Factors Associated with Extension Programme Participation: The case of discussion groups for Irish cattle farmers.

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Abstract

With agricultural extension being an important method of knowledge transfer and promoting innovation, we explore the factors associated with extension participation in the case of Irish cattle farmers. The cattle sector has a high reliance on direct payments and off farm employment is prevalent; we explore how these factors affect extension participation making use of data from a government funded extension program. By applying a sequential logit model, we found that subsidy dependence and off farm employment both had a significant and negative impact on participation.

Keywords: Extension Participation, Subsidy Dependence, Off-Farm Employment, Sequential Logit Model

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1. Introduction

The dissemination of information and knowledge is a prerequisite for the adoption of a new technology or management practice (Yapa and Mayfield, 1978), and the importance of social interactions and networks has long been recognised in the technology adoption literature (Rogers, 2003, Pannell et al., 2006). Imperfect knowledge is a barrier to adoption; however the barrier can be significantly diminished by 'learning by doing' and by learning spill over effects (Foster and Rosenzweig, 1995). In a European context, the Common Agricultural Policy (CAP) prioritises the fostering of knowledge transfer and innovation in agriculture under Pillar II. This is supported by measures such as agricultural extension, where information and knowledge from agricultural researchers and inventors is diffused to farmers. Farmer discussion groups is one method of extension, which seek to transfer knowledge amongst participants by developing local networks and utilising the social interactions of participants. The discussion group format enables the process of social learning by allowing farmers to disseminate their knowledge and experience of specific issues with other farmers in the group and therefore farmer discussion groups are an ideal method in promoting technology adoption.

There is a considerable gap in the literature surrounding extension program participation in economically developed countries, with Hennessy and Heanue (2012) and Läpple and Hennessy (2015) being notable exceptions; by assessing the factors associated with extension programme participation we aim to contribute to closing this knowledge gap. We give special consideration to the impact that subsidies and off-farm employment have on participation with extension. We hypothesize that farmers with a high reliance on subsidies and low market income are less likely to innovate and thus, the likelihood of participating with extension is reduced. When market income is low or negative, there is little incentive on the farmer to increase market income through participation with extension and technology adoption. Additionally, farmers with an off farm job are less likely to participate in extension due to the opportunity cost involved. To this end, we use data from a recent government funded extension program for cattle farmers in Ireland.

This paper is arranged into seven sections as follows: Section 2 provides a background to the structural issues surrounding the Irish cattle sector; Section 3 outlines relevant literature for this study; Section 4 presents the methodology used in this study; Section 5 provides a description of the data; Section 6 presents the results; and Section 7 closes with a discussion and some concluding remarks.

2. Background

As a result of Irish agricultural policy, farmer discussion groups have become an important delivery method of agricultural extension. Farmer discussion groups have been accessible to cattle farmers for over the last decade; however, the number of farmers participating in these discussion groups was low. The introduction of the Beef Technology Adoption Programme (BTAP) significantly increased the accessibility of beef discussion groups for farmers across Ireland. Operating for a three-year period (2012-2014), BTAP aimed at improving the innovation levels on cattle farms by promoting technology adoption. Included in the program was a financial incentive, whereupon the participants received a payment (not exceeding €1,000) for completing a series of tasks set out by the program. Similar to the long established discussion groups for dairy farmers, the discussion groups were locally based and operated with an extension officer or facilitator. While discussion groups for dairy farmers have been widely studied, showing relative success in promoting technology adoption and improving profitability (Hennessy and Heanue, 2012, Läpple et al., 2013, Läpple and Hennessy, 2015a, Läpple and Hennessy, 2015b), many of the findings in these studies are not transferable to the cattle sector. Significant differences exist between the dairy sector and cattle sector in structural issues ranging from demographics, the reliance on direct payments and the prevalence of off farm employment.

The demographic structure is a significant feature of the Irish cattle sector. Cattle farmers are on average older than farmers from other farming sectors, especially in comparison to the dairy sector. The 2010 Census of Agriculture (CSO, 2012) revealed that 29% of farmers in specialist beef production[1] were over the age of 65, with only 22% of specialist beef farmers below the age of 45. Thus, the age distribution of cattle farmers is heavily skewed towards older age categories. Additionally, training/agricultural education levels are low amongst cattle farmers, with 72% of cattle farmers having no formal agricultural training/education (CSO, 2012). Off farm employment has become an ever increasing feature of cattle farming,

[1] Cattle farms are classified as specialist beef production farms in the Irish Census of Agriculture

with off-farm income ensuring the economic sustainability of many cattle farms. Ireland's economic crash in 2008 stopped the increasing trend of off farm employment; however, there has been an uptick in off farm employment recently, with 42% of cattle rearing farm holders and 38% cattle other farm holders having off farm employment in 2014 (Hennessy and Moran, 2015)

