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Understanding producers' motives for adopting sustainable practices: the role of expected rewards, risk perception and risk tolerance

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Abstract

Understanding the motives and risk attitudes of producers to engage in sustainable practices is important for policy-makers who wish to increase the likelihood of adoption and improve the design of incentives. This article examines the underlying motives of producers to adopt sustainable practices. We focus on expected economic, social and personal rewards and analyse the role of producers' financial risk perception and risk tolerance. Results from personal interviews with 164 hog producers show that the adoption of sustainable practices is affected by expected economic rewards but not by social and personal rewards. Further, while perceived risk is a barrier to the adoption of sustainable practices, risk tolerance is a positive moderator of the relationship between economic rewards and adoption. In addition, perceived tax benefits and turnover have a significant positive relationship with adoption, while education and age do not play a role.

Keywords: motivation for adoption of sustainability, risk perception, risk tolerance

JEL classification: M31, Q56, D81

1. Introduction

Sustainability entails achieving a balance between economic prosperity, environmental quality, social inclusion and good governance (Elkington, 1999). Sustainable practices have become a new norm in business in response to societal and governmental demands, along with increasing consumer awareness (Chabowski, Mena and Gonzalez-Padron, 2010; Kotler, 2011). Demand for sustainable practices is particularly strong in agribusiness and the food industry,

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given concerns of the public about the impact of current production and commercialisation practices on the environment (waste, land usage, water resources and energy use), animal welfare, food safety and social dimensions like fair trade, labour rights and community development (Lee, 2005). As a result, sustainability has become a main component of the agricultural and food-policy agenda (e.g. the Common Agricultural Policy and the UN Sustainable Development Goals), shaping business practices such as labelling, traceability, fair trade and corporate social responsibility (CSR) (Maloni and Brown, 2006).

A question often asked is why agricultural producers engage in sustainable practices. The literature has focused on explaining how the characteristics and capabilities of farms influence the propensity to adopt. However, relatively less attention has been paid to understanding the underlying motives that lead to adoption. Further, the role of risk attitudes has not been examined to a great extent (Toma and Mathijs, 2007). In this article, we examine producers' motives to adopt sustainable practices with a focus on expected economic, social and personal rewards. In addition, we examine the roles of producer financial risk perception and risk tolerance, because the outcomes of investments in sustainability are often uncertain, which might be an important barrier to adopt sustainable practices.

In particular, we study farmers' decisions about building a certified sustainable stable for hogs in the Netherlands. Dutch hog farms can obtain tax benefits if they build a new stable or renew an existing one in line with the Dutch policy document 'Maatlat Duurzame Veehouderij' (MDV: Yardstick for Sustainable Husbandry).[1] To become certified, the stable must meet strict requirements on emissions, energy use, particulate matter, animal welfare and animal health. Each investment in equipment or procedures towards meeting the standards represents a certain number of points leading to certification. Between 2007 and 2013, 3,066 certified stables were built and 973 stables were in the pre-construction process.

Pork is an important component of the Dutch food industry, representing more than half of meat consumption in the Netherlands (Kemp *et al.*, 2014). Production has remained relatively constant since 2000, with almost two-thirds meant for export, mainly to the European market. However, the number of farms has decreased considerably, from around 15,000 in 2000 to about 6,000 in 2012 (van der Meulen, Evergingen van and Smit, 2012).

De Greef and Casabianca (2009) identify two main challenges for innovation initiatives in the Dutch pork sector: financial challenges (cost price), and societal acceptance, where the first one aims to enhance production efficiency, and the second to make a combination between societal acceptance and economic viability. Another point to take into consideration is the size of the decision-making unit. Most farming in the Netherlands is done by family businesses or small partnerships (Pennings and Garcia, 2004; Eurostat, 2012). The small size of the decision-making unit has implications for the adoption of sustainability practices; while large companies often have decision-making teams, thus incorporating a range of different opinions and values into the decision-making

1 Producers have the option to write off up to 75 per cent of their MDV investment. www.maatlatduurzameveehouderij.nl.

process (Schoemaker, 1993), in small companies (the owner-manager's) personal values are likely to play a more prominent role in decision-making (Jenkins, 2004). Most existing research on sustainability focuses on large companies, leading to findings that may not be (fully) applicable to small firms (Pedersen, 2009).

In this context, we develop a conceptual model tested with data from personal computer-guided interviews with 164 hog farmers in the Netherlands, using confirmatory factor analysis (CFA) and logistic regression. Results indicate that expected economic rewards and perceived tax benefits are the most important reasons to build sustainable stables for our sample of Dutch hog producers, while social and personal motives do not play a role in the decision. In addition we find risk perception to have a negative influence on adoption, while risk tolerance acts as a moderator in the relationship between expected economic rewards and adoption.

Zilberman (2013) states that the pursuit of sustainable development depends on the formation of science-based policies, integrating the understanding of economic systems, policies and natural resources, coupled with an improvement in our understanding of human behaviour. In this article, we contribute to the understanding of the motives and constraints influencing the adoption of sustainable practices. This understanding can help suppliers of sustainable products and services as well as public policy-makers aiming at stimulating sustainable behaviour to increase their effectiveness.

2. Literature review and hypotheses development

Understanding why firms adopt sustainable practices has been a recurring topic in the literature (Bansal and Roth, 2000; Crittenden *et al.*, 2011). Until recently, the traditional view on the adoption of sustainable practices involved the perception of incurring additional costs and managerial burden for firms (Stefan and Paul, 2008). Nowadays, the paradigm has shifted towards a view where sustainability is a key component of business strategy through both differentiation and cost advantages. Sustainable practices help obtain and retain a licence to operate, potentially shaping a better marketing position and leading to the improvement of long-term economic and financial performance (Molina-Azorín *et al.*, 2009). Furthermore, the long-term viability of a firm depends on its fit to the values of society, and the benefits that it achieves for all stakeholders (Brønn and Vidaver-Cohen, 2009). About 95 per cent of the top 250 largest corporations publish sustainable development reports as part of their core strategy, highlighting the relevance of sustainability in current business practices (Boiral and Henri, 2015).

The adoption of sustainable practices has been a topic of interest in various streams of the literature. Given our research question, we draw from management and agricultural economics literature to build our conceptual model. In summary, first, a recurring notion is that the adoption of sustainable practices may stem from both economic and non-economic motives. Second, given the large investments often associated with the adoption of sustainable practices

and the uncertainty whether these investments pay off, risk attitudes are expected to play an important role in the adoption decision. Third, farm characteristics and other exogenous variables have also been identified as explanatory factors for the adoption of sustainable practices. Our hypotheses and conceptual model are organised according to the structure identified above.

