Using a Technology Acceptance Model to test factors influencing farmers' intention to perform result-based contract solutions

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Abstract

A major focus of the Europe's "Green Deal" is the better delivery of public goods by agriculture. Improvements are expected by applying innovative agri-environmental contracts, e.g. based on results-based payments. For the implementation of such contract solutions, farmers' willingness to participate is key to success. This empirical study determines factors influencing farmers' intention to perform result-based contract solutions based on a Technology Acceptance Model (TAM). The direct and indirect relationships are tested by applying a Structural Equation Model (SEM) based on primary data of 235 Austrian farmers. Findings reveal that the intention to perform is significantly and directly driven by the attitude towards performing result-based contracts and by self-efficacy. Perceived usefulness and perceived ease of use are indirectly influencing the intention to perform via attitude. The subjective norm is influencing perceived usefulness directly and the intention to perform indirectly. Perceived risk is impacting perceived ease of use and therefore also indirectly impacting intention to perform. Our findings show, that especially for new voluntary AES, the socio-psychological constructs of farmers should be considered, which allows new levers in the design and successful introduction of these measures.

Keywords Structural equation modelling; Technology Acceptance Model; Result-based Agri-Environmental Schemes

JEL code Q18; Q57; Q28; C12

1. Introduction

Agriculture is part of the environment in which it operates, affecting a variety of public goods, such as biodiversity, soil functionality and health, water and air quality, as well as landscape and scenery (Westhoek et al., 2013). In order to counteract the negative effects of agriculture on such goods, Agri-Environmental Schemes (AESs) were introduced within the framework of the Common Agricultural Policy (CAP) (Batáry et al., 2015). The action-oriented approach is the dominant instrument in the current AESs, in which farmers receive financial compensation for implementing certain measures/actions on their farms/fields to improve ecosystem services (European Court of Auditors, 2011; Groth, 2009). However, the environmental- and cost-effectiveness of these action-oriented AESs are increasingly criticized (Batáry et al., 2015; Pe'er et al., 2014; Pe'er et al., 2019). The condition of many European agricultural ecosystems, as well as the provision of many public goods, continues to deteriorate, and, therefore, opportunities for improvement are now being sought (Pe'er et al., 2019). New AESs, implementing results-based (RB) approaches, are promoted as incentive tools to foster the delivery of Agri-Environmental-Climate Public Goods (AECPG). RB approaches are contract solutions (voluntary agreements) in which payments to farmers are based on the achievement of an environmental improvement rather than the implementation of prescribed management measures (Burton & Schwarz, 2013). Because of the linkage between environmental improvements and payments to farmers, researchers believe that land managers in RB contracts have a greater vested interest in achieving environmental goals (Matzdorf et al., 2008), have greater flexibility in making management decisions (Cullen et al., 2018; Herzon et al., 2018), and the capacity to innovate is increased (Allen et al., 2014; Cullen et al., 2018). On the other hand, the literature reveals several potential challenges for the implementation of RB approaches, such as a perceived higher administrative burden (Birge et al., 2017; Wezel et al., 2016), potential high costs of adoption, monitoring, and management, and increased risk due to external factors affecting environmental outcomes (e.g. climatic conditions, neighboring farmers, life cycle stages) (Gerowitt et al., 2003). In addition, potential barriers to farmer acceptance of RB contracts include perceived increased complexity (Cullen et al., 2018), and difficulty in general understanding (Wezel et al., 2018). If such voluntary new AESs are successful, however, depends on farmers' willingness to participate, driven by individual decision-making processes. Hereby, purely economic models that treat farmer decision-making as a predictable response to economic stimuli are considered insufficient for explaining farmer behaviour (Brown et al., 2017, 2021; Nilsson et al., 2019). Moreover, we need to gain an understanding of the psychology of the individual farmer, particularly the cognitions underlying behavior, if we seek to develop effective new AES to promote sustainable behavior (Kaplan & Kaplan, 2008). Psychosocial models have recently been applied in behavioural economics to improve the explanatory power of economic models (Camerer et al., 2011). Furthermore, taking behavioural factors into account enriches the economic analysis of farmers' decision-making and can lead to more realistic and effective agri-environmental policies (Dessart et al., 2019). According to Dessart et al., 2019 the debate on Common Agriculture Policy (CAP) reform after 2020 may provide an opportunity to take behavioural factors more into account especially when designing innovative agri-environmental policies (such as collective and result-based approaches).

In this contribution, we, therefore, study farmers' decision-making related to the intention to perform result-based AESs for the improved provision of biodiversity and/or soil conservation. We develop and apply a structural equation model, incorporating socio-psychological factors. As a theoretical model, we adapt the Technology Acceptance Model (TAM) developed by Davis et al. (1989) to the context of the intention to perform new AES, aiming to generate fresh insights about the socio-psychological factors influencing farmers' decision making. TAM adaptations are based on existing studies, applying the TAM in agricultural contexts (e.g. Naspetti et al., 2017; Rezaei et al., 2020), as well as in a political context (e.g. Pierce et al., 2014). However, to our best knowledge, this study is the first to apply the TAM in an agri-political context. We perform our study in Austria, where the European Commission sees a need for action especially in agricultural soil health and in supporting biodiversity conservation on agricultural land (European Commission, 2020). The number of participants in AESs is high in Austria, 82% of Austria's agricultural land is funded under the Austrian Agri-environmental Program (BMLRT, 2020). However, regarding RB contracts are low level of familiarity among farmers is assumed (Wezel et al., 2018) although already two RB contract solutions are implemented in Austria.

