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ARTICLE

Concern for animals, other farmers, or oneself? Assessing farmers' support for a policy to improve animal welfare

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Abstract

Public acceptance of farming practices relating to animal welfare is becoming increasingly important for dairy farmers. In this study, we assess dairy farmers' willingness to pay to support a policy aimed at improving calf welfare and link this to farmers' social preferences. We conceptualize the farmer's decision into private reasons and motivations to improve animal welfare or industry reputation. Our data come from a survey with over 400 Irish dairy farmers that included an experimental component. Specifically, we utilized a contingent valuation referendum method to elicit farmers' willingness to pay. We also used a financially incentivized social value orientation scale based on competitive, individualistic, prosocial, and altruistic preferences. Our findings indicate that most farmers are supportive of a policy scheme to improve animal welfare, and higher social value orientation (i.e. more altruistic preferences) is positively associated with higher willingness to pay. More detailed analysis suggests that industry concern is associated with more altruistic preferences but not concern for animal welfare. Our findings have important policy implications as we show that the majority of farmers are willing to financially support the implementation of a policy that can help to prevent public bads.

KEYWORDS

altruism, animal welfare, dairy industry, public policy, social value orientation, willingness to pay

JEL CLASSIFICATION

Q12, Q18

1 | INTRODUCTION

Public acceptance of farming practices relating to animal welfare is an ongoing concern (Lagerkvist et al. 2011; Lusk & Norwood 2011). Failure to maintain acceptance could drive negative perceptions, lowering consumer demand and creating legislative or regulatory pressures. Recent studies show that many dairy industry practices are perceived negatively by the public, including lack of pasture access (Schuppli et al. 2014), disbudding or dehorning without pain relief (Robbins et al. 2015; Widmar et al. 2017), tail docking[1] (Weary et al. 2011), and separating calves from dams soon after birth (Ventura et al. 2013).

Calf welfare offers a unique case, as specialized operations that raise calves are a common feature of the US and EU dairy industry, involving the movement of calves within days or few weeks of birth, sometimes across large distances. These transactions have the potential to create serious animal welfare concerns among consumers, if they become aware of suboptimal practices. In addition, calf welfare is likely to elicit strong emotional responses of sympathy. This is particularly relevant as most people feel empathy and have altruistic preferences for animals above and beyond private benefits from improved animal well-being (Cowen 2006; Lusk & Norwood 2012).

What makes matters worse is that some dairy farmers see surplus calves[2] as an unwanted byproduct of dairy production (Osawe et al. 2021), which can have implications on their treatment. For example, bull calves, which represent the majority of surplus calves, are less likely to receive adequate colostrum administration relative to heifer calves (Shivley et al. 2019). The quality of neonatal care provided at the dairy farm plays a critical role in calf welfare, because suboptimal colostrum management and navel care are key risk factors for mortality and morbidity. Thus, poor treatment of dairy calves has knock-on effects (Renaud et al. 2017; Shivley et al. 2019), which can be exacerbated if markets fail to represent the full value of calf well-being in sale prices.

One market-based solution to improve animal welfare is to increase the monetary value of surplus calves, as an animal that has a small monetary value is a potential welfare concern (Holden & Butler 2018). Higher values would incentivize good management practices. A breeding strategy that combines the use of sexed semen to generate replacements and beef semen on remaining dams has the potential to minimize the number of unwanted bull dairy calves and increase the number of dairy-beef crosses, which can sell at higher prices (Holden & Butler 2018).

This is particularly pertinent in Ireland, where the number of surplus dairy calves has increased significantly over the last decade, in line with a 57% increase in the national dairy herd between 2010 and 2020 (CSO 2020). Unconstrained milk production facilitated by the EU milk quota abolition in 2015 also resulted in a breeding focus on better milk production characteristics (Kelly et al. 2020). This led to a large number of bull calves with poor beef characteristics and therefore low economic value (Osawe et al. 2021). The higher number of surplus calves produced due to the increase in the national dairy herd meant that new market outlets for dairy calves needed to be found. Consequently, Irish dairy calf markets have come under pressure and the number of calves exported for veal production or slaughtered shortly after birth has increased significantly (Osawe et al. 2021). Coverage by the Irish media including video footage of abuse of live exported calves has exacerbated the situation and fueled consumer disapproval. Therefore, the welfare of dairy calves has developed into a pressing issue, which causes concern about the reputation of the dairy industry.

In this paper, we explore dairy farmers' willingness to pay (WTP) to improve calf welfare and the role of their social preferences. As it is difficult to directly assess how farmers value animal welfare, we focus on solutions to improve calf welfare. This is a similar concept used by previous studies that focused on farm animal welfare programs (Latacz-Lohmann & Schreiner 2019) and traceability (Schulz & Tonsor 2010) when eliciting farmers' preferences. As such, we focus on a new policy

[1]This practice is not used any more.
[2]Surplus calves are dairy calves that are not used for dairy production.

initiative with the potential to improve calf welfare. Specifically, we assess the implementation of a sexed semen laboratory (lab) in Ireland to facilitate greater uptake of sexed semen in the Irish dairy industry, which, as mentioned, has the potential to reduce the number of unwanted dairy bull calves. Although sexed semen has benefits beyond improving calf welfare, the WTP elicitation was framed around animal welfare by describing calf welfare issues and explaining how the use of sexed semen can help to alleviate these issues. To date, available sexed semen in Ireland is of lower genetic quality than conventional semen, as top bulls were not used for sexed semen due to the unavailability of a national lab. Although the implementation of a national sexed semen lab will increase supply of sexed semen from top bulls, and as such facilitate greater uptake, other factors that impede the use of sexed semen, such as lower conception rates and higher prices per straw, would still remain. However, significant concerns of Irish dairy farmers about the reputation of the dairy industry in relation to surplus calves (Osawe et al. 2021) will likely further stimulate farmers' interest in sexed semen.

We develop a conceptual framework that outlines farmers' motivations to financially support a policy to improve animal welfare. We explain that animal welfare provision can be divided into private and public reasons. Once the profit maximizing level of animal welfare is reached, support of a policy scheme is driven by public good motivations to supply improved animal welfare and concerns to eliminate bad practices elsewhere (public bads), which increase with altruistic preferences.

We conducted a survey with over 400 Irish dairy farmers, which included a double-bounded dichotomous referendum question where farmers voted on the implementation of a new sexed semen lab, which was associated with an annual fee per cow. We then used an experimental method to elicit farmers' social preferences by nting a financially incentivized form of the dictator game. Specifically, we used the social value orientation (SVO) scale developed by Murphy et al. (2011) that measures the magnitude of concern people have for others based on competitive, individualistic, prosocial, and altruistic preferences. We then link SVO to farmers' WTP and find that increasing altruistic preferences are positively related to higher WTP. In fact, when grouping farmers based on their SVO reveals that more altruistically minded farmers are willing to forgo more profit than less altruistically minded farmers. However, when exploring this further, our findings suggest that industry reputation concerns are associated with altruistic preferences but not animal welfare concerns. In fact, when directly asking respondents about their motivations, we find that private reasons are main motivating factors, whereas animal welfare improvements were of lower importance.

We contribute to the animal welfare economics and general agricultural economics literature as follows. First, we explicitly consider social preferences of producers in our empirical framework, and in contrast to previous studies that have conceptualized altruism in animal welfare (Cowen 2006; Lusk & Norwood 2012), we quantify the altruism effect. This is a new contribution to the literature. Second, our study is one of the first economic studies that explicitly consider dairy calf welfare from a producer point of view, which is surprising given ample evidence of dairy calf welfare issues (e.g., Renaud et al. 2017). Third, our study is one of the few studies that focuses on farmers' WTP for improved animal welfare, as the bulk of existing economic animal welfare studies elicit consumer responses (see Clark et al. (2017); Lagerkvist & Hess 2011 for overviews). Finally, our study also speaks to the general agricultural economics literature by eliciting farmers' WTP for a new policy incentive to reduce public bads. This is in contrast to the vast majority of existing ex-ante policy assessments that focus on farmers' willingness to accept (Krishna et al. 2013; Schulz et al. 2014).

The paper proceeds as follows: We explain the background in the next section, and outline relevant literature in Section 3. We develop a conceptual framework in Section 4. Section 5 describes the survey, whereas Section 6 provides a description of the data. This is followed by the methodology section. We then present and discuss the results from our empirical specifications, and the last section provides some concluding remarks.

2 | BACKGROUND

Dairy farming is centred around the production of milk. With replacement rates ranging from as low as 18% (Teagasc 2020) to much higher replacement rates depending on country and production system, not all dairy calves are needed for dairy production. Also, when using conventional semen, approximately 50% of calves are bull calves, which are not suitable for dairy production for obvious reasons. These "surplus calves" need to be marketed somehow if they are not reared on the dairy farm for slaughter.

