REFEREED ARTICLE

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Market risk management and the demand for forward contracts among Irish dairy farmers

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ABSTRACT

Irish dairy farmers have entered into a period of significant change with the European-wide abolition of the milk quota regime in April 2015. This abolition provides the opportunity for many profitable Irish dairy farms to increase their production levels. Market risk will influence decision-making at the farm level. Dairy farmers have recently acquired more experience of market risk through highly volatile market prices. This has the potential to affect risk attitudes and the farmers' selection of tools available to manage market risk. In this paper, we utilise econometric methods to examine the demand for the forward contracting risk management tool among Irish dairy farmers. Our findings suggest that recency effects are significantly associated with such demand as the recent price history appears to have significant effects on decision-making. 'Within the farm-gate diversification' and the 'number of children' in particular age categories have a positive and significant association with the adoption of forward contracting.

KEYWORDS: risk management; price volatility; dairy; forward contracts; risk aversion

1. Introduction

Agriculture and the dairy sector in particular have entered into a phase of considerable change. Traditional EU policy supports are now less prevalent due to recent CAP reform and the most significant policy in the dairy sector, the milk quota, was removed in April 2015. One of the consequences of recent shifts in policy is an increased exposure to price volatility both in terms of the milk output and input prices. In the past, the EU employed a suite of policy instruments with the aim of isolating internal EU dairy prices from the greater volatility associated with world prices. Intervention purchasing placed a floor on prices while other measures such as production quotas, export refunds, import tariffs and subsidised consumption measures were used to ensure higher and much less volatile prices than those pertaining in world markets (Jongeneel *et al.* 2010).

In some respects, these recent policy shifts demonstrate a movement away from the management of 'social risks through collective pooling mechanisms' and towards a more 'individualised risk management' approach as described by (Hamilton 2014, p. 453). This places a greater onus on the individual farmer to manage their own market risk situation. As part of an overall risk management strategy, the farmer can potentially transfer risk incidence to professional risk-taking institutions in the form of instruments such as forward contracting (Schaper, Lassen, and Theuvsen 2009).

Given the increase in the incidence of risk at the farm level and the increasing availability of private risk management tools in recent years, it is timely to investigate the factors influencing the potential adoption of the aforementioned tool. Hence, in this paper, the objective is to examine the potential willingness of Irish dairy farmers to adopt forward contracting tools and the factors that are likely to affect adoption in the Irish case.

In the next section of the paper, an overview of the incidence of market risk in Irish dairying is provided along with a background to the incidence of forward contracting in agricultural markets. Following this a description of the data sources used to perform the analysis is provided. The research findings are then outlined focusing on statistical and econometric analysis to identify the factors associated with the demand for forward contracting as a risk management tool. This is finally followed by some conclusions.

2. Background

Overview of market risk in Irish dairying

The degree of milk price variation is likely to be a contributory factor towards the demand for the forward

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contracting tool. In this section an outline is provided on the historic variation in milk and input prices. Milk price variation can be considered desirable in terms of providing price signals that reflect changing market conditions, which lead to changes in resource allocations. Nevertheless, the principles of economics suggest a set of mostly negative consequences of extreme price volatility for producers (Keane and O'Connor 2009). For example, very low prices can threaten the solvency of the farm unit, and lead to damage to productive capacity. Very high prices, however, can also be problematic, in that they can result in product substitution on the consumption side, (consumers forego a product whose price has risen in favour of a cheaper alternative) which can, later on, be difficult or even impossible to reverse.

The exceptional price volatility in several agricultural commodity markets in recent years has created problems for processors, farmers and other food supply chain participants. Figure 1 illustrates the historic variation in monthly farm level milk price in Ireland and on the world market (as illustrated by NZ milk price) from 2001 to 2013. Using New Zealand milk prices as a proxy for world milk prices, there has been a convergence in milk prices in recent years.