2.1. Economic and non-economic motives

Traditionally, economic motives have played an important role in explaining adoption decisions, such as the adoption of technologies or best management practices. Extensive research based on Rogers' (1995) model of diffusion of innovations has shown that the relative advantage of innovation (from an economic point of view) is a strong contributor to the adoption of innovations (Greve, 2009). Although sustainability practices differ from 'regular' innovations in the sense that they go beyond providing operational or cost benefits to the firm, and aim to benefit wider society as well, economic motives continue to play an important role (Lee, 2005; Campbell, 2007). After all, firms need to ensure they remain economically viable and therefore, decision-makers need to have the expectation that the adoption of sustainable practices will pay off, e.g. by decreasing costs or increasing productivity, in order to adopt those practices (Stefan and Paul, 2008). In hog farming in particular, expected economic rewards are to play an important role, because of low margins and the continuing struggle to be profitable (Vernooij, 2011). The first hypothesis is therefore:

H1 *Expected economic rewards are positively related to the adoption of sustainable practices, all else being equal.*

Expected rewards are defined as beliefs of extrinsic and intrinsic benefits that a producer would receive from adopting sustainable practices (Frazier, 1983). Firms' decision-making with regard to sustainable practices may not only be based on the pursuit of economic benefits but entails a balance between economic, social and personal motives (Aguilera *et al.*, 2007; Aguinis and Glavas, 2012). These different types of motives are also identified in the context of farmers' decision-making (Howley, 2015). For instance, Mzoughi (2011) found that fruit and vegetable growers in France have not only economical, but also strong social and moral motives related to the adoption of crop protection and organic farming. Howley (2015) argues that recent research identifies distinct categories of farmers, some more driven by economic motives, others valuing social and personal objectives more, with varying degrees.

Social motives are related to how society views the firm. Firms need to be seen as legitimate by society in order to retain their license to operate (Maignan and Ralston, 2002). With regard to hog farming, issues such as animal welfare and environmental performance have received (and still receive) much attention in the media. Thus, given that the agricultural industry has come under close scrutiny about sustainability, we argue that expected social rewards in the form of

increased organisational legitimacy – defined as 'a perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions' (Suchman, 1995) – are an important reason for hog farmers to adopt sustainable practices. This generates the following hypothesis:

H2 *Expected social rewards are positively related to the adoption of sustainable practices, all else being equal.*

Finally, the adoption of sustainable practices may be affected by personal moral values, for instance, the belief that something is 'the right thing to do' because of its benefits to others (Bansal and Roth, 2000). Doing the right thing may fulfil psychological needs such as a sense of pride, esteem and meaningfulness (Aguinis and Glavas, 2012). In particular, given the small-business nature of hog production in the Netherlands, we argue that what we call 'expected personal rewards' of the manager–owner play a role in the adoption of sustainable practices (in line with Howley, 2015; Mzoughi, 2011). Therefore, the third hypothesis is:

H3 *Expected personal rewards are positively related to the adoption of sustainable practices, all else being equal.*

2.2. Risk attitudes: risk perception and risk tolerance

A substantial amount of literature supports the idea that farmers' risk attitudes influence their decision-making. Roe (2015) identifies areas such as input use (Roosen and Hennessy, 2003), marketing strategies (Pennings and Garcia, 2001), investment behaviour (Fausti and Gillespie, 2006), insurance (Moschini and Hennessy, 2001) and technology adoption (Feder, 1980). While expected economic, social and personal rewards are likely to have a positive influence on producers' adoption of sustainable practices, risk associated with the adoption can be a barrier (Bocqueho, Jacquet and Reynaud, 2014).

The hog industry in the Netherlands has been going through a period of strong competition and consolidation. The Dutch Agricultural Economic Institute (LEI) reports that, although production levels of pork meat have been relatively constant over the last 10 years, the number of producers has been reduced to less than half (LEI, 2014). Producers who have remained in business tend to be larger, with turnovers of more than 1 million euros/year, but their profit margins remain low. In an environment of strong competition, the adoption of sustainable practices can entail a large risk, particularly for medium- and small-size producers who are struggling to remain in business and to be competitive while meeting market standards. The adoption of MDV-certified stables by hog producers in the Netherlands involves large financial investments such as building new stables and purchasing new machinery and equipment. Since the payoff of those investments is uncertain, we expect risk attitudes from a financial perspective to play an important role in the adoption of such stables.

Risk perception is defined as the producer's interpretation of the riskiness of the investment (Pennings and Wansink, 2004). Risk tolerance is the producer's general predisposition towards assuming financial risk (Hoffmann, Post and Pennings, 2013; Pennings and Wansink, 2004). As explained in Pennings and Wansink (2004), risk perception ranges from perceiving no risk at all to perceiving high risk, while risk tolerance ranges from extremely risk averse (refusing any risk under any condition) to extremely risk seeking (a preference for carrying risk). We expect an increase in risk perception to lead to a decrease in the adoption of sustainable practices, since producers will attempt to reduce their risk exposure. Financial risk perception has been identified as an important factor for the adoption of sustainable practices (Flaten *et al.*, 2005). As a result, we propose:

H4 *Risk perception is negatively related to the adoption of sustainable practices, all else being equal.*

Even if farmers can obtain economic gains in the long run by adopting new technologies, they may be less likely to adopt when facing increased risk (Bowman and Zilberman, 2013). As identified by Kuminoff and Wossink (2010), a risk-neutral farmer would need to be compensated for the initial investment and risk difference of engaging in a sustainable production practice (e.g. organic farming). We argue that an increase in a farmer's risk perception not only decreases the chances of adoption directly but also diminishes the role of expected economic rewards from the adoption of sustainable practices, since compensation for extra risk may be seen as insufficient.

Risk tolerance also influences the relationship between expected economic rewards and the adoption of sustainable practices. For a risk-averse producer, the expected economic gains would need to be higher to compensate for the increased risk of engaging in sustainable practices. Meanwhile, a more risk-tolerant producer would demand lower economic compensation for the adoption.