In general, there are several possible outlets for surplus dairy calves. They may be euthanized on the dairy farm or sold to an abattoir when they are a few days old for skins, pet food, or rennet. Other outlets are veal or beef markets, which both require transport to the respective rearing farms. The markets for dairy calves vary by country and depend on consumer preferences (Haskell 2020).

Traditionally, Ireland has a large beef sector, and many dairy calves went into beef production. However, the major dairy industry expansion initiated by the EU milk quota abolition in 2015 meant that dairy cow numbers in Ireland increased from one million dairy cows in 2010 to 1.57 million dairy cows 10 years later (CSO 2020). This almost 60% increase in dairy cow numbers had significant effects on the number of surplus calves that needed to be marketed.[3] Coupled with a spring calving system where the vast majority of calves are born in March and April meant that many more surplus dairy calves were produced than could be handled by national markets. An increased breeding focus on better milk characteristics (Kelly et al. 2020) further aggravated the problem, as these calves are less suitable for beef production. In fact, the majority of beef farmers in Ireland indicated that they were not willing to rear dairy bred calves for beef (Maher et al. 2021). Furthermore, unconstrained milk production post-quota allowed greater specialization in milk production, whereas during quota, restrictions diversifying farm businesses (e.g. beef production) were the only means to increase income. The Irish government actively supported growth in dairy production by setting a national growth target in 2010 of 50% increase in dairy production until 2020 (DAFM 2010). Financial support for agricultural extension services to facilitate efficient dairy production and investments in processing facilities were put in place to support the industry's growth. Ireland's comparative advantage in producing milk is due to low input costs (Läpple et al. 2020). In fact, Ireland is one of the lowest cost dairy producers worldwide (Dillon et al. 2008) and has significantly lower unit costs of production than other major EU dairy producers (Thorne et al. 2017). Low production costs in Irish dairy farming are based on favorable agronomic and weather conditions that sustain a grass-based, spring calving milk production system where cows are grazed outside from early spring to late autumn.

With an increased focus on dairy production, many dairy farmers reduced rearing their own calves for beef, which puts additional pressure on calf markets. This led to a sharp increase in dairy calves that were culled prematurely or sold for live exports to the EU for veal production. For example, in 2019 almost 30,000 dairy calves were slaughtered and almost 190,000 were live exported between birth and 6 weeks of age (DAFM 2019). The problem is that these market outlets for unweaned calves imply a series of stress factors such as transportation over long distances for veal production, food withdrawal, and movement through markets, and are therefore a cause for animal welfare concerns (Haskell 2020; Pardon et al. 2014).

3 | LITERATURE REVIEW

There is an increasing expectation by consumers that animal-based food products are produced with consideration for the welfare of farmed animals (Lusk & Norwood 2011; Veissier et al. 2008). This

[3]Ireland is an exception in relation dairy herd size increases in the EU. Although EU milk production increased by almost 7% between 2014 and 2020 (Eurostat 2021), milk production responses to milk quota abolition varied considerably across EU countries. For example, production increased in Ireland, the Netherlands, and Germany, it remained almost stable in Austria, Portugal, and Finland, whereas production declined in France and Croatia (Eurostat 2022).

increasing public expectation and awareness of animal welfare has led to an increase in economic studies that focus on farm animal welfare, beginning with the work by McInerney (1993) conceptualizing the economics of animal welfare and Bennett (1995) discussing the need to value animal welfare.

Since this early work, there are several contributions in the agricultural economics literature that discuss animal welfare from a conceptual point of view. Lusk & Norwood (2011), for example, outline how animal welfare relates to production economics, public economics, welfare economics, and consumer economics.

Insights from production economics can facilitate our understanding of the optimal level of animal welfare provision based on a profit maximization goal by farmers. It is generally accepted that farm animals who receive better care are likely to be more productive and will thus lead to more profit (Lusk & Norwood 2011). In addition, productivity and reproductive attributes are sometimes regarded as potentially effective measures of animal welfare (Curtis Pas 2007). This illustrates that there is a private benefit for the farmer to consider the welfare of farmed animals. However, Norwood and Lusk (2011) show that maximizing animal welfare is not equivalent to maximizing profit, as maximizing profit can lead to stocking animals beyond a level that maximizes animal welfare. It can also lead to suboptimal treatment of animals. For example, dairy bull calves, which are of lower economic value than heifer dairy calves, are less likely to receive adequate colostrum administration relative to heifer calves (Shivley et al. 2019).

Given that maximizing animal welfare is generally not equivalent to maximizing profit suggests that there is market failure in relation to animal welfare, as animal welfare is often not priced in any conventional way (Lusk & Norwood 2011). Animal welfare labels try to overcome this problem but have by no means eliminated the economic problem that animal welfare creates an externality. For example, providing pasture access to dairy cows results in a positive externality for other farmers who benefit from consumers associating dairy farming with high animal welfare (Schuppli et al. 2014), without having to provide pasture access themselves. In turn, farmers sending unweaned calves for live exports can create a negative externality that affects all dairy farmers if the public becomes aware and disapproves of such practices.

In addition, animal welfare is also a public good (or bad). For example, when a farmer provides high animal welfare, the farmer cannot exclude other farmers from benefiting from it. Similarly, if a farmer treats animals badly, other farmers will also be negatively affected. Animal welfare is also nonrival in the sense that no one can be excluded from benefiting (suffering) when the animals are treated better (worse) (Lusk & Norwood 2011; McInerney 2004). This leads to the classic social dilemma problem that justifies government intervention. Traditionally, regulations and quality assurance schemes are main instruments to ensure higher animal welfare (Lagerkvist et al. 2011; McInerney 2004). McInerney (2004) adds that from a policy perspective to provide a public good, there should be a perceived benefit for a large proportion of the population. Given that 94% of respondents of the Eurobarometer survey believe it is important to protect the welfare of farmed animals (Eurobarometer 2016), this condition is clearly met.

In addition to public policy, altruism has been recognized as a way to mitigate social dilemmas in general and to provide higher animal welfare specifically. However, for altruism to be relevant, a person needs to care about the welfare of animals, as otherwise it does not enter the utility function (McInerney 1993). But views on animal welfare differ widely as animal welfare is often perceived as an emotional topic (Nocella et al. 2010). In general, people are inclined to show altruistic tendencies for farm animals beyond the private benefit they may potentially derive from animal welfare (Cowen 2006). For example, Bennett and Blaney (2003), in their study to elicit UK citizens' WTP to support legislation to phase out the use of battery cages for egg production in the EU, found that in addition to concern for farm animal welfare, higher WTP also appears to be associated with altruistic tendencies such as "warm glow" effects, that is, the acquisition of moral satisfaction.

Animal welfare has also been discussed from the concept of use and nonuse values (Lagerkvist et al. 2011). Use values are derived from animals through productivity, whereas in relation to animal

welfare, nonuse values are ethical that are attached to the perception of how well the animals are kept (McInerney 2004).[4] Lagerkvist et al. (2011) develop a model that integrates livestock producers' decisions between use and nonuse values related to animal welfare. Specifically, they derive compensating variation for alternative levels of animal welfare, which equates to the change in expenditure to sustain original utility after nonuse value of animal welfare has increased. Hansson and Lagerkvist (2015) explore use and nonuse values of Swedish dairy farmers and find that use values relate to business and product quality considerations, whereas nonuse values relate to "warm glow" and further improvement of animal welfare. In another study (Hansson & Lagerkvist 2016), the authors identify the types of use and nonuse values that motivate dairy farmers and show that the economic value associated with better animal welfare includes use and nonuse values.

In relation to welfare economics, the question arises how to extend the economic utilitarian welfare analysis to account for animal welfare, and Lusk and Norwood (2011) outline how including altruism and the cost and benefits to animals and people complicates the matter. Nevertheless, a significant number of studies have set out to measure the economic costs of animal welfare.

Despite this increasing volume of work, the bulk of studies explore consumers' views by eliciting their valuation of animal welfare; see Lagerkvist and Hess (2011) and Clark et al. (2017) for meta-analyses and Bennett et al. (2019) for a recent example. Fewer studies use revealed preferences; see Andersen (2011). Specifically, Bennett et al. (2019) examined the benefits and consumers' WTP for farm animal welfare legislation (EU Broiler Directive) using a contingent valuation method. The authors estimated a WTP of £21.50 per household per year for the legislation.

Another consumer focused study is Liljenstolpe (2008), who explored WTP for animal welfare attributes when buying pork fillet among Swedish consumers. The study used a choice experiment and accounts for heterogeneity in individual consumer preferences and finds that consumer preferences are important leading to WTP estimates being positive or negative.

As mentioned, considerably fewer studies focus on farmers' perspectives. However, precedents do exist; see Latacz-Lohmann and Schreiner (2019). They explored willingness to accept higher animal welfare standards among German pig farmers using a discrete choice experiment. They found that farmers who expect to continue their farming business in the long term tend to be more likely to adopt higher animal welfare standards.

