Report Prepared for Dairy Research Ireland

An evaluation of suitable tools to manage price/income volatility at dairy farm level in Ireland

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Executive Summary

- Changes to EU policy have resulted in increased agricultural commodity price volatility over the last decade. This price volatility has been reflected in more variable family farm incomes for dairy farmers in Ireland. The definition of Family Farm Income in the Teagasc National Farm Survey, is consistent with the approach adopted to measure farm income across the EU28, as set out by the Farm Accountancy Data Network (FADN), of which Teagasc is a part.

- While some price volatility is desirable to convey signals of market developments to producers, extreme volatility, as has been experienced in Europe in recent years, negatively impacts on the development of the agri-food sector by curtailing investment, research and development and disrupting normal trade patterns.

- A survey of Irish dairy farmers revealed that farmers cite market risk and volatility in prices as the greatest risk facing their farms.

- The recent expansion in Irish milk production has in some cases been funded by borrowed capital, but to date has not significantly affected solvency rates on specialist dairy farms. Debt levels per cow in Ireland remain significantly below the EU average.

- Direct payments offer farmers a buffer from price volatility. The recent communication on the future of the CAP and the budgetary pressure in the upcoming MFF both suggest that there may be a reduced budget available for the traditional Pillar I farm payments. Furthermore, as dairy farmers increase milk production, the relative share of direct payments to overall farm income declines and hence the buffer is less effective.

- The increase in milk price volatility in recent years has led to frequent calls from dairy industry leaders for dairy farm adoption of forward contract milk pricing tools. The research carried out in this report indicates that Irish dairy farmers who have used these forward contracting tools to date were younger, operated larger herds and produced more milk per cow than farmers that did not adopt such tools. Dairy farmers from the South East were also more likely to have used milk forward pricing methods than dairy farmers located elsewhere, likely reflecting the fact that Glanbia has been the market leader in offering forward contracts in Ireland.

- Using data from 2016, it appears that Irish dairy farmers would have been better off by over 1 cent a litre if they adopted forward contracting for 20% of their milk production. Obviously, the results would be different in other years, and it must be borne in mind that the overall objective of fixed milk price schemes is to reduce income volatility rather than to 'beat the market'.

- This research has identified a method by which Teagasc National Farm Survey data can be used to track the impact of forward contracts on actual milk price paid and the impact on income volatility can be examined in future projects.

- Under the income averaging system, the participating farms are vulnerable in a situation where the farm income in a particular year falls well below the preceding four years. The Budget 2017 reforms have sought to address this anomaly by introducing the opportunity for a temporary opt-out. A temporary opt-out from income averaging is only a temporary suspension of the tax liabilities and the outstanding amounts must be paid in instalments over the following four years.

- There is a risk that more farms will permanently opt-out of the income averaging system in the years following the abolition of the milk quota system.

- The income averaging system has limited appeal as a risk management tool. The scheme eligibility rules relating to the off-farm employment of the spouse are restrictive and mean that over half of all specialist dairy farms are automatically excluded from participation in the system.

- The proposed 5-5-5 tool has the potential to significantly reduce the volatility of after-tax household disposable income and support farm investment, without greatly affecting the overall tax contribution.

- The proposed 5-5-5 tool provides farmers with a great deal of scope for decision-making and farmers will require sound financial advice prior to participation in the scheme. Poor farmer decision-making with the 5-5-5 tool could potentially lead to greater household income volatility than would be the case under sensible risk management decision-making.

- A combination of the 5-5-5 tool and other risk management tools, such as forward contracting, can provide adequate protection for farmers in managing risks. It is important that farmers consider a combination of risk management tools, especially during the initial years of operating the 5-5-5 tool. Even with participation in the 5-5-5 scheme, farmers may require added protection against income volatility immediately following a significant draw down of money from the fund.

- The maximum contribution to the 5-5-5 fund in any given year is 5% of milk receipts and this means that the scheme is highly unlikely to breach the De Minimis regulations.

- At present there are no revenue/margin insurance products available to Irish dairy farmers. In the US the Livestock Gross Margin Insurance Plan for Dairy Cattle (LGM-Dairy) was introduced in 2008, and the Margin Protection Program for Dairy (MPP-

Dairy) is available since 2014. However neither tool has been considered a success and have seen substantial revision in the recent Bipartisan Budget Act of 2018.

- Margin insurance is a relatively new type of insurance covering the revenue of a commodity minus its costs of production. Designing farm-specific gross margin insurance is data intensive, with data required on sales prices, input prices, and quantities (i.e., inputs and production). Moreover, moral hazard may be an issue as some of these data are influenced by the actions of the insured.
- As the risks associated with dairying in Ireland are largely systemic, some form of public-private partnership may well be necessary to encourage insurers to enter this market.
- Based on a simplified example, which excludes administration costs, indemnity costs rise in an almost exponential manner as the target price that is insured increases.
- Flynn (2016) found that if the 100% trigger was applied, the cost of the margin scheme could have been between €890m-€960m for this ten year period 2006-2015, while the cost for the 70% trigger scenario for the same period would have been between €28m-€104m and concluded that a tiered coverage approach for a margin scheme may be feasible.
- Flynn also raises the question of whether some of the direct payment funding could be set aside to cover the costs of a margin protection scheme which would kick-in in low margin/low income years, thus having a bigger impact on smoothing year to year income variability.
- Regarding the specific measurement of Family Farm Income, this income definition takes account of hired labour as a production cost, but excludes family labour (so called own labour) from the calculation of production cost. The methodology deems that Family Farm Income includes the remuneration of the unpaid family members working on the farm. It is worth noting that on the average dairy farm in Ireland 1.3 units of unpaid (own) labour are used.
- Unpaid family labour can be costed at an hourly rate and deducted from Family Farm Income to arrive at a return on the land and capital tied up in the farm. However, since family labour is by its nature unpaid, the appropriate hourly rate for that labour is an open question, with €15 per hour considered to be reasonable figure for such a calculation.

Glossary of Terms

CSO	Central Statistics Office
DAFM	Department of Agriculture, Food and Marine
DIRT	Deposit Interest Retention Tax
EU	European Union
FADN	Farm Accountancy Data Network
FAPRI	Food and Policy Research Institute
FDC	Farm Development Co-op
FMP	Fixed Milk Price
GAP	Glanbia Advanced Payment
GII	Glanbia Ingredients Ireland
ICOS	Irish Co-operative Organisation Society
IST	Income Stabilisation Tool
MDF	Milk Density Factor
MS	Member State
NFS	National Farm Survey
PRSI	Pay Related Social Insurance
PSA	Private Storage Aid
RDP	Rural Development Programme
SBCI	Strategic Banking Corporation of Ireland
SMP	Skim Milk Powder
UK	United Kingdom
US	United States
USC	Universal Social Charge
WTO	World Trade Organisation
YFS	Young Farmers Scheme

1. Introduction

Dairy farming is a growing sector within Irish agriculture, with approximately 16,100 specialist dairy farms engaging in milk production in 2016. This represents an increase of three per cent from 15,600 dairy farms in 2013 (CSO, 2018). The abolition of the EU milk quota system in April 2015 has contributed towards a growing population of specialist dairy farms and rising milk production in Ireland. At the same time, Irish dairy farmers are facing increasing uncertainty and risk with respect to their farm incomes. This increase in income uncertainty can be largely attributed to rising production, weather variability, policy reforms at the EU level and a rise in the volatility of global dairy markets. In recent years, national governments have sought to further reduce the provision of ad hoc measures to cover catastrophic risks, because of the unpredictable nature of the costs and the growing budget constraints at the EU level (Severini et al 2018). In this volatile environment, new and existing risk management tools must be developed to address the problem of income uncertainty and support dairy farmers in their efforts to manage income risk and plan for the future.

As in the case of meat and crop producing farmers, dairy farmers must make their production decisions with a view to the future, including the purchase of cows, the leasing of land and hiring of additional labour. Large unexpected income fluctuations can influence the access to credit and the repayment of debt (Key et al 2017). Large income fluctuations can be particularly problematic in the aftermath of significant expansion, as in the case of many Irish dairy farms in recent years. Even in the absence of significant expansion, dairy farms face risks associated with uncertain output and input prices, the risk of animal diseases and severe weather conditions. Specialist dairy farming is both capital intensive and labour intensive and only a small proportion of dairy farmers can opt for off-farm employment as a risk management device. The income instability experienced by dairy farmers can involve secondary effects and have negative implications for local rural economies (Vrolijk and Poppe 2008). These secondary effects further raise the importance of addressing the issue of income volatility.

In this report, we analyse the financial impact of a number of risk management tools on farm household income and the volatility of that income. Specifically, the tools to be examined will be forward contracting, taxation measures to counter income volatility, insurance contracts and the Basic Payment Scheme/Single Payment Scheme. The analysis will contribute towards an improved understanding regarding the significance of price volatility for Irish dairy farmers and the impact of price volatility on agricultural production and incomes. This report will provide insight into the types of risk management tools that are likely to be most appropriate in an Irish setting. The successful introduction and widespread adoption of appropriate risk management tools can ensure that the Irish dairy sector remains competitive and profitable in an uncertain future.

Farmers can use the information on price/income risk generated by this research in business and investment planning and thereby lead to better-informed discussion around the more suitable risk management tools from an Irish perspective.

Overall Project Objectives

- To outline and critically evaluate the tools (forward contracting, taxation measures to counter income volatility, insurance contracts and the Basic Payment Scheme/ Single Payment Scheme) which may be utilised by Irish dairy farmers to manage price/income volatility at farm level in Ireland

- To evaluate the consequences of employing these tools at representative farm level in Ireland from 2005 to 2016

The report begins with a detailed overview of the background to the growing issue of farm income volatility. In chapter three, we analyse the impact of direct payments on farm income volatility and the extent to which this impact varies between farms. In chapter four, we analyse the financial impact of forward contracting on specialist dairy farms during the course of 2016. Chapter five is concerned with the role of taxation policies in addressing income variability over time. Specifically, we analyse the financial impact of the 'income averaging' system and the 5-5-5 tool proposed by Dairy Research Ireland. In chapter six, we analyse the possible role of gross margin insurance in reducing farm income variability and the complications associated with developing this risk management tool in the first instance. This is followed finally by the conclusion section, where we summarise our findings from the various chapters in the report.

2. Background

It is now widely accepted that the significant increase in the level of price volatility experienced by the Irish agri-food sector in recent years is expected to persist, and perhaps even increase, as EU policy continues to become more market focused and EU agri-food prices become more and more aligned with international prices (Blanco 2018). Price variation, to some degree, is both desirable and inevitable in all free markets, as it reflects the changing needs and preferences of customers and the changing cost and competitive positions of participants at all stages in the supply chain. Price movements reflecting these changes occur through the price discovery process among market participants. These price movements act as price signals to reallocate resources efficiently. While this feature of price movement may be regarded as normal and desirable in free markets, the emergence of exceptional price volatility in dairy and food markets in recent years is creating many problems for processors, farmers and other supply chain participants.

The specific challenges which volatility presents for the Irish dairy sector are numerous. Extremely low dairy product prices cause many financial problems for farmers (e.g. low margins, cashflow management, and financing) and ultimately threaten solvency. While on the other hand extremely high dairy prices result in product substitution away from dairy products, which can subsequently be difficult or impossible to reverse. Dairy product traders also suffer adverse effects from volatility. Stable prices are preferable for planning and customer relationship purposes and hence, if alternatives are available, traders will prefer to conduct business with more price stable commodities. In an effort to avoid this situation, buyers in particular favour fixed price contracts or raw materials which display lower levels of price variability (O Connor and Keane 2009). Extreme volatility can also negatively impact on investment in all parts of the supply chain. Reduced certainty about cashflow can impair planning and restrict access to capital. Extreme volatility can also inhibit research and development, and innovation, while the adoption of appropriate tools and solutions will enhance sustainability and competitiveness. Finally, an industry which manages volatility will be more sustainable, as it will be less prone to stop-start development. In a highly cyclical, capital intensive, industry, it is most desirable to maintain efficiencies gained and not reduce capacity in the short term and have to rebuild it at a later time.

In addition there are a number of reasons to suggest that Ireland may be more exposed to dairy product price risk (in terms of both output and input prices) than other EU countries. Firstly, the highly seasonal nature of milk production in Ireland can magnify the effect of short term international dairy product price changes. This seasonality compounded with a product portfolio centred around commodity rather than value added products, contributes to price exposure. Secondly, the sector has a high dependence on third country markets, which are subject to greater volatility than the more mature EU markets. Thirdly, the sector has an exposure to currency fluctuation, given the importance of the UK (sterling) and the international (dollar) trade. Fourthly, the grass based nature of Irish milk production, which is conditioned by weather variations, is another factor that is quite specific to milk production in

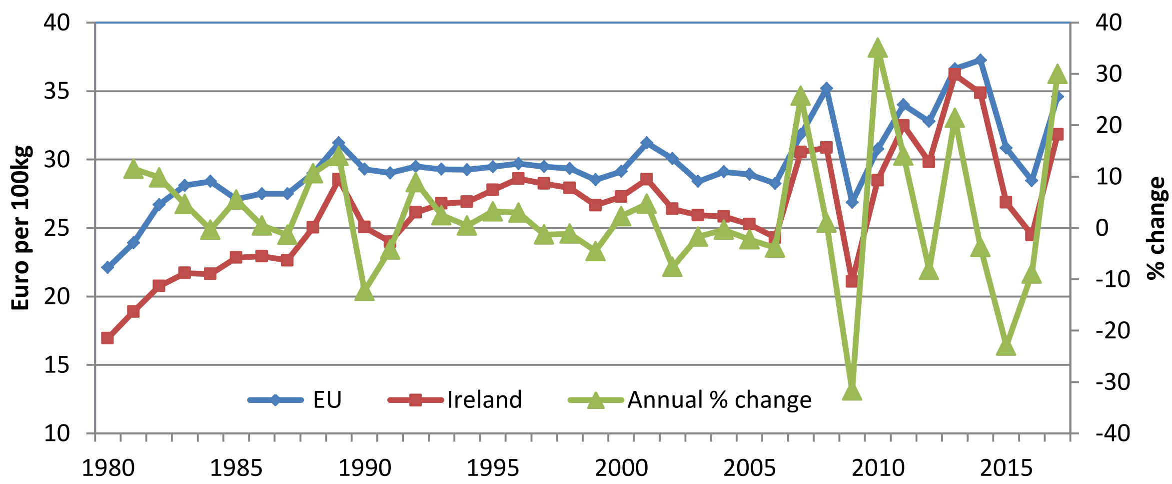
Ireland. Finally, the anticipated continued expansion of milk production post quota, will increase farm specialisation and thus price and income risk, while increasing working capital and finance commitments, along with accentuating the previously mentioned factors.

This increase in volatility translates into increased risk for all participants in Irish agriculture. The identification and adoption of suitable risk management tools will help to ensure that the agri-food sector remains competitive and profitable in an uncertain future. Thus the consequences and management of price volatility is now a central issue for both the dairy industry itself and public policy.

2.1 Price and Income Volatility Over Time

The increased level of price volatility faced by Irish dairy farmers is clearly presented in Figure 2.1-1. From the early 1990's to 2006 annual producer milk prices (for standardised milk) in Ireland fell within a tight range between 24 and 29 cent. From 2006 this range has increased dramatically with a low of 21 cent and a high of 38 cent. This volatility is more striking when we consider the annual percentage change (in green and measured on the secondary y-axis). We now see that annual changes of greater than 30% occur in recent times, while an annual change in excess of 10% was the exception prior to 2007. It is also evident that the volatility of Irish milk prices has exceeded the volatility in EU milk prices, a finding that is consistent with a recent study by Müller et al (2018).

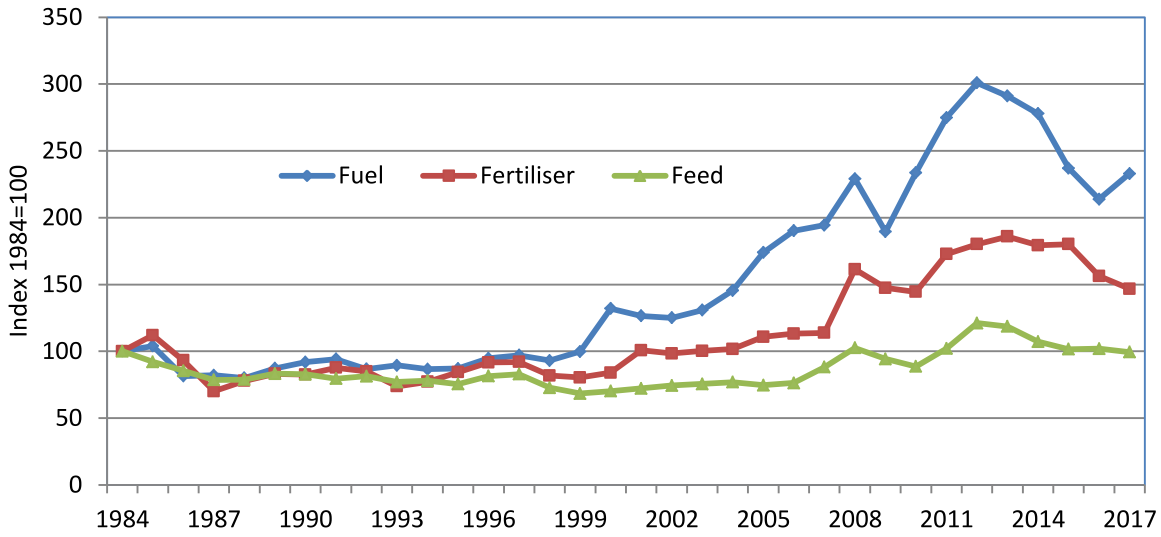
Figure 2.1-1: Producer Milk Price (3.7% butterfat): EU Average & Ireland 1980-2017



Source: CSO and FAPRI Model

Irish dairy farmers have also had to contend with volatile input prices. It is clear from Figure 5.1-2 that nominal fuel and fertilizer prices in particular increased dramatically post 2007 (due to the upward surge in oil and other energy prices) and are far more volatile than prior to 2007.

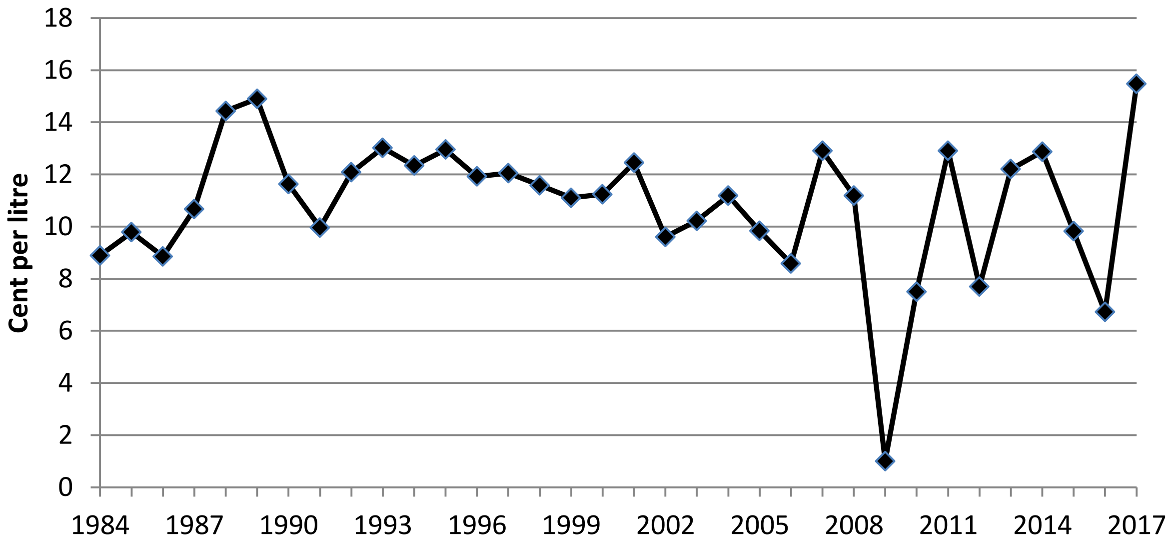
Figure 2.1-2: Agricultural Inputs Price Annual Index 1984 to 2017 (1984=100)



Source: CSO and authors' estimates

When these volatile input and output prices are combined with other costs, we can see that the average net margin per litre for milk production in Ireland displays greatly increased volatility from 2007 onwards.

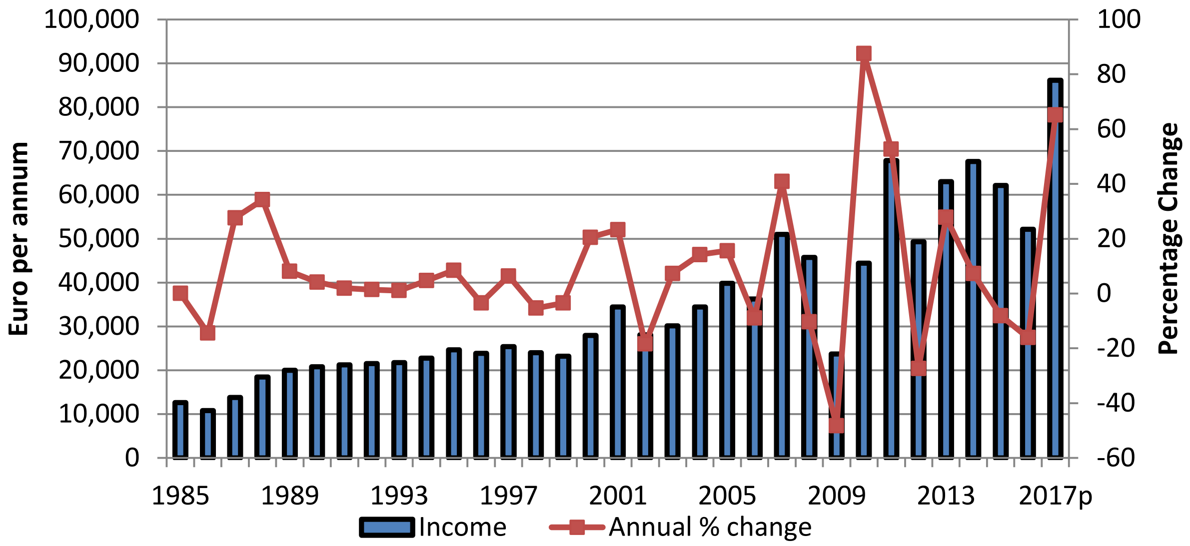
Figure 2.1-3: Average Annual Net Margin per litre on Specialist Dairy Farms in Ireland 1984 to 2017



Source: Teagasc National Farm Survey (various years), 2017 authors' estimates

This pattern of volatility is reflected in the average family farm income on specialist dairy farms in Figure 2.1-4. In more recent years there are examples where income has almost halved (2009) and doubled (2010) in the space of a year. Annual changes in average dairy farm income, as measured by the Teagasc National Farm Survey (NFS) of plus or minus 30% are now common.