The overall structure of the study takes the form of six chapters. The second chapter gives a brief review of the existing literature and our hypotheses development. The third chapter introduces the questionnaire, the means of data analysis, and the quality check of the measurement model. The fourth section presents the findings of the research, by testing the hypotheses of the TAM model. The fifth chapter discusses the findings of the analysis. The final chapter brings together the lessons from the study and provides some recommendations for the future design of result-based contracts.

2. Literature review and hypotheses development

2.1. TAM Basic Model

Various models for determining acceptance exist, such as the Theory of Reasoned Actions (TRA), the Theory of Planned Behaviour (TPB), the ABC Model of Attitudes, and the Technology Acceptance Model (TAM). Acceptance can be defined as “the willingness to accept someone or something” (Drosdowski, 1989). Acceptance models are concepts that attempt to determine the facets of the acceptance construct and the factors affecting it. One of the best-known models for explaining acceptance is the Technology Acceptance Model (TAM) developed by Davis in 1989. The TAM was adapted from the Theory of reasoned actions (TRA) (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975) and the Theory of planned behaviour (TPB) (Ajzen, 1988, 1991) and was designed to explain the factors that determine users' behaviour toward new information technologies (Davis, 1989). However, the TAM is recognized as an empirically validated and effective model for capturing and explaining different behaviours (King & He, 2006; Venkatesh & Davis, 2000) also beyond the technology sector, from which the TAM has evolved. TAM is broadly applied, also in the agricultural context (Michels et al., 2019; Naspetti et al., 2017; Rezaei et al., 2020; Schulze & Spiller, 2010), as well as for analysing policy questions (Pierce et al., 2014; Zhu et al., 2016).

The TAM assumes that the intention to use, and in a subsequent step to use it actually, is determined by the attitude towards use (Davis, 1989; Davis et al., 1989). Attitude is described as an individual's negative or positive feeling about performing the behavior in question (Fishbein and Ajzen, 1975). According to Fishbein and Ajzen's (1975) attitude theory, the original TAM considers attitude as a mediator, meaning the construct is inserted into the model as an intervening variable (Kurkinen, 2012), directly influencing behavioral intention or actual behavior (Sheppard et al., 1988). Furthermore, attitudes towards use are influenced by individual beliefs regarding the perceived ease of use and perceived usefulness (Ducey & Coovert, 2016; Verma et al., 2018). Perceived usefulness originally referred to "the prospective user’s subjective probability that using a specific application system will increase his or her job performance within an organizational context" (Davis, 1986). In contrast, perceived ease of use is defined as "the degree to which the prospective user expects the target system to be free of effort" (Davis, 1986). The more useful an information system is and the easier it is to use, the more likely the user is to use the new system (Davis, 1989). Moreover, Davis (1993) states that perceived ease of use directly impacts perceived usefulness, while perceived usefulness does not influence perceived ease of use, since the process of building the opinion on perceived usefulness depends mainly on the perceived ease of use (Venkatesh & Davis, 2000).

Based on the assumptions of the basic TAM we hypothesize that a farmer will form a positive attitude toward a new contract solution (voluntary agreement for delivering AECPGs) if she or he believes that this contract is technically simple (H3) and that the implementation of this innovative contract is useful (H2). Thus, the more a farmer sees this implementation of this innovative contract as positive, the more likely she/he is to participate in or implement the contract solution (H1). Moreover, the easier the farmer believes the contract solution to be, the greater the usefulness (H4).

These considerations lead to the basic model of the TAM in the context of innovative AESs, resulting in the following hypotheses:

H1: Attitude towards use has a significant positive effect on the intention to perform a result-based contract.

H2: Perceived usefulness has a significant positive effect on the attitude towards use/perform result-based contracts

H3: Perceived ease of use has a significant positive effect on the attitude towards use/perform result-based contracts.

H4: Perceived ease of use has a significant positive effect on perceived usefulness.

2.2. Extended TAM

Indeed, several studies have suggested that additional constructs should be added to the TAM to strengthen the model and improve its explanatory power (e.g. Amberg et al., 2004). Specifically, in a meta-analysis of 88 independent TAM studies, King and He (2006) found possible modifications. First, upstream/external factors can be included in the model as determinants for perceived ease of use and perceived usefulness (Venkatesh, 2000; Venkatesh & Davis, 2000; Wu et al., 2007). Already Venkatesh and Davis 2000 included as a social process variable (external stimuli) the subjective norm in the extended “TAM2”, as a reaction to the criticism that the TAM is not enough for explaining the complex process of building acceptance. In addition, Venkatesh 2000 included self-efficacy as determinant for perceived ease of use. In this contribution, we, therefore, added subjective norm, perceived risk, and self-efficacy as upstream/external factors. A second modification based on King and He (2006) can be the inclusion of additional factors proposed by other theories that directly influence intention to perform. In our study, we hypothesized self-efficacy is also directly influencing the intention to perform. Third, contextual factors such as characteristics of the user (Venkatesh et al., 2003) characteristics of the technology (Sun & Zhang, 2006), and organizational factors (Venkatesh & Davis, 2000) can be included as moderators in the model. The potential extensions of the TAM model are examined in the following sections regarding their suitability to the primary research question.