The Irish cattle sector has historically been very dependent on subsidies in the form of direct payments (both coupled and decoupled) and this has been highlighted annually by the Irish National Farm Survey (NFS) for more than twenty years. In 2014 direct payments accounted for 149% and 137% of family farm income for farms classified as cattle rearing and cattle other in the NFS (Hennessy and Moran, 2015). As Hennessy et al. (2014) outline, the dependence on direct payments developed from the MacSharry reforms to the Common Agricultural Policy (CAP) in 1992, when cattle farmers became less reliant on market transfers[2] and more dependent on coupled direct payments. Farmers were incentivised to maximise income from these coupled direct payments rather than through efficiency gains or productivity improvements, and this has been reasoned for the poor performance in measures of productivity (Newman and Matthews, 2007). The 2003 CAP reforms broke the link between production and direct payments, which was expected to improve productivity. Kazukauskas et al. (2014) found a marginal improvement in productivity on Irish cattle farms after the introduction of decoupled payments in 2005, albeit from a low base.

Many of the structural issues affecting the Irish cattle sector are mirrored across the agricultural sectors of many other European countries. There is an aging population of farmers across the EU, where 30% of farmers are over the age of 64 years in the EU27. Off farm employment has become an increasing phenomenon in many developed countries (OECD, 2009) and direct payments make up a significant proportion of farm incomes across the EU, especially in the EU15 (European Commission, 2012). In the next section, we will explore the literature to examine how these factors can affect extension participation.

3. Literature

[2] Market prices were kept artificially high by the CAP's price support mechanism

Much of the literature surrounding agricultural extension has focused on the economic returns from extension, and its impact on technology adoption and productivity [see for example Birkhaeuser et al. (1991) and Evenson (2001) for reviews of this literature]. Despite this, as outlined by Läpple and Hennessy (2015b), limited attention has been given to the factors associated with a farmer's decision to participate in an extension program. To the best of the authors' knowledge, only a handful of studies empirically explore the factors associated with extension program participation in an economically developed country. Thus we turn to the technology adoption literature for a contextual background; as extension programs have the specific aims of promoting technology adoption, it can be assumed that many of the factors associated with extension participation are interchangeable with the factors associated with technology adoption. Since the pioneering works of Griliches (1957) and Rogers (1962), an extensive interdisciplinary literature has been established exploring the factors associated with the adoption and diffusion of technologies in agriculture. This literature has taken two distinctive strands: diffusion studies and technology specific studies (Kelly, 2014). Both types of studies have been used to determine the factors influencing technology adoption.

In the technology specific studies, factors that are commonly cited in the adoption literature that have an influence on adoption are, *inter alia*, human capital (Huffman, 2001), farm structure, credit constraints, risk preference (Moschini and Hennessy, 2001), off farm work (Fernandez-Cornejo et al., 2005) and characteristics of the technology (Batz et al., 1999). The innovation diffusion theory, as presented by Rogers (2003), examines the adoption of an innovation throughout its lifecycle. Identifying five types of adopters in the diffusion process, an adopter's categorisation is based on the timing of adoption, with each category of adopter having specific characteristics. Adopters are classified as innovators, early adopters, early majority, late majority and laggards. This diffusion framework was used by Läpple and van Rensburg (2011) in exploring the differences between early and late adopters of organic farming.

Human capital factors such as age and education have a significant influence on technology adoption. It is generally accepted that age reduces the probability of technology adoption, as found in a meta-analysis of adoption studies in the USA by Baumgart-Getz et al. (2012) This negative impact on adoption can be compounded by older farmers having less education, as education increases the likelihood of adoption (Huffman, 2001). Baumgart-Getz et al. (2012) suggest the negative impact of age on adoption is due to older farmers having a shorter planning horizon than younger farmers; the benefits of a technology might not be accrued over this shorter planning horizon and thus, the technology is not adopted by older farmers.

As off farm employment has become an increasing feature of the agricultural sector in many economically developed countries, the effects of off farm employment have been widely studied, including its effects on technology adoption (Fernandez-Cornejo et al., 2005, Gedikoglu et al., 2011). The general assumption made in the literature is that off farm employment has a positive impact on the adoption of capital intensive technologies and a negative impact on the adoption of labour intensive technologies. Gedikoglu et al (2011) apply this hypothesis to examine the effect of off farm employment on two nutrient management practices by farmers in Iowa and Missouri. One of the management practices was a capital intensive practice (manure injection), while the other was a labour intensive practice (record keeping). The results indicated that off-farm employment had a positive impact on the adoption of manure injection, while having no significant impact on record keeping. This is consistent with the results by Fernandez-Cornejo et al. (2005), which showed a positive relationship between off farm work and the adoption of herbicide tolerant soybeans. While these studies indicate the impact of off-farm employment on different types of technologies, their transferability to extension participation is limited. Extension participation is a time consuming activity; therefore, due to the opportunity cost involved, it can be assumed *a priori* that off farm employment has a negative impact on extension participation.