Figure 2.1-4: Average Family Farm Income on Specialist Dairy Farms 1984 to 2017



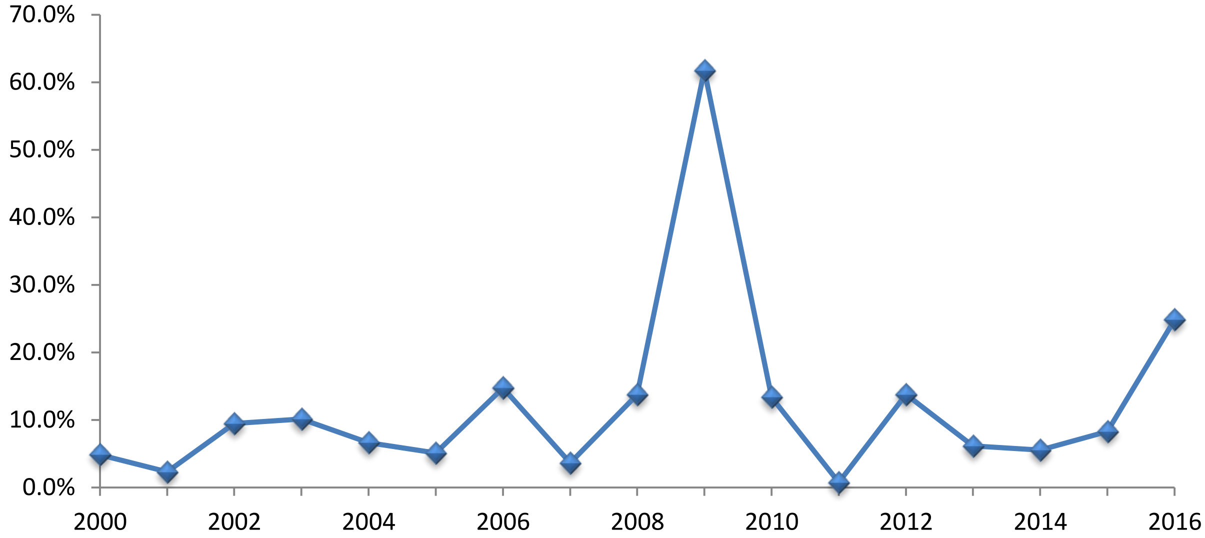
Source: Teagasc National Farm Survey

In figure 2.1-5, we show the proportion of dairy farms with at least a 30 per cent drop in farm income in each year. The threshold of a 30 per cent income drop is in line with the Green Box criteria of the World Trade Organisation (WTO) (See For Example, Mary, Santini and Boulanger, 2013). The reference period for measuring this income drop is the average income in the three preceding years. The European Commission have used this type of indicator to show that at least 20 per cent of farmers in the EU-25 experience an income loss larger than 30 per cent in most years. The Commission report that specialist dairy farmers in 2009 experienced the highest income drop, with 50 per cent of farmers in the EU-25 having an income loss of at least 30 per cent (European Commission, 2017).

In our sample of dairy farmers from the Teagasc National Farm Survey, the proportion of farms with a 30 per cent drop is over 60 per cent in 2009 and is also relatively high at approximately 25 per cent in 2016. The high share of farms with a large contraction in income in 2009 can be explained by a milk price crash in a period of elevated input prices. The situation in 2016 is somewhat different and is influenced by the strong farm incomes in 2013 and 2014, but also reflects the relatively low milk price in 2016.

The management of dairy product inventories can act to substantially lessen milk price volatility. This measure is employed in both the EU and US and can be considered to have an impact on both local and world dairy product and milk prices in the short run. Market authorities place a floor on domestic prices, while strengthening world market prices, as both these regions are major dairy exporters in particular dairy product categories. In the long run, however, it may be argued that this measure will keep more supplies in production in the supported region than would otherwise be the case which itself contributes to the need to manage volatility.

Figure 2.1-5: Proportion of Farms with at least 30% Drop in farm Income 2000-2016 [% Drop Relative to preceding three years]



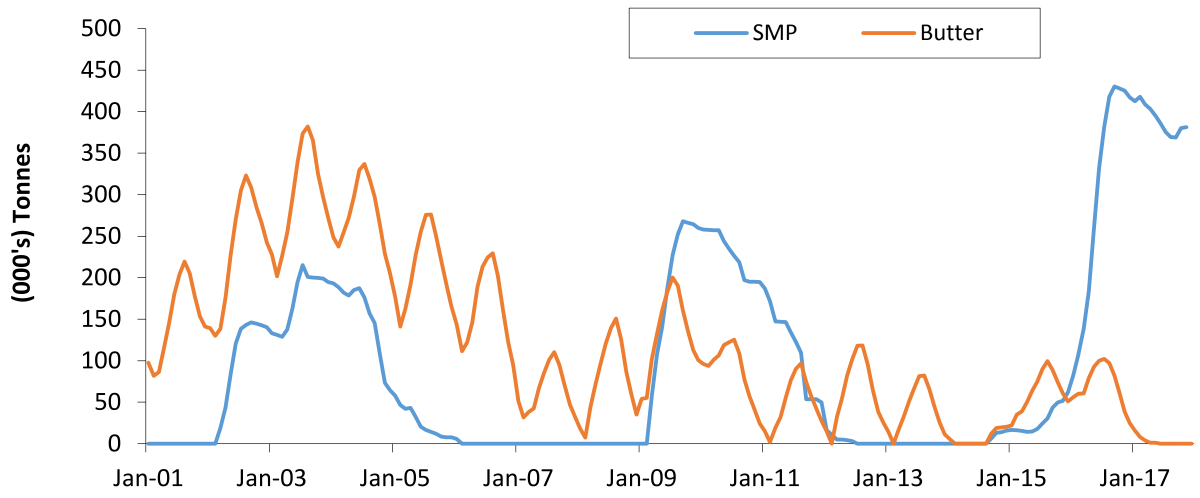
Source: Authors' Calculations Based on Teagasc National Farm Survey data 1998-2016

Furthermore when the markets recover from a period of disequilibrium, the disposal of built up stocks will dampen the upswing in dairy product prices, as these stocks will lead to greater supply in the market than would otherwise be the case. Intervention purchasing also creates an incentive for processors to produce the eligible commodities, regardless of the longer term demand for these commodities, thus compounding future negative effects. In addition intervention purchasing may not place an absolute floor on market prices, as the high production standards exclude certain produce, which may now be forced to trade at a discount to the intervention price, as not all processors can meet intervention product standards.

Nonetheless, engagement in counter-cyclical stock-holding appears sensible in the short run as a means of mitigating the effects of extreme price volatility that is provided that the intervention price is not set above the long-run market equilibrium. Changes in EU SMP and butter intervention stocks from 2001 to 2017 show very wide variation (Figure 2.1-6). Butter stocks peaked in 2003, with a smaller peak in 2009. There is a strong seasonal pattern in butter stocks which is absent for SMP.

In the period since 2000, there were three accumulations of SMP stocks in 2003/2004, late 2009 and 2016/17, with virtually zero SMP stocks held in the intervening periods. These accumulations naturally coincide with low SMP prices (Figure 2.1-7). The series WSMP refers to world skim milk powder prices and the series EUSMP refers to EU-level skim milk powder prices (note the inventory levels are read off secondary y-axis on right). The recent period of zero butter stock has coincided with historic butter price peaks. The use of buffer stocks by larger production regions acts as a very useful instrument in alleviating price volatility and is well established in economic literature.

Figure 2.1-6: EU Stocks (Intervention and PSA)



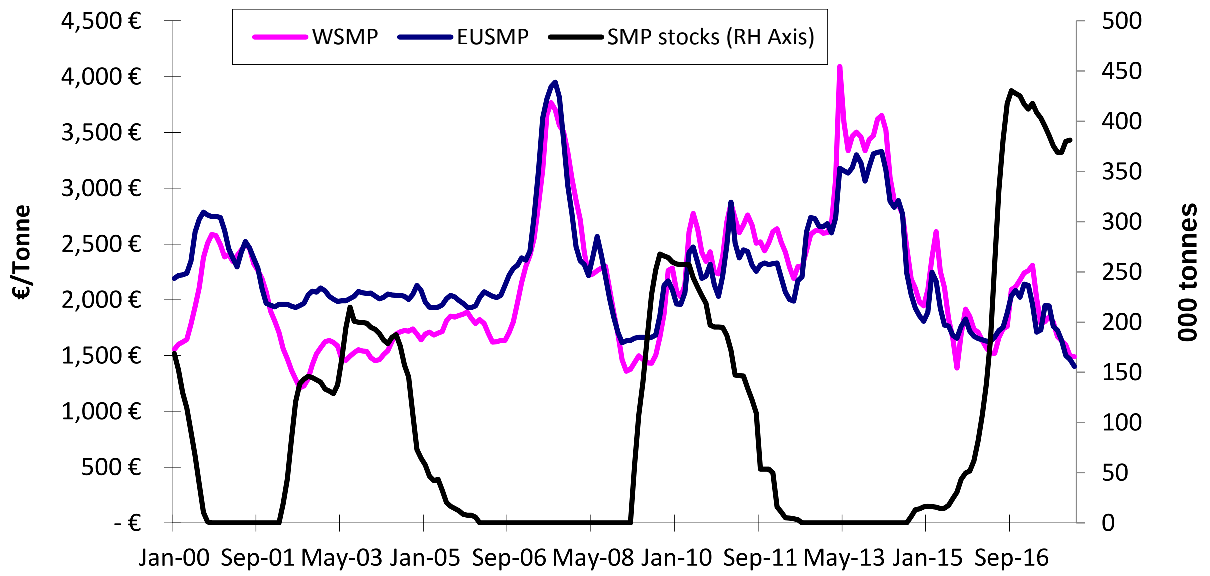
Source: Milk Market Observatory

There is a very well established theory in economics referred to as the cobweb model which suggests that, in certain circumstances, price volatility can display a recurring cyclical pattern[1] and this is now discussed in the context of variation in milk price and production in the US. The theory suggests that if there is a lag in production response to a price change, due to biological reasons, product prices and quantities produced will both move in an opposite cyclical recurring pattern. Thus for example an initial high price in period 1 will result in a lagged production response in period 2, which in turn will cause price to fall, the response to which will be a lagged cut in production in period 3, resulting in a high price again, which will then cause the whole process to repeat itself on an ongoing basis.

While quite difficult to isolate due to many other intervening factors, the US dairy industry appears to have displayed some aspects of this cyclical price and production pattern over the past 25 years, with milk price at farm level and milk production simultaneously moving in opposite directions to some degree at least in a recurring pattern for some of the period (Nicholson and Stephenson 2015). The contrast between the very occasional extreme price volatility in the EU dairy markets up to recent years and the somewhat more recurring cyclical pattern of price and milk production in the US, can perhaps be explained by the restricted production under the EU quota system. The introduction of the EU milk quota system in 1984 and the almost static EU milk production level for most of the period since then, with nearly all countries fully producing their quota for nearly all years up to recently, has meant that the normal production response to price change in a free market has not occurred in the EU prior to 2015.

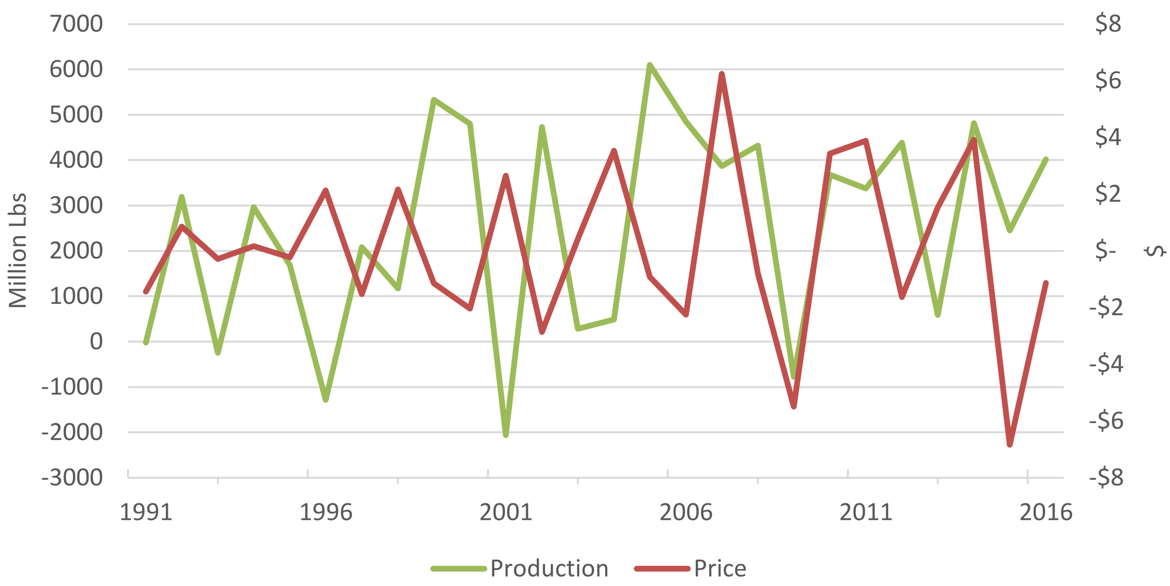
[1] Tomek W.G and Robinson K.L: Agricultural Product Prices: Cornell Univ. Press

Figure 2.1-7: SMP Inventory and Prices



Source USDA, Milk Market Observatory

Figure 2.1-8: Annual Change in US Milk Price ($/Cwt) and Milk Production (Mil. lbs)



Source: USDA

2.2 Multiple Forms of Risk

The increase in the volatility of both output and input prices, since 2007, has raised the exposure of Irish dairy farmers to market risks. Irish dairy farmers face a number of other risks in pursuing their livelihood. Hardaker et al., (2004) considers market risk to be one of five sources of risk for farm businesses.

Hardaker et al (2004) list the following five sources of risk in the following:

- market risk i.e. output and input price volatility;
- production risk i.e. weather variability, pest and animal disease;
- personal risk i.e. health, accidents, lifestyle, employee retention, successor;
- institutional risk i.e. changes in environmental standards, changes in subsidies; and
- financial risk i.e. changes in interest rates charged on debt.

Irish dairy farmers differ in terms of their exposure to the above sources of risk, with some farms more exposed than others in terms of financial risks, dependence on EU direct payments and risks associated with weather conditions. In 2011, Teagasc carried out a survey of 229 specialist dairy farmers in Ireland. Farmers were asked to rank five sources of risk according to their perceived importance. A ranking value of one indicates that the farmer considers the risk as being the most important, while a ranking of two indicates the second most important etc. For each risk type, we calculate the average ranking value. This research concludes that market risk is perceived as the main source of risk in Irish dairy farming. Production risks are perceived to be the second most important source of risk and personal risks are considered to be the third most important. The research identified some variability between farms, with approximately 40% of respondents identifying non-market risks as the main concern.

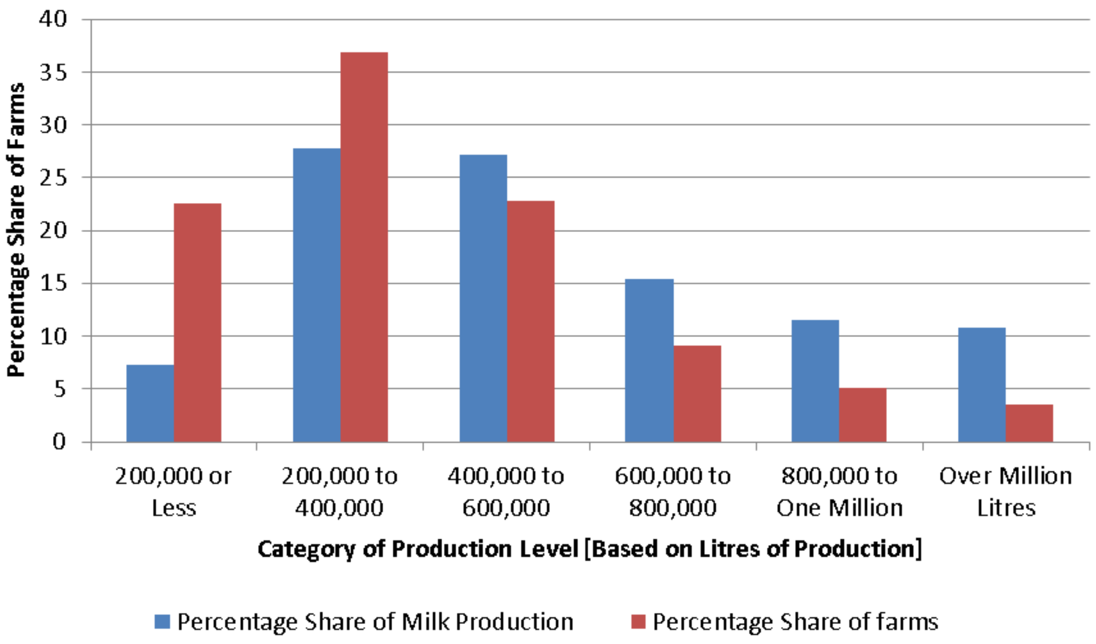
Table 2.2-1: Irish Dairy Farmers Attitudes to Risk (Average Ranking for Five Risk Factors)

Average Ranking Position	Risk Factor	Average Ranking
1st	Market Risk (e.g. Price Volatility)	1.74
2nd	Production Risk (e.g. Weather variability, pest and animal disease)	2.43
3rd	Personal Risk (e.g. Health, Accidents, Lifestyle, Employee retention and succession)	3.07
4th	Institutional Risk (e.g. change in environmental standard or subsidies)	3.40
5th	Financial Risk (e.g. change in interest rates)	4.33

Source: Teagasc National Farm Survey (Autumn Survey 2011)

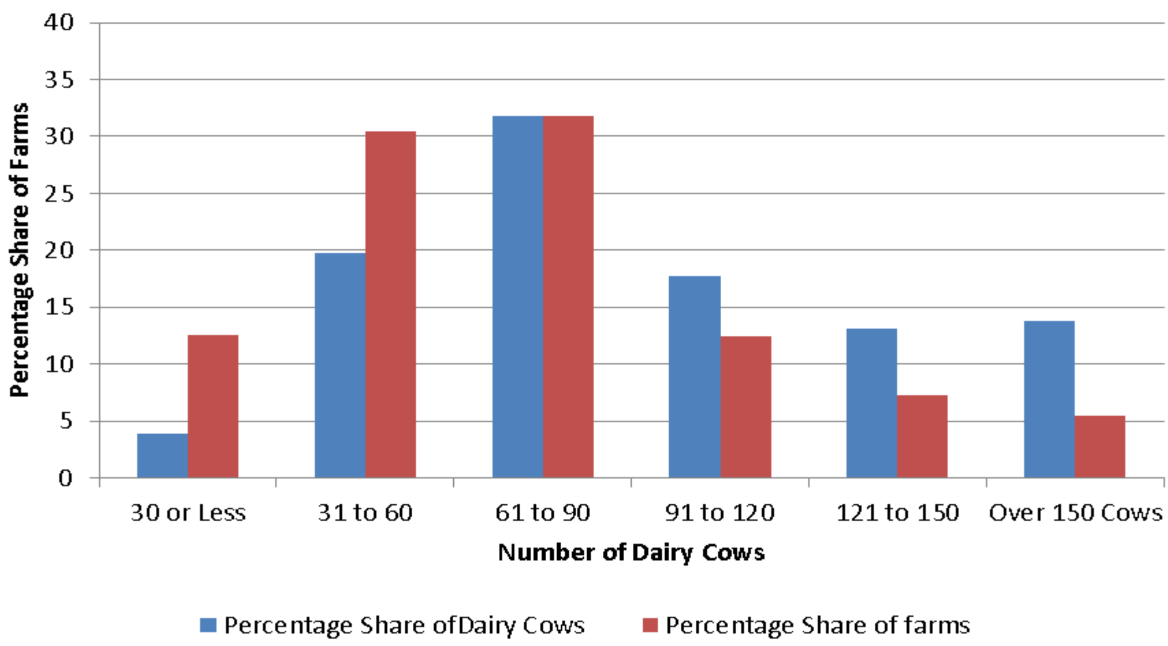
Irish dairy farmers vary in their scale of production, with implications for their exposure to different sources of risk. In figure 2.2-1, we illustrate the distribution of milk production in 2016. One can see from this graph that there is significant variability between farms in the scale of production. For instance, the share of farms with annual milk production of less than 200,000 litres is approximately 22 per cent. In contrast, approximately 17 per cent of farms have a level of milk production in excess of 600,000 litres. The variability in the scale of milk production between farms suggests that milk production risks vary between farms, with the larger farms facing relatively larger risks. The smaller farms are more likely to rely on family labour and owned land as opposed to hired labour and rented land. We will explore in more detail in this section. The varying distribution of farm size is further evident in figure 2.2-2, where the distribution of the number of dairy cows is provided.

Figure 2.2-1: Size Distribution of Annual Milk Production by Specialist Dairy Farms in Ireland



Source: Teagasc National Farm Survey Data 2016

Figure 2.2-2: Size Distribution of Dairy Cow Herd by Specialist Dairy Farms in Ireland



Source: Teagasc National Farm Survey Data 2016

Farms face financial risks associated with debt. Hardaker et al (2004) describe financial risk as a form of risk which emerges from the method of financing the farm. Borrowed funds can provide some of the capital for the farm, but this means that a share of the farms operating profit must be allocated towards meeting the interest repayments on the debt capital. In addition, the repayments of the principal amount must be met. Hardaker et al explain that the greater the ratio of debt capital to total capital, the greater the leverage and financial risk.