As a result, we expect risk perception and risk tolerance to moderate the relationship between expected economic rewards and the adoption of sustainable practices (Figure 1). Therefore, we propose:

H5 *The relationship between expected economic rewards and the adoption of sustainable practices is weakened by risk perception, all else being equal.*

H6 *The relationship between expected economic rewards and the adoption of sustainable practices is strengthened by risk tolerance.*

Finally, we expect risk perception and risk tolerance to interact, whereby the strength of the relationship between risk perception and adoption decreases as risk tolerance increases, since risk perception is a less important factor for adoption to producers with higher risk tolerance. In a similar context, Pennings and Wansink (2004) show that the interaction between risk attitude and risk perception is a useful predictor of hog farmers' contract behaviour. Gardebroek (2006)

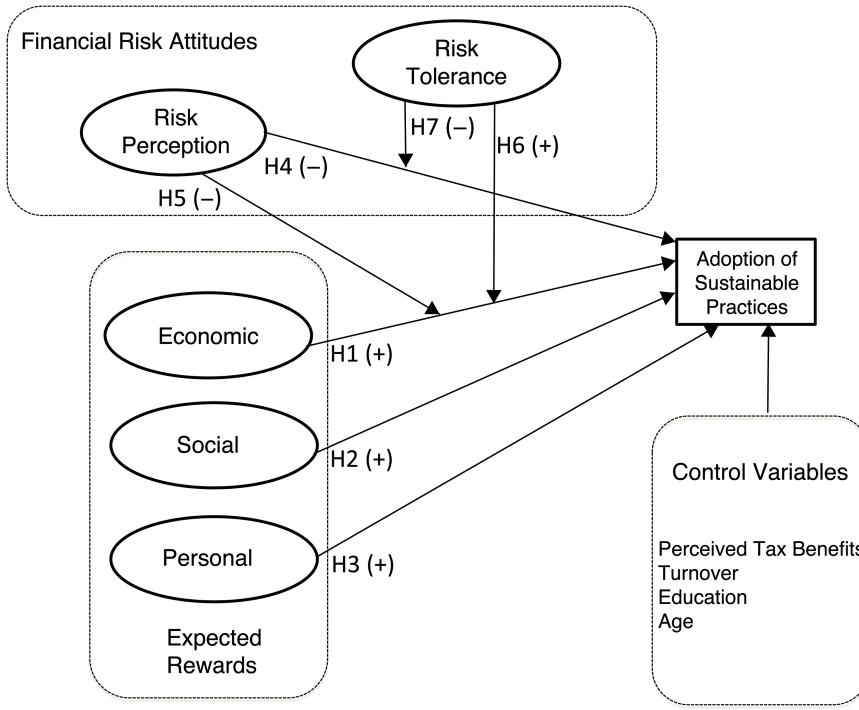

Fig. 1. Relating producers' expected rewards and risk attitudes to the adoption of sustainable practices.

shows that organic farmers are significantly less risk averse than their non-organic counterparts, indicating a negative moderating effect of risk tolerance on the relationship between risk perception and organic farming, because organic farming is considered to be more risky than conventional farming. Therefore, we hypothesise:

H7 *The relationship between risk perception and the adoption of sustainable practices is weakened as risk tolerance increases.*

2.3. Control variables

Characteristics and capabilities of farms have also been used as explanatory factors for the adoption of sustainable practices in agricultural production. Early work by D'Souza, Cyphers and Phipps (1993) identified farm characteristics such as human capital of the owner–manager (age, education), structural and financial characteristics (farm size, turnover), institutional characteristics (policy variables, participation in programmes) and environmental characteristics (contribution of the farm to environmental quality) as important to the adoption decision. More recent literature shows the effects of other variables such as ownership type and farming experience. For instance, Knowler and Bradshaw (2007), and Gebrezgabher *et al.* (2015) indicate that it is hard to generalise on

the effect of farmers' and farm characteristics on the adoption decision, since signs and significance of the empirical results depend on the technology involved, the industry and the context of study, as well as the statistical method used for estimation.

Related to our research question, Kemp *et al.* (2014) explore the adoption of sustainability-oriented innovations in pig husbandry in the Netherlands, considering characteristics of the farm, operation and institutional settings. Their results show that the age of the farmer is an important variable, where younger farmers are more willing to build a sustainable stable. Meanwhile, other characteristics such as farm size, education and performance tend to play a smaller role. Also, even though farmers are influenced by their network, they often rely on their own judgement for the adoption decision.

Several papers blend the structural approach, based on the use of observable characteristics, with latent variables. The advantage of such a mixed approach is that it accounts for latent variables, such as underlying motives and risk attitudes, while controlling for characteristics of the farms and farmers. For example, Toma and Mathijs (2007) employ structural equation modelling to identify factors that motivate the participation of farmers in organic farming programmes in Romania. Results show that, besides socio-economic factors, environmental risk perception also influences the propensity to participate in organic farming. Gebrezgabher *et al.* (2015) investigate factors influencing manure-separation technology in the Netherlands and combine the use of farm and farmers' characteristics with latent variables of farmers' attitudes as explanatory variables for technology adoption. Following this approach, we include perceived tax benefits, turnover, education and age as exogenous variables.

3. Research method

3.1. Survey design

We identified 2,830 hog producers who operate businesses with at least 1,000 hogs or 200 breeding sows in the five main farming provinces of the Netherlands. Of these producers, 400 were randomly selected, and they received a letter by mail in which they were informed about the research. Several days later, a telephone interviewer asked them whether they were willing to participate in the research. If they agreed, an appointment was made to visit the producer on the farm. A total of 164 hog producers were interviewed on site between October and November 2013, yielding an effective response rate of 41 per cent. The interviewers brought laptops on which the farmers answered the questions, and, on average, it took participants 30 min to complete the questionnaire. Farms in the survey were located in five Dutch regions: Drenthe ($n = 23$), Friesland ($n = 25$), Gelderland ($n = 95$), Limburg ($n = 20$) and Noord-Brabant ($n = 1$).