2.2.1. Subjective Norm

Subjective norm is defined as perceived social pressure to perform a behavior. It refers to a person's perception of how important others evaluate the behavior in question and the motivation to act in accordance with this judgment (Ajzen, 1985). Subjective norm is already considered as external stimuli for perceived usefulness in Venkatesh and Davis (2000) "TAM2" extension. Besides subjective norm also the term social influence is used in this context. Social influence indicates the extent to which an individual feels that important people in the social environment believe that he or she should use a new technology or system. Social influence and subjective norm are also an extension of the TAM, which have already been undertaken in the sustainable agriculture context (Naspetti et al., 2017; Rezaei et al., 2020). For our study, however, it is particularly relevant whether social influence has also already been studied with regard to innovative agri-environmental contracts. So far, several studies have explored the relationships between farmers and the social network they are embedded in (Brown et al., 2018; Burton & Paragahawewa, 2011; de Snoo et al., 2013; Rose et al., 2018). Studies show that neighbours, farming community, family, and other trusted sources of information can have a particular influence on the decision-making process of the farmers and are often underestimated (Brown et al., 2018; Rose et al., 2018; Salamon et al., 1997). Addressing farmers' surrounding networks in the understanding, promotion, and valuing of environmentally-friendly management practices can foster the effectiveness of implementing new solutions (Burton & Paragahawewa, 2011; de Snoo et al., 2013). This was also confirmed by Birge et al. (2017) who observed in relation to result-based approaches, that farmers believed that their peers and society would view this approach positively and the farmers, furthermore, stated that they would take their peers' opinions into account when making their own decisions. In addition, social recognition also matters in the decision-making process, according to Russi et al. (2016), as for example farmers often compare themselves and their performance against each other in a judgmental peer group (Burton, 2004). Consequently, this leads us to the hypothesis that the subjective norm is positively influencing the perceived usefulness of result-based contract solutions.

H5: Subjective norm has a significant positive effect on the perceived usefulness of result-based contract solutions.

2.2.2. Self-efficacy

Self-efficacy is defined as "people's beliefs about their capabilities to produce effects" or in other words to successfully perform a particular task (Bandura, 2015). Bandura 2015 argues that people with high self-confidence in their abilities view difficult tasks as challenges to be conquered, not as threatening to be circumvented or avoided. Self-efficacy has already been used by Venkatesh (2000) as a predictor of perceived ease of use in the context of the topic "computer". Furthermore, Abdullah & Ward (2016) highlighted in their meta-analysis of 107 TAM studies that self-efficacy is a powerful and often used determinant of perceived ease of use. In the research work investigating sustainable agriculture, Rezaei et al. (2020) expanded the TAM by including self-efficacy as a determinant for perceived ease of use and perceived usefulness, whereby the connection between self-efficacy and perceived ease of use was confirmed by the analysis. Perceived self-efficacy is also known as perceived behavioral control and refers to farmers' perception that they have the right skills and enough time to perform certain actions (Dessart et al., 2019). In line with this, studies about the conversion form conventional to organic farming show, that farmers, who feel they do not have sufficient skills and time, are more reluctant to convert their farm (Läpple & Kelley, 2013). This leads us to the following hypotheses H6 and H7:

H6: Self-efficacy has a significant positive effect on the intention to perform a result-based contract.

H7: Self-efficacy has a significant positive effect on the perceived ease of use of result-based contracts.

2.2.3. Perceived risk

Risk in result-based contracts needs to be considered differently than in action-oriented contracts (Burton & Schwarz, 2013). The increased freedom of action among the farmers is perceived as an important benefit, however, this benefit can also result in a shift of uncertainty of environmental outcomes from the government to farmers, which in turn would reduce the attractiveness of result-based measures among risk-averse farmers (Uthes & Matzdorf, 2013). An associated higher risk in RB contracts is grounded in various factors, including the influence of the unpredictable nature (yearly changes in weather, crops), and e.g. in spillover effects based on the behaviour of neighbouring farmers, meaning that results are not always in the hands of farmers implementing the RB scheme (Wezel et al., 2018). Perceived risk or uncertainty affects people's confidence in their decisions. Risky situations can be those in which the probabilities of a particular outcome occurring are unknown (Im et al., 2008). Burton and Schwarz (2013) further outlined two "key problem areas" in connection with RB contract, these are, besides difficulties in developing and monitoring indicators, the increased risk that these schemes pose to farmers. Risk has also been identified as an influence in a study investigating factors influencing participation in agri-environmental programs in general, most recently in the study by (Wąs et al., 2021). Wąs et al. (2021) conclude that risk aversion is an important determinant, however it is rarely analyzed in the literature. Based on the literature, we propose the following hypothesis (H8):

> **H8:** Perceived risk has a significant effect on the perceived ease of use of result-based contracts.

2.3. Additional factors influencing new AES uptake

Besides socio-psychological aspects in the uptake of new AES, also contextual factors such as farm economic factors, farm and farmer characteristics, as well as further dispositional factors can influence the intention to perform new AES. Several lines of evidence suggest that farm economic factors, such as the percentage of total household gross revenue from farming/forestry, land tenure, and labour have an impact on the decision to participate in general AES (Defrancesco et al., 2008; Lastra-Bravo et al., 2015; Ruto & Garrod, 2009) and therefore should also be considered in new AES. Farm structure characteristics such as farm size, location, and farm specialization can further be included in the model. With regard to farm size, there are studies stating that larger farms are more likely to participate in AES than smaller ones (Hynes & Garvey, 2009; Wilson & Hart, 2000) as well as the exact opposite (Capitanio et al., 2011) or that there is no influence at all (Ducos et al., 2009; Mathijs, 2003). Results are also diverse with respect to farm specialization. However, it is interesting to note that generally more extensive farms, organic farms, and less productive farms are more willing to implement AES (Peerlings & Polman, 2009; Ruto & Garrod, 2009; Zimmermann & Britz, 2016). The farmers' characteristics category involves age, education, and farm successor. The clearest associations in this category involved the effects of knowledge or experience with specific management options and general education level, both of which were strongly associated with uptake (Brown et al., 2021). Regarding age, some studies say both that younger individuals are more likely to participate in AUM and those that cite the opposite (Brown et al., 2021). Finally, dispositional factors such as farmers' environmental awareness, experience within current AES, and general satisfaction with AES can have an impact on new schemes uptake (Sattler & Nagel, 2010; Sutherland et al., 2016).