Debt to Asset Ratio

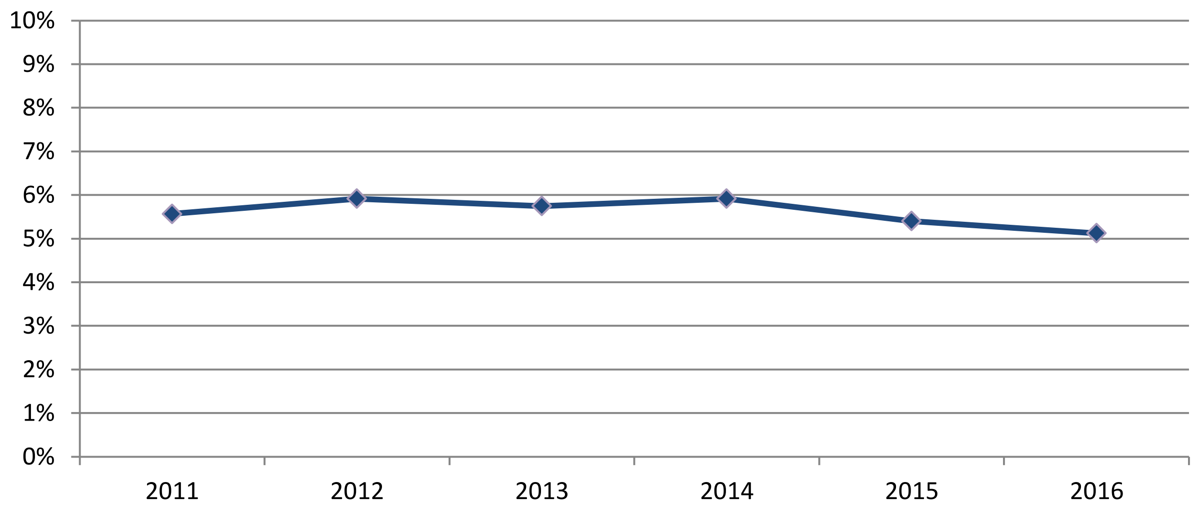
A review of the financial performance of Irish farms (including dairy farms) was conducted by Thorne et al., (2015), using a range of key financial ratios. Since that report was published, the expansion of the dairy herd has progressed following quota elimination in March 2015. Consequently, it is timely to revisit some of these financial ratios, to investigate the extent to which the financial risk has shifted in recent years.

Solvency, one of the often used indicators of financial risk, reflects the amount of borrowed capital used by the business relative to the amount of owner's equity capital invested in the business. In other words, solvency measures provide an indication of the business' ability to repay all indebtedness, if all of the assets were sold. Solvency measures also provide an indication of the business' ability to withstand risks, by providing information about a farm's ability to continue operating after major financial adversity and these solvency measures are concerned with long-term, as well as short-term, assets and liabilities.

Three widely used financial ratios to measure solvency are the debt-to-asset ratio, the equity-to-asset ratio and the debt-to-equity ratio. These three solvency ratios provide equivalent information, so the best choice is strictly a matter of personal preference. The debt-to-asset ratio expresses total farm liabilities as a proportion of total farm assets; the higher the ratio, the greater the risk exposure of the farm, and is one which is often cited using Teagasc NFS data.

The **debt-to-asset ratio** in Figure 2.2-3 provides a picture of the relative dependence of farm businesses on debt and their ability to use additional credit without impairing their risk-bearing ability. The lower the debt to asset ratio, the greater the overall financial solvency of the farm sector. The ratio shows that over the period 2011-2016, there was relative stability in the solvency ratio, with levels remaining around 5 to 6% over the period, similar to those identified by Thorne et al (2015).

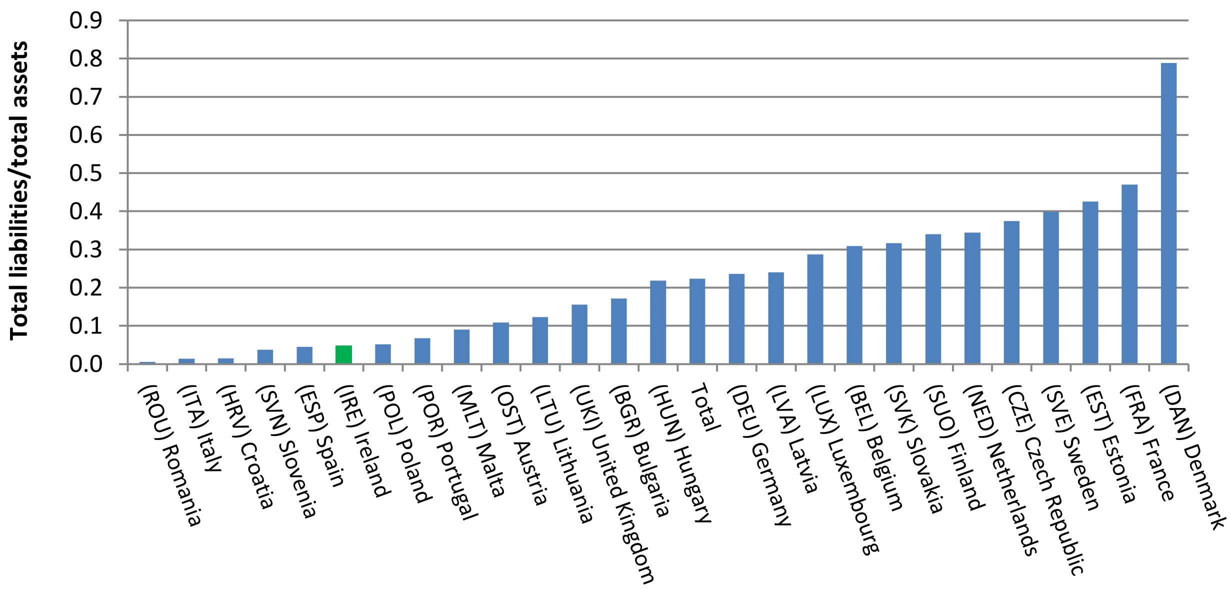
Figure 2.2-3: Debt/ Asset Ratio on Specialist Diary Farms (2011 - 2016)



Source: Teagasc National Farm Survey, various years and authors' own estimates.

To put this ratio in context, it is interesting to compare debt levels on Irish dairy farms with competitors in the EU. Figure 2.2-4 indicates that farms in Denmark, France, and Estonia had the highest debt to asset ratio amongst the EU countries examined (at over 0.4). The lowest average solvency levels (below 0.03) were observed in many Mediterranean MS. The level of indebtedness, and by extension of solvency, could stem from the fact that in these MS liabilities are typically not included in the farm accounts but in private accounts of farmers. Furthermore, the debt/asset ratio on Irish farms was well below the average of all farms in the EU examined, with a ratio of 0.05 in 2015.

Figure 2.2-4: Average Debt to Asset ratio per farm by FADN region in 2015 (specialist milk producers)

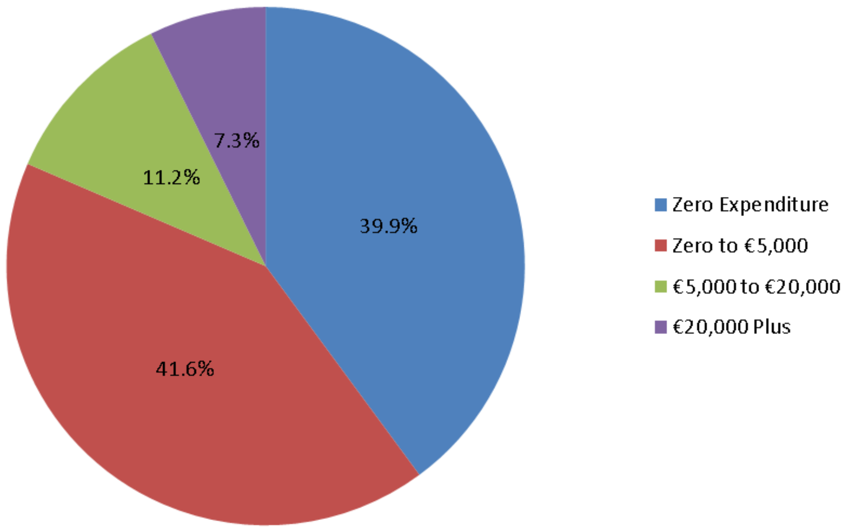


Source: DG Agri EU-FADN.

Irish dairy farms are expanding in terms of milk production, with implications for the number of working hours committed by farm operators, other family members and non-family workers on the farm. The rise in working hours and the well-recognised difficulties in hiring additional employees, are sources of personal risk. The recently published report by Teagasc entitled 'People in Dairy Project' concluded that Ireland will need approximately 6,000 new entrants over the next decade to replace retirees and meet the requirements of expanding herds.[2] Some of the additional labour will be required to sustain existing dairy farm operations where the owner wants to step back, via either employing a farm manager or entering collaborative farming arrangements (e.g. like those facilitated by the Macra Land Mobility Service). In addition, a much greater supply of seasonal labour will be in demand due to the additional workload during calving and breeding (Teagasc 2017).

Family labour contributes the vast majority of labour input on Irish dairy farms. The 2013 Farm Structures Survey (FSS) shows that an average of 1.75 total labour units (own labour and hired labour) are working on Irish dairy farms, with the average number of family labour units approximately 1.51 (FSS 2013). In figure 2.2-3, we show that most specialist dairy farms have a low reliance on casual or hired labour.

Figure 2.2-5: Distribution of Casual and Hired Labour Expenditure by Dairy Farms in Ireland



Source: Authors Calculations based on Teagasc National Farm Survey 2016

It is estimated that 39.9 % of farms have no expenditure on casual or hired labour in 2016, while 41.6 per cent have expenditure less than €5,000 per annum. Approximately 18.5 per cent of farms have expenditures greater than €5,000. On these farms, there is a strong reliance on hired labour and there is an associated risk attached to such labour availability. Farmers who wish to expand their milk production will need to consider hiring additional labour or further labour efficiencies at the farm level. Risks are associated with the retention,

[2] This figure of 6,000 new entrants includes farm managers, herd managers, farm assistants and part-time labour (Teagasc 2017)

health and wellbeing of the labour force on Irish dairy farms and farms with a relatively large labour force are more exposed to these personal risks. In the aftermath of milk quota abolition, hired labour will increase in importance over time on many farms.

Farms differ significantly in terms of both output value and farm income. Overall, 184 specialist dairy farms participated in the Teagasc NFS for all five years from 2012 to 2016. This sample in the Teagasc NFS can be divided into five equally sized income categories to provide summary statistics for each of these income groups. These data are reported in table 2.2-2. It is clearly evident that a wide disparity exists between the bottom and top income quintiles, both in terms of family farm income and the level of production and according to a number of other metrics, including the dependency on direct payments. Farms with a high dependency on direct payments are potentially at greater risk from adverse policy changes. This constitutes a form of institutional risk. It seems reasonable to assume that the farms in the bottom quintile have a greater risk of exiting from the dairy sector.

Table 2.2-2: Profile of Family Farm Income 2012-2016

Income Group	Average Family Farm Income 2016	Average Milk Production (Litres)	Average Number of Hectares	Average Number of Dairy Cows	Direct Payments [Share of Farm Income]	Average Labour Units
Lowest	17,772	199,563	35.4	41.0	57.3	1.3
2	43,791	340,166	47.3	62.5	35.7	1.4
3	61,813	390,023	56.6	73.9	28.4	1.4
4	84,612	516,187	70.2	89.1	28.0	1.9
Highest	124,952	651,144	82.7	112.8	23.2	2.2

Source: Authors' Calculations using Teagasc National Farm Survey 2012-2016

2.3 The Range of Risk Management Tools

In response to the multiple risks outlined above, a limited number of risk management tools are now in place to help mitigate the adverse consequences associated with these risks. These risk management tools are available from the European Union and at the national level, via taxation policies or industry initiatives.

Risk Management Tools at a European Level

The European Commission points to Intervention purchasing, Private Storage Aid – (PSA), Direct Payments, as presented in Chapter 3, and the Milk Reduction Scheme 2016, as tools which have mitigated the adverse consequences associated with price volatility. The most recent reform of the CAP in 2013, led to the introduction of three different risk management measures based on the developments of public-private partnerships, within the framework of the EU Rural Development Policy (RDP). These include 1) insurance premium subsidies 2) mutual funds and 3) Income Stabilisation Tool (IST).

Risk Management Tools at National Level

The Agri Cashflow Support Loan Scheme, developed in co-operation with the Strategic Banking Corporation of Ireland (SBCI) and administered by the main three 'Pillar' banks, is seen as a further tool developed with the assistance of the Department of Agriculture (DAFM) (€25m). Likewise income averaging as presented in Chapter 5 is also a public policy led initiative.

At industry level most processors now offer Fixed Milk Price (FMP) Schemes. These are discussed in detail in Chapter 4. In addition Glanbia offers its Glanbia Advanced Payment (GAP) Scheme, which automatically advances, to subscribers, a maximum payment of 2c/l on milk supply in any month where the base Glanbia milk price falls below 24c/l. These advances are repaid interest free when the GII (Glanbia Ingredients Ireland) base manufacturing price exceeds 30c/l at a maximum of 2c/L. They are no repayments during low supply months of November through to February. In addition GII offers a Milk Flex Loan Scheme, offering loans of between €25,000 and €300,000 to its dairy suppliers with flexible repayments indexed to milk prices.

For the purpose of this analysis, it is useful to look in more detail at the role of forward contracts and insurance in managing price volatility.

2.3.1 Forward Contracting

In its simplest form, a forward contract is an agreement to sell or buy a stated quantity of a good or service, at a stated period in the future, at a stated price. This type of risk management instrument has potential benefits to both seller and purchaser. These contracts offer both parties the opportunity to hedge their risk, as they are able to "lock in" prices, thereby reducing risk associated with price and income volatility and enhancing their ability to plan and to obtain new or continued financing. These contracts are flexible with regard to quantities and delivery dates and can be used alone or in conjunction with other pricing tools to manage price risk. Normally these contracts require delivery and thus ensure a physical market for the commodities. However once entered into, they have to be executed in the prescribed manner, regardless of market developments. This may in turn lead to one of the parties assuming the entire downside risk. A further issue which arises in forward contracting relates to the setting of the price at which the contract will be executed. This price should be transparent, verifiable and free from manipulation. Finally, these contracts may be subject to counterparty risk, so the trading partners need to have mutual confidence in each other. A well functioning futures market should be capable of providing transparent reference prices free from counterparty risk.

2.3.2 Insurance Contracts

The principle behind insurance is that of risk pooling, which involves combining the risks faced by a large number of individuals who contribute through premia to a common fund, which is used to cover the losses incurred by any individual in the pool. In order for a risk to be insurable the adverse effects of “asymmetric information” and “systemic risks” need to be managed. Asymmetric information refers to the situation where the buyer of insurance and the insurance company may not have the same information as regards the probability of losses occurring. This in turn may lead to adverse selection (i.e. where those at greater risk buy more insurance than those with a lesser risk, without the insurance company being aware of this) and moral hazard (i.e. an individual´s change in behaviour after having taken out an insurance policy, resulting in an increase in the potential magnitude and/or probability of a loss e.g. not spraying crops for certain diseases). Systemic risks result in many people making a claim at the same time, with the effect that the premia paid into a pool are not sufficient to cover the loss incurred, which may threaten the solvency of the insurance pool. Examples of systemic risks, are price risk or yield risk. Insurance is a popular means of risk management in crop production in the US in particular. However it can also be applied in a dairy context. In the US, the Livestock Gross Margin for Dairy Cattle Insurance Policy (LGM-Dairy) is available, as is the Milk Margin Protection Program, an insurance like product. Both are discussed in greater detail later in Chapter 6.

2.3.3 A Layered Approach to Risk Management

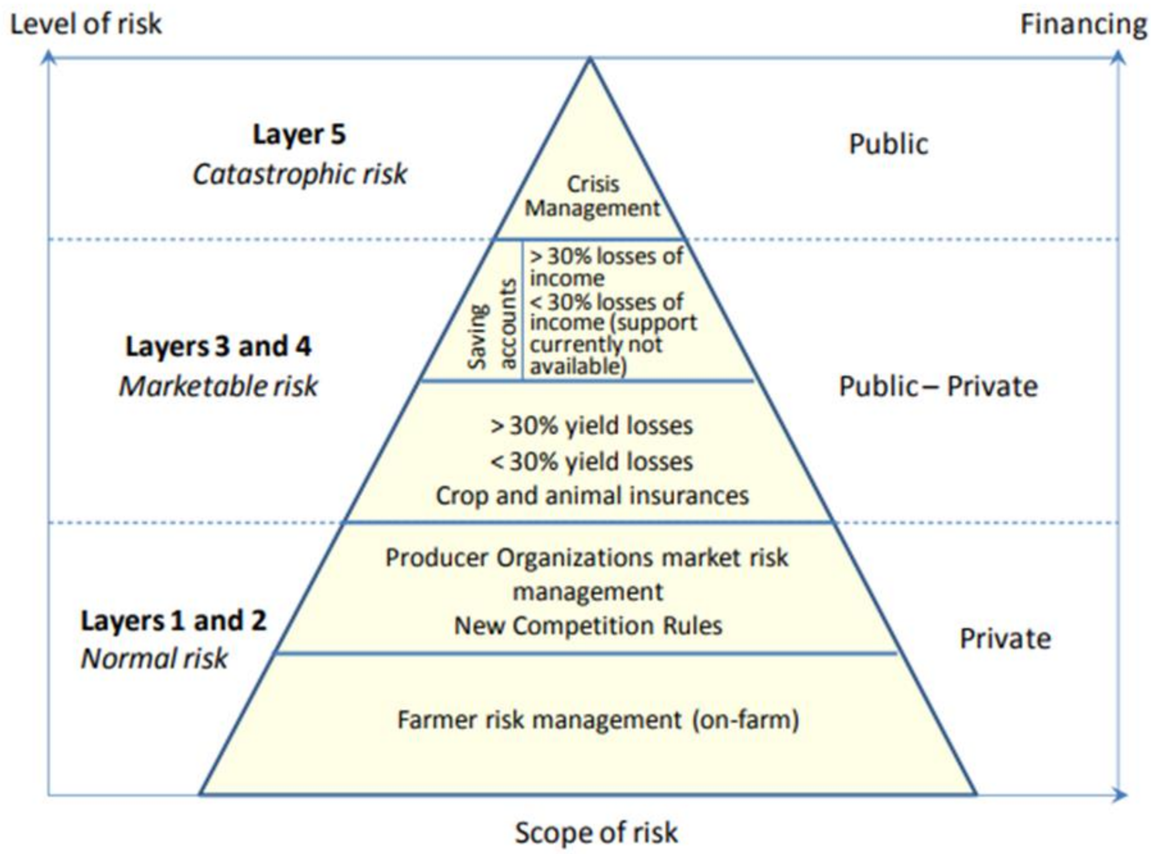
In a report for the European Commission, Bardají et al (2016) describe a layered approach to risk management and this is depicted below in figure 2.3.1. The layering system for agricultural risk management is based on the principle that different levels of risk (layers) should be managed by different actors with different instruments and financing.

Bardají et al distinguish between normal risks, marketable risks and risks associated with crisis. Normal risks can be addressed at the farm level (layer 1), through for example diversification or improved husbandry. These normal risks can also be addressed through producer organizations, cooperatives and other form of collective action (layer 2). The European Commission funded project entitled “Support for Farmer Cooperatives” identified the key role of cooperatives in reducing price volatility, whereby a large market share for cooperatives in a particular sector and country appears to increase the output price level and reduce the price volatility (Bijman et al., 2012). In addition, the presence of the cooperatives can generate a competitive yardstick effect benefitting farmers outside of the cooperative (Liang and Hendrikse 2016).

Marketable risks involve higher yield risks and should be managed through insurances, mutual funds or saving accounts. Within this group of marketable risks, Bardají et al distinguish between non-severe “normal” losses (less than 30% of yield or revenue/income i.e. layer 3) and severe losses (more than 30% of yield or revenue/income i.e. layer 4). Bardají et al conclude that non-severe risks could be managed through insurance or mutual funds, with support of State aids if necessary.

Severe risks (layer 5) corresponds to the highest level of risk known as catastrophic risk i.e. an income crisis due to production crisis (climate or animal health), market crises or both. Catastrophic risk often results in severe and massive revenue/income losses for the farmers of a specific sector. This type of risk should be managed through public intervention, such as the crisis reserve; safety nets (intervention buying, financed private storage or withdraws) and ad-hoc payments.

Figure 2.3.3-1: Layering model of agricultural risk management



Source: Bardají et al (2016)

2.3.4 Risk Management Strategies

Holzmann and Jogersen (2001) group Risk Management Strategies into three categories: (i) prevention strategies to reduce the probability of an adverse event occurring (ii) mitigation strategies to reduce the potential impact of an adverse event, and (iii) coping strategies to relieve the impact of the risky event once it has occurred (Table 2.3.4-1).

Table 2.3.4-1: A menu of possible farm risk management instruments and strategies

	Farm/household/community	Market	Government
Risk Prevention	Technological choice	Training on risk management	Macroeconomic policies Disaster prevention (flood control...) Prevention of animal diseases
Risk Mitigation	Diversification in production Crop sharing	Futures and options Insurance Vertical Integration Production/marketing Contracts Spread sales Diversified financial investment Off-farm work	Tax system income smoothing Counter-cyclical programs Border and other measures in the case of contagious disease outbreak
Risk Coping	Borrowing from neighbours/family Intra-community charity	Selling financial assets Saving/borrowing from banks Off-farm income	Disaster relief Social assistance All agricultural support programs

Source: Based on Holzmann and Jogersen (2001) and OECD (2001).

In this typology prevention and mitigation strategies focus on income smoothing, while coping strategies focus on consumption smoothing. These strategies can be based on actions at different institutional levels: farm household or community arrangements, market based mechanisms and government policies. The proposed tools can differ by region and farmer due to their size, location, knowledge or availability of information. Likewise the farmer might use a combination of tools that best fits risk exposure and the level of risk aversion of that farmer.