Table 1 shows the descriptive statistics of the hog farmers in the sample. Out of 164 producers, 84 (51 per cent) had built or were in the process of building a certified stable. Average annual turnover was over EUR 1,000,000 for 54 per cent of the farms, between EUR 500,000 and EUR 1,000,000 for 21 per cent,

Table 1. Descriptive statistics of survey variables ($N = 164$)

Variable	All farms	Raw %	Adopters	Non-adopters
Adoption of a certified sustainable stable	164		84	80
Turnover in thousands of Euros (Scale: 1–5)				
Less than 100	6	3.66	0	6
100–250	6	3.66	2	4
250–500	11	6.71	1	10
500–1000	35	21.34	12	23
1000 or more	88	53.66	62	26
Missing	18	10.98	7	11
Education (Scale: 1–6)				
Basic school	14	8.54	8	6
Middle school	13	7.93	4	9
Lower vocational	100	60.98	47	53
Intermediate vocational	25	15.24	18	7
Higher vocational	2	1.22	2	0
University or above	10	6.1	5	5
Perceived tax benefits (Scale: 1–6)				
Extremely low	4	2.56	1	3
Very low	2	1.28	0	2
Low	6	3.84	0	6
Neutral	12	7.69	2	10
High	20	11.54	6	14
Very high	38	23.72	16	22
Extremely high	79	49.35	59	20
Age (years)				
(20,30]	6	3.66	5	1
(30,40]	18	10.98	9	9
(40,50]	81	49.39	50	31
(50,60]	57	28.66	18	33
(60,80]	12	7.31	4	8
Gender				
Male	157	95.73	79	78
Female	7	4.27	2	2

between EUR 250,000 to EUR 500,000 for 7 per cent and less than EUR 250,000 for 7 per cent (11 per cent missing). Most producers were male (96 per cent) with an average age of 47 years. About 61 per cent of producers have an intermediary education degree (MBO), 15 per cent higher education (HBO), while 1.2 per cent completed university. About 77 per cent of the producers reported that the tax benefits that can be obtained by participating in MDV were very important or extremely important to them.[2]

2 The perceived tax benefits variable refers to the question of how much do producers value the tax reductions obtained by participating in the MDV programme. Tax benefit is a 1–6 scale variable that ranges from extremely low (1) to extremely high (6).

We build a model to explain producers' motives and risk attitudes influencing the adoption of sustainable practices. These motives and risk attitudes are latent psychological variables (e.g. constructs). As defined in Pennings and Smidts (2000), 'a latent variable is a hypothesised and unobserved concept that can only be approximated by observable or measured variables (indicators)'. We use CFA to uncover latent constructs built from observed indicators and to assess their measurement quality. Then we use the output of the CFA (factor scores), which captures the latent constructs, as explanatory variables for the adoption of sustainable practices, employing logistic regression. We also include other relevant observed variables, such as characteristics of the farms, as explanatory variables in the regression.

3.2. CFA

We use CFA to test the validity of the latent constructs. To measure our variables of interest (Figure 1 and Table 2), we adopt existing psychometric scales using multiple indicators on seven-point scales. Table 2 shows the measures of indicators, variables and corresponding latent constructs, defined as expected economic rewards (ER), expected social rewards (SR), expected personal rewards (PR), risk perception (RP) and risk tolerance (RT).

To measure expected economic rewards, we use 10 indicators identified as relevant in interviews with hog farmers and validated in focus groups before the survey was conducted. We measure expected social rewards using five indicators based on the definition of legitimacy by Suchman (1995) and the legitimacy scale developed by Handelman and Arnold (1999). Three indicators of expected personal rewards are based on the scales of Verbeke (2004) and Gouthier and Rhein (2011). For risk perception and risk tolerance, measures are taken with four indicators based on Pennings and Smidts (2000) and Pennings and Wansink (2004). The wording of the indicators was adapted based on whether producers had already built a certified stable, were in the process of building such a stable or did not have a certified stable at all. Table 2 offers a detailed overview with the corresponding question for each indicator and their measurements.

We start the empirical analysis by performing a principal component analysis of the indicators considered, checking whether the indicators met two criteria: (i) indicators load more on their own construct than on any other construct, and (ii) indicator loadings are at least 0.70 on their own construct (Bagozzi, Yi and Phillips, 1991). Indicators not meeting those criteria are dropped.

Next, we perform a CFA to test the factor structure of the constructs in Figure 1, since CFA allows the evaluation of their psychometric measurement quality. Here, we closely follow the explanation and notation of Pennings and Smidts (2000). The factor model assumes that observed variables (indicators) obtained in the survey questions are generated by a smaller number of latent variables. The relationship is represented as:

$$x = \Lambda\kappa + \delta, \tag{1}$$

where x is a vector of the n sets of observed variables, κ is a vector of the latent variables and Λ is a coefficient matrix of the regression relating indicators and

Table 2. Factor analytical model: standardised loadings and reliabilities ($N = 164$)

Constructs and indicators	Loading	SE	R^2
Economic rewards: (Cronbach's $\alpha = 0.922$)			
I expected that building a certified stable for my firm would lead to			
(1) An improvement in technical performance (ER1)	0.785		0.616
(2) An improvement in financial performance (ER2)	0.743	(0.074)***	0.553
(3) More efficiency (ER3)	0.832	(0.072)***	0.691
(4) Labour savings (ER4)	0.786	(0.073)***	0.618
(5) Lower cost price (ER5)	Dropped		
(6) Higher selling price (ER6)	Dropped		
(7) Higher productivity (ER7)	0.835	(0.072)***	0.697
(8) Lower financial risk (ER8)	Dropped		
(9) Higher returns (ER9)	0.863	(0.071)***	0.745
(10) More profits (ER10)	0.720	(0.075)***	0.518
Social rewards: legitimacy (Cronbach's $\alpha = 0.921$)			
I expected that building a certified stable would lead to my firm being			
(1) More appreciated by society (SR1)	0.854		0.729
(2) Perceived as more desirable by society (SR2)	0.888	(0.061)***	0.788
(3) Perceived as more proper by society (SR3)	0.832	(0.063)***	0.692
(4) Perceived as more appropriate by society (SR4)	0.868	(0.062)***	0.753
(5) Better at meeting the standards that people expect of agricultural entrepreneurs (SR5)	0.740	(0.068)***	0.547
Personal rewards: pride (Cronbach's $\alpha = 0.891$)			
I expected that building a certified stable would lead to me having feelings of:			
(1) Pride (PR1)	0.939		0.882
(2) Exhilaration (PR2)	0.815	(0.060)***	0.664
(3) Meaningfulness (PR3)	0.822	(0.060)***	0.675
Risk perception (Cronbach's $\alpha = 0.922$)			
From a financial perspective, I considered building a certified stable as:			
(1) Very risky (RP1)	0.909		0.827
(2) Safe (RP2rc)	Dropped		
(3) Dangerous (RP3)	0.831	(0.057)***	0.690
(4) Involving a lot of risk (RP4)	0.943	(0.052)***	0.888
Risk tolerance (Cronbach's $\alpha = 0.809$)			
(1) I prefer certainty over uncertainty when I invest in my firm (RT1rc)	0.833		0.693
(2) I avoid risks when investing in my business (RT2rc)	0.650	(0.083)**	0.422
(3) I like to take financial risks (RT3)	Dropped		
(4) I like to 'play it safe' when I invest in my firm (RT4rc)	0.836	(0.095)**	0.698

Notes: Scale of the items: 1 = strongly disagree, 7 = strongly agree. rc stands for reverse coded, α corresponds to the construct reliability.
***Significant at 1 per cent, **significant at 5 per cent.

constructs. To assess goodness of fit of the model, we use the standards recommended by Bagozzi and Yi (2012) and Hu and Bentler (1999) of a root mean square error of approximation (RMSEA) ≤ 0.06, comparative fit index (CFI) ≥ 0.95 and standardised root mean square residual (SRMR) ≤ 0.08.