The effects of agricultural subsidies on production have been widely explored with regards to productivity and efficiency, though little attention has been given to its effects on technology adoption and innovation. As productivity and technology adoption are jointly determined and positive (Zepeda, 1994), the effect of subsidies on productivity can theoretically have a similar effect on technology adoption and innovation. Subsidies have been shown to have both a negative and positive impact on productivity, depending if the subsidy leads to an allocative efficiency loss or an investment induced productivity gain (Rizov et al., 2013). Subsidies can create a soft budget constraint leading to the inefficient use of resources (Kornai, 1989) and can incentivise producers to lessen their search for cost saving methods (Leibenstein, 1966). On the other hand, subsidies can loosen a farms credit constraint by providing direct or indirect access to finance. The technology adoption literature gives considerable support to the positive impact the loosening of credit constraint has on technology adoption, especially on capital intensive technologies. Subsidies can also have a distorting effect on risk preference, by increasing a farmer's appetite for risk and thus increasing the likelihood of adopting a technology perceived as risky.

Finally, turning to the limited number of studies in the extension literature, Akobundu et al. (2004) found race and a visit by an extension agent as the significant factors associated with participation to a small outreach and training program in Virginia, while social capital and local networks were significant factors associated with participation of knowledge diffusion extension for farmers in the Italian region of Marche (Pascucci and de Magistris, 2012). In the context of farmer discussion groups, Hennessy and Heanue (2012) found that age had a negative impact and herd size had a positive impact on dairy farmers participating in farmer discussion groups. A regional impact was also found, with farmers in regions that had a higher concentration of dairy farms having an increased likelihood of being a discussion group participant. Introducing a financial incentive to participants encouraged some farmers to join a discussion group that otherwise would not have joined (Läpple and Hennessy, 2015b). The study which explored different types of participants and non-participants – similar to the framework applied by Läpple and van Rensburg (2011) – revealed that age and herd size were significant determinants for the participation decision of late participants versus both non-participants and early participants. Agricultural education was a significant factor in the participation decisions' between non-participants and late participants, while regional variables became significant factors between early participants and late participants.

Our review confirms that the literature on extension participation is relatively thin, especially in a developed country context; however, the literature on technology adoption does provide a useful contextual background. The studies reviewed confirm the significant effect of age, farm size and education levels across various settings. The effect of off farm employment have shown to have a positive impact on the adoption of capital intensive technologies, but inconclusive evidence on its impact on labour intensive technologies. However, there is a dearth of empirical evidence on the effect of subsidies on either farmers' participation in extension programmes or their adoption of new technology. Given the importance of direct payments across the EU and given the large number farmers with off farm employment, it is important to explore further the impact of these factors on extension participation.

4. Methodology

Conceptual Framework

The agricultural household model provides the theoretical foundation for this study. The agricultural household model emanates from the theory on allocation of time pioneered by Becker (1965), and the model was developed to deal with the dual role of a farmer as both a producer and a consumer (Singh et al., 1986, Taylor and Adelman, 2003). The economic decisions of the farm household including consumption, production and labour supply are combined into a single framework. The agricultural household model has evolved from its original purpose as a tool of price policy analysis and has been generalised to conduct research across a large number of areas including technology adoption.

Adopting Huffman's (1991) agricultural household model for a developed country, which was modified by Fernandez-Cornejo et al. (2005) to incorporate technology adoption, the farm household seeks to maximise utility, U, subject to three constraints: an income constraint, a time constraint and a technology (production) constraint. The household's utility is determined by the consumption of purchased goods, G, leisure, $\boldsymbol{L}$, human capital, $\boldsymbol{H}$, and other exogenous factors, φ, which includes weather etc. This can be represented as:

$$\text{Max } U = U(G, \boldsymbol{L}, \boldsymbol{H}, \varphi) \tag{1}$$

subjected to an income constraint

$$P_g G = P_q Q + D - \boldsymbol{P_x X'} + \boldsymbol{WM'} + A \tag{2a}$$

a technology constraint

$$Q = Q[\boldsymbol{X}(\Gamma), \boldsymbol{F}(\Gamma), \boldsymbol{H}, \Gamma, \boldsymbol{R}] \tag{2b}$$

and a time constraint

$$\boldsymbol{T} = \boldsymbol{F}(\Gamma) + \boldsymbol{M} + \boldsymbol{L}, \quad \boldsymbol{M} \geq \boldsymbol{0} \tag{2c}$$