Figure 1 not only provides an indication of the level of prices over the recent past, but also provides some indication about the volatility in milk prices over the same time period. Prior to 2007 there was virtually no evidence of extreme price volatility for farm gate milk price in Ireland. Milk prices fell to a small degree between 2000 and 2004. The fluctuations in milk price during these years followed a strong seasonal pattern with milk prices rising in the late autumn and declining early in the following year. However, post-2006 it appears that extreme volatility has become a major feature of the market. A seasonal pattern appears less obvious from the post 2006 data and price changes could therefore be considered to follow a more unpredictable pattern.

Incidence of forward contracting in agricultural markets

The practice of forward contracting is more closely associated with grain than milk production and this is reflected in the economic literature. In a study of three U.S. states, Davis *et al* (2005) found that more than 65 per cent of corn and soybean producers forward sold during the 1995-1998 period. In a study of Kansas farmers, Goodwin and Schroeder (1994) found that 43 percent of producers forward contracted during the 1990-1992 period. Other recent studies of grain forward contract adoption have included Velandia *et al* (2009), Franken *et al* (2012) and Taylor *et al* (2014). Among the few studies of milk forward contract adoption, Wolf and Widmar (2014) have found a positive association between milk forward contract adoption and the herd size and education level of the farm operator.

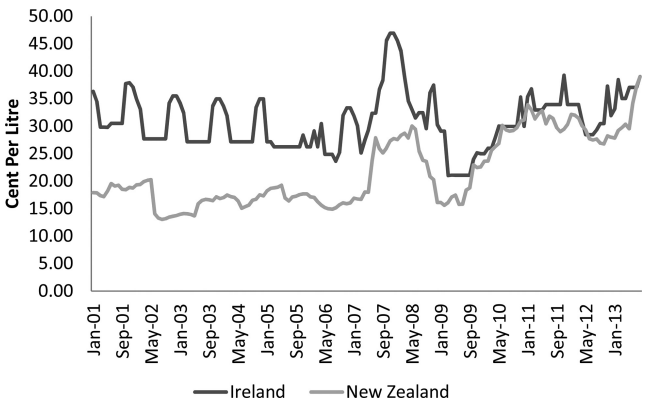

Figure 1: Monthly Farm level Milk Prices: Ireland and New Zealand (2001-2013). "**Source:** Milk Development Council, UK (2014)"

Across developed countries, a number of public and private market alternatives have emerged. The Private market alternatives include over the counter contracts (OTC) while publicly subsidized financial instruments have also emerged. Among the most widely researched public programmes is the Livestock Gross Margin for Dairy (LGM-Dairy) programme introduced in 2008 by the Risk Management Agency of the United States Department of Agriculture (USDA).[3] An evaluation of this programme finds that it significantly reduces economic downside risk, with potential to induce modest supply expansion if widely adopted (Burdine *et al.* 2014). The tool locks in a margin between the class III milk price and a weighted average of corn and soybean meal prices with the weights and deductibles chosen by the farmer within certain ranges (Valvekar, Cabrera, and Gould 2010). Bozic *et. al.* (2012, p. 7427) conclude that while 'hedging using nearby futures may help lock in above-average margins when times are good' it is found that 'only the consistent use of contracts with 9 to 12 months to maturity would have sufficed to protect against prolonged periods of very low margins'.

An example of a recently-developed private market measure is the Glanbia (Ireland) milk pricing scheme announced in late 2010. Glanbia is a public limited company with the majority of shares owned by the Glanbia co-operative society (Boland and Cook 2013). The Glanbia initiative was soon followed by the introduction of milk price guarantee certificates in February 2012 by the Dairy Trading Online BV (DTO) venture in the Netherlands[4] (LTO Nederland 2011). We do not examine the specific adoption rates for the Glanbia initiative but our analysis of experimental data will allow us to examine the willingness of Irish dairy farmers to engage in similar milk pricing schemes. Glanbia remains the only milk processor offering forward contracts to Irish dairy farmers and the majority of Irish dairy farmers have therefore no direct access to forward contracting arrangements.