In addition, beyond the specific animal welfare public good problem, other public good problems and alternative approaches for funding have been explored. For example, competitive tendering for the provision of public goods is one approach that has gained some interest in the literature (Bateman & Balmford 2018). Specifically, procurement auctions involve farmers to submit bids to undertake environmental improvement works, a classic example of the use of "Payment for Ecosystem Services" (Latacz-Lohmann & Van der Hamsvoort 1997; Schilizzi & Latacz-Lohmann 2007). Agri-environmental contracting is another approach that has been adopted to promote the provision of public goods (Broch & Vedel 2012). One advantage of contracting is that it can increase the scope for involvement of the private sector in the provision of public goods (Bateman & Balmford 2018). Another approach is the application of the so called "Polluter Pays Principle." A concept that implies that private agents (e.g., farmers) are responsible for the payment of the cost associated with negative externalities tied to their activities (Hanley et al. 1998). Although context specific, this concept argues that provision of public goods could be related to the "Beneficiaries Pay Principle" or the "Provider Gets Principle" depending on how the generated externality is perceived. Provision point mechanism, an example of a voluntary contribution approach, has also been used in the provision of public goods, for example in green power programs (Rose et al. 2002).

In summary, current research provides evidence that altruistic reasons play an important role in animal welfare (e.g. Lusk & Norwood 2012), and "warm glow" appears to influence producers' and

[4]Nonuse value is a common concept in environmental economics that arises if a person benefits from an environmental good without directly interacting with it (Phaneuf & Requate 2016). Farmers directly interact with their animals, which may make the concept of nonuse value less applicable when considering animal welfare from the farmers' point of view.

consumers' motivations to provide/support animal welfare (Bennett & Blaney 2003; Hansson & Lagerkvist 2015), but to date no study has directly quantified this effect. Our study aims to fill this gap in the literature.

4 | CONCEPTUAL FRAMEWORK

In this section, we develop a conceptual framework of farmers' motivations to support a policy to improve animal welfare and how this relates to altruism. Each farmer faces the decision of how much animal welfare to provide. Individual animal welfare decisions impact farm profits. However, at industry level, if the individual farmer does not contribute, other farmers may provide animal welfare, and the farmer can just free ride on their efforts. Conversely, individual decisions to forgo animal welfare can harm the entire industry, and despite other farmers providing higher animal welfare, the actions of one farmer providing low animal welfare can have a negative impact on other farmers. Thus, if costly solutions to improve animal welfare for the entire industry exist, the farmer's motivation to support animal welfare policies can be split into private and public good motivations.

Specifically, there is a private benefit to the farmer for providing animal welfare up to the point where improvements in animal welfare do not lead to higher profit any more. Note that this increase in profit can be achieved by more productive animals associated with better welfare (Lusk & Norwood 2011) or higher prices through, for example, advancing own breeding programs that can facilitate better marketing of calves associated with improved welfare.

Once the farmer exceeds the profit maximizing level of animal welfare, animal welfare has public good characteristics, and, as mentioned, individual decisions of farmers can benefit or harm the entire industry. Therefore, the farmer's decision to forgo some of the profit in the short run to support a policy for higher animal welfare can be motivated by improving animal welfare on the own farm or eliminating bad practices elsewhere. Both can be motivated by altruism, as outlined in more detail below.

One reason for the provision of animal welfare beyond private benefits are genuine animal welfare concerns, where better treatment can be motivated by feelings of "warm glow" or altruism more generally. However, this is only relevant for the individual farmer if the welfare of animals is part of the utility function and implies that a person cares about how animals are treated (Cowen 2006; McInerney 1993). This will result in other farmers benefiting too, as especially the treatment of calves evokes strong emotional responses from the public (Busch et al. 2017). Altruism motivates farmers to give a public good even if their actions only have a tiny effect on the overall outcome, that is, the welfare of farmed animals in general (Lusk et al. 2011).

The farmer can also make a decision to support the policy to facilitate better treatment of animals in the industry in general. This implies that the farmer's motivation to improve animal welfare can be driven by concerns about industry reputation that affects all farmers.[5] A positive industry reputation is important for maintaining profits in the long run, as bad animal welfare practices may result in stricter regulations that impose additional cost on all farmers. As such, industry reputation is a typical case of a social dilemma, where the individual farmer may be tempted to seek short term profits (i.e. avoid additional cost associated with better animal welfare), as opposed to behave in line with the dairy industry's long-term interest.

It follows that a farmer's provision of animal welfare is motivated by a mix of private benefits and providing public goods or eliminating public bads. We assume that the private benefit part of animal welfare is entirely driven by maximizing profits, whereas the public good/bad part is influenced by altruistic preferences.

We illustrate this concept in Figure 1.[6]

[5]Osawe et al. (2021) show that farmers express concerns about the dairy industry's reputation in relation to dairy calves.
[6]Our figure is similar to Figure 1 of Henningsen et al. 2018 who explain the link between animal welfare and economic performance.

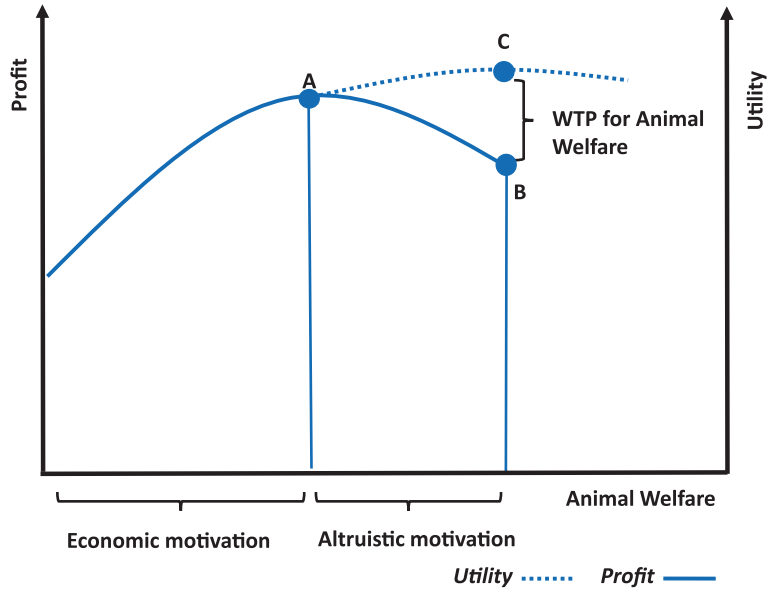

FIGURE 1 Conceptual framework

Initially, profit and utility coincide up until point *A*, and they then split and the dashed line that connects point *A* and *C* is the farmer's utility. Farm profit and utility increase initially with increasing animal welfare, as predicted by Lusk & Norwood (2011). In our diagram, this is the private benefit part of animal welfare, which is motivated by economic considerations. Up to point *A*, the cost of increasing animal welfare are smaller than the additional revenue gained, hence profit increases. However, once a certain level of animal welfare is reached at the profit maximizing point *A*, further improvements in animal welfare lead to reductions in farm profit. This can be due to lower stocking density than is optimal for profit maximization or other management strategies that increase farm animal welfare, such as better care for dairy calves that result in higher labor demand.

For the farmer whose utility includes animal welfare, the utility maximizing choice is point *C*. Our diagram suggests that the farmer is willing to forgo some of the farm profit (the vertical part between point *B* and *C*) to reach higher animal welfare and maximize utility. We refer to this as the farmer's WTP. We assume that this part of animal welfare provision is (at least partially) based on altruistic motivation. Yet, this altruistic motivation can be driven by genuine animal welfare or industry reputation concern. Figure 1 illustrates this concept and shows that WTP for animal welfare increases with altruistic motivation to provide a good for the wider public. In our empirical application, we explore the link between altruism (based on SVO) and WTP for animal welfare, and then assess what drives altruistic motivations, that is animal welfare or industry concern.

5 | SURVEY DESIGN

Data for this study come from a survey of Irish dairy farmers. The survey was conducted online,[7] and we received over 400 completed responses. The survey was implemented by two main means: First, we sent the link directly to dairy farmers through their dairy advisor. In addition, we posted a link in a popular Irish farming press.

[7]Online surveys with farmers have been successfully conducted in other EU countries, see for example Kuhfuss et al. (2016).

The survey consisted of several sections relating farm characteristics focusing on expansion, dairy breeding choices, attitudes toward animal welfare, calf treatment, farmer characteristics, as well as a section using a contingent valuation method to assess farmers' WTP for improved animal welfare and a section eliciting farmers' SVO. The latter two sections are described in more detail below, and the full survey can be found in the Appendix S1D.