Table 3. Correlational matrix of confirmatory factor analysis

	ER	SR	PR	RP	RT
Economic rewards (ER)	0.634				
Social rewards (SR)	0.455	0.702			
Personal rewards (PR)	0.522	0.553	0.740		
Risk perception (RP)	−0.001	0.015	−0.034	0.802	
Risk tolerance (RT)	0.097	0.108	0.143	0.075	0.604

Notes: Average variance extracted (AVE, AVE is the average amount of variance in indicator variables that a construct is able to explain) are on the diagonal; structural model fit: (179) = 2426.
$P \leq 0.023$, CFI = 0.982, TLI = 0.979, RMSEA = 0.038, SRMR = 0.044.
Any correlation above |0.10| is significant at 1 per cent.

Table 4. Summary statistics factor scores

	Mean	SD	Minimum	Maximum
Economic rewards (ER)	0	1.439	−2.950	2.935
Social rewards (SR)	0	1.512	−3.716	2.255
Personal rewards (PR)	0	1.416	−3.259	2.702
Risk perception (RP)	0	1.652	−2.404	3.421
Risk tolerance (RT)	0	1.177	−2.073	3.330

SD, standard deviation.

Results from the CFA shown in Table 3 are CFI = 0.982, TLI = 0.979, RMSEA = 0.038 and SRMR = 0.044. Reliability is high for all constructs (Table 2), above the recommended 0.70 (Kline, 2011). In terms of convergent validity, all indicator loadings are significant at the 0.01 level, and above 0.60, as seen in Table 2. After examining average variance extracted (AVE), we keep all indicators with AVE above the recommended 0.40 (Homburg, Allmann and Klarmann, 2014).

For discriminant validity of the constructs, we use a procedure suggested by Bagozzi *et al.* (1991) and implemented by Scheer, Miao and Garrett (2009). Each pair of constructs is evaluated using nested CFA models, where a one-factor model is compared with a two-factor model using χ^2 difference tests. Results show that the two-factor models exhibit a better fit in all cases. In addition, the AVE of each construct is higher than any of the correlations between constructs, as can be seen in the correlation matrix in Table 3, suggesting good discriminant validity. Table 4 provides summary statistics of the factor scores.

3.3. Empirical model results

We use logistic regression to examine the association between the latent constructs reflecting expected rewards and risk attitudes of Dutch hog farmers and the adoption of sustainable practices by building a stable that meets the

MDV certification standards. The dependent variable is binary, taking a value of one when a farmer adopts MDV certification and zero otherwise.

Besides latent constructs derived from the CFA, we also include relevant interaction effects that capture moderation effects, and observable characteristics of the farmers that may influence the adoption of sustainable practices. Then, we run a logistic regression represented as:

$$\begin{aligned}\text{Adoption}_i = {} & \beta_0 + \beta_1 \text{ER}_i + \beta_2 \text{SR}_i + \beta_3 \text{PR}_i + \beta_4 \text{RP}_i + \beta_5 \text{RT}_i \\ & + \beta_6 \text{Tax benefits}_i + \beta_7 \text{Turnover}_i + \beta_8 \text{Education}_i \\ & + \beta_9 \text{Age}_i + \beta_{10} \text{RP} \times \text{ER}_i + \beta_{11} \text{RT} \times \text{ER}_i \\ & + \beta_{12} \text{RT} \times \text{RP}_i + \varepsilon_i,\end{aligned} \tag{2}$$

where the endogenous binary variable adoption of sustainable practices (Adoption) is regressed on factor scores of the CFA, which are used as proxies of the latent constructs of expected economic rewards (ER), expected social rewards (SR), expected personal rewards (PR) and risk perception (RP). In addition, we include observable variables such as turnover, level of education of the owner and age, as well as perceived tax benefits (measured on a seven-point scale). The regression also includes the moderation effects of risk perception and risk tolerance (RT) on the relationship between economic rewards and adoption (RP × ER) and (RT × ER), and the moderation of risk tolerance on the relationship between risk perception and adoption (RT × RP), as shown in Figure 1. Subscript *i* corresponds to each farm in the sample.

We generate the interaction terms (RP × ER), (RT × ER) and (RT × RP) by obtaining the product of the factor scores ER, RP and RT derived from the CFA (Pennings and Smidts, 2000),[3] where the factor scores have a mean of zero.

We evaluate the goodness of fit of the model in several ways. First, no evidence of model misspecification can be found by the Hosmer and Lemeshow test (see Table 5). Further, the model correctly classifies 83 per cent of the adoption choices. That is, the fitted values of the model coincide with the observed values for most cases. This proportion exceeds the proportion of choices correctly classified by chance (Huberty's test: $P < 0.1$). We also include the proportional reduction of prediction error (PRPE), which indicates the improvement in predictive power compared with a null model without predictor variables. The closer PRPE is to one, the higher the improvement over the null model (Pennings, 2002). In our case, the PRPE equals 0.76. In addition, a Wald test comparing the likelihood of the proposed model against a null model including only an intercept is significant at $P < 0.001$.

Table 5 provides the results of the estimation of the logistic regression in Equation (2). Because of the nonlinear nature of the logit model, the marginal effects of predictors and interaction effects depend on the location of all the

3 Other approach to measure moderation includes the estimation of latent interactions within the measurement model (confirmatory factor analysis), which may account for measurement error bias (Marsh, Wen and Hau, 2004). We also evaluated this option and found consistent results with the approach used in the article.