3. Data

In this section, we describe the data source used to perform the analysis i.e. the Teagasc National Farm Survey. The main part of our analysis relies upon the annual survey for 2011 and the autumn survey of the same year. These are two very distinct surveys in terms of their data content but there is a high degree of

[3] The milk prices for LGM-Dairy agreements are based on simple averages of futures contract daily settlement prices. The indemnities equal the difference between the gross margin guarantee and the actual total gross margin for the insurance period USDA (2011).
[4] Each contract under this guarantee represented a volume of 50,000 kg of milk.

overlap in the farms participating in these two surveys. In 2011, a total of 239 specialist dairy farmers participated in both the Autumn survey and the Annual survey. This formed the vast majority of the 270 specialist dairy farms which took part in the 2011 annual survey. The 2011 annual survey contained a total of 1,055 farms, representing 105,535 farms nationally (Hennessy *et al* 2012).

In 2011, the autumn survey interviewed specialist dairy farmers in relation to risk perceptions and risk management including a series of experimental questions with respect to the use of forward contracting. Experimental methods are increasingly viewed by analysts as a superior path towards investigating the relationship between risk preferences and farm management or land use decisions (Herberich, Levitt, and List 2009; Hellerstein, Higgins, and Horowitz 2013). However some experimental methods such as lottery choices are found to be a poor candidate for predicting real-world farming behaviour (Hellerstein, Higgins, and Horowitz 2013).

Each farmer was asked to answer the following questions in relation to milk prices, preferences in the use of forward contracting and the farmer's own expectations for the near future.

1: What price do you **currently** receive per litre of milk?

2: What do you think will be the **average** price **over 2012**?

3: If you could bid to enter a contract to sell **20%** of your milk production at a fixed price over the year 2012 (e.g. forward contract with the co-op) what would be the minimum price per litre you would ask for?

4. Methods

The data described above was used to develop an econometric model which examined the preferences of Irish dairy farmers in the demand for forward contracting. In addition to this econometric model, a statistical analysis was conducted of the two groups i.e. a risk averse group of 'expected adopters' and an approximately risk neutral group of 'expected non-adopters'[5].

The classification provides an indication of the likely adoption rates for the forward contracting tool at a particular point in time but it is acknowledged that the classification does not provide a precise measure of risk aversion. For the purposes of classification, the sample average expected price for 2012 *ExpPrice* was used as a proxy for the markets future expected price. The average expected price of the sample was used as the key threshold rather than the individual's own expected price given the tendency for the individuals expected price to be dependent on relative optimism or pessimism for the following year, in this case 2012.[6]

Farmers who were only willing to forward sell milk at or above the samples average expected price were classified as expected non-adopters in the following:

$$Expected\ Non-Adopter\ if\ \ (ExpPrice \leq MinimumFCP_i) \quad (1)$$

where ExpPrice refers to the average expected price that the sample of farmers estimate for 2012 and MinimumFCP refers to the minimum price at which the farmer would be willing to forward contract 20 per cent of their milk production. Alternatively those farmers who claim a willingness to forward sell at lower than the average expected price are classified as expected adopters in the following:

$$Expected\ Adopter\ if\ \ (MinimumFCP_i < ExpPrice) \quad (2)$$

These groups provide some indication of the degree of risk aversion in the specific domain of forward contracting. In our analysis, we do not use the term risk loving. Many dairy farmers in the sample indicate willingness to forward sell, but only at a price higher than the samples average expected price. This may simply reflect a lack of knowledge about the forward contracting method. It does not necessarily indicate a risk loving response to market price variability.

In the econometric model, the demand is assessed for the forward contracting tool with respect to contract prices for 20 per cent of milk production. A stepwise OLS regression model was used to examine the factors driving the selected forward contract price at which farmers were willing to enter into agreement. While there are theoretical grounds for the inclusion of some variables such as the child-related variables and the farm income, the selection of variables is largely done on an exploratory basis. We therefore begin with a relatively large number of potential variables and use a backward stepwise approach to reach a final model. Variables are only included if the level of significance is below 0.1.