5.1 | Measuring willingness to pay for improved animal welfare

The difficulty to directly assess how farmers' value animal welfare are well known (Johansson-Stenman 2018; Lusk & Norwood 2012), and thus, we focus on solutions to improve farm animal welfare. This is a similar concept to previous studies that focused on farm animal welfare programs (Latacz-Lohmann & Schreiner 2019) or traceability (Schulz & Tonsor 2010) when eliciting farmers' preferences.

Specifically, we focus on the establishment of a sexed semen lab in Ireland, which, at the time the study was conducted, was discussed as an important means to reduce surplus dairy calves by facilitating better access to high quality sexed semen. In terms of animal welfare improvement, increased use of sexed semen has the potential to reduce the number of calves that are culled prematurely and can also help to reduce the number of unweaned exported calves. This is based on breeding choices that use sexed semen to breed dairy replacements and using beef bulls on the remaining cows leading to higher quality surplus calves that achieve higher prices through better market outlets.

A combination of factors prevent a private firm to establish a sexed semen lab in Ireland, and thus additional funding is required. First, the Irish dairy sector is based on a spring calving system, which means that the vast majority of breeding takes place in a short time interval in spring, with very little breeding taking place outside of this time frame. Hence, there is limited demand for sexed semen outside of this short time interval. In fact, it is common practice on Irish dairy farms to use a stock bull for cows that are not in calf after a certain date. In addition, there is low demand for sexed semen in Ireland in general. This suggests that importing sexed semen from abroad (i.e. the UK) is the only feasible option without additional financial support.

The establishment of a sexed semen lab was selected based on several focus groups with farmers, as well as discussions with industry experts and farm advisers. In fact, a sexed semen lab has been established in Ireland in November 2021 with financial support from "FBD Trust"[8] (this was not known at the time the study was conducted), which shows that our hypothetical scenario was very realistic.

We use a dichotomous choice referendum style double bounded contingent valuation (CV) question that assesses farmers' WTP for the establishment of a sexed semen lab in Ireland. Although the dichotomous choice referendum approach is the most common elicitation method, applications in agriculture are sparse. In the referendum approach, the respondent casts a vote. This setup is seen as incentive compatible if the farmer's best choice from a strategic perspective is to select the choice the farmer most prefers (Phaneuf & Requate 2016).

In the survey, farmers were first presented with background information introducing the problem with a clear focus on how the use of sexed semen can improve calf welfare. Specifically, we informed farmers about the quantity of calves that were culled prematurely or live exported in 2019, and explained how the use of sexed semen can help to alleviate the problem. Farmers were then asked to imagine that the Department of Agriculture is considering a new scheme aimed at decreasing the number of dairy bull calves. Under this scheme, a sexed semen lab in Ireland would be established in 2020. Please refer to the Appendix S1D for a description of the full survey.

[8]"FBD Trust" was established by the shareholders of the FBD Group (an insurance company) to advance the interests of the farming sector in Ireland generally, primarily through the support for research and educational scholarships, for training, development, and the support of groups and organizations that can advocate effectively for Irish farmers.

In addition, survey participants were presented with the main implications of an Irish sexed semen lab. In particular, we highlighted that a sexed semen lab would facilitate the availability of top dairy bulls, reduce the number of calves that are killed early and exported in an unweaned stage, and also enable better dairy beef system integration.

This was followed by the main part of the referendum CV question, as follows:

"Establishing a sexed semen laboratory in Ireland is associated with a significant initial investment and ongoing maintenance costs, which requires support from dairy farmers. Imagine establishing this new Irish sexed semen laboratory would be associated with a €3[9] annual fee per dairy cow for 5 years. This would mean an annual fee of €390, which would be subtracted from your June milk cheque for the next 5 years.

Suppose the Department of Agriculture is seeking the opinion of dairy farmers whether or not a sexed semen laboratory should be established in Ireland. If a majority of dairy farmers in Ireland support the establishment of an Irish sexed semen laboratory (i.e. vote yes), the new laboratory would be established next year, although it would not be established otherwise."

We then included "cheap talk" explaining hypothetical bias and reminding farmers that they should answer as if real payments were required. Cheap talk has been found to reduce WTP amounts in some situations (Lusk 2003). We also made explicit to farmers that this survey and their answers are important for future policy implementation.

The main question was as follows:

If the vote were held today, how would you vote? In your vote, consider that establishing a sexed semen laboratory in Ireland would require an annual fee of €3 per dairy cow for 5 years (i.e. a total annual fee of €390 given your herd size).

Farmers were asked to vote for or against the new lab, followed by a question to assess the degree of certainty respondents have in their answer, measured as "very certain," "somewhat certain," and "not certain at all."[10]

Next, we elicited the motivation of farmers for voting "yes" or "no." In particular, for "yes" votes, we were interested whether this motivation stems from private reasons (i.e., availability of top dairy bulls for sexed semen and the expectation of lower prices for sexed semen); animal welfare motivation (i.e., reducing the number of dairy calves that are killed early and reducing live exports of unweaned calves) or dairy industry motivation (i.e., improving dairy-beef integration and improving the dairy industry's reputation). Farmers could select up to three reasons. For "no" votes, we had similar reasons in a reversed format, as well as reasons that farmers feel they should not have to pay for the establishment of a sexed semen lab.

Each participant was randomly allocated a price from €1 to €9 in €2 increments. This was followed by an increase in price in the case of a "yes" vote and a decrease in price in the case of a "no" vote. More specifically, the follow-up prices for the second vote were €3, €5, €7, €9, and €11 when the initial response was "yes," and €0.5, €1, €3, €5 and €7 when the initial vote was "no." The number and levels of bids used were set using data obtained from a combination of an open-ended pilot study and focus group discussions with farmers.

5.2 | Social value orientation

In relation to measuring altruism, we implemented a measure of SVO (Murphy et al. 2011) in our survey. In general, SVO measures the magnitude of concern people have for others. Specifically, by implementing six items, SVO assesses the most common social orientations reported in the literature (i.e., altruistic, prosocial, individualistic, and competitive), and as such measures social preferences (Murphy et al. 2011). Social preferences have been studied under different names, including other-

[9]This is an example of a price of €3 for a farmer with a herd size of 130 cows.

[10]We found that 4% of participants were very uncertain in the first vote, which increased to 5% in the second vote.

regarding preferences, social motives, welfare trade-off ratios, altruism, collective interest, and SVO (Murphy & Ackermann 2011). A large literature has explored these concepts in more details; see Fehr and Schmidt (2006) for an overview.

The dictator game has frequently been used to study altruistic behavior, and research has shown that although giving nothing is the modal choice, on average people share about 25% of their endowment (Andreoni et al. 2010). Although this suggests altruistic behavior, other nonaltruistic explanations are also possible. For example, participants may not trust that choices are anonymous, which may influence giving behavior (Hoffman et al. 1994). But, reducing social distance has been found to increase giving in dictator games (Bohnet & Frey 1999; Charness & Gneezy 2008).

In addition, the ultimatum game can provide insight into fairness or inequality aversion. In general, inequality aversion, where individuals dislike unequal incomes, can successfully predict contribution behavior (Fehr & Schmidt 1999). In the ultimatum game, usually around 40%–50% of the endowment is offered to the responder, who has the opportunity to reject the offer (which is in contrast to the dictator game, where the responder must accept any allocated amount). Low offers are seen as unfair and often rejected, which has been found to be anticipated by proposers (Fehr & Schmidt 2006). Thus, fairness plays an important role in this game.

The SVO measure is similar to the dictator game in the sense that the responder has to accept the offer. Although previous experimental evidence shows that this reduces endowment allocated to others (Fehr & Schmidt 2006), our "game" is also anonymous, which has been found to reduce allocation to others (Bohnet & Frey 1999; Charness & Gneezy 2008). Therefore, one may consider findings from this game as lower bound of allocation of payoffs to others.

We followed the standard SVO measure and, as mentioned, implemented six items focusing on altruistic, prosocial, individualistic, and competitive behavior. In practice, this meant participants had to make six choices to allocate money between themselves and another anonymous person. The choices were financially incentivized in the sense that we paired each participant with another participant and randomly drew one of the six choices for payoff. Participants then received the average of what they allocated to themselves and what their partner allocated to the other person. Participants were also reminded that their choice had financial implications on their own and someone else's payment. Payment was in the form of gift vouchers as the survey was conducted online. We informed participants that they can expect a €25 gift voucher, but payments will depend on their choices, see Figure 2. The average voucher value was €25.64, ranging from €11 to €33.

Although the original SVO items have nine possible choices each to allocate money, we reduced the set of choices to four. This was based on pilot study results that revealed that participants were not assessing all nine choices but rather tended to just tick the first available choice. A further pilot test revealed that this problem was resolved with four choices. In addition, we divided the original scale by three to receive realistic monetary amounts for payoff. Again, this was informed by pilot tests.