3. Direct Payments

In this chapter we review the role of direct payments in the income of dairy farms in Ireland. Historically, milk production in the EU was not subject to significant direct payment support. Instead, specific support for milk production was provided through a range of market management mechanism, including the milk quota system and market price support via the butter and skimmed milk powder intervention mechanisms. A range of import tariffs and export refunds ensured that EU domestic prices for dairy products remained above the world price level. To facilitate greater integration with world agricultural markets, the EU suspended the use of export refunds. However, in order to do this, it first made downward adjustments to intervention prices for butter and skimmed milk power as part of the CAP Reform of 2003. In return, the EU provided dairy farmers with compensation for these intervention price reductions via the dairy premium.

However, this compensation was not the only form of CAP support available to dairy farmers in Ireland. Many dairy farmers also had another enterprise of some kind (generally drystock) and this was also subject to support payments. When the decoupling of payments was introduced in 2005, the relatively modest support for dairy intervention price reductions and the more substantial support available for other enterprises on dairy farms were bundled together to form a decoupled direct payment to milk producers.

Under the terms of the decoupled payment introduced in 2005, dairy producers were free to operate which ever farm enterprise they chose – with one exception. Their capacity to produce milk remained constrained by the amount of milk quota in their possession. However, the ending of the milk quota system in 2015 has allowed dairy farmers to move towards complete specialisation into the most profitable enterprise on their farm, which in general is milk production, without impacting on the value of the support the farm receives. In the CAP reform of 2013, the single payment to farmers was decomposed into a number of parts as explained in section 3.2 below. With another round of CAP reform now under negotiation, it is useful to examine the role which support payments currently have as a contributor to dairy farm incomes in Ireland, in particular the impact they have on income volatility. In some cases dairy farms are also in receipt of other support payments, which are not part of the direct payment, but generally the value of these other payments is small relative to the value of the direct payment.

3.1 Introduction

Preparations for the next CAP reform have begun, as have discussions relating to the next EU budget – the so called Multi Annual Financial Framework (MFF). The reform will set the agenda for the support and development of the agri-food sector for much of the next decade.

The circumstances surrounding the next CAP reform are challenging. EU Member States have specific interests (some of which are detailed below) that they would like to see addressed and this is likely to create friction that may hinder the process of agreeing the way forward.

Beginning where the negotiations surrounding the current CAP ended, there will be pressure to continue the process of external convergence, the mechanism by which the average level of support payment per hectare across the Member States is being brought into greater alignment. It remains the case that large differences in the average level of payment per hectare exist between the Member States, with Malta, Greece and the Netherlands receiving among the highest average level of payment per hectare and Latvia, Lithuania and Estonia amongst the lowest average level of payment per hectare. Ireland currently lies somewhere in the middle, with an average level of payment that is at a little over €260 per hectare.

Beyond disputes about achieving greater equalisation of payments between the Member States, there are concerns at the nation state level about internal convergence - achieving greater equalisation of payments between farms and between farmers within a Member State, largely though greater equalisation in the payment received per hectare. This issue is a concern in Ireland, as there was some dissatisfaction on the part of some farmers at the time of the previous negotiation that Ireland had made minimal changes in the allocation of payments between farmers. This left some farmers aggrieved that more should have been done to equalise the level of payments per hectare that would have advantaged particular farm systems, farms of a particular size or farms in particular regions.

Beyond these concerns, there is also a desire to see the CAP achieve more, notably in respect of the way in which it assists farmers to produce in a manner that could be considered sustainable, particularly from an environmental perspective. The “greening” concept that was introduced in the current CAP has been criticised for having achieved little so far. There are calls for the CAP to be redesigned, so that it can be more outcome or results driven when it comes to the provision of public goods, whereas it is currently considered to be more action driven without there being enough emphasis on the action achieving the desired outcome. Ensuring that the actions that are required to receive payments actually deliver the desired outcomes motivating the payments is therefore likely to form part of the next CAP.

A debate is also likely on the future of coupled payments, which have been used to differing degrees by some Member States as part of the current CAP. Some Member States are concerned about the demise of particular agricultural sectors in the face of competition from more efficient neighbouring countries. This concern has also been raised in Ireland with respect to the suckler herd.

Overriding all of these concerns are the pressures in the MFF discussions to spend some element of the EU budget in a different way to support actions outside of agriculture, notably concerns about EU security and defence, the management of migration and broader actions that would make the EU economy more competitive on a global scale. All of these concerns place demands on the overall EU budget and suggest that the share of that budget devoted to the CAP (currently about 38%) will come under pressure.

Then there is the question of Brexit and the extent to which this will impact on the capacity of the EU to raise the budget it requires to carry out its objectives. On paper the departure of the UK, currently the EU's second largest net contributor, from the EU will leave a hole of some €10 billion in the EU budget. This hole can either be filled via an increase in the contribution of the remaining 27 EU Member States or it can be managed through a reduction in the EU's expenditure.

If the EU Budget were to become smaller, then this would add to the pressure for a reduction in the percentage share of the EU Budget spent on agriculture. There would then also need to be discussions about how much smaller the CAP budget would become. The Commission has already produced a number of texts on the future of the EU budget. One of these speculatively mentions a reduction of the CAP budget of 30 percent (EC 2018a). The subsequent draft legal text suggests a smaller reduction of about 5 percent (EC 2018b). Even if the global reduction in the EU budget was clear at this point, the question as to how it would impact on individual MS receipts under the CAP would remain unclear.

In the event of reduction in the EU and CAP budget, the share of that reduction borne by Ireland would also be a subject for negotiation, but even a 10% reduction in the CAP budget to Ireland would have a significant impact on Irish farm incomes, especially in systems where a significant percentage of farm income is derived from income support.

In table 3.1-1, we show the average level of farm income by farm system in 2016. This reveals quite a disparity in income levels, but a much smaller disparity in terms of the average level of support received across the different farms systems. The comparatively higher level of market based income on the average dairy farm, means that in percentage terms the income derived from support is on average lower in the case of dairy than in the other farm systems, particularly drystock systems. However, in years of very low milk price such as 2009, the buffer effect of direct payments for dairy farmers was very apparent.

In the event of a reduction in Ireland's CAP budget, this may lead to proposals to transfer some portion of the payment away from dairy farmers to protect the income support received by drystock farmers. The impact of so doing is explored in this section of the report. An important caveat is that drystock farmers far outnumber dairy farmers in Ireland. Roughly speaking there are 6.8 drystock or specialist livestock grazing farmers for every dairy farmer (Eurostat 2017). This means that any reallocation of support away from dairy farmers would be spread across the much larger number of drystock farmers in Ireland, diluting its value to individual farmers.

In this study our specific interest is not so much the level of income on dairy farms, it is the volatility of that income over time. For the purposes of this exercise the impact of removing 10% of support from dairy farmers is examined, specifically in the context of the impact it has on the volatility of dairy farm income.

Table 3.1-1: Average Family Farm Income and Reliance on Direct Payments by Farm System in 2016

Farming System	Family Farm Income	Direct Payment	Share of Direct Payments in Farm Income
Dairy	52,155	19,735	38
Cattle Rearing	12,516	14,400	115
Cattle Other	16,853	16,209	96
Sheep	15,708	17,946	114
Tillage	30,840	26,331	85

Source: Teagasc National Farm Survey

3.2 Statistics on Direct Payments 2005-2016

The Department of Agriculture, Food and the Marine explain that under the current Direct Payment system a farmer's payment can be a combination of payment under four separate schemes (DAFM, 2018).

- Basic Payment Scheme (BPS)
- Payment for Agricultural Practices beneficial for the Climate and the Environment (Greening Payment)
- Young Farmers Scheme (YFS)
- Aid for Protein Crops

In table 3.2-1, we show the average family farm income on specialist dairy farms (inclusive of direct payments) and the value of direct payments from 2005 to 2016. This analysis excludes the disadvantaged area payments, which are decoupled payments. We also exclude the GLAS payments and the payments from the Rural Environmental Protection Scheme (REPS). It is clearly evident from this data that the average family farm income on specialist dairy farms has been highly volatile since 2007. The direct payments component of the family farm income appears to be much more stable through time. This underlines the importance of the direct payments in stabilising overall dairy farm incomes.

In table 3.2-2, we show the share of direct payments in family farm income on specialist dairy farms from 2005 to 2016. These results show that the share of direct payments in farm income has always remained above 24 per cent. There is some volatility however, from year to year and this is particularly evident in 2009 when the annual average standardised milk prices fell to approximately 21 cent per litre. In 2009, the direct payments accounted for two thirds of family farm income on the average specialist dairy farms.

Table 3.2-1: Average Family Farm Income on Specialist Dairy Farms and Direct Payment 2005-2016

Year	Family Farm Income (€)	Direct Payments Excluding the Young Farmer Scheme (€)	All Direct Payments
2005	39,937	11,163	11,163
2006	36,449	14,207	14,207
2007	51,731	14,775	14,775
2008	45,182	15,496	15,496
2009	23,794	15,862	15,862
2010	44,178	14,976	14,976
2011	67,947	17,512	17,512
2012	49,330	17,068	17,068
2013	62,925	16,638	16,638
2014	67,797	16,647	16,647
2015	62,059	15,446	15,446
2016	52,075	16,514	16,827

Source: Authors' calculations using the Teagasc National Farm Survey data

Table 3.2-2: Share of Direct Payments in Family Farm Income on the average Specialist Dairy Farms 2005-2016

Year	Percentage Share (%)
2005	28.0
2006	39.2
2007	28.6
2008	34.3
2009	66.7
2010	33.9
2011	25.8
2012	34.6
2013	26.4
2014	24.6
2015	24.9
2016	32.3

Source: Authors' calculations using the Teagasc National Farm Survey data

3.3 Measuring Farm Income Volatility

To estimate the degree of farm income volatility at the farm level, we calculate the *Arc Percentage* change in farm income. The Arc percentage change in farm income differs from the standard year-on-year percentage change. In calculating the Arc percentage change, we express the change in farm income relative to the average of two base years i.e. the average of the income from the current and previous year. This contrasts with the standard year-on-year percentage change in income, where the change in income is expressed relative to the preceding year only. A reliance on the standard year-on-year percentage change can result in the calculation of extreme percentage changes in income. These extreme values can be attributed to the reliance on a single base year for the calculation. The Arc percentage change in farm income removes some of this problem by using the average of two years as the base period. This approach is applied in a number of studies dealing with the volatility of household incomes (See For Example Dynan et al 2012) in a study of household income volatility in the United States and the recent USDA study on farm income risk by Key et al (2017).

In formal mathematical terms, the arc percentage change in farm income for each farm in each year is given in the following:

$$I_{it} = [100(E_{it} - E_{it-1})/E_{i\tau}$$

where $E_{i\tau}$ = $(E_{it} + E_{it-1})/2$ for each farm i with earnings E_{it} in year t.

3.4 The Effect of Direct Payments on Income Volatility

In table 3.4-1, we show the typical or median Arc percentage change in Farm Income for each year from 2006 to 2016. It is clearly evident from this analysis that the direct payments contribute towards reducing the extent of farm income volatility.

Table 3.4-1: Median Arc Percentage Change in Income for the average dairy farm

Year	Arc Percentage Change in Family Farm Income	Arc Percentage Change in Income without Direct Payment
2006	23.0	33.3
2007	36.5	50.8
2008	25.1	33.8
2009	60.3	89.0
2010	57.2	99.8
2011	35.1	47.8
2012	33.5	39.9
2013	28.9	38.8
2014	19.8	24.3
2015	20.9	28.1
2016	23.7	34.4

Source: Authors' calculations using the Teagasc National Farm Survey data

With the inclusion of the direct payments, the median Arc percentage change in farm income is lower in all years considered. The differential between the arc percentage change in income (with and without direct payments) is particularly evident in the years when farm incomes are at their most volatile i.e. 2009 and 2010.

3.5 Direct Payments per Unit of Production

In addition, we express the value of the direct payment relative to the volume of milk production, acknowledging of course that the payment is decoupled. This is particularly relevant in the context of the increased milk production in the post milk quota period.

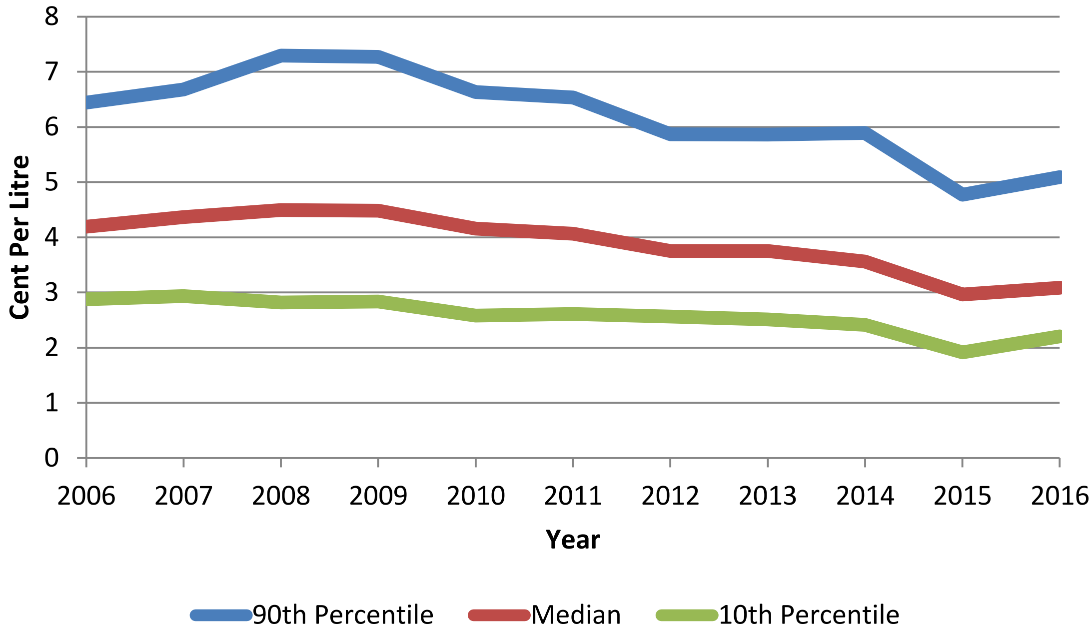
Assuming that increased levels of milk production per farm are produced with a positive net margin, this will tend to dilute the value of direct payments within farm income. This is because on most farms direct payments are unlikely to increase in proportion with the increase in milk production, and in the extreme case direct payments will remain fixed in absolute terms while milk production increases.

In general a dairy farm is only likely to experience an increase in direct payment, if the area of the farm increases. Even in this circumstance it is likely that the intensification of milk production per hectare will still insure that the farm's increase in milk production will outpace the increase in support payments. In order to carry out this exercise, we must adjust the farm level payment for the non-dairy component of the farm production.

To account for the non-dairy component, we calculate the dairy share of farm output and multiply this value by the farm's total direct payment. This is divided by the number of litres of milk production to arrive with an estimate of the direct payment per litre of milk.

$$\frac{Direct\ Payment * Dairy\ Share\ of\ Farm\ Output}{Total\ Litres\ of\ Milk\ Production}$$

Figure 3.5-1: Direct Payment in Cent Per Litre of Milk 2006-2016 [Median, 10th and 90th Percentile]



Source: Authors' calculations using the Teagasc National Farm Survey data

Figure 3.5-1 shows the evolution of the value of direct support when expressed as a share of milk output over the period 2005 to 2016, with the median value, 10th and 90th percentile of the distribution shown. In 2006, the 10th percentile is the region of 3 cent per litre. In some circumstances, this is due to an increase in production from 2004 to 2006. Another important factor influencing the low payment per litre is that differences existed between the number of litres produced and the number of eligible litres. We can confirm that all farms in the Teagasc NFS received 1.2 cent per eligible litre in 2004 and 2.4 cent in 2005, where such payments were made.

Clearly the level of support per litre of milk produced has declined over the period examined across the full distribution to a median level of 3.1 cent per litre in 2016, relative to 4.2 cent per litre in 2005. It is also evident that for the 90th percentile the value of support per litre of milk actually increased in the period when milk prices collapsed in 2009. This effect is much less noticeable for the median of the series.

Next, we simulate a reform scenario involving a 10 per cent decline in the value of the direct payment and a 20 per cent increase in milk production relative to the 2016 levels. We estimate the impact of this reform scenario on the value of the direct payment per litre of milk. The motivation for conducting this analysis is to demonstrate how farmers' exposure to risk increases as the value of direct payments decline relative to milk production levels, whether because of a declining budget for direct payments of because of increasing farm output.

Table 3.5-1 illustrates the scenario of rising production, with the median payment per litre declining to 2.6 cent from 3.1 cent in 2016. Under the scenario of rising production and a reduction in support, the payment per litre declines to 2.3 cent for the median case. Regardless of the scenario in question, there exists a wide discrepancy between the top and bottom of the distribution. Essentially, some farms are much more reliant on the direct payments relative to other farms. In 2016, the farm at the 90th percentile received payments totalling 5.1 cent per litre. By contrast, the farm in the 10th percentile received just 2.2 cent per litre.

Table 3.5-1: Direct Payment Per Litre Under Different Scenarios

	Payment Per Litre in 2016	Payment Per Litre with 20% Rise in Milk Production	Payment Per Litre under 10% support cut and 20% Rise in Milk Production
90th Percentile	5.1 Cent	4.4 Cent	3.8 Cent
Median	3.1 Cent	2.6 Cent	2.3 Cent
10th Percentile	2.2 Cent	1.8 Cent	1.7 Cent

Source: Authors' calculations using the Teagasc National Farm Survey data

3.6 Conclusions

In this chapter we have shown that direct support makes a considerable contribution to income on dairy farms. While acknowledging that support is decoupled from milk production, it is clear that the value of support, when measured against the volume of milk produced, has been on the decline over the last decade.

Over the decade examined, the level of support, when expressed as a share of dairy farm income, has varied considerably. This reflects the strong variability in the average net margin achieved on dairy farms over the period. This in turn reflects the market based volatility in milk prices, the volatility in the price of purchased inputs and the weather related grass and silage production volatility that has been experienced.

It is also clear that analysis based on average performance tends to mask the income difficulties of producers with higher production costs, whose dependence on support payments as a supplement to their market based income has been far higher than in the average case.

Taking a forward view, the decline in the value of support, when expressed in per litre terms, can be expected to continue as milk production increases. Furthermore, if the overall level of support falls as a result of CAP reform, this will accelerate the decline in the value of support payments per litre and increase the exposure of Irish dairy farms to income variations associated with market and production related volatility.

4. Forward Contracting

4.1 Introduction

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). However, EU policy 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 some respects, these policies represent a shift in the policy environment and 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). 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 potential adoption of the aforementioned tools. Hence, in this chapter, the objective is to examine the availability of forward contract offers, factors that affect adoption of these tools at farm level, and the potential impact on farm level price of adoption using recent Teagasc NFS data.

In this chapter, the recent history of forward contract offers from the Irish milk processing sector and their uptake at farm level are reviewed (section 4.2), followed by the results from an econometric model examining the impact of various factors on adoption of forward contracts at farm level (section 4.3) and finally simulation results of the possible impact of forward contracting on farm level prices using Teagasc NFS data from 2016 (section 4.4).

4.2 Recent History of Forward Contracting in Ireland

Detailed information on the recent history of forward contract offerings for milk producers in Ireland was collected. Figure 4.2-1 shows the basic forward contract prices being offered by a selection of processors since 2011. Glanbia was the first of the Irish milk processors to announce a fixed price forward contract for Irish dairy farmers in late 2010. This was closely monitored by other Irish milk processors and the Glanbia initiative was soon followed by the introduction of forward fixed milk price guarantees by a number of other processors. The precise terms and conditions of these forward contract offerings varies between processors.

For this reason, we should not seek to make direct comparisons between processors in terms of the overall value of the fixed price agreements for farmers. The fixed milk prices shown in Figure 4.2-1 are basic fixed prices and the overall value of fixed milk price agreements can be further influenced by the addition of bonuses or adjustments for input costs, among other things.

Whilst we do not have information on the specific adoption rates at farm level for the individual processor fixed price schemes, as outlined in Figure 4.2-1, anecdotal evidence suggests that the share of milk production committed to the forward contract varies between milk processors. To gain a better understanding of the propensity of the farm sector to adopt forward contracts in the recent past, Teagasc NFS data was used. The weighted average of specialist dairy farms in the NFS having forward sold in 2016 was found to be 37%.

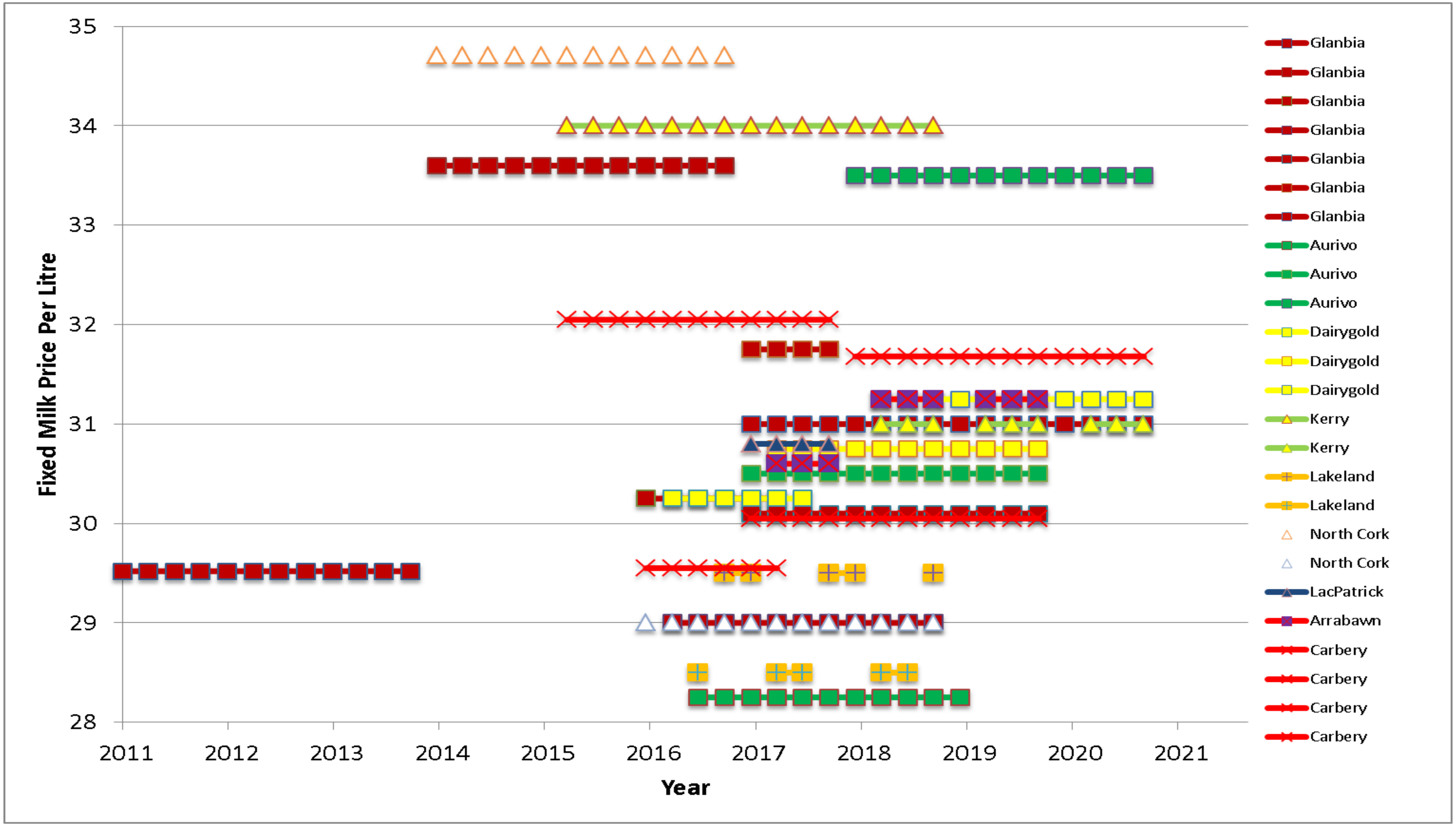
To learn more about the profile of farmers that enter into forward contracting arrangements, a number of key descriptive statistics for forward contract adopting farmers and non-adopting farmers are outlined in Table 4.2-1. We find that the family farm income is typically larger among the farms adopting forward contracts relative to the non-adopters. The share of the direct payment in farm income is lower among the farms that have adopted forward contracts relative to the group of non-adopters. A large majority of farms in the sample had the opportunity to enter into a fixed milk price agreement with their co-op during 2016. However, some of the disparities between the two groups may be due to the limited availability of fixed milk price contracts for smaller-scale processors.