3. Materials and Method

3.1. Theoretical TAM framework

Based on the literature review presented above we developed our theoretical model (Figure 1), for determining the factors influencing farmers' intention to perform RB contracts. In our model seven latent constructs are involved, namely "Intention to perform a result-based contract" (ITP), "Attitude towards performing" (Att), "Perceived ease of use" (PEOU), Perceived Usefulness (PU), "Self-efficacy" (SE), "Subjective norm" (SN) and "Perceived risk" (PR). The basic TAM hypothesis that Att is influenced by PU (H2) and PEOU (H3), PEOU is impacting PU (H4) and Att is influencing ITP (H1). In addition, the extended TAM is suggesting that SN is impacting PU (H5), and SE is influencing ITP (H6) and PEOU (H7). Finally, PR is influencing PEOU (H8).

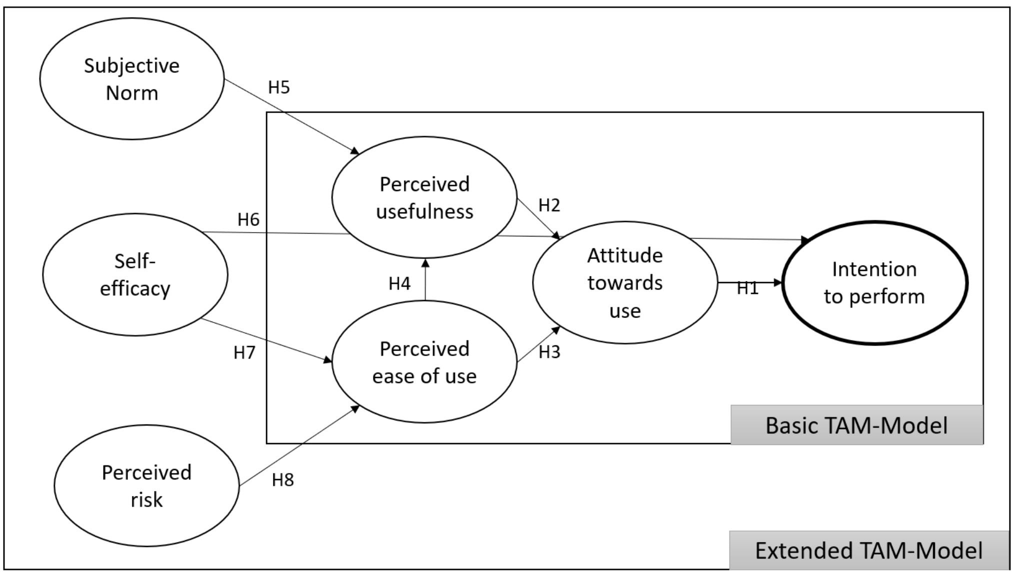

Figure 1: Proposed theoretical research framework

3.2. SEM implemenation

We conducted a covariance analytical approach by applying a Structural Equation Model (SEM) (figure 1). SEM is a set of statistical methods for analyzing relations between latent variables, with the aim to test a system of theoretical hypotheses with empirical data (Jöreskog & Sörbom, 1979; Bagozzi, 1980; Bollen, 1989). We used the SEM for our study, based on three reasons: First, with the SEM we can include besides observable variables also latent variables. Latent variables are complex constructs, which cannot be measured or observed directly (Homburg et al., 2008), and, therefore, indicator-sets are used to measure the construct. Moreover, SEM is considered to be the most powerful method for the analysis of complex structures with latent variables (Homburg, 1992). Second, SEM is often used in social and behavioural science and is a preferred method for testing the TAM. Third, the literature increasingly points to the importance of including socio-psychological constructs among farmers in understanding participation in AES programs, in addition to economic-driven factors (Dessart et al. 2019; Brown et al. 2017, 2021; Nilsson et al., 2019). However, this requires a reorientation of the methods and also leads to the application of SEM in agricultural economics to calculate these behavioral constructs, which are already widely used in marketing, for example. Data used in this study were gathered from a sample of Austrian farmers through an online survey (N = 235) conducted in Summer 2021 with the help of a market research institute. In total, 267 responses from farmers were received, 235 valid responses were used for the analysis.