Figures 2 and 3 show screenshots of the introduction to the SVO part of the survey. This was followed by a screen that explained what the individual choice meant (e.g., this choice means you have allocated €30 to yourself and €15 to the other person) and a reminder to consider all choices. A full description of the SVO part of the survey can be found in Appendix S1C.

The SVO measure results in a single score for each participant (measured as an angle of a circle), computed as follows (Murphy et al. 2011):

$$\mathrm{SVO}^{\circ} = \arctan\left(\frac{(\overline{A}_O - 16.7)}{(\overline{A}_S - 16.7)}\right), \tag{1}$$

where $\overline{A}_O$ is the mean allocation to the other person, whereas $\overline{A}_S$ is the mean allocation to the own person. We then subtract 16.7[11] from each of these means in order to move the base of the resulting

[11]Calculated as 50/3 as we adjusted the original scale to get payoffs that could be realized with our survey budget.

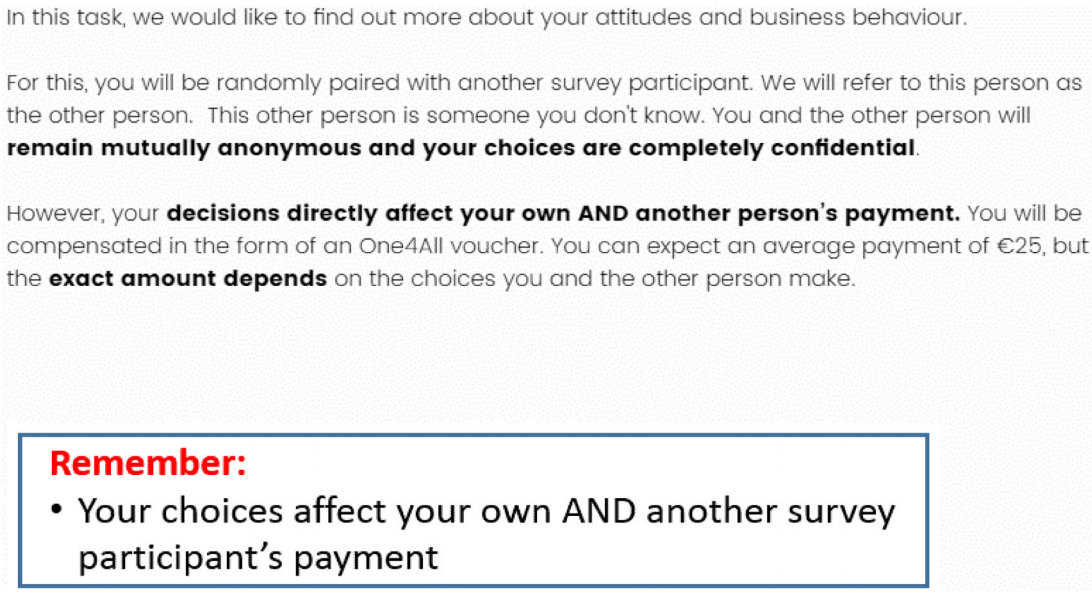

FIGURE 2 Introduction to SVO measurement

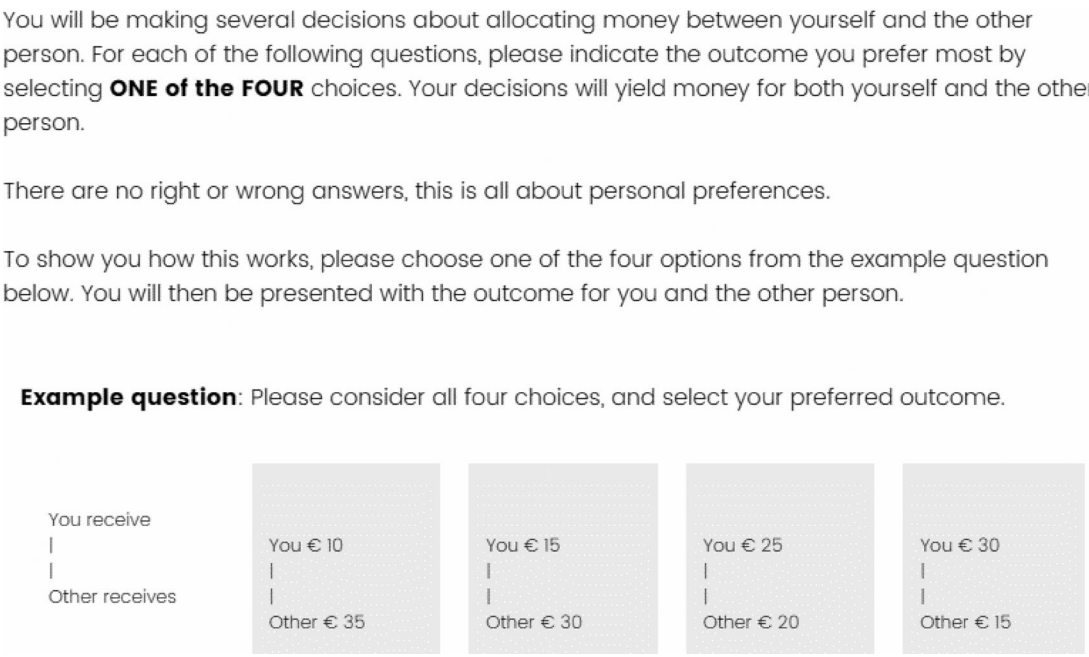

FIGURE 3 Overview of SVO measurement

angle to the center of the circle. Finally, the inverse tangent of the ratio between the means is computed, resulting in a single index of each respondent's SVO. Please see Murphy et al. (2011) for an illustration of the allocation plane and location of the four main social orientations.

6 | DATA DESCRIPTION

6.1 | Farm characteristics

Table 1 provides summary statistics of our data, and we received 403 usable responses. On average, farms have a herd size of 133 dairy cows and farm 80 hectares. As such, sample farms in this survey are considerably larger than the national average of 80 dairy cows with a total farm area of 61 hectares (Dillon et al. 2020). Additional summary statistics can be found in Table SA1 in the Appendix A.

One variable that warrants further explanation is sexed semen. This variable elicits if the farmer has used sexed semen on any cows or heifers in 2019. Almost 20% of farmers indicated that they used sexed semen, but more detailed data exploration revealed that only 39% of those farmers used sexed semen on all heifers, whereas the remaining farmers used sexed semen on selected animals only. Hence, although 20% of farmers used sexed semen in 2019, our data do not mean that sexed semen is used on 20% of the dairy herd.

In relation to farmer characteristics, 41% of our sample farmers are older than 46 years of age. In comparison, the average age of Irish dairy farmers in 2020 was 52 (CSO 2021). More detailed analysis of the age of our sample respondents (please see Table SA1 in Appendix A) reveals that 4% of our sample farmers indicated that they are older than 65 years of age. This compares to approximately 16% of Irish dairy farmer being older than 65 (Dillon et al. 2020). As such, our sample farmers are younger than the average Irish dairy farmer.

6.2 | Contingent valuation

Overall, 68% of farmers answered "yes" to the first vote, and 53% said "yes" to the second vote. When breaking this down into second votes that were presented with a higher value (i.e. initial yes votes), 65% of farmers answered "yes" to the higher amount, whereas in the group of farmers who answered "no" to the initial vote, only 27% answered "yes" to the second vote. The distribution of "yes," and "no" votes for the first and second votes is shown in Table 2. As can be seen, the proportion of "no–no" votes increases with increasing prices, and the proportion of "yes–yes" votes is higher for the lowest price than the highest.

We explore response patterns in more detail and find that participants are responsive to price in the first vote in the sense that "yes" votes decrease with higher prices. This is generally seen as an indicator of validity (Kling et al. 2012). When considering price responsiveness in more detail for

TABLE 1 Descriptive statistics of sample data

Variable	Description	Mean (std. dev.)	Median	Min	Max
Herd size	Number of cows	133.44 (93.65)	102	5	740
Farm size	Area farmed in hectares	80.47 (53.05)	68.80	3.24	453.23
Stocking rate	Dairy cows/hectare	1.72 (0.56)	1.65	0.22	4.12
Breed	% of cows in herd that are Jersey Frisian cross	15.58 (27.76)	0	0	100
Sexed semen	= 1 if the farmer used sexed semen	0.18 (0.39)	0	0	1
SVO	Social value orientation	34.21 (12.73)	36.03	−16.43	88.83
Age*	= 1 if the farmer is older than 46	0.41 (0.49)	0	0	1
Education*	=1 if the highest level of education is third level or higher	0.64 (0.48)	1	0	1
Observations	403 (*395)				

*Indicates a different number of observations.