where the price and quantity of purchased goods for consumption are denoted by P_g and G, respectively; D represents decoupled direct payments; P_q the price and Q the quantity of farm output; $\boldsymbol{P_x}$ the price and $\boldsymbol{X}$ the quantity of farm inputs; $\boldsymbol{W}$ off farm wages and $\boldsymbol{M}$ the hours worked off the farm by the household; A is other sources of non-labour income that includes investment returns and government transfers; $\boldsymbol{R}$ are exogenous factors that shift the production function; $\boldsymbol{T}$ the household's time endowments; $\boldsymbol{F}$ the number of hours worked on the farm by the household; and Γ is the adoption intensity of technology. The production function $Q(\cdot)$ is strictly concave. It is assumed that adoption of a new technology has a time effect[3], therefore the time spent working on the farm by the household, $\boldsymbol{F}$, is a function of adoption intensity.

As outlined by Läpple and Hennessy (2015b), joining a discussion group has an associated benefit, B_{DG}, and cost, $C_{DG,}$ for the farmer. Prior to BTAP's introduction, a farmer joined a discussion group if the expected benefits were greater than the costs of joining (i.e. $B_{DG} > C_{DG}$ for early entrants). With the introduction of BTAP, the benefits and cost changed to include the payment, P_{BTAP}, received by the participant and the extra transactional costs, C_{BTAP}, associated with the programme. Therefore, a farmer only joined BTAP if the expected benefits plus payment exceeded the total costs of participation (i.e. $B_{DG} + P_{BTAP} > C_{DG} + C_{BTAP}$ for late entrants). The discussion group membership decision denoted by DG can be represented as a function of these factors, such that:

$$DG = f(B_{DG}, P_{BTAP}, C_{DG}, C_{BTAP}, \boldsymbol{Z}) \qquad (3)$$

where $\boldsymbol{Z}$ is a vector of farmer and farm characteristics. Discussion group membership affects the adoption intensity of technology, therefore $\Gamma \sim \Gamma(DG)$. Discussion group participation also has an impact on the human capital of the participant through peer learning and learning by doing. The utility function, equation 1, and constraints, equations 2a, 2b and 2c, can be reformulated to include discussion group participation, such that:

$$\text{Max } U = U[C, \boldsymbol{L}, \boldsymbol{H}(DG), \varphi] \qquad (4)$$

subjected to the constraints

[3] The time effect is dependent on the technology adopted, with some technologies having a time saving effect and other technologies requiring additional time.

$$P_g G = P_q Q + D + P_{BTAP} - (\boldsymbol{P_x X'} + c_{BTAP}) + \boldsymbol{WM'} + A, \quad (4a)$$

$$Q = Q[\boldsymbol{X}, \boldsymbol{F}(\Gamma), \boldsymbol{H}(DG), \Gamma(DG), \boldsymbol{R}], \quad (4b)$$

$$\boldsymbol{T} = \boldsymbol{F}(\Gamma) + \boldsymbol{M} + \boldsymbol{L} + T_{DG} \quad (4c)$$

where c_{BTAP} is the monetary cost involved with BTAP participation and T_{DG} is the time associated with discussion group participation.

Empirical Model

Variants of the logit model have been widely used in modeling agricultural program participation. For example, a logit model was employed by Unay Gailhard et al. (2014) in examining the adoption of agri-environmental measures by organic farmers in Germany and the role that interpersonal communications had in the adoption decision. Läpple and van Rensburg (2011), in modeling the decisions between the early and late adopters of organic farming, used a multinomial logit model, as did Läpple and Hennessy (2015b) when examining the impact a financial incentive had on early and late entry into dairy farmer discussion groups. In this paper we apply a sequential logit model, which accounts for the sequential nature of the participation decision(s) farmers faced.

The decision to participate in farmer discussion groups can be considered as a sequential decision problem, with the introduction of BTAP creating a subsequent decision for the cohort of farmers that refrained from participating in the initial farmer discussion groups. The decision tree for discussion group participation is presented in Figure 1, where the first decision, D1, represents the decision to join the initial discussion groups (prior to BTAP's introduction), and the second decision, D2, represents the decision by the cohort of farmers that initially eschewed discussion groups to participate in BTAP and thus join a discussion group

Initially used in the education literature to model the process of educational attainment, the sequential logit model has more recently been applied in technology adoption studies where adoption decisions are sequential. Sauer and Zilberman (2010) employed a sequential logit model to investigate the adoption of automatic milking machines by Danish dairy farmers between 2002 and 2006, while the sequential logit model was used to study the adoption decisions of Hungarian farmers between conventional and organic systems of farming by Fertő and Forgács (2009).