The OLS regression model is estimated as follows:

$$FCP_i^{min} = \alpha + \beta_1 X_i + \beta_2 MP_i + \varepsilon \quad (3)$$

where

$$\varepsilon \sim N(0, \sigma_i^2) \quad (4)$$

where FCP_i^{min} refers to the selected minimum Forward Contract Price and X refers to a series of farm and non-farm explanatory variables while MP refers to a series of market price variables i.e. recent, current or expected future milk price. These market price variables may be able to capture recency effects or the effects of relative optimism on forward contracting decisions. Basing the econometric analysis solely on the forward contract price avoids the pitfalls associated with classifying farms into risk averse or risk neutral categories. In table 1, the variables that are initially included in the econometric model are outlined. All of these variables relate to individual farm level data from the Teagasc National Farm Survey. Some of these variables will be excluded from the final model due to the stepwise approach. The fat and protein indicators represent proxy variables to account for milk quality. These are important components in the formation of

[5] Previous research on risk aversion has employed terms such as 'risk averse adoption' to describe risk preferences among farmers (Serra, Zilberman, and Gil 2007). For the remainder of the article, we refer to the former group as 'expected adopters' and the latter group as 'expected non-adopters'.

[6] For instance, take a farmer in 2011 with an expected milk price of 40 cent per litre for 2012 and a willingness to enter into a forward contract at 37 cent per litre. This farmer would be classified as an expected adopter if the classification is based on a comparison of the individual's expected milk price and the minimum forward contract price. In addition, the likelihood of a forward contract being offered at 37 cent per litre is very low. We conclude that it is unreasonable to assume that the classification of farmers into these groupings could remain stable over time where the individual expected milk price is used as the key threshold.

Table 1: Teagasc National Farm Survey Variables used in the estimation of the models

Variable Name	Definition
Forward Milk Price	The Minimum Forward Contract Price that each respondent is willing to enter into a forward contract for 20% of their milk
Log Recent Price Change	The ratio of the Log of the Current 2011 Milk Price to the Log of the Average 2010 Milk Price
Log Expected Price Change	The ratio of the Log of the Expected 2012 Milk Price to the Log of the Current 2011 Milk Price
Current Price	The Milk Price at the time of interview
Diversification	The Share of Farm Gross Output devoted to non-Dairy Output
Production (10,000 Litres)	Total Litres of Milk Production in 2011
Costs Per Litre	Average Cost Per Litre of Milk in 2010 expressed as cent per litre
Protein Indicator	The Ratio of Kilograms of Protein to the Total Litres of Milk Production
Fat Indicator	The Ratio of Kilograms of Fat to the Total Litres of Milk Production
Operators Age	Age of the Farm Operator in Years
Coupled Income (€10,000)	Farm Income excluding decoupled subsidies
Off Farm Job	The Presence of an off-farm job for the farm operator (0 = no off-farm job, 1 = off-farm job)
Farm Size	Total Farm Size in number of Hectares
Teagasc Advisory	Contact with the Teagasc Advisory Service (0=no, 1 =yes)
Formal Training	Farm Operator has formal agricultural training (0 = no, 1=yes)
No. Livestock Units Per Hectare	The number of livestock units per Hectare
Discussion Group	Participation in a Dairy Discussion Group (0= no, 1 = yes)
No. Children 0-5	Number of Children in the Household Aged 0-5
No. Children 5-15	Number of Children Aged 5-15
No. Children 16-19	Number of Children Aged 16-19

milk prices within a multiple-component pricing model (Roibas and Alvarez 2012; Geary *et al*. 2010, 2013).