TABLE 2 Overview of bid levels

Price of first vote (in €)	No–no (%)	No–yes (%)	Yes–no (%)	Yes–yes (%)	*n*
1	11.70	19.44	23.96	24.86	85
3	13.83	27.78	30.21	19.21	86
5	20.21	22.22	14.58	22.60	81
7	27.66	13.89	18.75	14.12	74
9	26.60	16.67	12.50	19.21	77
Observations (*n*)	94	36	96	177	403

the second vote, it is important to realize that observations in each follow up category are lower than in the initial categories, which questions definite conclusions. With this in mind, it appears that responsiveness to price is only evident for initial "no" votes, whereas this is not the case for initial "yes" votes, that is, increases in price. One explanation for this pattern could be that strategic responses of farmers who voted "yes" to the initial question are possible. These farmers may have a stronger interest that a sexed semen lab will be developed compared to farmers who voted "no" to the initial question. Hence, the latter group is less likely to show strategic behavior. Please see Appendix S1B for more details. This relates to the frequently discussed issue in the contingent valuation literature that follow up questions can introduce bias but increase statistical efficiency (Hanemann et al. 1991). However, as mentioned, lower observation counts in follow up categories question definite conclusions about strategic behavior.

6.3 | Social value orientation

In relation to social preferences of our sample farmers, the average SVO score is 34.11, ranging from −16.43 to 88.83, where a higher score implies more altruistic preferences. An overview of the SVO data is provided in Figure 4. In line with expectations (Murphy et al. 2011), prosocial preferences are the clear majority type.

We divided farmers in three groups based on their SVO scores, as follows: the top 25% of sample farmers were classified as altruists, the middle 50% as prosocials, whereas the bottom 25% were classified as individualists.[12] Characteristics of the three groups are shown in Table 3. Altruists have the largest farms with a herd size of 147 dairy cows and an average farm size of 87 hectares. Their herd consists of 17% Jersey Friesian cross breeds (*breed*). Only 13% of individualists use sexed semen, whereas this figure is 21% among prosocials. Thirty-nine percent of altruists are older than 46 years, whereas this proportion increases to 44% for individualists.

7 | METHODOLOGY

Our contingent valuation question was based on a double-bounded referendum question where farmers voted "yes" or "no" on the implementation of a sexed semen lab that was associated with a specific price per cow. Double-bounded models give more information about each participant's WTP as they provide an additional data point and thus improve estimation efficiency (Hanemann

[12]Following Murphy et al. (2011) altruists have an SVO score greater than 57.15; prosocials have values between 22.45 and 57.15, individualists are between −12.04 and 22.45, whereas competitive people have scores smaller than −12.04. When dividing our sample following this classification, we find that the vast majority of farmers fall into the prosocial scale (82%), whereas the proportions of altruists and competitive people in our sample are very small. Therefore, following the categorization by Murphy et al. (2011) did not provide sufficient observations in each group. Hence, we decided to create groups based on sample size.

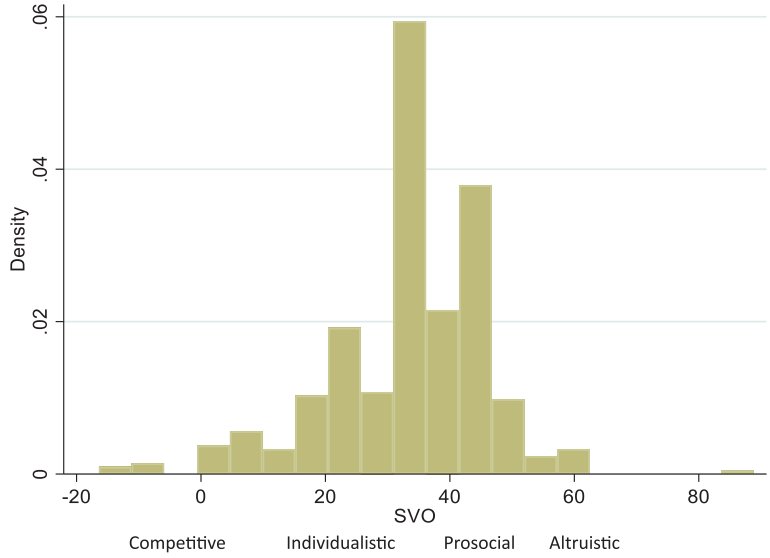

FIGURE 4 Distribution of SVO

TABLE 3 Descriptive statistics by SVO group

Variable	Altruists	Prosocials	Individualists
Herd size	147.47 (95.35)	128.57 (93.48)	128.75 (91.66)
Farm size	87.18 (51.19)	80.17 (57.44)	74.02 (44.48)
Stocking rate	1.74 (0.57)	1.68 (0.53)	1.79 (0.61)
Breed	17.39 (31.34)	15.05 (25.80)	14.57 (27.64)
Sexed semen	17.48 (38.16)	21.18 (40.96)	13.26 (34.09)
Age (46 +)	0.39 (0.49)	0.42 (0.49)	0.44 (0.49)
SVO	47.42 (6.15)	36.05 (3.45)	16.53 (9.93)
Observations	103	202	98

et al. 1991). Although the use of a single, binary-choice question is currently seen as best practice for valuing public goods (Johnston et al. 2017), this is based on the premise that there are enough observations and statistical power to execute the analysis without using follow-on bids.[13] Thus, the double-bounded method as suggested by Hanemann et al. (1991) has an advantage over other elicitation methods in terms of statistical efficiency, and we apply this methods in this study.[14] Despite the understanding that the trade off is that some bias from strategic behavior might affect estimates, the double-bounded model by Hanemann et al. (1991) is still used in recent applications, please see Tokunaga et al. (2020) and Markosyan et al. (2009) for examples.

In the double-bounded method, if the participant answers "yes" to the initial question with price p_{j1}, the participant receives a follow up question with price $p_{j2}^{U} = p_{j1} + a$ with a being the change in price for j randomly assigned prices. If the participant answers "no" to the first question with p_{j1}, the

[13]It is possible to only use the first bid of a double-bounded survey if respondents are unaware that they will be asked a follow up question. Although the incentive compatibility of the first question will not be compromised in this instance (Johnston et al. 2017), we decided against this option due to a low sample size by using one bid only. Thus, the better model may involve using multiple responses per person.
[14]Iterative bids can introduce problems due to starting point bias and incentive incompatibility as discussed by Alberini et al. (1997) and Whitehead (2002, 2004). These authors develop models that account for biases but produce separate WTP estimates for each bid.

TABLE 4 WTP scenarios

Scenario	WTP
"yes"–"yes"	$p_{j2}^{U} \leq \text{WTP}$
"yes"–"no"	$p_{j1} \leq \text{WTP} < p_{j2}^{U}$
"no"–"yes"	$p_{j1}^{L} \leq \text{WTP} < p_{j1}$
"no"–"no"	$\text{WTP} < p_{j2}^{L}$

participant receives a follow up question with a lower price $p_{j2}^{L} = p_j - a$. This leads to the four scenarios shown in Table 4.

The empirical representation is as follows:

$$\text{WTP}_i = \alpha + \delta p_j + \beta_1 \text{SVO}_i + \beta_2 X_i + \beta_3 D_i + e_i \tag{2}$$

with $e_i = N(0, \sigma^2)$.

In addition, p_j is the randomly assigned price for each respondent i, SV O is our main variable of interest indicating whether SVO is associated with WTP differences. The vector of covariates X_i consists of farm characteristics expected to be related to the decision of whether or not to contribute to the establishment of the sexed semen lab. Specifically, we include herd size and stocking rate, which control for farm size and intensity, and also serve as a proxy for farm income.[15] We also control for whether the farmer used sexed semen and the percentage of the herd that are Jersey Friesian cross breeds.[16] D_i includes the farmer's age and level of education as sociodemographic characteristics.

To proceed with the estimation, one must construct a log-likelihood function to obtain parameter estimates for β and σ using maximum likelihood estimation (Lopez-Feldman 2012), as shown in Equation 3.

$$\begin{aligned}\ln(L) = \sum_{i=1}^{N} \Bigg[& d_i^{yy} \ln\left(\Phi\left(X_i\frac{\beta}{\sigma} - \frac{p_{j2}^{U}}{\sigma}\right)\right) + d_i^{yn} \ln\left(\Phi\left(X_i\frac{\beta}{\sigma} - \frac{p_{j1}}{\sigma}\right) - \Phi\left(X_i\frac{\beta}{\sigma} - \frac{p_{j2}^{U}}{\sigma}\right)\right) \\ & + d_i^{ny} \ln\left(\Phi\left(X_i\frac{\beta}{\sigma} - \frac{p_{j2}^{L}}{\sigma}\right) - \Phi\left(X_i\frac{\beta}{\sigma} - \frac{p_{j1}}{\sigma}\right)\right) + d_i^{nn} \ln\left(1 - \Phi\left(X_i\frac{\beta}{\sigma} - \frac{p_{j2}^{L}}{\sigma}\right)\right)\Bigg]\end{aligned} \tag{3}$$

d_i^{yy}, d_i^{yn}, d_i^{ny}, d_i^{nn} are indicator variables that are either one or zero depending on each respondent i's choice, that is, "yes–yes," "yes–no," "no–yes" and "no–no."