3.3. Questionnaire

The questionnaire was designed to contain 54 items in 10 sections. The survey started with an introduction to results-based agri-environmental measures. Due to the novelty of RB measures and the perceived complexity reported in the literature (Cullen et al. 2018), it was decided to conduct the survey using two specific agri-environmental goods (biodiversity and soil quality and health). The given RB example represents an "in-production scheme" as it calls for reconciling production and conservation on managed land (analogous to Batary et al. (2015) ("land sharing"). It is also strongly result-based, as no additional requirements are given (Burton and Schwarz, 2013. In the exemplary scheme, farmers are only paid after achieving a certain level of environmental improvement (Allen et al., 2014). If the environmental performance increases, the payment also does. High priority was given to comprehensibility and clarity, therefore, we asked participants if they understood the example, using a five-point

Likert scale. For the latent constructs of the TAM, measurement scales were predominantly used whose validity has already been confirmed in other studies. Adjustments were made to the terminology that relates to the subject under study. All measurement items were asked on a Likert scale from 1 (strongly disagree) to 5 (strongly agree). The number of items per construct ranged from three to four indicators, between three and four are advised as an optimal number of indicators from Bollen 1989. The construct "perceived risk" was designed by the authors themselves considering information from a survey conducted in Austria in spring 2021, where farmers (N=148) and stakeholders from the agricultural sector (N=32) were asked about their opinion regarding result-based schemes. Two pretests were conducted, first on contents, in which six scientists and two farmers reviewed the questionnaire and tested its comprehensibility, accuracy, and answerability. Various changes were made based on the feedback: a video was created, questions were simplified and more concretely aligned to the example and the public goods. The second pretest was conducted with 31 farmers. This pretest was subjected to a comprehensive quality test to ensure the quality of the measurement models in the main study, by means of a reliability and validity test. Based on the results, the constructs and their indicators were expanded, shortened, or replaced. In August and September 2021, the main investigation was conducted.

3.4. Data analysis

The data were analyzed using SPSS Statistics 27 and SPSS AMOS 27. As part of the data analysis, a quality check of the reflective measurement models was carried out. The reliability and validity of the measurement instruments were evaluated, first with the pretest data and then again with the data from the main survey. Subsequently, the structural equation model was estimated with AMOS using maximum likelihood estimation. The maximum likelihood (ML) method is the most commonly used estimation algorithm. Assuming a multinormal distribution, as well as a sufficiently large sample size, the ML method provides the most precise estimators. The sample size (N) should be greater than or equal to five times the number of parameters (t) (Loehlin, 1987). In our case, N is 235 and the total number of parameters is 23. Finally, an assessment of the overall model fit was performed based on model fit criteria.

3.4.1 Reliability and validity testing

First, an exploratory factor analysis (EFA) was conducted to confirm the assignment of measurement indicators to hypothesized constructs, and the one-dimensionality of an indicator set (Homburg and Giering, 1996). Therefore, Kaiser-Meyer-Olkin (KMO) scores, Bartlett's test, "Measure of Sampling Adequacy" (MSA) scores, pattern matrix, commonalities, and the number of identified factors were calculated. All KMO-values were above 0.6 (ranged from 0.636 to 0.839) (Kaiser and Rice, 1974), Bartlett tests were significant, MSA-values were above 0.5 (between 0.589 and 0.907) shown in Table 1. The communalities were above 0.500, except PU$_3$ with 0.336, indicating that PU$_3$ provides a smaller explanatory contribution to the construct PU. In the pattern matrix, only one factor was extracted in each construct indicating one-dimensionality (Weiber and Mühlhaus, 2014). Furthermore, we tested for discriminant validity with the EFA by looking at whether the individual indicators "group" to the imputed constructs under simultaneous consideration of all constructs. With a KMO value of 0.872 (and a significant Bartlett test) the variable set was very well suited for factor analysis. The variable-related MSA values were also in an acceptable range between 0.662 (PR$_1$) and 0.947 (Att$_2$). Seven factors were extracted and 69.222% of the variance (mediocre value) was explained. The pattern matrix showed the correlations of the indicators with the factors (factor loadings) and confirmed our suspected structure. To measure internal consistency the Cronbach's alpha coefficient was calculated. All values were far above the recommended minimum level of 0.70 (ranged from 0.798 to 0.919) (Cortina, 1993) (Table 1)

Constructs	Measurement items	MSA	Communality	KMO Value	Composite Reliability	Cronbach's α	AVE	SMC
ITP								
	ITP$_1$	0.815	0.659	0.724 (average)	0.919	0.916 (stand. 0.904)	0.793	0.674
	ITP$_2$	0.661	0.937					0.904
	ITP$_3$	0.724	0.774					0.799
Att								
	Att$_1$	0.872	0.738	0.839 (meritorious)	0.920	0.919	0.742	0.716
	Att$_2$	0.907	0.593					0.584
	Att$_3$	0.804	0.818					0.819
	Att$_4$	0.796	0.822					0.850
PEOU								
	PEOU$_1$	0.794	0.554	0.797 (average)	0.864	0.850	0.614	0.534
	PEOU$_2$	0.809	0.660					0.666
	PEOU$_3$	0.785	0.708					0.687
	PEOU$_4$	0.799	0.535					0.569
PU								
	PU$_1$	0.622	0.596	0.636 (mediocre)	0.831	0.807	0.628	0.676
	PU$_2$	0.589	0.963					0.845
	PU$_3$	0.768	0.336					0.365
SE								
	SE$_1$	0.756	0.731	0.751 (average)	0.894	0.895	0.739	0.719
	SE$_2$	0.758	0.728					0.724
	SE$_3$	0.740	0.758					0.773
SN								
	SN$_1$	0.701	0.706	0.738 (average)	0.801	0.798	0.573	0.635
	SN$_2$	0.744	0.469					0.537
	SN$_3$	0.661	0.550					0.548
PR								

	PR_1	0.736	0.500	0.705 (average)	0.800	0.798	0.572	0.500
	PR_2	0.677	0.658					0.637
	PR_3	0.708	0.558					0.579