Table 4.2-1: Average Descriptive Statistics for Adopters and Non-Adopters of Milk Price Forward Contracts in Ireland

	Non-Adopters	Adopters	Total
Family Farm Income [€]	44,495	61,848	50,911
Direct Payment [€]	14,900	18,360	16,179
Direct Payment as Share of Farm Income [%]	42.26	31.47	38.27
Disadvantaged Area Payments [€]	1,686	1,274	1,534
Farm Size [Hectares]	50.81	57.57	53.31
Livestock Units Per Hectare [LU]	2.01	2.14	2.06
Annual Milk Production [Litres]	344,862	447,532	382,828
Annual Milk Sold [Litres]	330,125	424,818	365,141
Annual Milk Fed to Livestock [Litres]	14,636	22,607	17,584
Annual Creamery Milk Production [Litres]	317,210	403,164	348,994
Fat Percentage of Creamery Milk [%]	4.09	4.14	4.11
Protein Percentage of Creamery Milk [%]	3.44	3.51	3.47
Annual Liquid Milk Production [Litres]	12,915	21,655	16,147
Costs Per Litre [Cents]	22.26	20.53	21.62
Overhead Costs Per Litre [Cents]	9.27	8.83	9.11
Direct Costs Per Litre [Cents]	13.00	11.70	12.52
Number of People in Household	3.09	3.59	3.28
Number of Children 0-5 Years Old	0.10	0.18	0.13
Number of Children 5-15 Years Old	0.39	0.66	0.49
Number of Children 16-19 Years Old	0.23	0.28	0.25
Number of Children	0.72	1.11	0.86
Family Labour Units	1.36	1.38	1.37
Paid Labour Units	0.14	0.26	0.19
Total Labour Units	1.50	1.64	1.55
Sample Size [N]	144	90	234

Source: Authors' calculations using the Teagasc National Farm Survey data

Figure 4.2-1: Fixed Milk Price contracts available from Irish milk processors 2011-2021



4.3 Factors Affecting Forward Contract Adoption

The practice of forward contracting is more closely associated with grain than milk production and this is reflected in the economic literature. 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.

To determine the factors affecting forward adoption in the Irish case, Teagasc NFS data on specialist dairy farms for the year 2016 was used. A binary choice probit model was used to examine the factors driving adoption of the fixed price forward contracts. The discrete decision of whether to adopt forward contracts can be estimated using many different functional forms depending on the assumed functional form of the error term. For example, past studies have used a probit model when the disturbances are assumed to be distributed normally (Goodwin and Schroeder, 1994) or a logit model when the distribution is assumed logistic (Asplund, Forster, and Stout, 1989). For the purpose of this study, the error term is assumed to be distributed normally, hence a probit model was used.

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 (Paudel et al., 2008). We therefore begin with a relatively large number of potential explanatory variables. In the selection process of explanatory variables, number of hectares was excluded due to strong correlation with number of cows. The closing loans variable was excluded due to its insignificance. Table 4.3-1 shows the results for two separate model specifications, with both models including the following variables: number of litres per cow, per cent share of direct payment in the farm income, number of cows, farm operator age, number of school going children in the household, kg of concentrate feed per litre of milk produced and model 1 also includes a dummy variable for the South East region.

Table 4.3-1: Results for Probit regression of Forward Contract Adoption with 2016 data

	Model 1	Model 2
Number of Litres Per Cow	0.284*** (0.10)	0.273*** (0.10)
Share of Payments in Farm Income	-0.00627 (0.00)	-0.00819* (0.00)
Number of Cows	0.00361 (0.00)	0.00331 (0.00)
Farm Operator Age	-0.0154* (0.01)	-0.0136* (0.01)
Number of Children Aged 0-19	0.0927 (0.08)	0.0858 (0.08)
KG of Concentrate Per Litre	-0.0298** (0.02)	-0.0407*** (0.01)
South East (0,1)	0.965*** (0.20)	
Constant	-1.080 (0.74)	-0.484 (0.70)
Sample Size [N]	234	234

Source: Authors' calculations using the Teagasc National Farm Survey data

Table 4.3-1 presents the probit model estimation results of whether the forward contract tool had been used in the past 12 months. Relative to non-adopters of forward contracts for milk, those that used milk forward pricing methods had significantly higher milk production per cow, were younger in age, fed less concentrates per litre of milk produced, and were more likely to be located in the South East region.

4.4 Simulating the Impact of Forward Contracting on Milk Price

The general consensus within the dairy industry is that fixed priced forward contracts should be used as a risk management tool, with adopters benefiting in price terms in some years and losing out in other years, with a net reduction in risk exposure being the ultimate aim. Whilst a reduction in risk exposure is acknowledged as the ultimate objective of these contracts, the interest in examining the impact of adoption is important for a number of reasons, for example, from the perspective of estimating average annual milk prices for forecasting purposes and from an educational point of view for farmers, in learning how the process has impacted income in certain years. Hence, the objective of this modelling exercise was to simulate, using Teagasc NFS data, the potential impact on average annual milk price of adoption of the various forward contract fixed milk price schemes on offer in 2016 from the various processors, as outlined in Figure 4.2-1 previously.

Data and Assumptions

Micro data from specialist dairy farms in the Teagasc NFS, 2016 was used in this analysis. All farms that sold milk to a processor that had a forward milk price contract on offer were included in the analysis, with a total of 228 sample of farms examined, representing 11,500 specialist dairy farms nationally.

Two separate scenarios were simulated:

(i) baseline – no forward milk price contracts adopted and
(ii) adoption scenario – 20% of all milk was forward contracted to an individual processor, using the fixed price contracts on offer, by month in 2016. If a number of fixed price contracts were on offer by one processor, an average of the various offers was used on a monthly basis.

Given that all forward milk price contracts offered by Irish processors in 2016 were based on actual fat and protein levels on a monthly basis, the monthly fat and protein levels per farm within the NFS were used to simulate milk prices under the baseline and adoption scenarios outlined above. No bonuses were included in the analysis. VAT was included.

Impact of milk solids and seasonality on milk price

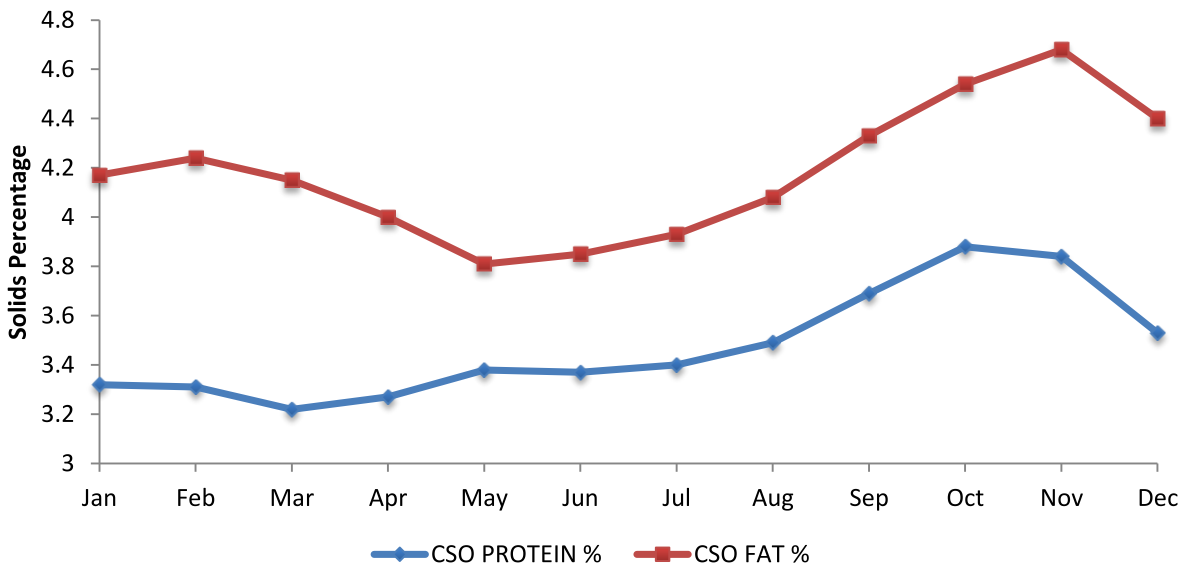
The basic fixed prices shown in figure 4.1-1 are standardised milk prices i.e. standardised for fat and protein content. In Ireland, forward contract prices are typically standardised according to solids content of 3.6 per cent for fat and 3.3 per cent for protein. In recent years, the solids content of milk production has increased significantly. This is evident from the CSO statistics illustrated in figure 4.4-1. This increase in solids content has major implications for the actual fixed price of forward contracting arrangements.

Figure 4.4-1: Annual Fat and Protein Percentages in 2005-2016

Source: Central Statistics Office (2018)

In addition, there is seasonality in milk deliveries and in constituents to consider, which is outlined in Figure 4.4-2.

Figure 4.4-2: Monthly Fat and Protein Percentages in 2016



Source: Central Statistics Office (2018)

All processors in Ireland are now applying the A+B-C formula to calculate the monthly milk price. The C component reflects transport and processing costs and is approximately 4 cent per litre for most processors.

Exclusive of VAT, the manufacturing milk price can be described in the following:

$$M_{no\ vat} = A + B - C$$

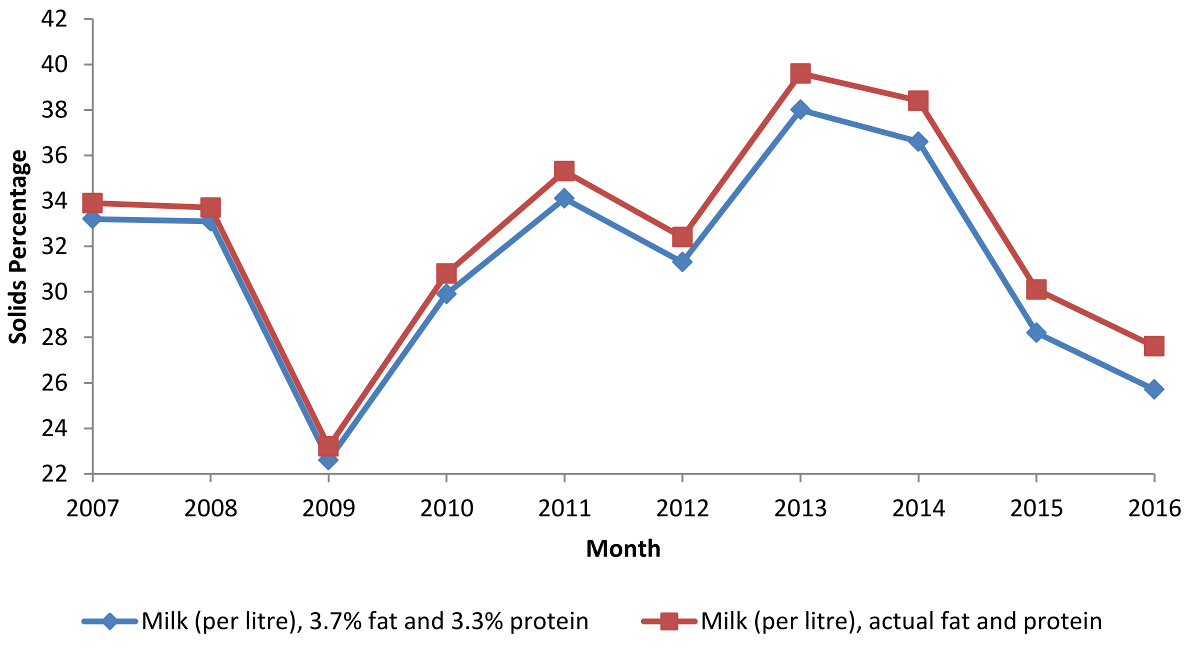
In more detail and with the inclusion of VAT, the average farm-level milk price (M) can be calculated in the following:

$$M = \left[\frac{\left[\left(P_f * KG_f * MDF\right) + \left(P_p * KG_p * MDF\right)\right]}{Y} - C\right] * (1 + Vat_{rate})$$

where P_f is the price of fat, P_p represents the price of protein, KG_f represents the farms total number of kilograms in fat and KG_p represents the farms total number of kilograms in protein and Y is the total number of litres. The formula is adjusted using a milk density factor (MDF) typically with a value of approximately 1.03 to convert litres to kg of milk.

The rise in solids content is reflected in the growing gap between actual and standardized milk prices as evidenced in figure 4.4-3.

Figure 4.4-3: Actual and Standardised Milk Prices 2007-2016



Source: Central Statistics Office (2018)

During the course of 2016, a number of co-ops offered their suppliers a standardised fixed price in the region of 30 to 31 cent per litre, with adjustments for market changes in output and input prices in the case of Glanbia. Many of these standardised fixed prices were based on 3.6 per cent fat and 3.3 per cent protein. A farm producing milk with 4.1 per cent fat and 3.5 per cent would achieve a significantly higher milk price.

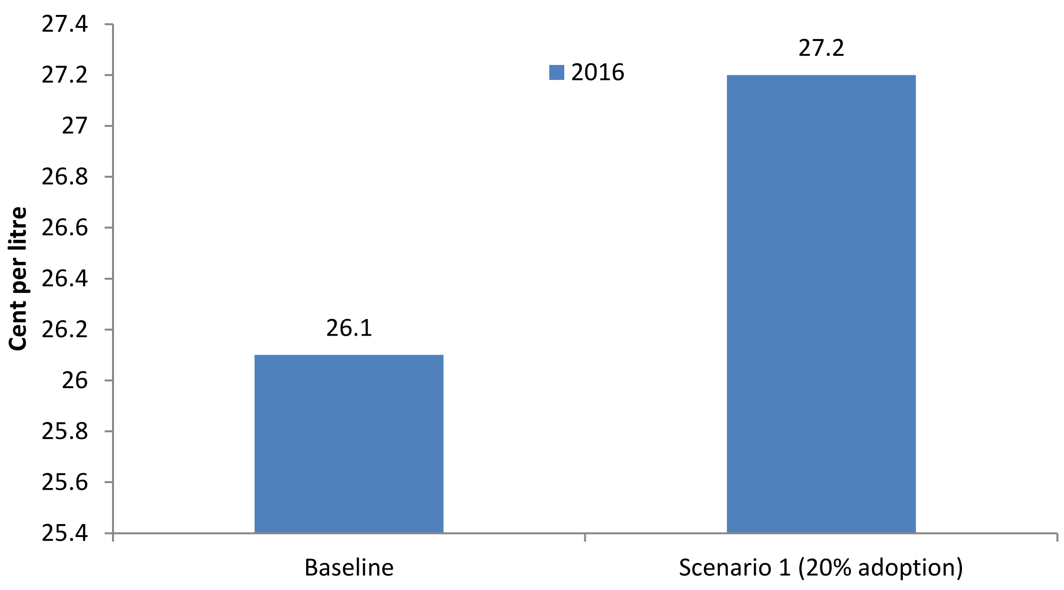
With a fixed price of approximately 30 cent per litre, it can be imputed that the fixed fat price can amount to approximately €3.40 per KG and fixed protein prices are effectively €5.90 per KG. In this scenario, we estimate that the difference between actual and standardised fixed price to be in the region of 3 cent per litre. This is a very significant difference from the often quoted standardised forward price.

The Impact of Forward Contract Adoption on Milk Price

The results presented in Figure 4.4-4 identifies what would have happened in terms of milk price received if each farm had committed 20 per cent of their production for the particular fixed price scheme of their processor in 2016. On an annual average basis, Figure 4.4-4 shows that dairy farmers would have gained 1.1 cent per litre if they adopted their processor fixed price contract for 20% of the their milk in 2016. It is important to note that the data presented in Figure 4.4-4 is exclusive of bonuses which would have been paid on the spot price and the fixed price but is inclusive of VAT.

Whilst the data in Figure 4.4-4 does not show a substantial benefit in terms of milk price paid in the fixed price scenario, it is clear that movements in the marketplace moved in the opposite direction during the course of 2016, relative to that anticipated at the time the prices were fixed for 2016, by the individual processors, resulting in a net benefit for those farmers that adopted the forward contracts.

Figure 4.4-4: Forward Contract Simulation, 2016, Spot Price versus Fixed Price Scenario



Source: Authors’ calculations using the Teagasc National Farm Survey data

Anecdotal evidence would suggest that in 2015, the opposite case occurred, with spot prices during 2015 trading lower than the fixed prices set by the few processors that had set fixed prices for 2015. Due to the relatively small sample size of processors that had offered fixed prices in 2015, it was not possible to replicate the analysis presented in Figure 4.4-4 for that year. However, in future years, with additional data collected in the NFS at farm level, (such as the proportion of milk forward sold and the fixed price level, along with A, B and C weightings) it will be possible to replicate this analysis.

4.5 Conclusions

The increase in milk price volatility in recent years has led to frequent calls for dairy farm adoption of forward contract pricing tools by industry leaders. The research carried out in this chapter examined the extent to which forward pricing tools have been used by Irish dairy farmers, the factors affecting adoption and the potential impact on average annual milk price. These results might be used to target educational programmes toward non-adopters.

Results have indicated that Irish dairy farmers that have used these forward contracting tools to date were younger, operated larger herds and produced more milk per cow. Dairy farmers from the South East were also more likely to have used milk forward pricing methods than dairy farmers located elsewhere, likely reflecting the fact that Glanbia was the market leader in offering forward contracts in Ireland.

Finally, using data from 2016, it appears that Irish dairy farmers would have been better off by over 1 cent a litre if they adopted forward contracting for 20% of their milk production. Obviously, the results would be different in other years, and it must be borne in mind that the overall objective of fixed milk price schemes is to reduce income volatility and not to 'beat the market'. However, this modelling exercise has identified a method by which NFS data can be used to track the impact of forward contracts on actual milk price paid and the impact on income volatility can be examined in future work.

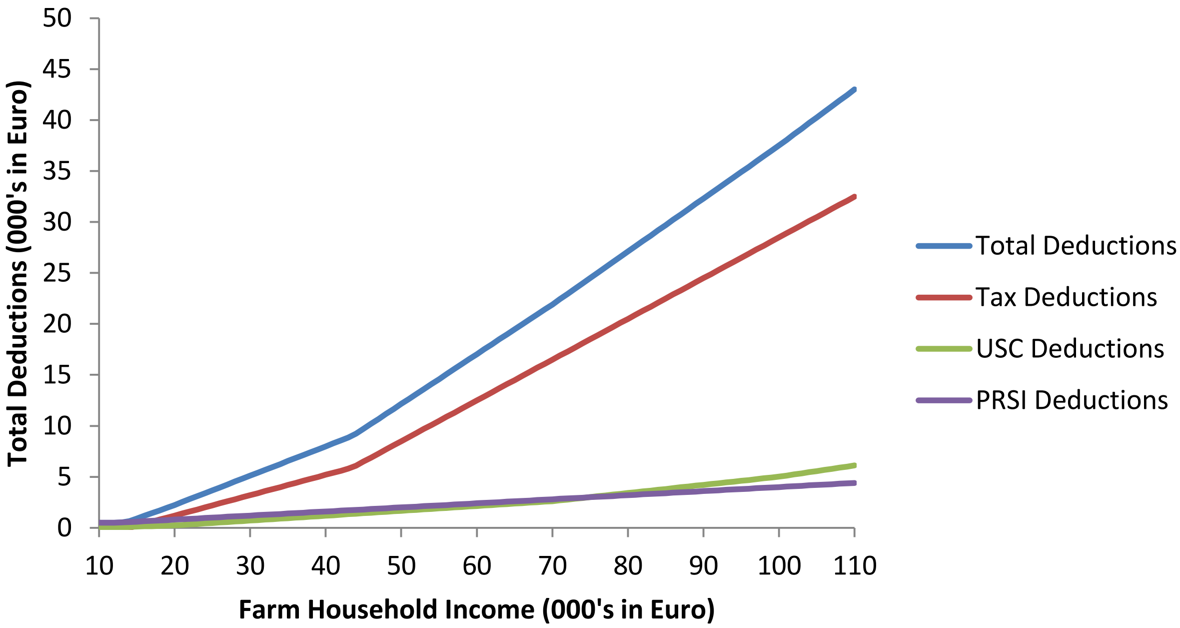
5. Taxation

5.1 Introduction

In this chapter, we analyse the income tax system and the role of new and existing risk management tools in smoothing the variability of taxable income and taxation liabilities over time. The analysis is based on both hypothetical farms and actual farm data from clients of the Farm Development Co-op (FDC). We examine the effectiveness of 'income averaging' and the potential effectiveness of the proposed '5-5-5 risk management tool' in smoothing taxable incomes. The latter instrument is proposed by the Irish Co-operative Organisation Society (ICOS) and involves savings accounts, which encourage a long-term approach towards risk management. The analysis is carried out with respect to farm households, which are specialising in milk production. The analysis is however, highly relevant to other farm households given that income volatility is an important issue for non-dairy farms. The economic modelling in this chapter is focused on income taxation and therefore excludes policy instruments such as state pension, farm assist and capital taxes.