The sequential logit model estimates a separate logit for each decision known as a transition. The model assumes, as outlined by Buis (2010), that for a subject to be 'at risk' of passing a transition it has to have passed all previous transitions. As the whole sample is at risk of passing the first transition, the probability of passing the first transition is:

$$\Pr(pass_1 = 1|\boldsymbol{x}) = \widehat{p_1} = \frac{\exp{(\boldsymbol{x\beta}_1)}}{1 + \exp{(\boldsymbol{x\beta}_1)}} \tag{5a}$$

where $pass_i$ = 1 denotes passing transition i. The probability of passing a subsequent transition is calculated from the subsample of subjects that have passed the previous transition, with the probability of passing transition k defined as:

$$\Pr(pass_k = 1|\boldsymbol{x}) = \widehat{p_k} = \frac{\exp(\boldsymbol{x\beta}_k)}{1 + \exp(\boldsymbol{x\beta}_k)} \quad \text{if} \quad pass_{k-1} = 1 \tag{5b}$$

The sequential logit model was estimated using the Stata package `seqlogit` (see Buis 2010).

5. Data

Data used in this study are selected from the Irish National Farm Survey (NFS) for 2012 (Hennessy et al., 2013). The NFS is a survey carried out on a representative sample of approximately 1000 Irish farms each year and forms part of Ireland's contribution to the European Union's Farm Accountancy Data Network (FADN). The NFS contains an extensive range of data that are used for a range of purposes including research. Farm level data that include key financial and physical measures are collected, together with data from the farm household. Farms in the survey are currently classified by total standard output into one of six farming typologies[4]. For the purpose of this study, a subsample of farms classified as cattle rearing, cattle other and specialist sheep with a cattle enterprise is utilised. To be included in the subsample, the cattle enterprise has to have more than 5 livestock units, to ensure that small scale cattle enterprises do not have a distorting effect on the findings. When this was completed, the subsample had 454 observations.

A list of the variables used in the model is presented in Table 2. The explanatory variables in the model include characteristics of the farmer, farm structure and regionality. Variables that account for the farmer's attributes in the model are the farmer's age, marital status, use of advisory services and formal agricultural education. Human capital variables such as age and education are often cited in the literature as significant factors associated with technology adoption, with younger and more educated farmer's having a higher likelihood of adopting technologies. Agricultural education is measured by three dummy variables, indicating if the farmer attended a full-time agricultural course, a part-time agricultural course or has no formal agricultural education. Another human capital variable that is used in adoption studies is the farmer's experience measured by the number of years farming; however, these data are not available from the NFS. The farmer's access to information is determined by the use of farm advisory services, as other measures of information access such as the use of online resources or access to agricultural media are not available.

The subsidy dependence variable is the proportion of total output on farm that is derived from subsidies, as the NFS includes total subsidies in the farm's gross output measure. Subsidies include the Single Farm Payment (which is a decoupled payment from the CAP), disadvantage area payments and cattle subsidies. Subsidy dependence is expected to have a negative impact on participation in farmer discussion groups. Three dichotomous dummy variables are included to account for off-farm employment. These dummy variables indicate if the farmer works off the farm on a full time basis, on a part-time basis or does not work off the farm. Full time work is defined as working between 0.5 and 1 annual work unit (AWU)[5], while part-time work is defined as working off the farm up to 0.5 AWU. Off farm employment by the spouse is also included as a dummy variable.

[4] These categories are: (i) specialist dairy, (ii) cattle rearing (predominantly single suckler farms), (iii) cattle other (predominantly beef finishing farms), (iv) specialist tillage, (v) sheep and (vi) other.
[5] 1 AWU = 1800 hours

Farm specific characteristics included are farm size (measured by utilizable agricultural area), specialisation in cattle production, and the of type cattle production system. Larger farms tend to adopt technologies earlier than smaller farms, with a critical lower bound existing for many technologies that have significant transaction and/or information costs. The farm specialisation variable is calculated as the proportion of cattle livestock units to the total farm livestock units. It is expected that more specialised farms have a higher likelihood of participation in discussion groups. The cattle production system dummy variables are based on the four life stages of beef cattle (calf, weaning, store and finish) and the farms are classed as a calf to finish system, calf to weaning/store system, weaning/store to finish system or other.[6]

Three regional dummy variables are included in the model to control for regional characteristics. The distribution of farming typologies in Ireland has a regional bias, with the proportion and quality of cattle farms differing across regions. The BMW (Border, Midlands and West) region has a higher concentration of cattle farms, while the south-west region is dominated by dairy farming and the eastern region contains most of Ireland's specialist tillage farms. This regionalised distribution of cattle farms could have led to a pre-determined provision of local discussion groups by BTAP administrators.

