in using a new system, including time and financial aspects. The economic burden is expected to be a significant identifier of farmers' decisions to join the scheme. We associate the insurance premium paid by farmers for the crop insurance (*INSPR*) as a proxy for the farmers' effort, since the insurance premium is one of the three factors that outline the annual IST coverage cost. The annual IST fee is calculated on the basis of the multi-peril crop insurance premium paid in 2019 (*INSPR*), which, in turn, depends on farm size and orchards characteristics. These variables are usually found to be important determinants for the application of risk management instruments at farm level (*INSPR*) (Sherrick et al., 2004; Enjolras et al., 2012). We expected an inverse relationship between the insurance premium and the farmer's decision to buy the income coverage, because a higher subscription cost means a greater effort for the farmer, who is already insured or has implemented on farm mitigation tool (e.g., anti-hail nets). There are other costs that may have been used to identify the effort expectancy construct, such as transaction costs, cost of acquiring new information about the IST, paperwork time and administrative burdens. However, information on these variables were not available in our dataset. Also, the IST quotas paid by the farmers were observed only for those farmers who participate in the IST

and not for the entire sample, thus we could not use this variable to measure the effort construct more accurately.

Facilitating conditions refer to the existing organizational or technical structures that may support the use of the new system. Formal and informal infrastructures in place can facilitate or hinder the implementation of the IST. We conclude that the ownership characteristics of the farm can remove or add barriers towards the new scheme. In our dataset, we have two typologies of farms status: enterprises and sole traders (SOLE_TRADER). Agricultural enterprises may have higher managerial abilities and lower individual liability than sole owners and therefore may be more willing to innovate and adopt new risk management instruments. Farm status is found to affect risk management decisions also in other studies at European level, which found that sole farmers are less likely to purchase insurance compared to other type of farm ownerships (Lefebvre et al., 2014).

Perceived vulnerability is defined as the subjective judgment regarding the user's risk exposure (Johnston and Warkentin, 2010). This construct stems from protection motivation theory (PMT) (Rogers, 1975) and is found to have an effect on adoption of a new system, especially if the adoption reduces subject's risk exposure (Rogers, 1975; Sun et al., 2013; Zhao et al., 2018). Different studies have demonstrated the substantial impact that subjective risk perception can have on farmers' attitude and behavior. This construct is usually moderated by sociodemographic variables such as gender and age (Menapace et al., 2013; Cerroni, 2020). In our study, this construct is captured by two variables: the on-farm risk strategies (*RP*) and the amount in Euros of indemnities paid in 2019 (*INDEM*) by the multi-perils crop insurance. The farmers' use of other on-farm risk management tools such as nets to protect form hailstorms or anti-frost systems may have an effect on the IST acceptance. On the one hand farmers using these on-farm risk management tools are more concerned about damages due to hail and/or frost and therefore more likely to see the additional benefits of the IST. These farmers may perceive the IST as attractive tool to hedge against sources of risks other than climate and disease related risks, and to stabilize their income over time. On the other hand, it is possible that farmers who have already invested in nets and anti-frost system, perceive their yields to be protected enough and the IST not to be cost effective. These farmers perceive the IST as a substitute tool for other risk management tools and thus may have forgone

the IST because of cost-related implications (Co.Di.Pr.A., 2020). The amount of indemnities paid to the farmers in 2019 (*INDEM*) by multi-perils crop insurance is not only an indicator of the farm risk profile and the possible distress associated with the farming activities, but also help to set out a picture of the previous year production outcome. A farmer who is exposed to environmental risks and with a higher payout may be more favorable to participate in the IST due to the fact that his/her expected income is likely to fall below the threshold triggering compensations. This may open up the question whether the IST scheme could be affected by adverse selection problems.

The *habit* construct is defined as the extent to which people tend to repeat behaviours automatically, and is driven by the familiarity of the economic agent with the innovation. *Habit* can be considered as a perceptual construct that reflects the results of prior experiences (Venkatesh et al., 2012) and it affects how quickly and easily the novelty is integrated into the organizational processes of the farm and into the farmer's existing habits. The impact of this construct on the behaviour and future actions generally (i.e., strength) depends on the number of time a given behaviour was repeated (i.e., frequency) (Ouellette and Wood, 1998; Schukat et al., 2019). Two variables in our model connect with the *habit* construct: the insurance frequency (YEARS_INS) and the participation to other mutual funds in 2019 (MF_PART). Farmers who generally sign the multi-peril crop insurance and already participate in other mutual fund mechanisms may be more favorable to the new scheme, and therefore, we expect a positive effect on the IST acceptance rate. Farmers' experience with similar system is expected to positively influence adoption because it is linked with improved individual technical and managerial skills (Ghadim and Pannell, 1999). It is also true that farmers may perceive the IST as an alternative protection instrument. For this reason, we could expect the participation in the IST to be negatively influenced by the insurance frequency (YEARS_INS) and the participation to other mutual funds (MF_PART).