Table 5. Logit estimates of parameters estimates explaining the adoption of a certified sustainable stable

Variable	Estimate	SE	*t*-value	*P*-value
(Intercept)	−8.259	2.791	−2.96	0.003***
Economic rewards (ER)	0.458	0.219	2.09	0.037**
Social rewards (SR)	0.148	0.211	0.70	0.483
Personal rewards (PR)	−0.084	0.219	−0.38	0.701
Risk perception (RP)	−0.426	0.195	−2.19	0.029**
Risk tolerance (RT)	0.294	0.236	1.25	0.212
Perceived tax benefits	0.735	0.236	3.12	0.002***
Turnover (income)	1.055	0.335	3.15	0.002***
Education	0.010	0.209	0.05	0.961
Age	−0.017	0.030	−0.57	0.561
Risk perception × economic rewards (RP × ER)	0.059	0.107	0.55	0.582
Risk tolerance × economic rewards (RT × ER)	0.237	0.153	1.55	0.120
Risk tolerance × risk perception (RT × RP)	−0.243	0.163	−1.49	0.138

***Significant at 1 per cent, **significant at 5 per cent.
Hosmer and Lemeshow test χ^2 (df) = 7.33(8), $P = 0.51$; pseudo $R^2 = 0.3625$; Cragg-Uhler (Nagelkerke) $R^2 = 0.52$; correctly classified = 82.95 per cent; PRPE = 0.758.
Huberty's test: $P < 0.1$.

covariates. As a result, the analysis can be enhanced by visualisation of the relationships across the range of values of the covariates (Hoetker, 2007).

With respect to the observed covariates, turnover and perceived tax benefits are positively and significantly related with the adoption of sustainable practices, meanwhile, education and age do not play a role in the adoption decision.

With respect to the derived latent constructs, findings from the estimation suggest that expected economic rewards have a positive relationship with the adoption of sustainable practices. Taking the derivative from equation (2) yields:

$$\frac{\partial \,\text{logit}(\text{Adoption}_i)}{\partial \text{ER}_i} = \beta_1 + \beta_{10}\text{RP}_i + \beta_{11}\text{RT}_i, \tag{3}$$

therefore, the overall effect depends not only on the effect of the economic rewards predictor, but also on the interactions of economic rewards with risk perception and risk tolerance. Accordingly, we calculate the corresponding average marginal effects. Figure 2a depicts the average marginal effects on the probability of adoption for all the range of economic rewards values, leaving all other independent variable values as observed. Economic rewards always exhibit a positive and significant effect on the probability of adoption.

We also evaluate the behaviour of economic rewards at different levels of other covariates. In Figure 2b and c, we evaluate the average marginal effects of economic rewards on the probability of adoption for the range of turnover (Figure 2b) and perceived tax benefits values (Figure 2b). The relationship between economic rewards and adoption is positive and significant for medium

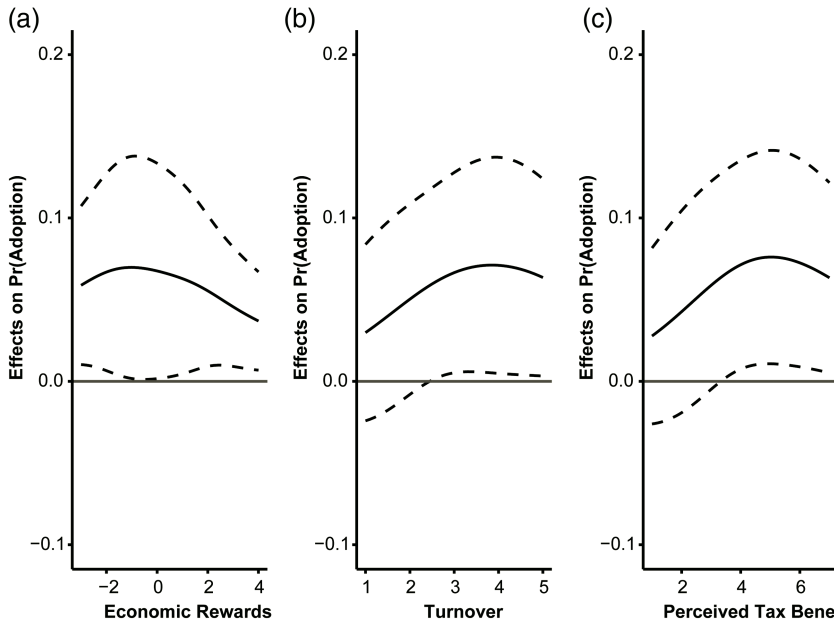

Fig. 2. Average marginal effects of economic rewards. (a) Average marginal effects of the range of economic rewards on the probability of adoption. (b) Average marginal effects of economic rewards on the probability of adoption over the range of turnover levels. (c) Average marginal effects of economic rewards on the probability of adoption over the range of tax benefits levels.

and high turnover values, while for low values the relationship becomes non-significant. Same patterns are observed for perceived tax benefits. Most farmers surveyed have medium or high turnover, and claim perceived tax benefits as high (Table 2), therefore H1 is supported.

Social and personal rewards do not exhibit a significant impact on the adoption decision. In Figure 3, we evaluate the marginal effect of social rewards (Figure 3a) and personal rewards (Figure 3b) on adoption, for the range of turnover values. In both cases, the effect is never significant. We also evaluate these relationships at different risk perception, risk tolerance and tax benefit levels, finding the same results,[4] hence H2 and H3 are not supported.

Similar to economic rewards, the effect of risk perception on adoption of sustainable practices also includes an interaction term, in this case the interaction between risk perception and risk tolerance. As seen in Figure 3c, we calculate the average marginal effects of risk perception on adoption at different turnover levels. The figure shows a negative and significant average marginal effect at medium and high turnover levels that represent most of the sample, while a lack of significance at low turnover, thereby supporting H4.[5]

4 Figures that depict such scenarios are available from authors upon request.
5 We observe the same patterns for perceived tax benefits values, and risk tolerance levels.