Table 1: Reliability and validity testing

We calculated the Indicator Reliability/Squared Multiple Correlation (SCM), Factor Reliability (FR)/Composite Reliability (CR), and the Average Variance Extracted (AVE) per factor by performing a Confirmatory Factor Analysis (CFA) using AMOS and Excel (for second-generation reliability criteria). First, we built a path diagram (including seven latent variables) and estimated the parameters using the ML method. All variables reached the required SCM of 0.4 (ranged from 0.5 to 0.904) (Bagozzi and Baumgartner, 1994), the required CR of 0.6 (ranged from 0.8 and 0.920) (Bagozzi and Yi, 1988), and the required AVE value of 0.5 (ranged from 0.572 to 0.793) (Fornell and Larcker, 1981). Only the indicator PU_3 (0.365) was slightly under the SCM value of 0.4 and is thus considered less important. Convergent validity was given due to the DEV values above 0.5 (ranged from 0.572 to 0.793) (Fornell and Larcker, 1981). The measurements of the constructs must differ significantly, then one can speak of discriminant validity. Based on the already performed CFA an unrestricted model was calculated, in which the factor correlations were freely estimated. For each construct, a restricted model was then calculated and compared regarding the $\chi 2$ with the unrestricted model. Speaking of discriminant validity all $\chi 2$-difference values should be above the critical value of 3.84, this was the case for all constructs (Homburg, 1998). Finally, the Fornell/Larcker criterion also indicates discriminant validity. The AVE values should be higher than the DEV values (Fornell and Larcker, 1981). The squared factor correlations were between 0.004 and 0.423. The DEV values were between 0.572 and 0.793, thus discriminant validity was given according to the Fornell/Larcker criterion.

3.4.2. Model fit

Besides the validity and reliability check, the data were further analyzed considering the multinormal distribution of the data, and the evaluation of the overall model fit.

The individual variables are tested for their normal (univariate) and multinormal distribution. Kurtosis values above 3.00 indicate that a variable is not normally distributed (Westfall & Henning, 2013), all values are within the range given. The fit of the overall model was tested considering various goodness-of-fit criteria. CMIN/DF[1] (2.110; 2.002), RMSEA value[2] (0.068;

[1] Minimum Discrepancy Function by Degrees of Freedom divided

[2] Root Mean Square Error of Approximation

0.065), SRMR[3] (0.069; 0.0804), CFI[4] (0.964; 0.936), IFI[5] (0.964; 0.937) and TLI[6] (0.955; 0.926) were all in the required range (cutoff-values from the literature) for the basic as well as the extended TAM and thus indicate an acceptable to good model quality (Table 2).

Model fit	Basic TAM	Extended TAM	Sources
RMSEA	0.068	0.065	≤ 0.05-0.08 Browne/Cudeck (1993)
CMIN/DF	2.110	2.002	≤ 2.5 Homburg/Baumgartner (1995)
SRMR	0.069	0.0804	≤ 0.10 Homburg/Klarmann/Pflesser (2008)
IFI	0.964	0.937	≥ 0.90 Bollen (1989)
TLI	0.955	0.926	≥ 0.90 Homburg/Baumgartner (1995)
CFI	0.964	0.936	≥ 0.90 Homburg/Baumgartner (1995)

Table 2: Quality indicators for the assessment of the overall fit of the basic and extended TAM

4. Results

4.1. Descriptive results

In total, 235 valid responses from farmers were received. The farm and farmer characteristics profile of the respondents were compared with the characteristics of all farms in Austria. The age distribution of the sample is close to that of the Austrian farms. With 40.8%, slightly more women answered the questionnaire than the Austrian distribution in terms of gender at the farm (31% female to 69% male). Regarding the farm characteristics, with 72.8% more part-time farms are in our sample than among the Austrian farms (55.4%), also the organic share with 31.9% is higher (Austrian farms 20%). The agricultural land managed corresponds to those of the Austrian farms. Arable farms (18.7) and husbandry farms (28.9%) are most apparent in our sample followed by special and permanent crops (17.4%) and forestry (11.5%). 88.1% of the respondents have planned to continue the farming activity in the next 5 years. 54.9% of the participants indicated having already experience with AES and 13.6% stated to have already experience with RB contracts.

[3] Standardized Root Mean Squared Residual
[4] Comparative Fit Index
[5] Incremental Fit Index
[6] Tucker-Lewis Index