Regarding the moderating variables, we hypothesize that older farmers (AGE) to be less involved in the IST due to a lower inclination to innovation (Venkatesh et al., 2003; Frosch, 2011). Moreover, older farmers are less likely than younger to participate in the IST that focuses on income as they may have less debt and more wealth which rely on (Mishra and Goodwin, 2003; 2006). Female (FEMALE) farmers are also expected to have a lower propensity to adopt a new system as they are usually found to innovate less

than men (Venkatesh et al., 2003). On the other hand, it could be argued that women who are generally more risk and ambiguity averse than men (Eckel and Grossman, 2002, 2008; Cerroni, 2020) may be more inclined to adopt the IST since the instrument could reduce their risk exposure. Barham et al. (2014), for example, showed that risk and uncertainty aversion can facilitate the adoption of a risk reducing technology. Other moderating factors could have been considered, such as farmers' experience, education level. As our study is still in a seminal status, we will collect such information in the coming years. On the other hand, we purposely omitted from our analysis other moderating factors such as the orchard size due to correlation issue. Indeed, farm size is intrinsically correlated to the crop insurance premium in our case.

Table 2
Core constructs, corresponding variables and expected effect on the dependent variable

***UTAUT* Construct**	**Corresponding variables**
Performance expectancy	AREA_TSR, AREA_VAL, AREA_VNS, AREA_BVL
Effort expectancy	INSPR_LOW, INSPR_MED, INSPR_HIGH
Facilitating condition	SOLE_TRADER
Perceived vulnerability	RP_NO, RP_NETS, RP_FROST, RP_MIX, INDEM
Habit	MF_PART, YEARS_INS
Moderators	FEMALE, AGE

5. Model estimation and discussion

We estimated a logit regression model with cluster robust standard errors to accommodate for the fact that a farmer may have more than one insurance contract. The binary dependent variable is the farmer's choice to participate in the IST (*IST*). Table 3 shows the estimation results of the logistic regression, both odds ratio and log-odds are reported.[6] Our results show that *performance expectation,* as expected, is particularly important in explaining farmers' participation in the IST. Farmers who operate in *Valsugana* (*AREA_VAL* = -0.409, p <0.05), in *Trento Sud- Rotaliana* (AREA_TSR= -0.531, p <0.001), and in *Bleggio – Valle dei Laghi* (AREA_BVL= -0.620, p <0.001) are less likely to subscribe the IST coverage than those operating in *Val di Non – Val di Sole*. As mentioned before, the area *Val di Non and Val di Sole* is

[6] Odds ratio represent the estimated changes in the odds of IST adoption that is caused by a one unit increase in the respective explanatory variable and holding all other variables fixed at their mean values. For example, a 1-unit increase in the number of years insured, would increase the odds that a farmer participates in the IST by 11.8%. In contrast, being an older farmer would reduce the odds of participating in the IST by 39.6% compared to being a young farmer.

characterized by a very high apple production intensity, therefore the income of local producers is heavily dependent on apple production. The production of farms located in other areas is more diversified and as a consequence the expected performance of the IST-apple is lower. Previous research also indicated that specialized farms are more likely to adopt risk management tools as they can not use crop diversification as a risk mitigation strategy (Sherrick et al., 2004; Finger and Lehmann, 2012).

The *effort expectancy* influences farmers' decision to join the IST. The crop insurance premium per hectare paid in 2019 is found to be positively correlated with the likelihood to participate to the IST (*INSPR_MED* = 0.463, p <0.001, *INSPR_HIGH* = 1.366, p <0.05). Premiums are a function of the quantity of apples insured, which is in turn related to the size of the orchard and its total value. Our results suggest that farmers who own larger and higher valued orchards are more likely to participate in the IST. Economies of scale appear to play an important role in farmers' decision regarding joining the mutual fund. Similarly, previous studies confirm that larger farmers have a greater demand for insurance and other risk management tools (e.g. Sherrick et al., 2004; Velandia et al., 2009; Enjolras and Sentis, 2011b; Finger and Lehmann, 2012; Di Falco et al., 2014; Menapace et al., 2016).