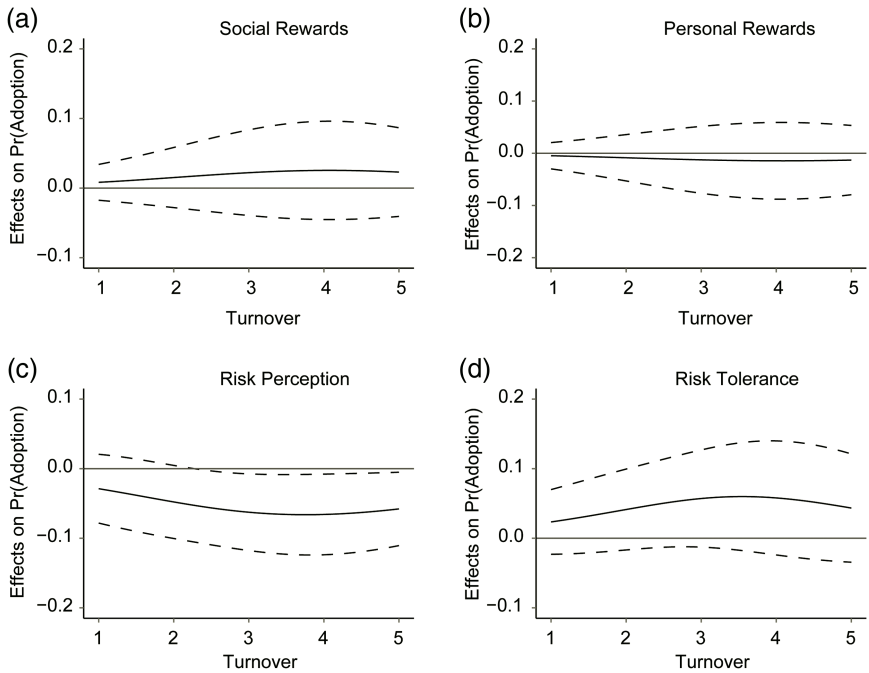

Fig. 3. Average marginal effects of social rewards, personal rewards, risk perception and risk tolerance for the continuum of turnover values.

To assess moderation effects, the literature recommends to evaluate the effects at different values along the continuum of the moderator to observe its effect on the predictor (Brambor, 2005; Hoetker, 2007). An alternative that provides similar information is the Johnson–Neyman technique (Johnson and Neyman, 1936; Hayes and Matthes, 2009; Mulatu *et al.*, 2010), that indicates significance levels at a selected α level (probability of Type I error) of the predictor for the values of the moderator, by calculating the regions of significance and confidence intervals for the marginal effects (Bauer and Curran, 2005). We use both approaches to evaluate the moderation effects.

We start the analysis with the pick a point strategy (Hayes and Matthes, 2009). Figure 4 shows the continuum of values of risk perception on the average marginal effects of economic rewards on the adoption. We also include risk tolerance by evaluating the relationship in three points: Low risk tolerance (one standard deviation below the mean), risk tolerance at the mean and high risk tolerance (one standard deviation above the mean). Figure 4a shows that under low risk tolerance the marginal effect of economic rewards on the adoption would be non-significant for all values of risk perception. Figure 4b shows that under a mean value for risk tolerance, the economic rewards are positively related to adoption for mild risk perception, while low and high risk perception lead to a non-significant relationship. Figure 4c shows similar characteristics as Figure 4b, but a more pronounced curvature for high risk perception levels.

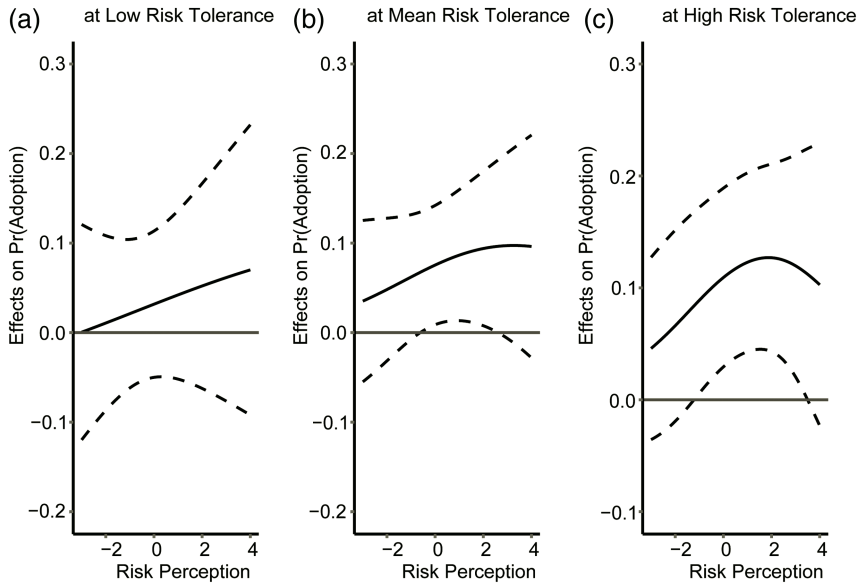

Fig. 4. Average marginal effects for interaction terms of economic rewards, risk perception and risk tolerance.

Figure 4 provides further support to H1 by showing positive and significant economic rewards effects for the most common observed values of risk tolerance and risk perception (Table 4). The figure also indicates that risk perception and risk tolerance may moderate the relationship between economic rewards and adoption, since their levels influence not only its significance but also its shape, with a higher curvature at high risk tolerance levels.

We use the Johnson–Neyman plots in Figure 5 to provide additional information about the interaction effects. Figure 5a resembles closely Figure 4b which is not surprising given that Figure 4b corresponds to the most frequent observations of the sample. This information suggests a positive interaction effect between risk perception and economic rewards on the adoption of sustainable practices that is significant in the neighbourhood of mean risk perception, while it does not influence the relationship at low or high risk perception levels. Hence, H5 is not supported.

Figure 5b shows the interaction effects of economic rewards and risk tolerance. The relationship is positive and significant for values above the mean of risk tolerance, while not significant for low risk tolerance values. This is consistent with H6, where risk tolerance is expected to strengthen the relationship between economic rewards and the adoption of sustainable practices.

Finally, we evaluate H7 by looking at Figure 5c. Risk tolerance and risk perception exhibit a negative slope, that is significant for medium and high levels of risk tolerance but not significant at lower levels, providing partial support to H7.