4.2 Hypothesis testing

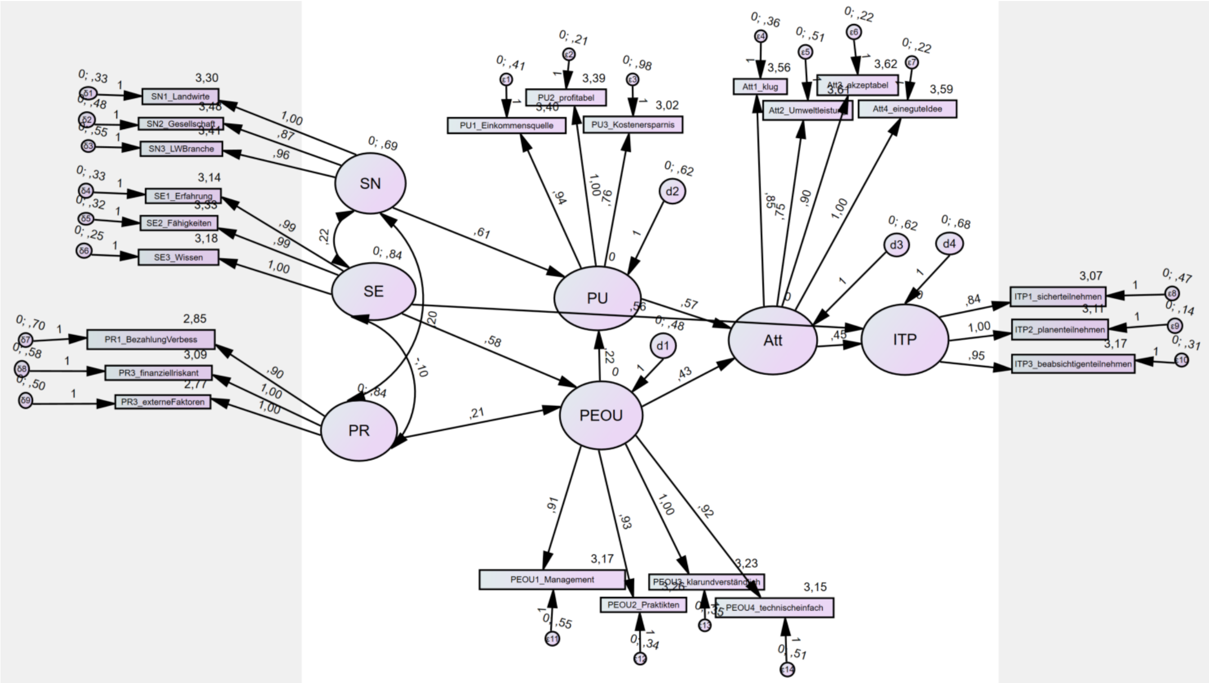

Figure 2: Tested structural model in AMOS

In the basic TAM, the squared multiple correlation coefficient (R^2) of farmers' ITP for result-based contract solutions was 0.335, indicating that 33.5% of the variable's variance was explained by the included constructs (Table 3). Moreover, the results shown in table 4 and figure 2 indicate that Att (β = 0.579, p < 0.001) had a positive relationship with farmers' ITP. Similarly, PU (β = 0.455 p < 0.001) and PEOU (β = 0.317, p < 0.001) had significant positive effects on Att. PEOU (β = 0.419, p < 0.001) significantly affected PU. Therefore, H1, H2, H3, and H4 were supported in the basic TAM. By extending the basic TAM by the constructs SE, SN, and PR the R^2 increased from 0.335 to 0.502, which corresponds to an increase of 16.7% of the variance. This was also confirmed by comparing the basic and extended TAM with the chi-square difference index, which showed a significant difference in explanatory power ($\Delta\chi 2$ = 284.4, df = 146, p < 0.001). Concerning the hypothesised structural relationships, the results reveal that H1, H2, H3, and H4 are supported in the extended TAM similar to the basic TAM. Att (β = 0.425, p < 0.001) had a statistical positive relationship with ITP. PU (β = 0.504, p < 0.001) and PEOU (β = 0.346, p < 0.001) affected Att. PEOU (β = 0.201, p = 0.006) positively impacted also PU. Furthermore, the standardised path coefficient between PR with PEOU (β = 0.221, p = 0.001) was significant. Moreover, SE had a significant positive impact on PEOU (β = 0.607, P < 0.001), and on ITP (β = 441, p < 0.001). Finally, SN is impacting PU (β = 0.515, p <

0.001). Therefore, the hypotheses H1, H2, H3, H4, H5, H6, H7, and H8 were supported in our analysis.

Construct	Estimate
Basic TAM	
PU	.175
Att	.486
ITP	.335
Extended TAM	
PEOU	.386
PU	.354
Att	.486
ITP	.502

Table 3: Basic TAM and extended TAM – Squared Multiple Correlations R^2

Construct	d	Construct	Estimate	S.E.	C.R.	P	Estimate*	Hypothesis	Result
Basic TAM									
PU	←	PEOU	.485	.084	5.760	***	.419	H4	Supported
Att	←	PU	.501	.076	6.595	***	.455	H2	Supported
Att	←	PEOU	.473	.085	5.537	***	.317	H3	Supported
ITP	←	Att	.604	.063	9.514	***	.579	H1	Supported
Extended TAM									
PEOU	←	SE	.585	.069	8.502	***	.607	H7	Supported
PEOU	←	PR	.213	.067	3.200	.001	.221	H8	Supported
PU	←	PEOU	.223	.081	2.736	.006	.201	H4	Supported
PU	←	SN	.608	.099	6.165	***	.515	H5	Supported
Att	←	PEOU	.430	.082	5.248	***	.346	H3	Supported
Att	←	PU	.565	.077	7.381	***	.504	H2	Supported
ITP	←	Att	.453	.059	7.621	***	.425	H1	Supported
ITP	←	SE	.563	.075	7.491	***	.441	H6	Supported

Table 4: Tested hypotheses

5. Discussion

This study investigated the factors influencing farmers' intention to perform result-based contract solutions by applying a SEM implementing a TAM. Regarding the model, the basic TAM explained 33.5% of the variance in the farmers' ITP result-based contract solutions, a result suggesting satisfactory efficiency of applying a TAM for studying ITP of innovative AES since being in accordance with literature indicating the basic TAM to typically clarifying the variance of 40% in user's behaviour (Venkatesh & Davis, 2000). Moreover, the results of the extended TAM indicated an R^2 of 50.2%, representing a significant improvement over the original TAM. Our results revealed that Att influences ITP, PEOU is impacting Att and PU, and PU is impacting Att. These basic hypotheses are confirmed in both calculated models (extended and basic TAM). There are several meta-analyses of TAM studies repeatedly demonstrating the stability of the relationships modeled in the basic TAM (e.g. King & He, 2006).