Our results indicate that *vulnerability perception* is related to farmers' participation in the IST, specifically the use of other on-farm risk management strategies (i.e., nets and anti-frost systems) impacts farmers' decisions to join the IST scheme. Farmers using nets to protect their orchard from hail are more likely to participate in the IST (*RP_NETS*= 0.277, p <0.001) compared to other farmers who do not use any type of protection. Also, farmers who protect their orchards with anti-frost systems (*RP_FORST*) or both instruments (*RP_MIX*) do not show a greater inclination to accept the IST. This mixed behaviour may relate to the fact that such on-farm risk management strategies can be perceived as substitute to crop insurance and mutual funds by farmers, who tend to be less willing to face an additional economic burden (e.g. Enjolras et al., 2012; Di Falco et al., 2014; Santeramo et al., 2016). However, in our study we do not find this evidence. In contrast, we found that farmers installing nets are more likely to join the IST and this may be linked to the fact that hailstorm is perceived to be very damaging by farmers in the PAT , hence they would not stop using nets even when joining the IST scheme. Menapace et al., (2016) have estimated that hail causes an average loss of 12% of the aggregate crop value in the PAT, thus implying a higher

susceptibility to hailstorm rather than to other climatic events. In addition, previous studies suggested that farmers who expect substantial future yield losses are more likely to reduce their risk exposure (Sherrick et al., 2004; Menapace et al., 2016). Secondly, the cost of installing nets is substantially lower than the cost of fixing an anti-frost system, and virtually has no impact on farmers' decision to join the IST scheme. Thirdly, in our sample, farmers appear to perceive the IST as a complementary measure as compared to other risk management strategies. While nets and anti-frost systems mitigate losses in production due to specific adverse climatic events, the IST aims to stabilize farmers' income from multiple risks.[7] For example if the Polish production of apple is high, the apple price will fall lowering PAT farmers' income. Crop insurance and existing mutual funds do not provide support in case of income reduction due to market unfavourable conditions. On the contrary the IST, being triggered by the income reduction, fills this gap by compensating farmers whose income has fallen below the target threshold.

Habit shows a positive influence on the likelihood of participating in the IST. Farmers adopting other mutual fund in 2019 increase their likelihood of participating in the IST (*MF_PART* = 1.358, p <0.001). This relates to the fact that mutual funds are commonly used in the territory of the PAT and farmers have a positive experience with such schemes. Similarly, a higher insurance frequency increases the probability to join the IST (*INS_YEARS* = 0.122, p <0.01). Generally a strong positive relationship between prior experience with insurance products and demand for similar products has been reported in the literature (Sartwelle et al., 2000; Sherrick et al., 2004; Cole et al., 2014; Ye et al., 2017; Santeramo, 2019). It shall be noted that the magnitude of the estimated coefficients suggests the *habit* construct as the strongest predictor of the farmers' decision making.

In conclusion, our results indicate that women (*FEMALE* = -0.401, p <0.001) and older farmers (*AGE_OLD* = - 0.575, p <0.001) are less likely to join in the IST with respect to male and younger farmers.[8] Our results confirm the general evidence that *moderating factors* such as gender and age influence farmers' adoption of an innovative system, and that lower innovation rates are associated to women (Venkatesh and Morris, 2000; Venkatesh et al., 2012) and older farmers, who may have less incentives to adopt this new

[7] As additional checks we performed Wald tests on the dummy variables discussed. These results are available if needed.
[8] We also treat the age variable as continuous, and the resulting estimates show a negative statistically significant effect.

tool as they are usually less attracted by insurance instruments (Smith and Goodwin, 1996; Foudi and Erdlenbruch, 2012; Santeramo, 2019).