We estimate mean WTP for the overall sample as follows:

$$E(\text{WTP}) = \frac{1}{\hat{\delta}}\left(\hat{\alpha} + \hat{\beta}_1 \overline{\text{SVO}} + \hat{\beta}_2 \overline{X} + \hat{\beta}_3 \overline{D}\right) \tag{4}$$

where $\overline{\text{SVO}}$, $\overline{X}$, and $\overline{D}$ are the mean values of the covariates for the full sample, and $\hat{\delta}$, $\hat{\alpha}$, and $\hat{\beta}$ are the estimated parameter values. Standard errors are obtained by the delta method. We then calculate

[15]Due to the difficulty of eliciting farm income in a survey, we asked for milk price instead and calculated revenue by multiplying milk output with price. This control variable (on a per cow basis) was not significantly associated with WTP. Therefore, due to the associated uncertainty of the accuracy of this income variable, we decided to proceed with farm characteristics as control variables instead.

[16]In general, Jersey breeds have poor beef characteristics and surplus calves have a lower value.

WTP for the three SVO groups separately by replacing the sample mean values with mean values from each respective group.

Parametric estimation requires some assumption on the distribution of WTP, which can mean that one faces the risk that the chosen distribution is incorrect (Aizaki et al. 2014; Kriström 1990). Thus, to check the robustness of the parametric WTP estimate from the double-bounded model, we also use a nonparametric estimator. Kriström (1990) suggested a nonparametric estimator for single-bounded models. The estimator begins by calculating the proportion of "yes" responses for each price p_j as

$$\widehat{S}\left(p_j\right) = \frac{n_j}{N_j}, \tag{5}$$

with n_j being the number of respondents answering "yes" to price p_j out of the complete subsample N_j that were randomly assigned to price p_j (Aizaki et al. 2014). This method can be extended to double-bounded models (Carson & Steinberg 1990). If this forms a nonincreasing sequence, it provides a distribution free maximum likelihood estimator of the probability for acceptance (Kriström 1990). There are several ways of interpolating between each probability, and the most commonly used approaches are linear interpolation (Kriström 1990) and the Kaplan–Meier-Turnbull estimator (Carson et al. 2005). The latter estimator is commonly seen as a lower bound of WTP and is applied in this paper.

8 | RESULTS AND DISCUSSION

8.1 | Estimation results

We begin by presenting the estimation results from a double-bounded model with a varying number of control variables, see Table 5. Model 1 includes a constant only, whereas Model 2 also includes SVO, our main variable of interest. In Model 3, we add a set of farm characteristics, whereas in Model 4 we also include farmer characteristics.[17] Comparing the AIC statistics at the bottom of Table 5 suggests that Model 4 is the preferred model, and we thus proceed with this model for further WTP estimates.

The model estimates in Table 5 indicate that survey participants responded rationally to increases in the contribution they were asked to pay as the price coefficient is negative and statistically significant in all models. Our main variable of interest is the farmer's SVO score, which is statistically significant and positive in all models. The positive coefficient indicates that with increasing altruistic tendency the propensity to vote "yes" increases. This is in line with findings in the animal welfare literature that altruism plays an important role in animal welfare provision (Cowen 2006), but it also coincides with the wider literature on WTP that finds that feelings of "warm glow" can motivate increased WTP amounts (Kahneman & Knetsch 1992; Nunes & Schokkaert 2003). We explore potential motivations for this effect in more detail below.

In relation to farm characteristics, stocking density (*stocking rate*) and the proportion of Jersey Frisian cross breeds in the herd (*breed*) are significantly and positively associated with WTP, whereas herd size (*herd*) and whether or not the farmer used *sexed semen* are also not statistically significantly related to a "yes" or "no" vote.

In addition, the farmer's *age* and *education* are not statistically significant.[18]

[17]The difference in observations can be explained by the fact that some respondents exited the survey before completing the last section of the survey.

[18]We tested whether the survey was conducted on a mobile phone or computer, and whether it was completed through a link from an advisor or an online farming media is significantly related to the "yes" or "no" vote. Neither of the variables were statistically significant and a LR test revealed that the inclusion of these variables did not improve the models.

TABLE 5 Estimation results

	Model 1	Model 2	Model 3	Model 4
p_j	−0.175*** (0.112)	−0.175*** (0.112)	−0.178*** (0.012)	−0.177*** (0.012)
SVO		0.010** (0.004)	0.009** (0.004)	0.010** (0.005)
Herd			−0.0003 (0.000)	−0.0005 (0.000)
Stocking rate			0.192* (0.110)	0.218* (0.111)
Breed			0.004* (0.002)	0.004* (0.002)
Sexed semen			0.213 (0.151)	0.189 (0.152)
Age				0.123 (0.132)
Education				−0.169 (0.136)
Constant	1.163*** (0.086)	0.841*** (0.175)	0.491* (0.254)	0.477* (0.286)
Observations	403	403	403	395
AIC	1085.45	1082.98	1081.81	1051.91
WTP	6.664 (0.336)	6.658 (0.335)	6.661 (0.332)	6.719 (0.339)

Note: Standard errors in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

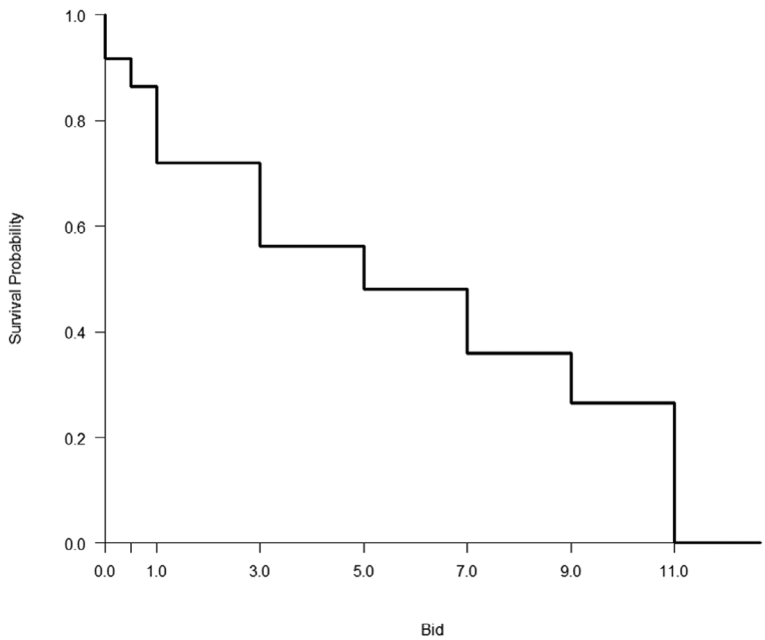

FIGURE 5 Kaplan–Meier-Turnbull survival function

The calculated mean values of WTP are reported at the bottom of Table 5. The calculated value of the preferred model (Model 4) is €6.72 per cow. In addition, we also calculate WTP based on a nonparametric methods, which provides a mean value of €5.66. This can be seen as a lower bound of WTP. Figure 5 provides an overview of "survival" probabilities at each bid level. The median value can be found at 0.5 survival probability, which suggests a median value ranging between €5 and €7. Therefore, our parametric WTP estimates lie within estimated WTP values from the nonparametric estimator.

When putting the WTP estimates in context, the average Irish dairy farmer had gross margins per cow of €1160 in 2019 (Dillon et al. 2020). Thus, our WTP is about 0.5% of income per cow for

TABLE 6 WTP for SVO groups

Median WTP	Mean (std. dev.)	95% CI
WTP (all farms)	6.719 (0.339)	6.054–7.383
WTP altruists	7.409 (0.508)	6.413–8.403
WTP prosocials	6.813 (0.345)	6.136–7.490
WTP individualists	5.799 (0.591)	4.642–6.958

an average Irish farmer. However, as our sample farmers with 133 dairy cows have significantly larger dairy herds than the average Irish farmer with 81 dairy cows (Dillon et al. 2020), the estimated WTP amount is likely an even smaller proportion. Thus, our WTP estimates appear to provide realistic values that farmers may be willing to contribute.

8.2 | WTP

As previously outlined, we are interested how WTP differs depending on SVO. To this end, we calculate mean WTP for the full sample and for three SVO groups. Results are reported in Table 6.

The results in Table 6 indicate that altruists have the highest WTP estimate with €7.41 per cow, equating to €1089 per annum based on the group's average herd size of 147 dairy cows. In contrast, farmers that fall into the prosocial category have an estimated WTP of €6.81 per cow, which is €872 per farm (average herd size 128), whereas farmers that fall into the individualist category have the lowest estimated WTP with €5.80 resulting in a farm WTP of €748 based on their average herd size of 129 dairy cows.