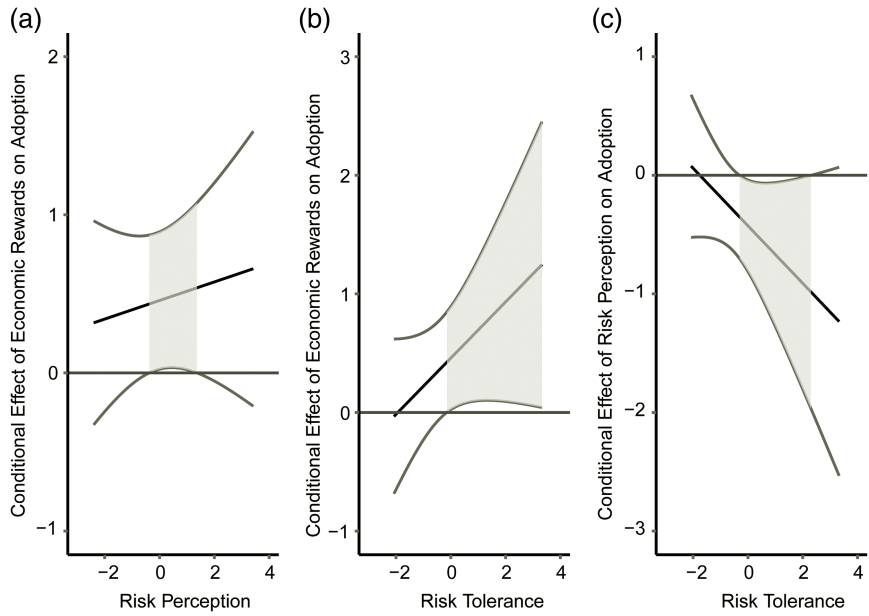

Fig. 5. Johnson–Neyman plots for interaction terms of risk perception and economic rewards (RP × ER), risk tolerance and economic rewards (RT × ER) and risk tolerance and risk perception (RT × RP).

Discussion

Implementation of sustainable production practices is becoming a prerequisite to operate in many markets, particularly in the food industry where stakeholders demand practices that generate less waste, improve food safety and animal welfare and require less use of land, water and energy. We developed a framework that explains the motivations of hog farmers to pursue sustainable practices by adopting certified sustainable stables. Table 6 provides a summary of our hypotheses, expected relationships and findings.

Results show that expected economic rewards are the main motivation to invest in the certified stables. Meanwhile expected social and personal rewards do not significantly influence the decision to invest. Farmers value investments in sustainable technologies that yield improvements in efficiency, performance and profitability. Moreover, we find that perceived tax benefits are a powerful incentive for producers to engage in sustainable practices. This suggest that suppliers of sustainable products and services, as well as policy-makers aiming at stimulating sustainable behaviour among producers, should focus on the economic benefits that result from the adoption by advocating tax policies that encourage participation.

While the literature suggests that expected personal and social rewards may also play a role on the adoption of sustainable practices, our empirical results do not support this for hog producers in the Netherlands. There may be several reasons for these findings: first, this may be due to the increasing power of

Table 6. Summary of empirical results for the hypotheses regarding the adoption decision

Hypotheses		Expected relationship	Finding
H1	Expected economic rewards → Adoption of sustainable practices	Positive	Supported
H2	Expected social rewards → Adoption of sustainable practices	Positive	Not supported
H3	Expected personal rewards → Adoption of sustainable practices	Positive	Not supported
H4	Risk perception → Adoption of sustainable practices	Negative	Supported
H5	Risk perception moderates expected economic rewards → Adoption of sustainable practices	Negative	Not supported
H6	Risk tolerance moderates expected economic rewards → Adoption of sustainable practices	Positive	Supported
H7	Risk tolerance moderates risk perception → Adoption of sustainable practices	Negative	Supported

government policies and guidelines widely expected to become legislation soon.[6] Although the MDV programme is currently not government enforced and merely a guideline aiming to encourage hog producers to engage in sustainable practices, its standards are becoming commonplace. Since both government regulation and control of sustainable practices are expected to increase, producers may look at these investments as mere anticipation on incoming production standards.

In addition, idiosyncratic characteristics of the Dutch hog sector may also explain this result. The hog industry in the Netherlands has faced financial difficulties for a long period, with many farmers struggling to generate viable turnovers (Vernooij, 2011). Hence, in a Maslow pyramid paradigm, one of the producers' main concerns is farm operation viability, explaining that economic rewards dominate the decision to adopt sustainable practices over personal and social expected rewards. Kuminoff and Wossink (2010) identify similar behaviour in the organic food industry in the United States, where adopters are 'motivated by profitability, not ideology', suggesting that in other industries the economic component also tends to dominate, certainly when one of the Maslowian fundamentals, one's livelihood, is at stake.

Other factors that may explain the small role of social and personal motives in the adoption of sustainable practices by Dutch hog farmers are lack of awareness and agreement about the cost and benefits of their implementation among the participants in the supply chain (de Greef and Casabianca, 2009). If society and other stakeholders are not informed about the value of sustainable practices, the social pressure on farmers may be lax, negatively affecting their motivation to adopt. In general, awareness is a prerequisite to forming attitudes about a topic (Forsyth *et al.*, 2004), both as a person and as a society. Although sustainability

6 We thank an anonymous reviewer for raising this point.

standards have been rapidly developing and awareness is rising, illiteracy about the concepts and benefits of sustainable practices is still widespread. Therefore, besides economic incentives, there is a need for education programmes reaching all stakeholders involved.

We find that higher risk perception is associated with lower levels of adoption. Therefore, perceived financial risk is a barrier to the adoption of sustainable practices. Hence, it is important to provide producers with more content knowledge about the risk and uncertainty of their investment.

Meanwhile, risk tolerance positively moderates the economic rewards–adoption relationship. That is, the impact of economic rewards on adoption strengthens as the producer's risk tolerance increases, in particular for mild and high levels of risk tolerance when the farmer becomes less risk averse. However, risk tolerance does not directly influence adoption (Figure 3d). For the design of policies and incentives this is an interesting finding. It would be useful to identify and target the segments of more risk-tolerant farmers who are likely to respond positively to economic incentives. For the segment of less risk-tolerant farmers, other options, such as tighter legislation, may be the proper policy instrument.

Risk perception has a negative impact on the adoption. In addition, risk tolerance at medium and high levels exhibits a negative moderation effect on the relationship between risk perception and the adoption. Hence, educating farmers about the true probability (chance) that the financial risk associated with investing in sustainable practices will become manifest (e.g. risk perception) is a powerful tool.

Also, farm turnover is positively associated with adoption. The Dutch pork sector has been going through a consolidation process, in which the number of farms has reduced dramatically. Surviving farms tend to be bigger, with higher annual turnover. We observe that most adopters in our sample spent between EUR 500,000 and EUR 2 million on building certified stables, which is a considerable amount for most farmers. Therefore, the positive and significant result of the turnover variable at medium and high turnover levels suggests that farms that generate higher turnover are more willing and able to make such investments.

This study has limitations that motivate further research. Although this study is based on high-quality personal interviews, we only examined one industry in one country; caution is therefore needed when generalising its outcomes to other decision contexts. Further research may explore other contexts, comparing industries with different levels of competition, margins and growth levels. Also, longitudinal studies allowing for a better understanding of adoption patterns over time and mapping the differences in intertemporal preferences are another interesting avenue for future research.

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