Table 3
Income stabilization (IST) tool uptake decision (logit model)[a]

	Odds ratio	Log-odds
Performance expectancy		
AREA_VAL (= 1 if farm area Valsugana; otherwise = 0)	0.664 *	-0.409*
	(0.118)	(0.178)
AREA_VNS (= 2 if farm area Trento Sud – Rotaliana; otherwise = 0)	0.587 ***	0.531 ***
	(0.072)	(0.123)
AREA_BVL (= 3 if farm area Bleggio – Valle dei Laghi; otherwise = 0)	0.537***	-0.620***
	(0.078)	(0.145)
Effort expectancy		
INSPR_MED (= 1 2019 insurance premium between €1,000ha and €5,000/ha; otherwise = 0)	1.589 ***	0.463 ***
	(0.167)	(0.105)
INSPR_HIGH (= 2 if 2019 insurance premium above €5,000/ha; otherwise = 0)	3.921 *	1.366 *
	(2.432)	(0.620)
Facilitating conditions		
SOLE_TRADER (= 1 if farm is run as sole trader; otherwise = 0)	0.919	-0.083
	(0.215)	(0.234)
Perceived vulnerability		
RP_NETS (= 1 if farm uses net; otherwise = 0)	1.318 ***	0.277 ***
	(0.101)	(0.076)
RP_FROST (= 2 if farm uses anti-frost system; otherwise = 0)	0.725 *	- 0.321*
	(0.105)	(0.146)
RP_MIX (= 3 if farm use net and with anti-frost system; otherwise = 0)	1.382	0.324
	(0.468)	(0.338)
INDEM (Indemnities received in 2019 in €1,000)	1.008***	0.008***
	(0.002)	(0.002)
Habit		
MF_PART (= 1 if farmers participate in other mutual funds in 2019; otherwise = 0)	3.890 ***	1.358 ***
	(0.728)	(0.187)
YEARS_INS (N° years with multi-peril insurance subscription 2015- 2019; otherwise = 0)	1.130 **	0.122 **
	(0.043)	(0.038)
Moderating factors		
FEMALE (= 1 if farmer is female; otherwise = 0)	0.669 ***	-0.401 ***
	(0.079)	(0.119)
AGE_ADULT (= 1 if farmer's age between 35 and 70; otherwise = 0)	0.781	- 0.246
	(0.111)	(0.143)
AGE_OLD (=2 if farmer's age above 70; otherwise = 0)	0.562 ***	- 0.575 ***
	(0.092)	(0.164)
CONSTANT	0.194 ***	-1.638 ***
	(0.063)	(0.324)
Log-likelihood		-3744.19
Observation		5,701

Note: * $p < 0.05$, ** $p<0.01$, *** $p<0.001$; [a] Clustered standard errors at the farmer level are in parenthesis.

6. Conclusion and policy implications

European farmers can choose among several options to reduce risk exposure and hedge against negative events. The most recent and innovative risk management tool proposed by the Common

Agricultural Policy (CAP) 2014-2020 is the Income Stabilisation Tool (IST). This scheme operates through a mutual fund and aims to stabilize farm income over time and therefore increase farmers' resilience to income fluctuations, environmental and market risks (i.e. price volatility). Generally, risk management tools, such as crop insurance or mutual funds, cover a single commodity or hedge specific risk of the agricultural business (e.g., hails, crop disease). On the contrary, the IST is a form of whole farm protection that is activated as soon as the farm income falls below a well-defined threshold (i.e., 20% of the previous-three-years average income) going beyond the source of the loss. Despite public support accounts for 70% of the mutual fund initial upfront costs, only the Autonomous Province of Trento (PAT) has established and operationalized the IST in the entire European Union. Specifically, the PAT has implemented two sector-specific ISTs in 2019, one concerning the apple-sector, the other concerning the dairy sector. In this paper, we focus on the former which is the largest and the most developed scheme.

In the existing literature, a good number of simulation studies have analysed the IST from different perspectives, for example, its effect on income inequality and variance and its economic feasibility at national or regional level. Collectively, these studies highlight the potential benefits of implementing the IST, but remain theoretical in their application. To the best of our knowledge, this is the first study to analyse an operating IST and to identify the factors that have influenced farmers' real decisions to enrol in the new scheme fund. We rely on the Unified Theory of Acceptance and Use of Technology (*UTAUT*) theoretical framework, and estimate a logit model to capture the drivers affecting farmers' choice to join the IST.

Our results suggest that the probability of accepting the IST is determined by the farmers' sociodemographic characteristics (i.e., age and gender), the farm characteristics and the risk management strategies that were already used by farmers. These variables were associated to different constructs that are at the core of the *UTAUT* framework. We found that the *habit, perceived vulnerability, performance* and *effort expectancy* constructs have a strong influence on farmers' decision to join the IST.