Our findings are also in line with the results of empirical studies in the context of TAM (e.g. Teo, 2010) and in sustainable agriculture (e.g. Rezaei et al., 2020). Furthermore, studies investigating farmers' willingness to participate in AES or to adopt environmentally-friendly farming practices have repeatedly shown that farmers' attitudes play an important role in understanding their willingness to implement environmental measures (e.g., Defrancesco et al. 2008; Sattler & Nagel 2010) and therefore support our confirmed positive influence of farmers' attitudes on their intention to enter into results-based contracts. The positive influence of perceived ease of use on farmer attitudes and indirectly on implementation intentions are consistent with the observations of Defrancesco et al. 2008 that the more farmers believe they can easily implement practices, the more likely they are to participate in an environmental program. Based on the TAM2 we tested also for the influence of subjective norm on perceived usefulness and confirmed a medium-strong positive influence, and mirror the results of several previous studies e.g. Park et al., 2014, Teo, 2010 and Venkatesh & Davis, 2000. However, considering this finding in the light of AES, farmer and the relationship to their social network has been explored (Browne et al. 2018; Rose et al., 2018; Burton and Paragahawewa, 2011; de Snoo et al., 2013) and show a particular influence on the decision-making process (Salamon et al., 1997, Browne et al. 2018; Rose et al., 2018). In RB contracts this was supported by Birge et al. (2017) who stated that farmers would take their peers' opinions into account when making their own decision about participation in RB contracts. This relationship may partly be explained by the assumption that farmers often compare themselves and their performance against each other in a judgmental peer group (Burton 2004; De Snoo et al. 2010) and social recognition also matter in the decision-making process (Russi et al. 2016). Another important finding is that the added construct self-efficacy has a strong positive influence on perceived ease of use as well as a medium positive influence on intention to perform RB contracts. This result is in accordance with other studies for the connection of self-efficacy and perceived usefulness (e.g. Venkatesh, 2000; Rezaei et al., 2020) and the connection of self-efficacy and intention to perform (Sharifzadeh et al., 2017). Moreover, SE in general is a powerful and often used determinant of perceived ease of use (Abdullah & Ward, 2016). Several factors could explain this connection. Firstly, self-efficacy reflects people’s beliefs about their capabilities to successfully perform a particular task

(Bandura, 1994). Having a high self-confidence in the abilities, new and difficult tasks are perceived as less threatening and easier to fulfill (Bandura, 1994). Second, farmers who believe they have sufficient time and skills to perform a specific action are more likely to do so. This is evident, for example, in conversion to organic farming (Läpple and Kelley, 2013), adoption of soil conservation practices (Wauters et al., 2010), and participation in AES (Defrancesco et al., 2008; Josefsson et al., 2017). Thirdly, RB contracts are perceived as complex (Cullen et al. 2018), and knowledge about the environment and how to perform certain tasks is assumed. However, farmers who participated in a RB program indicated that they already had a great deal of expertise due to their professional background and therefore relied on their ability to acquire the necessary skills to perform specific tasks such as self-monitoring (Birge et al. 2017). Finally, our results showed that perceived risk had a weak but significant effect on perceived ease of use. This result can be explained in part by the experience that perceived risk or uncertainty affects people's confidence in their decisions (Im et al. 2008). Risky situations can be those in which the probabilities of a particular outcome occurring are unknown (Im et al. 2008) which is often the case in RB contracts and is exacerbated by the fact that payment is linked to the result. As a consequence, RB contracts are often perceived as riskier than action-based contracts (Wezel et al. 2018, Uthes and Matzdorf, 2013). However, the explanatory power of this result may be limited due to the weak influence reported (H8: β =0.221).

6. Conclusion

This study investigated the factors influencing farmers' intention to perform result-based contract solutions by applying a SEM implementing a TAM. Our results confirm that farmers' decision to participate in result-based contract solutions is positively influenced by their attitude towards performing these contracts and by their self-efficacy. Furthermore, farmers perceived usefulness and perceived ease of use of these contracts are indirectly influencing also their intention to perform via attitude. Interestingly, farmers perceived risk and the subjective norm are also indirectly affecting the intention to perform. Based on these findings (e.g. influence SN on PU) we emphasize that farmers' surrounding networks should be addressed in the understanding, promotion, and valuing of environmentally-friendly management practices as these can foster the acceptance of new solutions which is also confirmed by e.g. de Snoo et al. (2013). The high influence of self-efficacy on perceived usefulness and the intention to perform indicates that farmers who believe that they have the skills, knowledge, and experience to implement RB-schemes are more willing to perform them, highlighting the importance of knowledge support, training, and advisory in new AES (Allen et al., 2014). Furthermore, result-based contracts, in contrast to action-based contracts, are associated with higher risk for participating farmers (Wezel et al. 2018; Uthes and Matzdorf, 2013). Our results reveal a direct influence of perceived risk on perceived ease of use, which is indirectly influencing the decision to participate. Including mechanisms for risk distribution, such as the implementation of hybrid solutions by combining action and result-based elements in one contract, can help to minimize the perceived risk. Findings show that especially for new voluntary AES, the socio-psychological constructs of farmers should be considered, which allows new levers in the design and successful introduction of these measures. To conclude, this study is to our best knowledge the first research that has successfully applied the TAM in an agricultural policy context. The TAM model and particularly the extended model proved highly suitable for predicting the farmers' intention to perform result-based contract solutions.

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