The volatility of farm incomes has implications for the income tax liabilities of farm households. The income tax system in Ireland (and wider system of income deductions) is progressive. The income tax rate differs according to the level of household income. This is illustrated in figures 5.1-1 and 5.1-2 below. Deductions in the form of taxation, universal social charge (USC) and social insurance (PRSI) are relatively low as a proportion of farm income where income is below €20,000 per annum, but rise significantly thereafter.

Figure 5.1-1: Relationship between Farm Household Income and Deductions for Married Dairy Farmer with two Children [No Off-Farm Sources of Income or Spouse Employment]



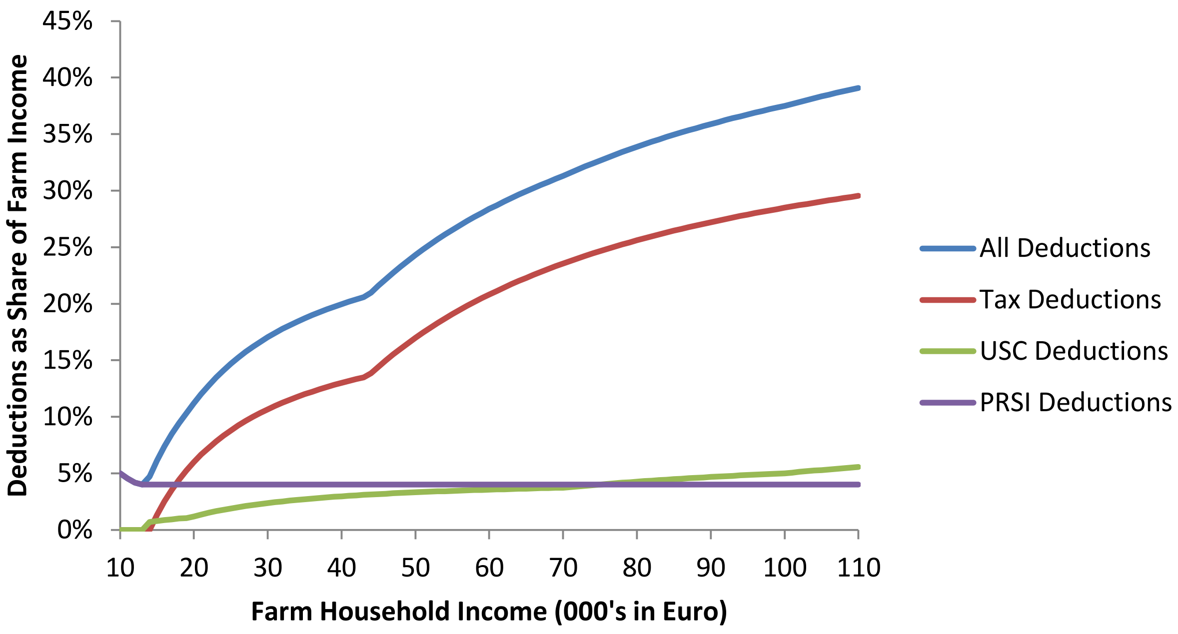
Source: Authors calculations using taxation rules from Revenue Commissioners

A standard rate of taxation applies to incomes below a certain threshold and a higher rate of taxation applies to incomes above this threshold. The rules regarding these thresholds vary according to the household composition and whether or not the spouse is engaged in paid employment. In the conventional taxation system, the rules are the same for farm and non-farm households, regardless of whether or not off-farm employment is present. However, the rules become much more complicated under the taxation system with the inclusion of 'income averaging', which we discuss later in this chapter.

For the case of a married couple (where the spouse does not work on or off-farm), a rate of 20 % applies to incomes below €43,550, while a rate of 40 % applies to incomes above this threshold. Where a spouse does work, the rate of 20 % applies to incomes below €69,100, while a rate of 40 % applies to incomes above this threshold. We find that 49 % of specialist dairy farms have a spouse with off-farm employment in 2016 (Teagasc 2017). These households do not enter the top income tax bracket until the combined income reaches €69,100. We also find that 10 % of specialist dairy farm operators have off-farm employment in 2016 and 55 % of specialist dairy farm households have either an operator or spouse with off-farm employment (Teagasc 2017).

The volatility of farm incomes can significantly change the effective tax rate, which may apply to individual farm households from year to year. This is clearly illustrated in figure 5.1-2.

Figure 5.1-2: Deductions as a Share of Household Income – The Case of a Married Dairy Farmer with two Children and no Off-Farm Sources of Income or Spouse Employment



Source: Authors calculations using taxation rules from revenue commissioners

During relatively good years, the farm household may incur particularly high tax liabilities, which are not reflective of the farms' average or typical income earned on the farm. For instance, in the case of a married couple with the spouse not in employment, the share of deductions in farm household income is approximately 20 per cent when the income is €40,000. The deductions reach 30 per cent of farm household income when the income is €65,000.

From a tax perspective, it is beneficial to have a spouse working on-farm. It allows the farm household to qualify for income averaging. Regardless of the family composition, the farm household pays no income tax up to €14,000. This is due to the standard and self-employed tax credits. The inclusion of tax credits reduces tax liabilities for all farm households, but is particularly important for low to middle income farm households, where tax credits account for a greater proportion of overall income.

In 2011, the introduction of the USC added another layer of complexity to the system. In 2018, this charge involves eight alternative rates of payment, increasing with the level of eligible income. The non-linear and progressive design of the tax system means that the effective tax rate can vary substantially between farm households in any given year.

A number of taxation policies seek to address the challenges posed by income volatility and enable farm households to reduce their tax liabilities over the medium term and better withstand periods of low farm income. For instance, the averaging of farm profits is permitted under section 657 of the Taxes Consolidation Act of 1997 and this enables farm households to smooth their tax liabilities over the medium-term. The 1997 Act enabled farm households to calculate their tax liabilities on the basis of their average income over three years. In Budget 2015, this policy underwent reform with an increase in the duration of the relevant period of 'income averaging' from three to five years. In Budget 2017, the policy was further reformed to allow farm households to withdraw temporarily from 'income averaging' for one year. This means that a farmer could revert to the normal tax system for one year and income tax would be assessed solely on the basis of income in that year.

The policy of 'income averaging' is limited however, in its capacity to address farm income volatility. Farms may still incur significant farm income volatility, but not benefit significantly from the adoption of the 'income averaging' tool. We explore the precise reasons later in this chapter. The tool may have limited impact where farm income fluctuates within a particular income tax bracket. In addition, the adoption of 'income averaging' is not permitted where the operator or spouse is engaged in off-farm employment. Given that 55 per cent of specialist dairy farms have either a farm operator or a spouse with off-farm employment, the income averaging system is certainly limited in terms of addressing the problems associated with high farm income volatility.

This rule is outlined in the following:

"Farmers who, or whose spouses/civil partner, carry on another trade or profession or who, or whose spouses/civil partner, are directors of companies which carry on a trade or profession cannot elect for income averaging unless that trade or profession is in relation to on-farm diversification and is conducted on the farmland" (Office of the Revenue Commissioners, 2018a).

During periods of relatively low farm income, the ability of farm households to meet their tax liabilities can be challenging. Dairy Research Ireland has proposed the implementation of a risk management tool, which would smooth the taxable income over the medium term. This risk management tool enables dairy farmers to set aside money during years of relatively high income and enables farmers to draw down the funds during years of relatively low income. The money would be allocated to a recognised, interest bearing fund, which would be managed by their milk processor, as a loan stock type instrument. This tool, referred to as the '5-5-5 tool' henceforth, leaves the farmer with significant room for decision-making with regard to when income is taxed and we describe some of the possible decision-making rules in more detail in section 5.3.

In this chapter, we outline the relationship between farm income volatility and income taxation for a set of hypothetical and actual farms. The use of hypothetical farms is due to the regulations surrounding the use of the Farm Accountancy Data Network (hereinafter "FADN") data for taxation purposes. This ensures compliance with the regulations set out in Council Regulation (EC) No 1217/2009 regarding the use of FADN data. Specifically, the text for this regulation ensures that the data 'are covered by strict confidentiality rules and can only be used to meet the needs of the CAP. For example, they cannot be used by authorities for tax or compliance purposes'.

We illustrate the financial impact of income averaging and the adoption of the 5-5-5 tool with the hypothetical farms and follow this with analysis from a sample of the FDC client farms. We use Teagasc NFS data to guide us in estimating the typical farm income volatility during recent times but we do not simulate taxation liabilities for farms in the Teagasc NFS. Due to data availability, the data from the FDC client farms is based on a five year period. For a more comprehensive assessment of the 5-5-5 risk management tool, we have established hypothetical farms with income variability being illustrated for a ten year period.

5.2 Income Averaging

In this section, we provide some hypothetical examples of farm households with variable incomes and with the adoption of the income averaging system. The first two of these examples are taken from a 2018 Revenue report regarding the income averaging system (Office of the Revenue Commissioners 2018A). In these Revenue examples, the extent of income variability was significantly greater than that experienced by the typical farm in the Teagasc NFS, over recent years.

We therefore create two other hypothetical farm examples. In these hypothetical examples, the farm household income varies from year to year and the extent of this variation is similar to the level of farm income variability evident from specialist dairy farms in the Teagasc NFS during the 2012 to 2016 period. Overall, we find that the income averaging system has significant limitations in terms of its capacity to reduce the uncertainty of after-tax income. These limitations are still evident despite the 2017 budget reforms, which have represented an improvement on the previous design of the system.

In this analysis, we refer to farm income in a particular year and the total deductions associated with farm income in that year. We acknowledge that, in practice, there is a time lag between the year of the farm income and the timing of the associated taxation payment. The pay and file deadline is typically at the end of October in the year following the receipt of the farm income. We do not deal with the cashflow implications of this time lag. We associate the year of the farm income with the taxation liabilities for that year and this is consistent throughout the analysis.

In table 5.2-1, we show an example from aforementioned the Revenue report, where the income varies strongly from year to year and the farm commences income averaging in 2015. This appears to be a good year to commence income averaging, as farm income is well above the average for the period 2011 to 2015.

Table 5.2-1: Income Averaging commenced in 2015

	Profit/loss in year of assessment	Aggregate for year of assessment and 4 previous years	Average profit for assessment (1/5 of Column 3)	Profit/loss Being Assessed
2011	15,000			15,000
2012	18,000			18,000
2013	21,000			21,000
2014	24,000			24,000
2015	30,000	108,000	21,600	21,600
2016	(21,000)[3]	72,000	14,400	14,400
2017	33,000	87,000	17,400	17,400

Source: Office of the Revenue Commissioners (2018a)

Under the income averaging system, the average profits for the year of assessment and the previous four years (i.e. 2011 to 2015) are subject to taxation, USC and PRSI. One can see from this hypothetical example that there are large differences between the actual profit in the year of assessment (Column 2) and the average profit for assessment under the income averaging system (Column 4). These differences only apply from 2015 to 2017 as the farm does not participate in income averaging during the earlier years. If the farm commits to participating in the income averaging system, the income subject to taxation is lower in 2015 and 2017 relative to the conventional taxation system. On the other hand, the income subject

[3] As the farmer has incurred a loss in 2016, he/she may choose to elect to temporarily opt out of averaging in that year.

to taxation is higher in 2016 under the income averaging system relative to the conventional taxation system.

Prior to the Budget 2017reforms, the total liabilities were calculated solely on the average income from the year of assessment and the preceding four years. The reforms announced in Budget 2017 allow the farm household to withdraw from income averaging for one year. In the first example outlined in table 5.2-1, this would have allowed the farm to temporarily opt out of income averaging in 2016.

In the following, we show an example of a hypothetical farm entering the system in 2014, where the farm operator decides to temporarily opt-out of the income averaging system. This example is again directly taken from the recent Revenue report. In this example, the farm operator faced a potential dilemma in 2016 where the averaged profit (column 2) greatly exceeded the actual profit in that year (Column 3). The amount of money subject to taxation would be much greater with the averaged profit relative to the actual profit in 2016. This farm does not have a particularly high farm income during any year and it is therefore likely that the farm would struggle to meet tax liabilities in 2016 under the income averaging system.

Table 5.2-2: Income Averaging with Temporary opt-out in 2016

Year	Averaged Profit	Actual Profit	Income Tax on Average Profit[4]	Income Tax on Actual Profit	Deferred Tax	Instalment (A-B /4) Payable over 4 years	Income Tax Due
2012		€37,000					
2013		€34,000					
2014[5]	€36,000	€37,000					
2015[6]	€37,000	€40,000					
2016[7]	€30,700	€ 5,500	€6,140	€1,100	€5,040		€1,100
2017	€24,900	€ 8,000	€4,980			€1,260	€6,240
2018	€20,100	€10,000	€4,020			€1,260	€5,280
2019	€18,700	€30,000	€3,740			€1,260	€5,000
2020	€17,700	€35,000	€3,540			€1,260	€4,800

Source: Office of the Revenue Commissioners (2018a)

Before the deduction of tax credits, the income tax on average profit would be €6,140 under the income averaging system and just €1,100 under the conventional tax system, where

[4] Assuming farmer pays tax at the standard rate.
[5] First elected for averaging in 2014, averaging calculated over 3 years
[6] Special measure for farmers who first elected to average in 2014, 2015 calculated over 4 years
[7] Averaged over 5 years

taxation is based on actual profit in that year of assessment i.e. 2016. This Revenue example excludes the deduction of tax credits.

The decision to temporarily opt-out of income averaging may therefore be a simple solution in the short-term. The farm operator can decide to temporarily opt-out and defer the payment of income tax. In this scenario, this involves postponing the payment of €5,040 in income tax (Column 6). This figure of €5,040 represents the difference between the income tax under the income averaging system in 2016 (i.e. €6,140) and the income tax due under the conventional system (i.e. €1,100). If the farm operator elects to temporarily opt-out and defer the tax payments, the farmer must then pay the amounts in instalments over the course of the following four years. These instalments are given in column 7 and total €1,260 in each year from 2017 to 2020.

The Budget 2017 reforms provide a short-term solution by allowing farmers to temporarily opt-out of income averaging. The farmer is required however, to repay amounts in instalments and this can pose serious problems in subsequent years where the farmer incurs consecutive years of relatively low farm income. This very much depicts the situation in this example from the Revenue report, where farm income is very low in three consecutive years from 2016 to 2018. The temporary opt-out provides short-term relief for the farmer in 2016, but the farmer faces a tax bill in 2017 and 2018, which is well in excess of the income tax that would be liable had the farmer stayed in the conventional tax system.

Representative Farms

In the following, we describe two representative farms with income variability that can be considered as typical for the period from 2012 to 2016. In these two examples, we assume that the operator and spouse have no off-farm income. In those circumstances, the income averaging system can apply.

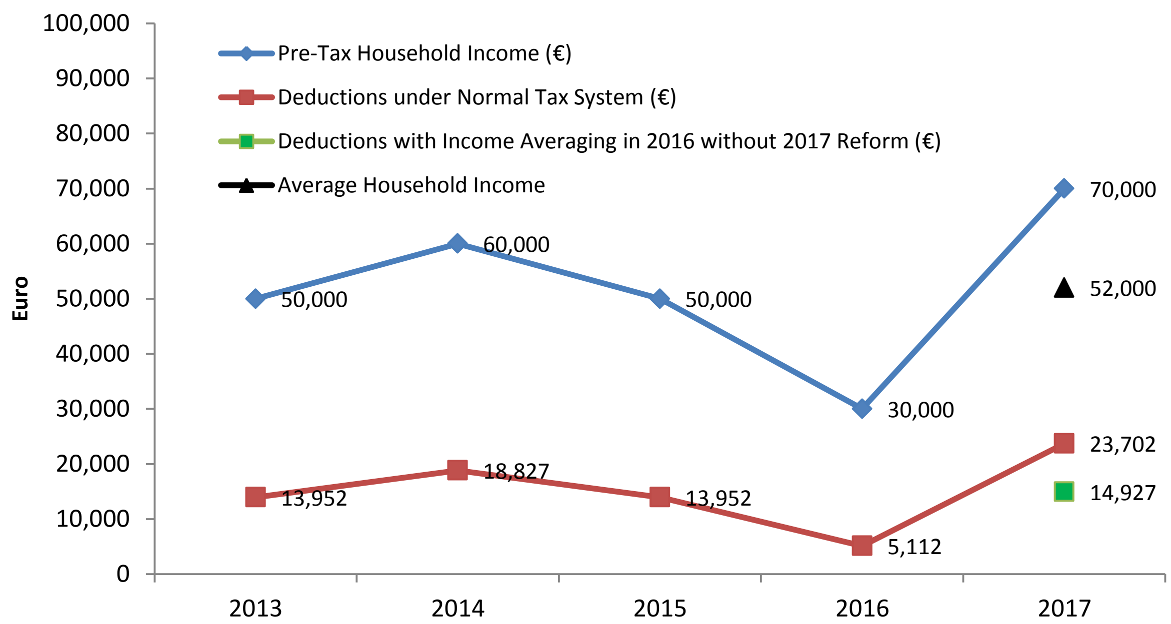
In figure 5.2-1, we provide an example of a farm household, which benefits in the short term, from participation in the income averaging system and is unlikely to temporarily opt-out of income averaging. Income variability is measured using the coefficient of variation. This measure is the standard deviation of income divided by the mean income and has been used frequently to estimate the variability of farm incomes (See for instance; Key et al 2017). In this example, the coefficient of variation in farm household income is 0.26 and is therefore quite typical for a specialist dairy farm in Ireland between 2012 and 2016[8]. We assume that the household entered the income averaging system in 2017 based on incomes from 2013 to 2017. In this example, we assume that five year averaging is present and the farm household can potentially choose between two alternative tax bills in the fifth year of participation in the income averaging system.

[8] Teagasc National Farm Survey data for 2017 is not available at the time of publication. We calculate the Coefficient of Variation using the data from 2012 to 2016.

In figure 5.2-1, the farm income is represented by the blue line, while the red line represents total deductions under the conventional taxation system. According to the blue line, farm income in this example is €50,000 in 2013, €60,000 in 2014, €50,000 in 2015, €30,000 in 2016 and €70,000 in 2017. According to the red line, total taxation, USC and PRSI liabilities under the conventional taxation system are €13,952 in 2013, €18,827 in 2014, €13,952 in 2015, €5,112 in 2016 and €23,702 in 2017. With the application of the income averaging system in 2017, the total liabilities for 2017 can be reduced to €14,927 as indicated by the green symbol.

In this example, the farm household can choose to pay total liabilities of €23,702 or total liabilities of €14,927 in 2017. The former amount reflects the total liabilities under the conventional taxation rules, while the latter amount reflects the total liabilities based on the average income from 2013 to 2017. In the short-term, the farm household can benefit by €8,775 via the reduced tax bill. The additional money can be allocated to a savings account and earn interest or used for additional investment. In subsequent years, the relatively high 2017 income will influence the averaged income. The benefits of the reduced tax bill in 2017 will therefore be cancelled out in subsequent years.

Figure 5.2-1: Household Income and Deductions 2013-2017 Single Dairy Farmer with no Off-Farm Income

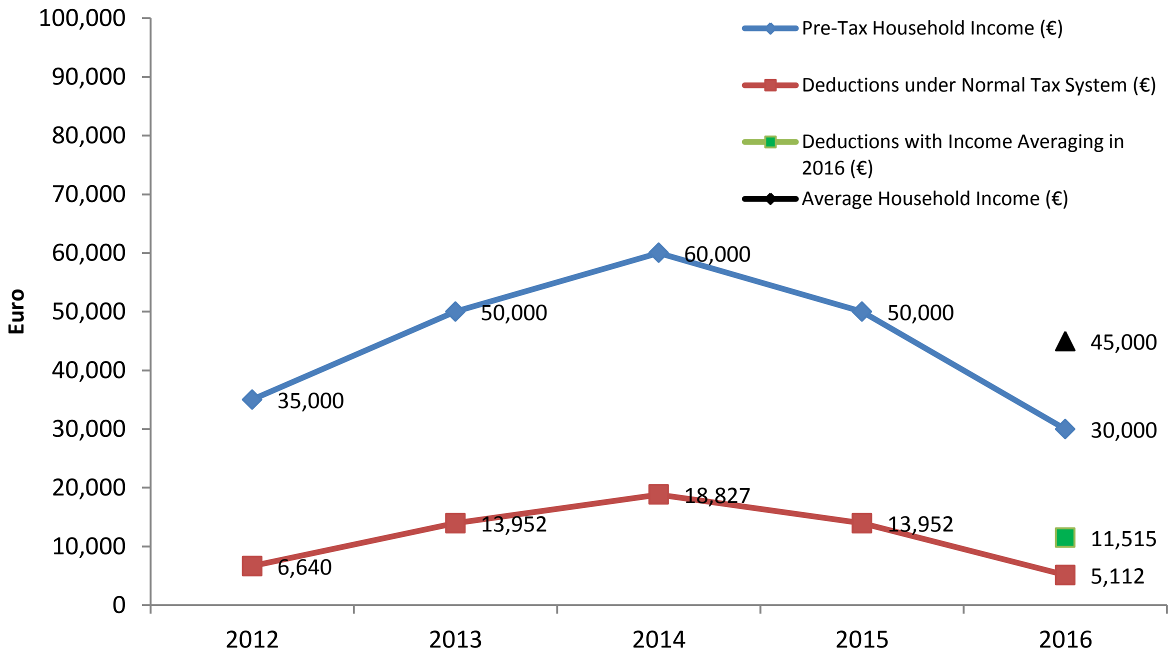


Source: Author's calculations using Teagasc National Farm Survey data

In figure 5.2-2, we provide our second hypothetical example. In this example, the coefficient of variation in farm household income is 0.24. This is again quite a typical level of income variability for a specialist dairy farm between 2012 and 2016. We assume that this farm is a participant in the income averaging system, but does not find the system to be beneficial in 2016. In this example, the farm income is again represented by the blue line. The relevant amounts are €35,000 in 2012, €50,000 in 2013, €60,000 in 2014, €50,000 in 2015 and €30,000 in 2016. The total deductions in taxation, USC and PRSI are represented by the red line. This line represents the total deductions with the conventional taxation system as applies with the 2018 tax policies. These deductions total €6,640 in 2012, €13,952 in 2013, €18,827 in 2014, €13,952 in 2015 and €5,112 in 2016.