5. Results

Examination of participant groups

In Table 2, the descriptive statistics by entrant type are presented. On examination of the subsidy dependence variable, non-entrants have a higher dependence on subsidies than both discussion group entrants, with 41% of farm gross output coming from subsidies for non-entrants. This is in comparison with 35% and 37% for early and late entrants respectively. Examining the off farm employment variables, a higher proportion of non-entrants have a full-time off farm job than early and late entrants, while 12% of early entrants work off farm part-time compared to 10% of non-entrants and 6% of late entrants.

On examination of the farmer's characteristic variables, late entrants are on average younger than farmers refraining from participating in a discussion group, with the reverse being true

6 The system is determined by which life stage greater than 70% of cattle enter the farm and which life stage greater than 70% of cattle exit the farm.

when comparing late entrants with early entrants. Early entrants and late entrants also have higher levels of formal agricultural education and a greater proportion of entrants use farm advisory services. The statistic that 96% of early entrants use an advisory service compared to 78% of late entrants and 52% of non-members can be accounted for by the connection between the farm advisory services and discussion group facilitators. A greater proportion of early entrants, at 83%, are married in comparison to late entrants at 79% and non-entrants at 68%.

The farms of early entrants are larger in size and have a higher level of specialisation in cattle farming than the farms of non-entrants and late entrants. This is also the case when comparing late entrants with non-entrants, however surprisingly non-members have a higher degree of specialisation in cattle production than late entrants. Examining entrants by cattle farming systems, the majority of early entrants come from farms' with a calf to weaning/store or calf to finish system (combined at 76%). The original focus of beef discussion groups prior to BTAP was on farms that had a suckler herd, thus accounting for this high proportion.

Examining the regional variability, 52% of early entrants in the sample were from the BMW region, with 28% and 20% of members from the East and South-West regions respectively. This is consistent with the regional distribution of cattle farms in Ireland. As local beef discussion groups were not widely available before BTAP, cattle farmers in non-cattle dominated areas might not have had the same opportunities to join a local discussion group. A regional breakdown of late entrants reveals an interesting statistic. Only 6% of late entrants in the sample are from the South-West region, posing questions on BTAP's success in developing beef discussion groups in this region.

Participation decision models

The results of the sequential logit model are presented in Table 3. Examining the model overall, the null hypothesis that the two groups in each transition can be combined into one group is rejected by the Wald test at the 1% level of significance. Therefore, this indicates that there is a significant difference between the groups. As estimated by the count R^2, the model predicts 95.2% and 85.5% of observations correctly for transition 1 and transition 2, respectively. The dependent variable contains many zeros in both transitions; therefore a skewed logit (scobit) as per Nagler (1994) was performed. The likelihood-ratio test indicated that the scobit model for each transition is not significantly different from the logit model, and thus, it is appropriate to use the logit model for this analysis.

Focusing on the results of the model and the factors affecting participation, the subsidy dependence variable has a negative impact on discussion group participation in both transitions and is statistically significant at the 10% and 5% level of significance for transition 1 and transition 2 respectively; therefore, farms that have a higher share of farm output deriving from subsidies have a decreased likelihood of being a discussion group member. This result indicates that subsidy dependence has a negative effect on farm innovation and would validate our hypothesis that farmers with a greater dependence on subsidies have less of an incentive to innovate and grow their market income. Full-time off farm employment, estimated against the base of no off farm employment, has a significant negative impact on participation in both transitions. This confirms the hypothesis that off farm employment decreases the likelihood of extension participation, due to the opportunity cost involved with participation and the time constraint it produces.

The use of advisory services has a positive impact on participation that is statistically significant at the 1% level of significance in both transitions. The use of advisory services increases the probability of a farmer joining a discussion group. This result is consistent with expectations, as more innovative farmers are more likely to seek farming advice and information. Age has a negative impact on the likelihood of the farmer to participate in a discussion group and is statistically significant at the 10% level in transition 1; thus, an increase in age decreases the probability of a farmer joining the initial discussion groups prior to the introduction of BTAP. This result is in accordance with the finding of many studies in the technology adoption literature, where an increase in the age of the farmer diminishes the likelihood of the farmer's willingness to innovate. It is surprising that age does not have a significant impact on participation in the second transition. Full-time agricultural education had a significant and positive impact on participation in both transitions,

Farm size was significant in transition one, the only farm structure variable to be significant in the model. It had a positive impact on early participation, which is in line with expectations. The model also indicated significant regional factors, with the eastern region having a negative impact on early participation against the base region of the BMW and the south-west region having a negative impact on participation in the second transition when compared against the base region of the BMW.

Discussion and Conclusion

Innovation levels on Irish cattle farms are lower than those on commercially orientated dairy farms, with extension participation rates mirroring these levels of innovation. The prevalence of off farm employment and high reliance on direct payments are two major differences between dairy and cattle farming in Ireland; we speculated that these differences could be significant reasons for the low levels of innovation in the cattle sector. We make use of data from the Irish National Farm Survey on a recent extension program for cattle farmers to test if these factors had an effect on participation.