5. Results

Willingness to Adopt

Table 2 outlines the results for a two way sample t-test used to compare the expected adopter and the expected non-adopter groups.[7]

In terms of comparison between these two groups, the main differences appear to be with respect to the current and recent price variables. The significant difference with respect to these variables suggests that recency effects are important and that the recent experience of milk price is an important factor in determining the demand for a forward contract. The result suggests that farmers who are currently experiencing higher than average milk prices are less likely to be categorised as 'expected adopters'. This result can be interpreted in a number of different ways. It could reflect a damaging bias among farmers due to recency effects. It could also however, simply reflect the strong cash flow situation among farmers with the highest prices at a particular point in time.

The expected adopter group has significantly higher average income, levels of milk production and livestock intensity i.e. the number of livestock units per hectare. The number of children in the 5-15 years old age group and the 16-19 age group are both significantly higher among the risk averse expected adopter group. Studies outside of agricultural economics have found a positive relationship between the presence or number of children and risk aversion e.g. (Jianakoplos and Bernasek 1998; Di Mauro and Musumeci 2011).

In the literature on farm succession, Hennessy and Rehman (2007, p.69) found that higher educated potential heirs are less likely to pursue the occupation of full-time farming. Hennessy and Rehman (2007, p.73) also found that the nominated heirs on the "more profitable farms are less likely to pursue tertiary education and therefore more likely to enter full-time farming". Dairy farmers tend to have higher incomes on average relative to the other sectors of Irish agriculture (Hennessy *et al* 2012). In the case of Dairy farming, the result for the 16-19 age group may be related to issues surrounding farm succession and future expansion rather than the desire to fund university education although both may prove to be important factors depending on the family circumstances.

Factors affecting the willingness to adopt forward contracting

In this section, the findings from the backward stepwise OLS regression model of the forward contract price are outlined. The results are presented separately with the current price variable, the recent price change variable and without price variables. These results reflect a parsimonious model. The results for the entire model are available on request. Our results are the product of a particular sample of farmers at a particular point in time and the findings for this particular research are not necessarily applicable to dairy farmers operating in other countries or under alternative policy environments. The relatively low r-squared value indicates that the explanatory power of the model is quite limited especially with the exclusion of the price variables.

As suggested by the descriptive statistics, between-farm variability in current prices and recent price changes appears to strongly influence risk aversion and adoption of the forward contracting tool. This suggests that farmers place a great amount of weight on recent market price developments in forming risk averse

[7] The sample size is smaller for the recent price change variable as only 170 of the 204 farmers are included in both the 2010 and 2011 annual Teagasc national farm surveys and the 2011 autumn survey. The sample size is smaller for the expected price change variable as there are two farms with no response for this particular variable.

Table 2: Two Way Sample Mean Comparison t-test

	Expected Non-Adopters	Expected Adopters	Difference	Sample Average	N
Forward Milk Price	35.59	31.19	-4.40***	32.93	204
Log Recent Price Change	17.83	12.24	-5.59***	14.53	170
Log Expected Price Change	-3.38	-4.78	-1.40	-4.22	202
Current Price	35.66	34.18	-1.48***	34.76	204
Diversification	18.06	19.21	1.15	18.78	204
Milk Protein Indicator	3.28	3.29	0.00	3.28	204
Milk Fat Indicator	3.80	3.80	0.00	3.80	204
Production (10,000 Litres)	29.91	37.61	7.70*	34.44	204
Costs Per Litre	26.37	25.03	-1.34	25.58	204
Operators Age	51.74	48.19	-3.55*	49.58	204
Coupled Income (€10,000)	4.33	5.40	1.07*	4.95	204
Off Farm Job	0.08	0.08	0.01	0.08	204
Farm Size	53.02	56.52	3.49	54.96	204
Teagasc Advisory	0.77	0.84	0.06	0.81	204
Formal Training	0.65	0.80	0.15**	0.74	204
No. Livestock Units Per Hectare	1.74	1.89	0.15**	1.83	204
Discussion Group	0.50	0.55	0.05	0.53	204
No. Children 0-5	0.13	0.27	0.14	0.22	204
No. Children 5-15	0.42	0.70	0.28**	0.58	204
No. Children 16-19	0.19	0.36	0.17**	0.29	204
N-Sample Size	80	124			204

Significance Levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

preferences and their selection of the minimum forward contract price. Farmers who experienced larger than average increases in milk price between 2010 and the autumn of 2011 appear to demand higher forward contract prices for 2012. This could reflect recency bias with possibly negative effects on future decision-making and profitability. This could also however, simply reflect the decision-making of farmers with above normal cash flow surpluses.