In particular, farmers who are more specialized in the apple production and have a larger income from the apple-related activities perceive the IST as an opportunity to stabilise their income (*performance expectancy construct*). This opens up the discussion about whether adverse selection may arise in a

cooperative context, like the IST scheme. Similarly, farmers' multi-perils insurance premium is positively correlated with the IST acceptance, implying that farmers insuring a greater quantity of apple are more likely to buy the income coverage offered by the IST. Also, the importance of *habit* and *prior experience* with similar risk sharing mechanism is related to farmers' decision to join the IST. Participation in other mutual funds and the custom of buying insurance products are positively correlated with the probability of subscribing to the IST. The PAT has a long-standing tradition on agricultural cooperatives and this may have played a key role in farmers' decision to join the new mutual fund. This paper also found evidence that farmers who implement on-farm risk management strategies, such as anti-hail nets, may respond favourably to the IST opportunity. This suggests that at least a portion of our sample perceives the IST as complementary tool to classic insurance contracts. As predicted by the *UTAUT* theoretical framework, our analysis confirmed that gender and age may affect farmers' decision to join the IST scheme. In fact, in our empirical application, women and older farmers were less attracted by the new risk management instrument.

The present study presents some limitations, which are mainly related to the lack of information on factors that may be relevant drivers of farmers' decision to accept the IST. Our dataset did not include information regarding farmers' income and production costs which are not available at the present. These variables would increase the explanatory power of our model and allow a more detailed analysis of the drivers affecting farmers' acceptance of the new tool. This information that will be available in the future will allow us to investigate the effect of the IST on income dynamics and the farmers' decision to re-join the IST scheme at the end of the three years operating period of the IST (i.e. 2022). Another limitation concerning this study is the estimation of a simple logit model. The *UTAUT* is a theoretical framework that it would be better approximated using a structural equation modelling approach that allows for the specification of the covariance structure of the variables employed. In this study it was not possible to follow this approach due to the limited set of variables available in our data set. For example, our dataset did not include behavioral factors, such as risk, uncertainty and time preferences. Previous research has empirically shown the effect of these behavioral factors on farmers' decision-making process (Moschini and Hennessy, 2001; Menapace et al., 2013; Cerroni, 2020). Further research could enrich this dataset thanks to data collect in the field using economic experiments and/or stated preference studies and improve

the modelling of farmers' decision regarding the IST. Thanks to this additional data it will be possible to expand our preliminary analysis regarding the IST acceptance.

Despite these limitations, this paper provides an original contribution to the existing literature on farmers' risk management practices, as well as relevant policy implications. Firstly, it represents the very first attempt to investigate the drivers of farmers' decision to participate into an IST scheme which is currently operative. Our findings could be used to understand the farmers and farms profiles that are more inclined to accept and subscribe this new tool. Even more important, our study help identifying those farmers who were not interested in participating to the scheme. This information, in turn, may help designing education, communication and outreach strategies to engage these farmers in conversations. For example, our study shows that female and older farmers should be targeted as they are less likely to join the scheme at the moment. Similarly, we found that habit is an important driver. Farmers who are not involved in other mutual funds or do not generally sign classic insurance contracts are less likely to sign the IST coverage. Such farmers should not be left behind, as they should be approached and educated regarding the potential benefits of using risk management tools proposed by the EU, especially the IST.

In conclusion, since the novelty of our empirical application, we believe that our findings could be relevant also for other countries or regions that are planning to operationalize the IST. We acknowledge that our findings are not necessarily transferable to other EU Member States given the peculiarity of the PAT. This is an area where agricultural cooperatives have a long-standing tradition. However, our results could inform policy makers across Europe regarding general drivers affecting farmers' participation to the IST scheme and help understanding barriers and opportunities that farmers face when given the possibility to use this new risk management tool. Understanding the links between farmers' characteristic and IST participation will help to spread this new tool that previous studies have proved to be effective in stabilizing farmers' income. Crop insurance will play a major role in the future, helping farmers to cope with higher climatic variability. However, the IST has the ability to increase the agricultural business ability to face any type of risk making the whole food production system more resilient. Not to mention, farmers with a lower income variability may be more favorable to engage in innovative and eco-friendly practice, thus giving the IST the potential to support the transition towards a more sustainable farming system.

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