By applying a sequential logit model, both our hypotheses were confirmed; i.e. (i) a higher reliance on subsidies has a significant and negative impact on extension participation, and (ii) working off the farm on a full time basis decreases the likelihood of a farmer to participate in extension. Our results also indicated that farmer characteristics of age, full time agricultural education and marital status had an impact on participation, together with a significant regional impact.

The results of this study have policy implications with regards to the role of subsidies and its impact on innovation. Successive reforms of the CAP have led cattle farmers to be almost exclusively reliant on direct payments for income, with 100% of farm income on many farms coming from direct payments. This situation provides little incentive to innovate and improve a farm's economic performance, as any market gain would have a small effect on farm income. Additionally, the presence of off farm income can magnify this disincentive to innovate, as farm income is only a fraction of total household income in that situation. The results also pose questions in the ability of policy makers to tackle challenges such as climate change, which require a behavioural change by farmers to adopt practices and technologies that reduce greenhouse gas emissions (GHG). The use of financial incentives to induce farmers to adopt GHG abatement technologies might be insufficient and the situation might need a more targeted approach needed.

The BTAP has been successful in increasing the numbers of cattle farmers participating in discussion groups, as Table 4 shows a threefold increase in the number of discussion groups being available to farmers and a fourfold increase in the number of participants. Though taking the numbers into context with the overall population of farmers engaged in a cattle production system, the number of participants of discussion groups is still relatively low at less than 10% of cattle farms. While increasing the numbers of discussion group participants, it does not necessarily follow that participation will increase productivity and economic performance on these farms. Previous work by Läpple and Hennessy (2015a) indicated that farmers that joined a discussion group program after the introduction of a financial incentive had no significant improvements in economic performance. Therefore, further research needs to be carried out to determine if the program was successful in its aims of improving innovation levels on cattle farms and thus, improving productivity and profitability.

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FIGURES

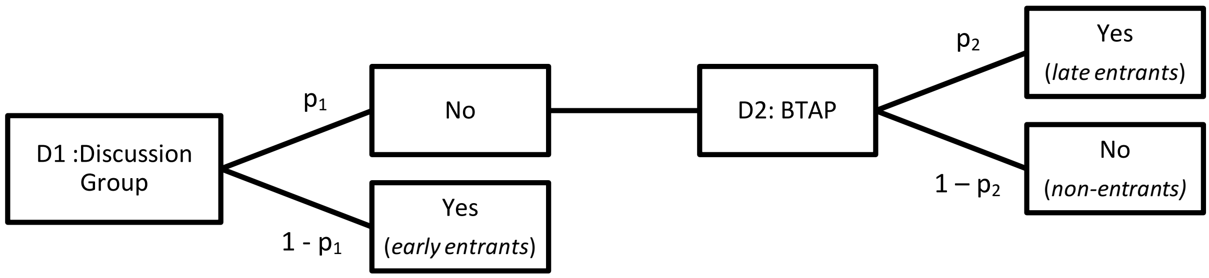

Figure 1: Decision tree for discussion group participation. D1 represents the decision to participate in farmer discussion groups prior to the introduction of BTAP and D2 represents the decision to participate in the BTAP.

TABLES

Table 1: Variable definitions

Variable	Description
Age	Age of the farm holder measured in years
Married	Marriage status of the farm holder, = 1 if farmer married
No agricultural education	= 1 if farm holder has no formal agricultural education
Part-time agricultural education	= 1 if farm holder has taken a part-time education course in agriculture
Full-time agricultural education	= 1 if farm holder has taken a full-time formal agricultural education course
Advisory service	Farm advisory services, = 1 if farmer avails of service
No-off farm job	= 1 if the farmer does not work off the farm
Off farm part-time job	= 1 if the farmer works up to 0.5 AWU off the farm
Off farm full-time job	= 1 if the farmer works between 0.5 AWU and 1 AWU off the farm
Spouse job	= 1 if yes if the spouse has a job
Subsidy dependence	Proportion of total subsidies to total farm gross output
Farm Size	Size of the farm in hectares as measured by utilizable agricultural area
Specialisation	Specialisation in cattle farming measured by proportion of cattle livestock units to the total farm livestock units
Calf to weaning/store	= 1 if the farm engages predominantly in a calf to weaning/store cattle system
Calf to finish	= 1 if the farm engages predominantly in a calf to finish cattle system
Weaning/store to finish	= 1 if the farm engages predominantly in a weaning/store to finish cattle system
Other	= 1 if the farm engages predominantly in a other cattle system
BMW	= 1 if farm is in Border, Midlands and West region
East	= 1 if farm is in East region
South west	= 1 if farm is in South-West region

Note: AWU stands for annual work unit. 1AWU = 1800 hours.