In the fifth year of the income averaging period, the farm is liable for taxation according to the income in the year of assessment and the preceding four years. This average profit figure is €45,000 in 2016, based on the incomes from 2012 to 2016, and this is represented by the black triangle. This figure exceeds the actual farm income in that year. The year 2016 proved to be difficult for many Irish dairy farmers, so this is not an unusual example. This means that total taxation, USC and PRSI liabilities are much greater in 2016 under the income averaging system relative to the conventional taxation system. The total liabilities reached €11,515 in 2016 under the income averaging system as represented by the green symbol. This contrasts with the total liabilities of €5,112 in 2016 under the conventional taxation system, as represented on the red line.

Figure 5.2-2: Household Income and Deductions 2012-2016 Single Dairy Farmer with no Off-Farm Income

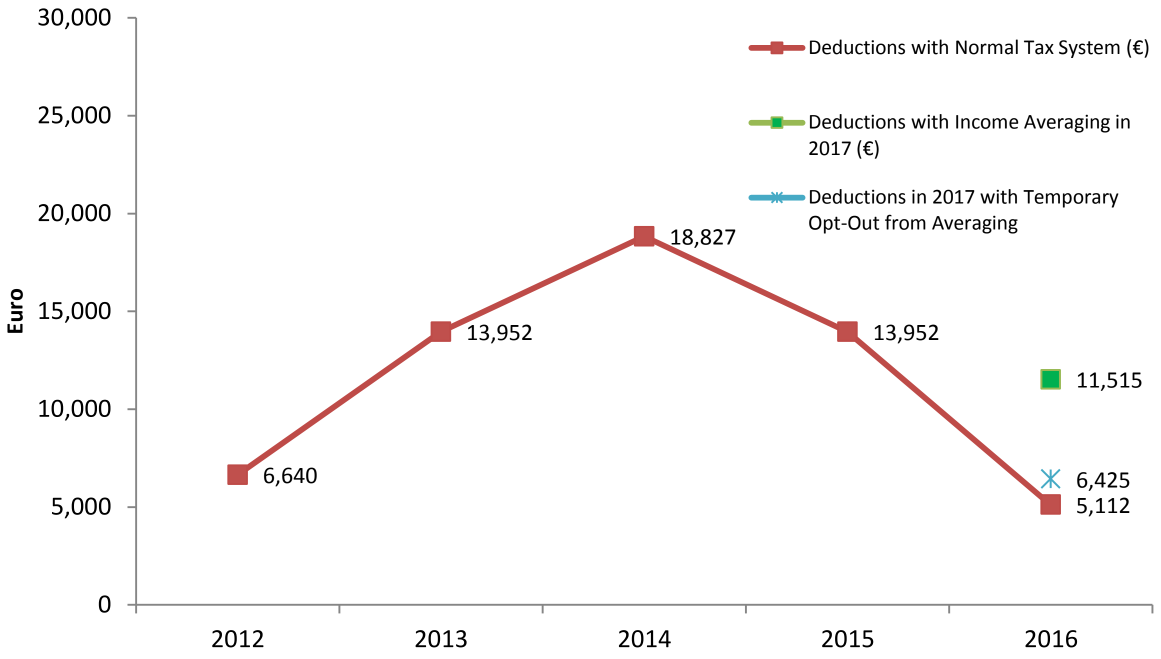


Source: Author's calculations using hypothetical Farm data

The option to temporarily opt-out of averaging means that the farm household can withdraw from income averaging for one year. In that situation, the farm household may incur reduced taxation liabilities. The situation is complicated however, by the rule which forbids farmers from deferring the payment of USC and PRSI. We illustrate the implications of this rule for 2016 in figure 5.2-3. This rule means that the farm must forego €6,425 in taxation, USC and PRSI combined, even if the farmer wishes to temporarily opt-out of income averaging.

In figure 5.2-3, we show that the farm household could have faced three alternative tax bills in 2016, depending on their decision about when to first enter the averaging system and their decision to potentially opt-out of income averaging for one year. The liabilities would have totalled €5,112 in 2016, if the farmer had chosen to stay with the regular taxation system and never adopted the income averaging system. If the farmer had decided to adopt income averaging, but not temporarily opt-out of averaging, then the total liabilities would have been €11,515 in 2016. If the farmer had adopted income averaging, but chosen to temporarily opt-out, then the total liabilities in 2016 would have been €6,425. In summary, there is an incentive for the farmer to temporarily opt-out of income averaging in 2016. It is the case, however, that the farmer is only permitted to temporarily opt-out once during a five year period.

Figure 5.2-3: Total Taxation, USC and PRSI Deductions 2012-2016 Single Dairy Farmer with no Off-Farm Income



Source: Author's calculations using hypothetical Farm data

Our overall assessment from these four examples is that the income averaging system has limitations. This is despite the Budget 2017 reforms, which do represent an improvement on the previous policy design. The income averaging system has limited appeal as a risk management tool. The rules relating to the off-farm employment of the operator and spouse are onerous and mean that over half of all specialist dairy farms are automatically excluded from participation in the system. The income averaging system does not perform well in circumstances where there are consecutive years of low income. This is illustrated by the second example from the recent Revenue report.

Arguably of greater significance is that the income averaging system does not encourage farmers to act in a pro-active manner. The election to participate in income averaging represents an active attempt by the farmer to manage income risk. However, the participation in income averaging is largely a passive form of risk management once the farmer enters the scheme. While farmers can elect to temporarily opt-out of the scheme or indeed permanently opt-out, there is little space for active risk management while the farmer remains within the scheme.

With more control over the risk management process, farmers could potentially succeed in managing income risk, while simultaneously making decisions to expand or reduce their milk production. Many farms have expanded heavily as a result of the abolition of milk quota and this involves heightened production risk in addition to increased price risk. With increasing production levels, farms can experience larger swings in farm income, relative to that experienced during the quota era. This means that farm income can reach unexpected lows and threaten the viability of the farm. At the same time, farmer may wish to reduce their production levels significantly and the income averaging system can be problematic in those circumstances. With income averaging, farmers wish to avoid situations where their tax liabilities are based on production and income levels, which are much lower in the year of assessment relative to the preceding four years. Dairy farmers require risk management tools, which encourage them to plan for the future, taking into account expansion and contraction decisions.

5.3 The 5-5-5 Risk Management Tool

The 5-5-5 risk management tool involves savings accounts, which encourage a long-term approach towards risk management. There are many reasons in support of establishing this form of risk management tool. In a report for the European Commission, Bardaji et al (2016) outline a number of advantages of savings accounts and explain that 'savings accounts provide a solution towards information asymmetries, especially moral hazard'. The problem of moral hazard is diminished with this form of risk management tool. Farmers are incentivised to actively manage risk in their farming activities, as it is their own money which is at stake. Bardaji et al concluded that 'saving accounts encourage a long-term vision of risk management, compared to insurance policies which have to be renewed each year'. There remain concerns however regarding the design of the withdrawal conditions, which could lead to large amounts of capital remaining in the accounts and this would lessen the role of savings accounts as an income stabilization tool. The 5-5-5 tool is designed to ensure that large amounts of capital do not remain in the account for a long duration. In the following, we outline, in some detail, the design of the 5-5-5 tool and the potential impact on managing farm income variability over time.

The farmer has a good degree of autonomy under the proposed 5-5-5 tool and can therefore manage risk in a proactive manner. The farmer can pursue a number of alternative decision rules in operating the 5-5-5 risk management tool. The precise decision-making process is likely to be influenced by the farmer's attitude to risk, their exposure to income risk and their determination to smooth their taxable income over the medium term.

ICOS have proposed the introduction of this income stability tool with three components:

- 5 year income averaging: The scheme should be open to farmers participating in the 5 year income averaging scheme already in place
- 5% of annual milk receipts: The scheme will permit a farmer to voluntarily defer up to 5% of their milk receipts in any one year
- 5 year draw down period: The scheme will allow the deferred funds to be drawn down at any time within a maximum of 5 years, and subject to income tax at the time of draw down

The farmer can choose to defer 5% of their milk receipts in a good income year, by placing it in an interest bearing account. The farmer can make further decisions about when to draw down the money. This money is then subject to income tax at the time it is drawn down. The maximum period any sum of deferred income can be retained in the scheme is 5 years from the date the deferred income is introduced to the scheme (the scheme will operate on a 5 year rolling; first in-first out basis). The tool applies to farm households with and without off-farm employment. The tool allows farmers to earn interest on the fund at a compound rate of 3% per annum. This interest rate lies well above currently available deposit rates. The relatively high interest rate of 3% is included in our analysis as a form of stress test for meeting the de minimis regulations. Under these regulations, member states can transfer a maximum of €15,000 to any single undertaking over any period of 3 fiscal years. The interest earned with the application of the 5-5-5 tool can be considered as a form of state aid and the amount of interest earned must fall within the de minimis regulations.

This analysis does not account for the deduction of the Deposit Interest Retention Tax (DIRT). The DIRT tax can lead to a significant reduction in the value of interest earned through the application of the 5-5-5 risk management tool. The DIRT rate in 2018 is 37% and this is set to decrease to 35% in 2019 and decrease by a further 2% in 2020 to 33% (Office of the Revenue Commissioners 2018b).

Farmer Decision-making Rules

In order to model the potential impact of the 5-5-5 tool, we must make assumptions about the farmers' decision-making behaviour. For practical reasons, we assume that the farmer has a good estimate of their average farm income over the ten year period but is unsure about the extent of income volatility that will arise. In our hypothetical examples, the ten year period ranges from 2008 to 2017.

The farmer has a clear incentive to create a buffer stock of deposits in the early years in the scheme, which will enable the farm household to withstand extreme forms of income volatility in the following years. In the first two years of the scheme, the decision rule is that the farmer will allocate 5% of their receipts or the difference between their farm income in that year and 80% of a farm income threshold, whichever is the lower. This type of behaviour is consistent with an attempt to accumulate buffer stocks. Each farmer has an income threshold in mind when making decisions with this tool. After the first two years in the scheme, the farmer allocates 5% of their receipts or the difference between their farm income in that year and the farm income threshold, whichever is the lower amount. In some years, the farmer will not defer the full 5% of milk receipts, because the farm income may not greatly exceed the income threshold. By using 80% of the normal threshold in the first two years, the farm is committing to the creation of a buffer stock of deposits, which can be accessed over the following three to four years.

In the following hypothetical example (Table 5.3-1), we show the income threshold and chosen deferred amount under this set of decision rules. In this example, where the threshold is €45,000, the farm income exceeds the threshold in 2013, 2014 and 2017. The farmer decides to defer money into the fund in all of these years. The maximum allowable amount is €10,000 in any year, as this constitutes 5 per cent of total milk receipts. The chosen deferred amount is slightly lower than the maximum in 2013 as the farm income exceeds the threshold by €9,000 and therefore the farmer does not allocate the maximum €10,000 into the fund in that particular year. In 2014 and 2017, the farmer allocates the maximum amount into the fund. We do not mention the drawing down of income in this table, but income is likely to be drawn down in 2015 and 2016 in order to smooth taxable and disposable household income over time. The funds deferred in 2013 must be drawn down in 2018 at the latest, as five years will have elapsed.

Table 5.3-1: Income and Deductions 2008-2017 Dairy Farmer with no Off-Farm Income

Year	Farm Income	Total Milk Receipts	Income Threshold[9]	Maximum Deferral	Chosen Deferral
2013	€45,000	€200,000	€36,000	€10,000	€9,000
2014	€60,000	€200,000	€36,000	€10,000	€10,000
2015	€35,000	€200,000	€45,000	€10,000	€0
2016	€30,000	€200,000	€45,000	€10,000	€0
2017	€65,000	€200,000	€45,000	€10,000	€10,000

Source: Author's calculations using hypothetical farm data

[9] Threshold is lower in the first two years so that the farm can accumulate buffer stock of deposits in the fund.

Impact of 5-5-5 Tool on Farm Income Variability - Example One

We now describe a hypothetical example encompassing decisions relating to both the deferral and draw down of money to and from the fund. In this first example, we analyse a farm with average income and a median or typical level of farm income volatility from 2008 to 2017. In this first example, the farm does not undergo significant expansion despite the milk quota abolition. Throughout these examples, we refer to two alternative definitions of income 1) pre-tax household income and 2) disposable household income, the latter includes the deduction of taxation.

In this first example, the farm operator is willing to defer money into the fund when the pre-tax farm household income exceeds €38,000 in any given year. The farm draws down money when the farm income falls below this threshold. In the first two years of applying the tool, the threshold is 80 per cent of €38,000 (i.e. €30,400) as the farm seeks to create a buffer stock of deposits in the fund.

Income variability is typical and the coefficient of variation in pre-tax household income is 0.34 over the ten year period and therefore similar to the national average of 0.33 identified in the Teagasc NFS. Income variability between 2008 and 2017 was heavily influenced by the severe downturn in milk prices in 2009 and the less severe downturn in 2016. In this scenario, the farmer has managed to smooth their taxable income over the ten year period. Under the adoption of the 5-5-5 tool, the farmer has deferred funds in 2008, 2011, 2012, 2013, 2014, 2015 and 2017. Funds are drawn down in 2009 and 2016. The money deferred in any given year must be drawn down within five years. For example, the money deposited in 2011 must be drawn down by 2016 at the latest. The money deferred in 2017 must be drawn down by 2022 at the latest. No money is drawn down from the fund in 2010 as the fund is empty at that point in time. This underlines the importance of applying multiple risk management tools when there is little or no money in the savings account.

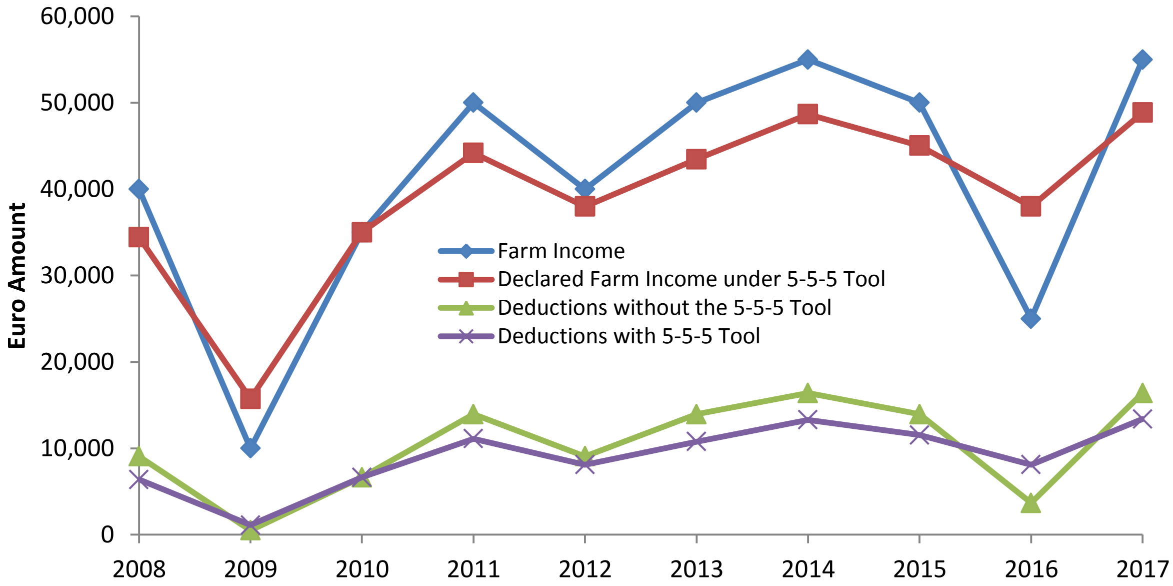
The adoption of the 5-5-5 tool helps the farmer reduce the farm income variability significantly. This is evident from Figure 5.3-1, where we provide a comparison of farm income and the declared farm income under the 5-5-5 tool. The red line represents the declared income under the 5-5-5 tool and is smoother than the blue line, representing farm income under the conventional taxation system.

In table 5.3-3, we report the impact of the 5-5-5 tool on the statistics for income variability. In terms of disposable household income (i.e. after income tax), the coefficient of variation for disposable household income declines from 0.28 to 0.19. In terms of pre-tax household income, the coefficient of variation declines from 0.34 to 0.24. By adopting the 5-5-5 risk management tool, the farmer in this example has reduced deductions in tax, USC and PRSI over the ten year period. This is due to the impact of the 5-5-5 tool in smoothing farm income over the ten year period. The farmer possesses a gross fund totalling €22,215 at the end of 2017. This money will be subject to taxation when it is drawn down.

Arguably, the main benefit of adopting the tool is that income variability is reduced and the availability of money in the interest-bearing fund reduces economic uncertainty for the farmer. The farmer can make future decisions for farm expansion with less worry or concern about the potential negative effects of price and income volatility.

One limitation of the 5-5-5 tool is however, evident in this example. In this example outlined in figure 5.3-1, there is no money in the fund in 2010 and the farm household is limited in terms of its ability to smooth the post-tax disposable income. It therefore seems reasonable to conclude that farmers should consider adopting multiple risk management tools in the early years of applying the 5-5-5 tool or any other similar risk management deposit scheme. With low funds in the account, the farm remains very vulnerable to price and production risks. A combination of forward contracting and the 5-5-5 tool could have supported much better outcomes in 2009 and 2016. Neither the forward contracting tool nor the 5-5-5 tool were available in 2009, although most farmers could potentially avail of forward contracting at some point during 2016.

Figure 5.3-1: Income and Deductions 2008-2017 Married Dairy Farmer with no Off-Farm Income



Source: Authors' calculations using hypothetical farm data and taxation rules from Revenue Commissioners

Table 5.3-2: Income and Deductions 2008-2017 Married Dairy Farmer with no Off-Farm Income

	Pre-Tax Farm Household Income	Pre-Tax Farm Household Income under 5-5-5 Tool	After-Tax Income	After-Tax Income under 5-5-5 Tool	Deferred Amount	Milk Receipts
2008	40,000	34,440	30,923	28,051	5,561	111,210
2009	10,000	15,727	9,500	14,618	0	76,560
2010	35,000	35,000	28,360	28,360	0	101,640
2011	50,000	44,176	36,048	33,063	5,825	116,490
2012	40,000	38,000	30,923	29,898	2,000	106,920
2013	50,000	43,466	36,048	32,699	6,534	130,680
2014	55,000	48,664	38,610	35,363	6,336	126,720
2015	50,000	45,034	36,048	33,503	4,967	99,330
2016	25,000	38,000	21,325	29,898	0	91,080
2017	55,000	48,862	38,610	35,465	6,138	122,760

Source: Authors' calculations using hypothetical farm data and taxation rules from revenue commissioners

Table 5.3-3: Summary Statistics for Farm Income in Example One

	Farm Income	Farm Income under 5-5-5 Tool	After-Tax Income	After-Tax Income under 5-5-5 Tool
Standard Deviation	13,748	9,241	8,682	5,750
Average	41,000	39,137	30,640	30,092
Coefficient of Variation	0.34	0.24	0.28	0.19
Pool of Funds (inc. interest due)		22,215		

Source: Authors calculations using hypothetical farm data and taxation rules from revenue commissioners

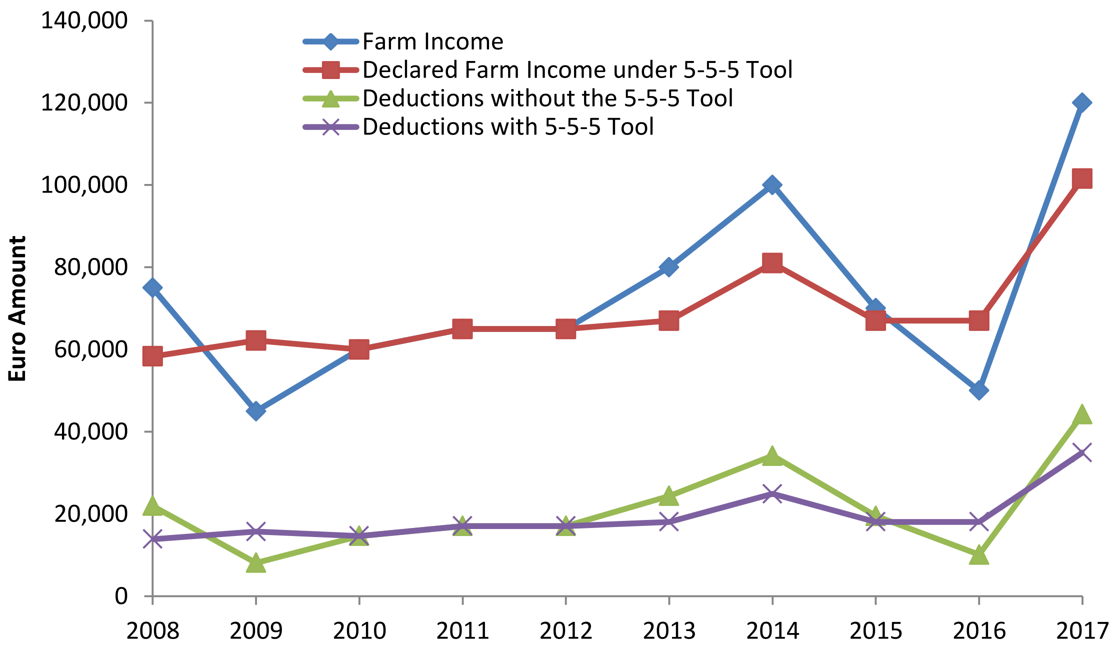
Impact of 5-5-5 Tool on Farm Income Variability - Example Two

In the second example, we analyse the situation of a farm with above average farm income and typical farm income variability. In this example, the adoption of the 5-5-5 tool supports the reduction in pre-tax farm household income. In this scenario, the farmer has managed to smooth their taxable incomes over the ten year period while expanding production. This is a farm which has maintained production at 990,000 litres of production over the ten year period. In this example, the farm operator is willing to defer money into the fund when the pre-tax farm household income exceeds €67,000 in any given year. The farm draws down money when the farm income falls below this threshold. In the first two years of applying the tool, the threshold is 80 per cent of €67,000 (i.e. €53,600), as the farm seeks to create a buffer stock of deposits in the fund.