One of the added advantages of the OLS regression model is that we can interpret the coefficients as being cents per litre. For instance, it appears from table 3 that a one cent higher milk price is associated with a 0.44 cent increase in the minimum forward contracting price. This is robust to the inclusion of the milk quality indicator relating to milk protein. This suggests that farmers will demand significantly higher fixed contract prices when milk prices are relatively high and conversely will be willing to negotiate at lower fixed milk prices when the milk price is relatively weak. The original format of the Glanbia fixed milk price scheme actually accounted for this sensitivity to the market milk price through the inclusion of a market adjuster.

The inclusion of the milk quality variables for milk protein and milk fat provide some interesting results. We find that higher milk protein is associated with willingness to forward contract at a significantly lower price. The milk fat indicator appears to have the opposite effect but this is only with the inclusion of both the milk quality and milk fat indicators. There are circumstances where the milk fat content can be too high and is therefore a less reliable quality indicator than milk protein. As a result, milk protein tends to have higher rewards per volume in comparison to milk fat (Bailey *et al* 2012). One possible explanation for this apparent relationship between protein levels and the

Table 3: Results of stepwise OLS Regressions of Forward Contract Prices

	(1)	(2)	(3)
Current Price	0.442*** (0.07)		
Log Recent Price Change		0.139*** (0.02)	
Diversification	-0.077*** (0.02)	-0.070*** (0.02)	-0.066*** (0.02)
Milk Protein Indicator	-5.174*** (1.21)	-2.913** (1.23)	-5.425*** (1.86)
Number of Children 16-19	-0.631** (0.29)	-0.751** (0.31)	-0.610* (0.32)
Operators Age	0.037** (0.02)		0.031* (0.02)
Milk Fat Indicator			2.471* (1.32)
Cost Per Litre (Cent)	0.087** (0.04)		
Production (10,000 Litres)	-0.044*** (0.01)		-0.031** (0.01)
Farm Size	0.022** (0.01)		0.020** (0.01)
Coupled Income (€10,000s)	0.150* (0.08)		
Constant	31.81*** (4.35)	42.21*** (4.11)	41.26*** (4.33)
Sample Size	204	170	202
R Squared	0.285	0.263	0.124
Adjusted R Squared	0.252	0.245	0.093

forward price is that farmers are conscious of the desire to protect against declines in milk quality.

We find that price expectations are insignificant in determining the likelihood of forward contracting adoption and the stepwise process is responsible for dropping this variable. This may suggest that over-optimism is not a major issue and that any bias which does exist is better described as a recency bias. We cannot however rule out the possibility of over-optimism being an important factor for some farms. As explained by Couelho (2010), the main concern with relative optimism is whether or not it is grounded in realism or can be considered unrealistic. For example, a superior milk quality at the farm level could be realistic grounds for relative optimism. The concept of 'unrealistic optimism' is examined in a growing literature (see e.g., Coelho 2010; Harris and Hahn 2011; Shepperd *et al*. 2013 on this important subject).

In terms of the non-price variables, it was found that within the farm gate diversification has a positive and significant relationship with risk aversion in the use of forward contracting. A one per cent increase in diversification is associated with a 0.07 per cent decline in the minimum forward contract price. This suggests that farmers who devote a large share to other farm enterprises such as tillage and drystock cattle are more likely to provide a risk averse response to the question on forward contracting and are therefore considered more likely to adopt the forward contracting tool.