8.3 | Motivation for WTP

Our estimation results suggest that WTP is associated with altruistic preferences, as suggested by the positive and significant coefficient estimate of SVO. However, as this does not provide insights in what drives altruistic motivations, we explore this aspect further, in line with our conceptual framework. Recall that once the profit maximizing level of animal welfare is reached, animal welfare has public good characteristics. As previously explained, we see altruism as a main motivator to provide a public good, but this public good motivation can be driven by genuine animal welfare or industry reputation concerns. Therefore, we explore the relationship between SVO and stated animal welfare and industry concerns by way of regression analysis.

Industry concern was measured by the following statement: "The reputation of Irish dairy farming in relation to calves is of increasing concern," whereas animal welfare concern was measured by the average of the following two statements: "The feelings of animals are not important (reversed score)" and "Farm animals should be guaranteed a happy and content life." All statements were measured by a 5-point Likert scale asking for respondents' agreement. In relation to reputation concern, we created a dummy variable that equals one if the farmer agreed (very) strongly with the statement, whereas farmers were divided in low, medium, and high agreement groups for the animal welfare statements. Please see Table SA2 in the Appendix A for summary statistics of the statements and Appendix S1D for the survey questions. In the empirical model, we also control for herd size and stocking rate, and low animal welfare concern is used as base category. Results are reported in Table 7.

As can be seen, concern about industry reputation (*reputation concern*) is positively associated with SVO, whereas we do not find a statistically significant relationship between stated animal welfare concern and SVO. Therefore, farmers who express stronger concern for animal welfare do not

show higher altruistic preferences, suggesting that dairy industry reputation concern may be a stronger motivation for altruistic public good provision.

In addition, we also asked respondents directly for their WTP motivation by presenting farmers with six reasons: two reasons related to animal welfare (i.e., help to reduce the number of dairy calves that are killed early and reduce live exports of unweaned calves), two reasons related to the dairy industry (i.e., improve dairy beef system integration and help the Irish dairy industry reputation), and two private reasons (i.e., availability of sexed semen from top dairy bulls and lower prices for sexed semen).

Each farmer could select up to three reasons. The proportion of how often each reason was selected separated by SVO group is shown in Figure 6.

The first observation is that private reasons were the most frequently mentioned reasons to support the establishment of a sexed semen lab by all groups. A Kruskal Wallis test confirms that there is a significant difference between the three groups. A direct group comparison based on a χ^2 test reveals that the answers from individualists differ significantly from the prosocial group. Initially, it appears counter intuitive that a lower proportion of individualists select private reasons when

TABLE 7 Estimation results: Associations with SVO

SVO	
Reputation concern	3.326** (1.509)
Medium AW concern	0.095 (1.795)
High AW concern	0.664 (1.580)
Herd size	0.017** (0.007)
Stocking rate	−0.864 (1.186)
Constant	30.576*** (2.406)
Observations	403
R^2	0.025

Note: Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$.

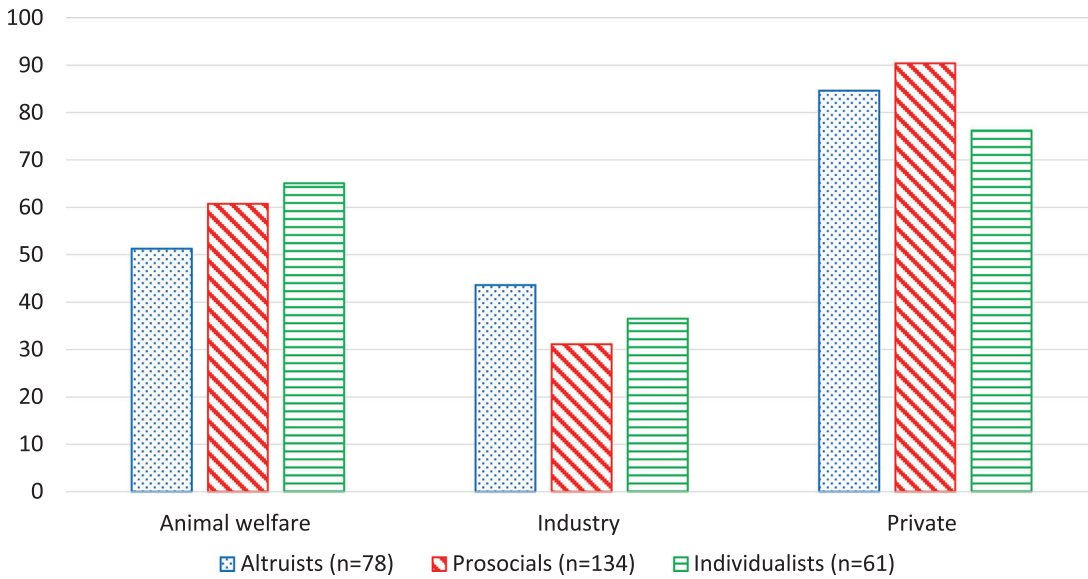

FIGURE 6 Reasons to support a sexed semen lab by SVO group

compared to prosocials. However, the fact that only 11% of individualists (who voted "yes") use sexed semen (when compared to 20% use of sexed semen in the other groups) may explain this finding.

In relation to industry related reasons, it appears that altruists were more likely to be motivated by industry concerns than prosocials, whereas there is no significant difference between altruists and individualists. This may suggest that altruists are more motivated by industry concerns to support a public good, as suggested by our regression model presented in Table 7 and conceptual framework.

Finally, in relation to animal welfare reasons, we do not find significant differences among the three groups, which is in line with our regression model presented in Table 7, which does not indicate significant differences in animal welfare concern in relation to altruistic preferences.

Overall, it appears that although animal welfare concern is a reason to support the establishment of a sexed semen lab, it is neither the main driver nor do altruistic preferences enhance this motivation. As such, a combination of different reasons appear to facilitate support for animal welfare.

9 | CONCLUSION

Animal welfare has attracted increasing attention over the last number of years, and the fact that an overwhelming majority of Europeans feel it is important to protect the welfare of farmed animals (Eurobarometer 2016) shows that this topic is of general interest. In contrast to most economic studies on animal welfare that focus on consumer views, in this paper we explore dairy farmers' willingness to pay (WTP) for a new policy scheme to improve animal welfare. We focus on the establishment of a sexed semen lab in Ireland that has the potential to improve dairy calf markets, which have become under pressure due to a major expansion of Ireland's dairy industry. Specifically, live exports of unweaned calves and premature culling have attracted consumer disapproval. This caused reputation damage to the industry fueled by animal welfare concerns in relation to the treatment of those calves.

We developed a conceptual framework that divides the provision of animal welfare into private benefits and public good motivations. Public good motivations can be targeted at the provision of better animal welfare on the own farm or the aim to reduce bad practices on other farms. These can be driven by genuine concern about animal welfare or concerns about industry reputation, which are both connected to altruism. Empirically, we link farmers' WTP to their altruistic preferences, measured through a social value orientation (SVO) scale (Murphy et al. 2011), and find that more altruistically minded farmers are willing to contribute more to support a policy to improve animal welfare. More detailed analysis revealed that industry concern is associated with more altruistic preferences but not concern for animal welfare.

Our findings have important policy implications. First, our results show that the majority of farmers are willing to financially support the implementation of a new policy to improve farming practices. Although we focused on animal welfare, it is likely that these findings also hold for other policies aimed at the prevention of public bads that have the potential to damage the reputation of the entire industry. One obvious example are policies to reduce greenhouse gas (GHG) emissions from dairy farming, as similar to animal welfare, negative actions by individual farmers (or ignorance of the problem in this case) cause significant harm to the entire industry. Importantly, the use of sexed semen is also an important GHG mitigation measure. Thus, supporting the uptake of sexed semen will likely bring considerable public good benefits.

Second, we find that more altruistically minded farmers have a higher WTP for the animal welfare friendly policy. However, in contrast to previous literature on animal welfare that suggests altruism is important in its provision (Bennett & Blaney 2003), we do not find that farmers with altruistic preferences are more motivated by animal welfare considerations when compared to less altruistically minded farmers. If anything, it appears that reducing negative actions of others (i.e. preserving industry reputation) is of higher importance to farmers with more altruistic preferences.

Finally, we make an important contribution to the animal welfare literature in economics as we show that farmers are motivated by a number of reasons including private benefits and public good and bads. Importantly, we find that private reasons are the main motivating factor to support a public policy aimed at improving animal welfare. This may imply that there is still room to simultaneously improve animal welfare and increase farm profit. Although this suggests further improvements in animal welfare will provide economic gains to farmers, it also raises cause for concern about the general industry level of animal welfare. Considering that Lusk and Norwood (2011) show that maximizing animal welfare is not equivalent to maximizing profit, it indicates that further animal welfare improvements are required. An increased focus on farmers' animal welfare decisions will be important to help achieve this target.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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