Table 2: Summary statistics

	Non-Entrants (N=365)	**Early Entrants** (N = 25)	**Late Entrants** (N = 64)	**All** (N = 454)
VARIABLES	Mean (Std. Dev.)	Mean (Std. Dev.)	Mean (Std. Dev.)	Mean (Std. Dev.)
Age	58.21	52.12	54.80	57.39
	(11.37)	(9.662)	(10.73)	(11.31)
Married	0.679	0.840	0.828	0.709
	(0.467)	(0.374)	(0.380)	(0.455)
No education	0.630	0.360	0.422	0.586
	(0.483)	(0.490)	(0.498)	(0.493)
Part-time education course	0.222	0.160	0.297	0.229
	(0.416)	(0.374)	(0.460)	(0.421)
Full-time education course	0.148	0.480	0.281	0.185
	(0.356)	(0.510)	(0.453)	(0.389)
Advisory Service	0.521	0.960	0.781	0.581
	(0.500)	(0.200)	(0.417)	(0.494)
No Job	0.671	0.760	0.766	0.689
	(0.470)	(0.436)	(0.427)	(0.463)
Part-time Job	0.099	0.120	0.062	0.095
	(0.299)	(0.332)	(0.244)	(0.293)
Full-time Job	0.230	0.120	0.172	0.216
	(0.421)	(0.332)	(0.380)	(0.412)
Spouse Job	0.274	0.440	0.453	0.308
	(0.447)	(0.507)	(0.502)	(0.462)
Subsidy Dependence	0.413	0.352	0.368	0.403
	(0.134)	(0.103)	(0.0994)	(0.129)
Specalisation	0.861	0.879	0.808	0.854
	(0.212)	(0.139)	(0.230)	(0.212)
Size	49.28	77.99	61.43	52.57
	(37.05)	(56.58)	(29.46)	(38.06)
Calf to Weaning/Store	0.499	0.400	0.531	0.498
	(0.501)	(0.500)	(0.503)	(0.501)
Calf to Finish	0.181	0.360	0.219	0.196
	(0.385)	(0.490)	(0.417)	(0.397)
Weaning/Store to Finish	0.200	0.0800	0.188	0.192
	(0.401)	(0.277)	(0.393)	(0.394)
Other	0.121	0.160	0.0625	0.115
	(0.326)	(0.374)	(0.244)	(0.319)
BMW	0.523	0.520	0.578	0.531
	(0.500)	(0.510)	(0.498)	(0.500)
East	0.208	0.280	0.359	0.233
	(0.407)	(0.458)	(0.484)	(0.424)
South West	0.268	0.200	0.0625	0.236
	(0.444)	(0.408)	(0.244)	(0.425)

Table 3: Results of the sequential logit model

VARIABLES	Transition 1	Transition 2
Age	0.0432*	-0.0244
	(0.0254)	(0.0159)
Married	-0.965	0.780*
	(0.692)	(0.420)
Full-time education	-1.123*	0.735*
	(0.617)	(0.430)
Part-time education	0.702	0.354
	(0.703)	(0.373)
Advisory	-3.329***	1.136***
	(1.101)	(0.355)
Subsidy Dependence	4.517*	-2.832**
	(2.341)	(1.404)
Off farm part-time work	-0.474	-0.801
	(0.773)	(0.594)
Off farm full-time work	1.478*	-0.782*
	(0.778)	(0.431)
Spouse job	0.170	0.411
	(0.561)	(0.347)
Farm size	-0.0108**	0.00572
	(0.00543)	(0.00368)
Specialisation	-1.865	-0.0113
	(1.358)	(0.680)
Calf to finish	0.0312	-0.194
	(0.589)	(0.405)
Weaning/store to finish	0.661	-0.371
	(0.839)	(0.417)
Other	-0.532	-0.831
	(0.709)	(0.602)
East	1.075*	-0.115
	(0.611)	(0.361)
South-West	0.720	-1.707***
	(0.648)	(0.574)
Constant	4.071*	-0.613
	(2.276)	(1.283)
Observations	454	429
Log likelihood	-69.489	-148.417
χ^2 (15)	54.58***	64.63***
Pseudo R^2	0.282	0.179
Count R^2	0.952	0.855

Notes: Standard errors in parentheses. * signifies the following levels of significance: *** p<0.01, ** p<0.05, * p<0.1. Transition 1 is a comparison of the late entrants and non-members combined against early entrants. Transition 2 is comparison of late entrants against non-members.

Table 4: Discussion group participation

Year	Number of DG	Applicants	Completed	Completion Rate (%)
2011	80 (approx.)	1200 (approx.)	-	-
2012	274	5145	3932	76
2013	288	5235	4574	87
2014	286	4811	4423	92

Source: Teagasc