In terms of the number of children in particular age categories, it was found that the number of children in the 16-19 age group is highly significant with an additional child in this category being associated with 0.6 to 0.75 cent reduction in the minimum forward contract price. The literature in this area is certainly under-developed although studies such as Wölfel and Heineck (2012) have examined the effect of parental risk aversion on schooling choices finding some differences between the effect of mothers parental risk aversion and the effect due to the risk aversion level of the father. Cameron, DeShazo, and Johnson (2012) find that parents of infants are, on average, more risk averse than other people with respect to net income and that this risk aversion declines as the children become teenagers. This suggests that the age of the child is an important factor in determining parental risk attitudes.

Our result is perhaps due to the fact that our indicator of risk aversion is domain-specific to dairy farming and a particular risk management tool. There is extensive evidence that risky decisions are affected by domain effects (Reynaud and Couture 2012; Vlaev *et al*. 2010; Tversky and Kahneman 1981). Domain-general estimates of risk aversion can however be useful predictors of real-world behaviour (Dohmen *et al*. 2011). We should therefore be careful in the interpretation of the results with respect to age categories as a different measure of risk aversion could be associated more with children in younger age categories. That being said, it is the case that children in the age categories between 16 and 19 are likely to be either entering or participating in third level education or preparing for a larger role within the farm business. In these circumstances, the added risk aversion of the parents would be understandable where income uncertainty exists.

6. Summary

In this paper, statistical and econometric techniques were used to estimate the factors associated with the demand for forward contracting as a market risk management tool in Irish dairy farming. Our results show that farm diversification, demographic variables, milk quality and the farmer's individual milk price history are significantly associated with the likelihood of the adoption of forward contracts for milk production. The significance of the farmers recent milk price history indicates that recency effects are strongly influencing preferences in the demand for forward contracting. This could also reflect the behaviour of farmers with superior cashflow positions due to high recent milk prices. We found that the future expected milk price has no statistically significant impact on the demand. Given the dangers of the proof-seeking fallacy (Hansson 2004), we should not rule out the possibility that over-optimism exists for some farm households and that unrealistic optimism can inhibit sound decision-making in market risk management.

The findings can support a better understanding about risk management on Irish dairy farms in the post milk quota era and the expected expansion on many profitable Irish dairy farms. It appears from our results that expansion will involve a heightened concern among dairy farmers towards market risk at the farm level. Farmers are somewhat limited in terms of the number of risk management tools at their disposal. For instance the option of forward contracting is only available to clients of one co-operative in Ireland.

The Irish situation contrasts with dairy farmers in the United States where Wolf (2012) reports that approximately 39 per cent of sampled Michigan Dairy farmers avail of feed price risk management tools such as forward contracting and over the counter contracts. In addition, farmers in the United States can avail of publicly subsidised gross margin insurance through the (LGM-Dairy) programme (Burdine *et al*. 2014).

The degree to which Irish dairy farmers exhibit risk averse behaviour will continue to be important for policymakers to consider both in terms of productivity and inequality (Vollenweider, Di Falco and O'Donoghue 2011). Our analysis suggests that the factors driving the formation of risk averse behaviour are an interesting study in themselves for the case of Irish dairy farmers. Further analysis is required to examine the extent to which these subjective judgements may conform to or depart from the actual decision making. The analysis has sought to examine the risk aversion of farmers through experimental data in the specific domain of forward contracting. We expect that our analysis has provided useful insights into the risk aversion of Irish dairy farmers at this particular point in time and that future research can be devoted towards examining the evolution of risk attitudes and management as more market risk management tools become available to dairy farmers.

Finally, the research findings outlined in this paper have shown that market risk is an inherent part of the dairy farm business. Depending on the individual's inherent attitude to risk, some elements can be considered desirable, but the principles of economics suggest a set of mostly negative consequences of extreme

volatility for producers. Consequently, the ever-increasing role which risk is playing in the dairy farm business must be managed at some level. Various instruments, both in the public and private market, which may be utilised to manage price and income volatility, will play an ever-increasing role in the business and financial strategies of the dairy farm business.

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