Under the adoption of the 5-5-5 tool, the farmer has deferred funds in 2008, 2013, 2014 and 2017. Funds are drawn down in 2010 and 2016. The farmer decides against drawing down money in 2009 in order to maintain a buffer stock of deposits.

In table 5.3-5, we show that the adoption of the 5-5-5 tool helps this farmer reduce the pre-tax farm household income variability significantly with the coefficient of variation declining from 0.29 to 0.18. The coefficient of variation for disposable income (i.e. after tax income) declines from 0.21 to 0.12. By adopting the 5-5-5 risk management tool, this farmer has reduced deductions in tax, USC and PRSI over the ten year period. This is again due to the impact of the 5-5-5 tool in smoothing farm income over the ten year period. The farmer however, possesses a fund totalling €40,674 at the end of 2017. This money will be subject to taxation when it is drawn down.

Figure 5.3-2: Income and Deductions 2008-2017 Married Dairy Farmer with no Off-Farm Income



Source: Authors' calculations using hypothetical farm data and taxation rules from Revenue Commissioners

Table 5.3-4: Income and Deductions 2008-2017 Married Dairy Farmer with no Off-Farm Income

	Household Income	Household Income under 5-5-5 Tool	After-Tax Income	After-Tax Income under 5-5-5 Tool	Deferred Amount	Milk Receipts
2008	75,000	58,319	53,023	44,445	16,682	333,630
2009	45,000	62,182	36,873	46,454	0	229,680
2010	60,000	60,000	45,336	45,336	0	304,920
2011	65,000	65,000	47,898	47,898	0	349,470
2012	65,000	65,000	47,898	47,898	0	320,760
2013	80,000	67,000	55,586	48,923	13,000	392,040
2014	100,000	80,992	65,836	56,094	19,008	380,160
2015	70,000	67,000	50,461	48,923	3,000	297,990
2016	50,000	67,000	39,873	48,923	0	273,240
2017	120,000	101,586	75,762	66,649	18,414	368,280

Source: Authors' calculations using hypothetical farm data and taxation rules from Revenue Commissioners

Table 5.3-5: Summary Statistics for Farm Income in Example Two

	Household Income	Household Income under 5-5-5 Tool	After-Tax Income	After-Tax Income under 5-5-5 Tool
Standard Deviation	21,471	12,205	11,073	6,258
Average	73,000	69,408	51,855	50,154
Coefficient of Variation	0.29	0.18	0.21	0.12
Pool of Funds (inc. interest due)		40,674		

Source: Authors calculations using hypothetical farm data and taxation rules from revenue commissioners

Impact of 5-5-5 Tool on Farm Income Variability - Example Three

In the third example described in table 5.3-7, the farm expands significantly in advance of the milk quota abolition. The coefficient of variation of farm income is 0.4. This farm has income variability, which is initially higher than the median case from the Teagasc National farm survey data from 2008 to 2017. As an expanding farm, this case is not unusual with significant expansion in advance of milk quota abolition. In this third example, the farm operator is willing to defer money into the fund when the pre-tax farm household income exceeds €37,000 in any given year. The farm draws down money when the farm income falls below this threshold. The exception applies for the first two years in the scheme when the farmer is willing to defer money when the farm income falls below 80% of €37,000 i.e. €29,600.

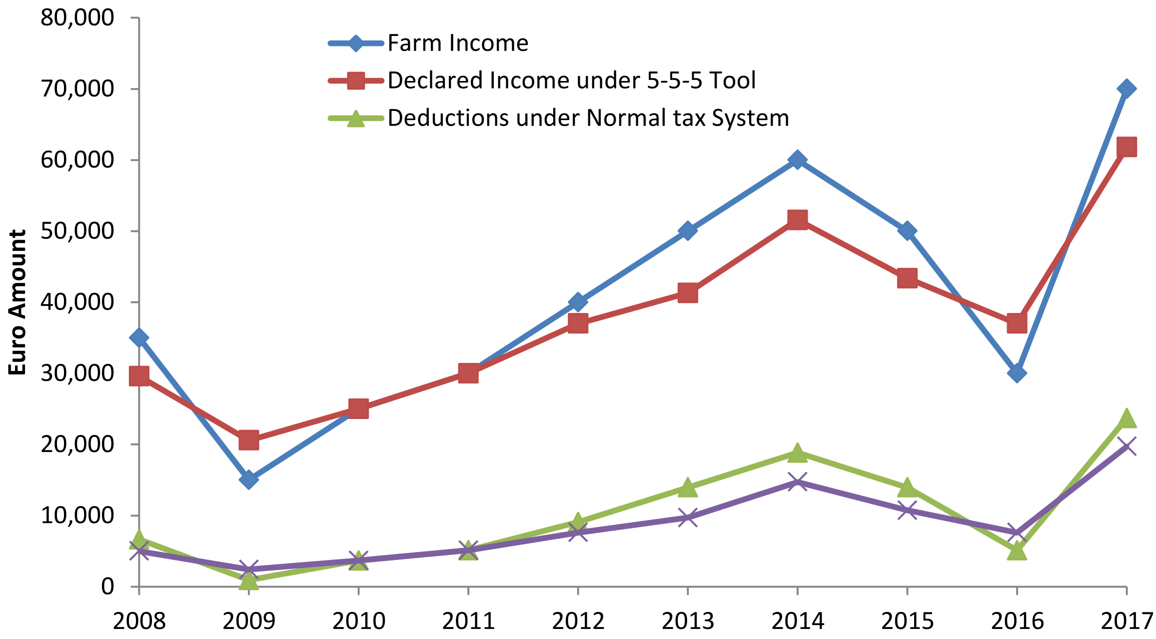
In figure 5.3-3, we show that the farm has an income of €35,000 in year one and this is above 80 per cent of the threshold income of €29,600. For this reason, the farm chooses to defer income in year one (i.e. 2008) with the total deferred amount reaching €5,400. This deferral is the difference between the €35,000 of pre-tax income and the figure of €29,600, which is the threshold in the first two years of participation in the 5-5-5 scheme. This is still somewhat below the maximum allowable deferral, which would amount to 5 per cent of total milk receipts. These milk receipts totalled €148,280 in 2008 (Table 5.3-6) and 5% of this figure would amount to €7,414.

In this example, the Milk receipts vary from year to year due to the changing milk price and some expansion in advance of milk quota. Apart from 2008, the farm does not commit large deferrals in the early years of participation with the tool. This is due to the farm income being relatively low and the amount of money in the fund being also low or indeed empty in 2010. In 2013, the farm income is €50,000 and therefore well above the threshold and the farm income of the previous years. In 2013, the farm commits the full 5 per cent of milk receipts i.e. €8,712 to the fund. The resulting income volatility and tax deductions are illustrated in Figure 5.3-3.

In this example, the farm manages to smooth their taxable income over the ten year period and incurs lower tax deductions in 2008, 2012, 2013, 2014, 2015 and 2017 than would have been the case without the 5-5-5 tool. In table 5.3-7, we show that the variability of pre-tax farm income declines significantly in this example with the coefficient of variation of farm income declining from 0.4 to 0.31. The application of the 5-5-5 tool helps reduces the income variability to the level experienced by the average specialist dairy farm during this time. The farm incurs significantly higher tax deductions in 2016. This is due to the decision of the farmer to draw down money in 2016. Over the ten year period, the variability in post–tax household disposable income also declines. The coefficient of variation in the household disposable income declines from 0.3 to 0.23.

At the end of 2017, the farmer has a fund totalling €31,429. This money will be subject to taxation when it is drawn down. Arguably, the main benefit of adopting the tool is that income variability is reduced and the availability of money in the interest-bearing fund reduces economic uncertainty for the farmer. This farmer has experienced modest incomes for most of the period, but has taken advantage of the milk quota abolition and is intent on further expansion. Under these circumstances, the farmer can make business decisions, with less uncertainty about the potential negative effects of price and income volatility.

Figure 5.3-3: Income and Deductions 2008-2017 Single Dairy Farmer with no Off-Farm Income



Source: Authors' calculations using hypothetical farm data and taxation rules from Revenue Commissioners

Table 5.3-6: Income and Deductions 2008-2017 Single Dairy Farmer with no Off-Farm Income

	Farm Income	Farm Income under 5-5-5 Tool	After-Tax Income	After-Tax Income under 5-5-5 Tool	Deferred Amount	Milk Receipts
2008	35,000	29,600	28,360	24,603	5,400	148,280
2009	15,000	20,562	14,080	18,163	0	102,080
2010	25,000	25,000	21,325	21,325	0	135,520
2011	30,000	30,000	24,888	24,888	0	155,320
2012	40,000	37,000	30,923	29,385	3,000	142,560
2013	50,000	41,288	36,048	31,583	8,712	174,240
2014	60,000	51,552	41,173	36,843	8,448	168,960
2015	50,000	43,378	36,048	32,654	6,622	132,440
2016	30,000	37,000	24,888	29,385	0	121,440
2017	70,000	61,816	46,298	42,104	8,184	163,680

Source: Author's calculations using hypothetical farm data and taxation rules from Revenue Commissioners

Table 5.3-7: Summary Statistics for Farm Income in Example Three

	Farm Income	Farm Income under 5-5-5 Tool	After-Tax Income	After-Tax Income under 5-5-5 Tool
Standard Deviation	16,039	11,830	9,201	6,827
Average	40,500	37,720	30,403	29,093
Coefficient of Variation	0.40	0.31	0.30	0.23
Pool of Funds (inc. interest due)		31,429		

Source: Authors' calculations using hypothetical farm data and taxation rules from Revenue Commissioners

5.4 Impact of 5-5-5 Risk Management Tool on FDC Farms

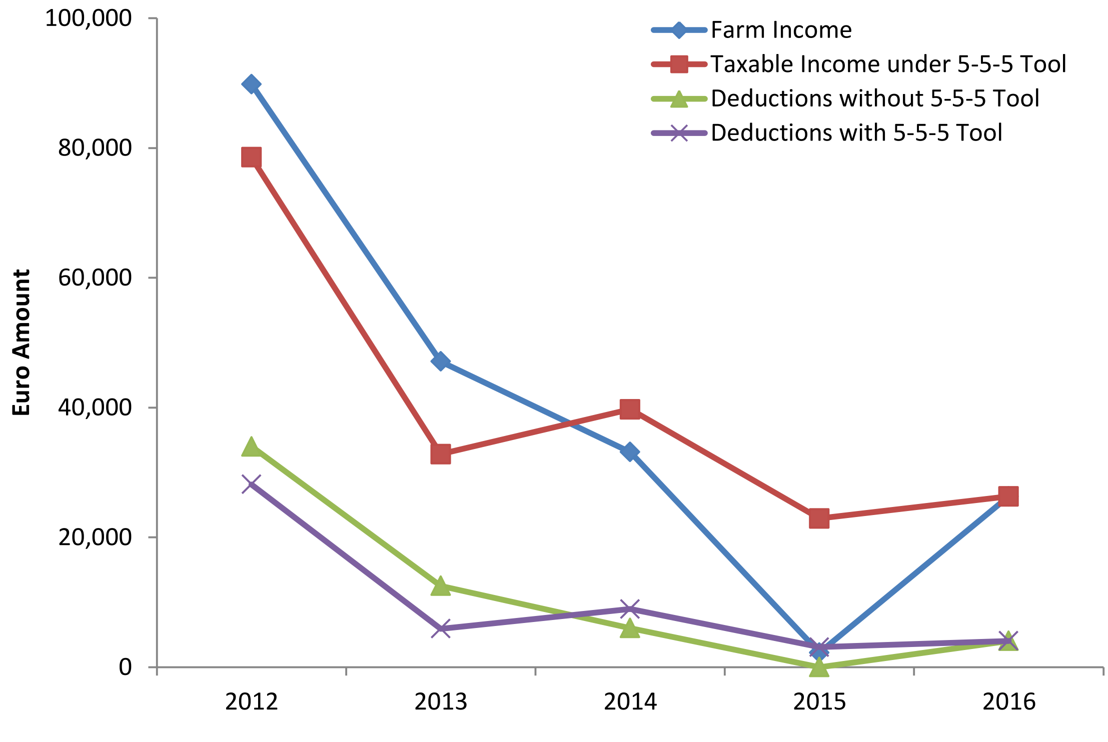
In this section, we present simulation results for three FDC farms under three scenarios 1) with the adoption of the 5-5-5 tool and 2) with the adoption of income averaging 3) without the adoption of income averaging or the 5-5-5 tool. These farms are clients of the FDC accountancy firm and have kindly agreed to supply farm income data for the five year period from 2012 to 2016 to allow the exercise to be conducted. The FDC farm data provides us with real-world examples of income volatility during recent years. The levels of farm income volatility are high in all three scenarios and it is valuable to assess the impact of the tool on income variability in these scenarios. The detailed FDC accounts data illustrate the reasons for the volatility in farm incomes from year to year. These reasons vary across all three farms and concern both price and production risks. In addition, the detailed farm data shows the impact of deliberate decisions such as the hiring of labour or renting of additional land. We take care in not providing detailed figures from the detailed accounts in this section to preserve anonymity, but we do provide a summary of the impact of adopting the 5-5-5 tool on income variability over time.

These three FDC farms are quite different in terms of their average income level. In all three cases, the degree of income variability is well above the national average. In the first case, the farm does not expand significantly in terms of production, but there is considerable expansion in production in the second and third farm in our examples.

FDC Farm One

We describe the first example in figure 5.4-1. Statistics are provided in tables 5.4-1 and 5.4-2. Table 5.4-1 shows the farm incomes with and without the application of the 5-5-5 tool. In this example, the farm income is relatively low for much of the period and there is no great increase in milk production despite quota abolition. The farm commits the maximum 5% of milk receipts to the fund in the first two years of participation in the scheme. This amounts to €11,270 in year one and €14,264 in year two. The farm experiences a large negative shock to farm income in 2015 and struggles thereafter. The application of the 5-5-5 risk management tool helps smooth the taxable farm income.

Figure 5.4-1: Married Farmer with no Off-Farm Income and Relatively Low Farm Income



Source: Authors' calculations using data from the FDC accountancy firm

For this farm, participation in the 5-5-5 scheme significantly reduces the amount of deductions in taxation, USC and social insurance over the five year period. Total deductions are reduced by approximately €6,500 over the five year period. The farmer has committed the maximum allowable deferral in 2012 and 2013 in order to establish a buffer stock of deposits. Monies are therefore available to be drawn down from the fund in both 2014 and 2015. The coefficient of variation in after-tax income declines from 0.61 to 0.36, as a result of adopting the 5-5-5 tool. The success of the farmer in managing the 5-5-5 tool and the income variability is dependent on depositing the maximum allowable amount in the first two years.

Table 5.4-1: Married Farmer with no Off-Farm Income and Relatively Low Farm Income

	2012	2013	2014	2015	2016	Total deductions
Milk receipts	225,391	285,274	286,466	232,532	198,720	
Farm Income	89,831	47,095	33,154	2,242	26,313	
Deductions without 5-5-5 Tool	34,013	12,536	6,019	0	4,052	56,620
Farm Income Under 5-5-5 Tool	78,561	32,831	39,727	22,919	26,313	
Deductions with 5-5-5 Tool	28,153	5,926	8,944	3,076	4,052	50,151

Deferred Income	11,270	14,264	0	0	0
Drawn Down	0	0	6,573	20,677	0
Pool with Interest Added	11,608	26,647	20,677	0	0
5% of Receipts	11,270	14,264	14,323	11,627	9,936
Threshold	31,782	31,782	39,727	39,727	39,727

Source: Authors' calculations using data from the FDC accountancy firm

Table 5.4-2: Summary Statistics for FDC Example 1

	Farm Income	Farm Income under 5-5-5 Tool	After-Tax Income	After-Tax Income under 5-5-5 Tool
Standard Deviation	28,958	20,087	17,397	10,861
Average	39,727	40,070	28,403	30,040
Coefficient of Variation	0.73	0.50	0.61	0.36
Pool of Funds (inc. interest due)		Zero		

Source: Authors calculations using data from the FDC accountancy firm

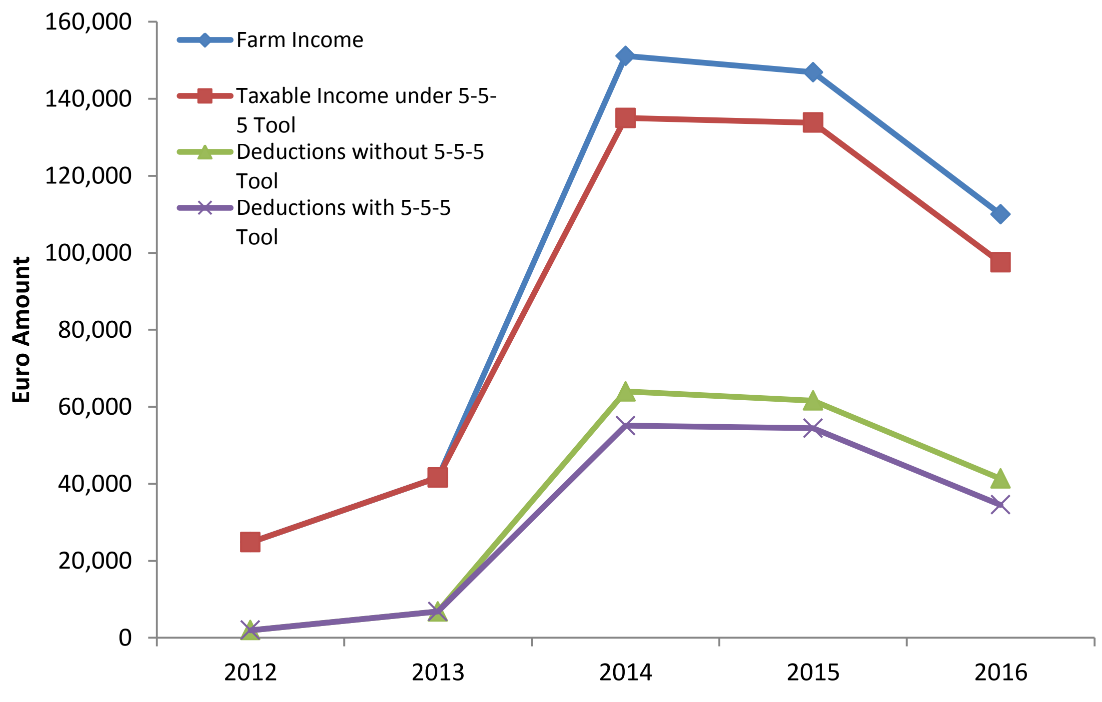
FDC Farm Two

We describe the second example in figure 5.4-2. In this example, the farm has significantly higher average farm income than in the previous example. The farm experiences two difficult years at the beginning of participation in the 5-5-5 scheme and it is assumed that the farm makes no deferrals in year one and two. In this actual farm example, the farm income increases substantially in 2014, declines marginally in 2015 and declines more significantly in 2016. Farm income in 2016 is still however, in the region of €110,000 and therefore well above the national average.

In this second example, we assume that the farm does not make any withdrawals from the interest-bearing fund and that the level of deposits in the fund reaches €44,376 at the end of 2016. The farm will need to withdraw funds by the end of 2019 as deferred income can only be retained in the account for a maximum of five years. In this example, the adoption of the 5-5-5 tool has very limited impact on controlling farm income variability. This is largely due to two factors 1) no deposits are made in year one or two 2) in those years when money is deferred, the pre-tax farm income remains in the highest tax bracket, so there is no change in the marginal tax rate.

In table 5.4-4, we show that the coefficient of variation in farm income declines to a small extent from 0.55 to 0.53. This underlines the importance of adopting multiple risk management tools in attempting to control farm income volatility. This is particularly important when the funds available from the deposit account are relatively low.

Figure 5.4-2: Married Farmer with no Off-Farm Income with Difficult Year 1 and 2



Source: Authors calculations using data from the FDC accountancy firm

The relatively weak impact of the 5-5-5 tool in this example is partly because the difficult income years occurred at the beginning of the five year period. Loan repayments and high machinery costs hampered the apparent income performance in the initial years. Some of the improvement in income in 2014 is likely to have been anticipated, as these costs declined and production expanded. The difficult winter in 2013 resulted in much increased feed costs and the hiring of additional labour added to costs. In subsequent years, the income performance on the farm improved with reduced feed bills, interest repayments and machinery expenses.

Table 5.4-3: Married Farmer with no Off-Farm Income with Difficult Year 1 and 2

	2012	2013	2014	2015	2016	Total deductions 2012-2016
Milk receipts	253,565	320,933	322,274	261,598	250,332	
Farm Income	24,816	41,651	151,128	146,878	110,007	
Deductions without 5-5-5 Tool	1,972	6,812	63,971	61,634	41,355	175,744
Farm Income Under 5-5-5 Tool	24,816	41,651	135,014	133,798	97,490	
Deductions with 5-5-5 Tool	1,972	6,812	55,109	54,440	34,546	152,879
Deferred Income	0	0	16,114	13,080	12,517	
Drawn Down	0	0	0	0	0	
Pool with Interest Added	0	0	16,597	30,567	44,376	
5% of Milk Receipts	12,678	16,047	16,114	13,080	12,517	
Threshold	75,917	75,917	94,896	94,896	94,896	

Source: Authors calculations using data from the FDC accountancy firm

Table 5.4-4: Summary Statistics for Farm Income FDC Example 2

	Farm Income	Farm Income under 5-5-5 Tool	After-Tax Income	After-Tax Income under 5-5-5 Tool
Standard Deviation	52,609	45,887	26,317	23,291
Average	94,896	86,554	59,747	55,979
Coefficient of Variation	0.55	0.53	0.44	0.42
Pool of Funds (inc. interest due)		44,376		

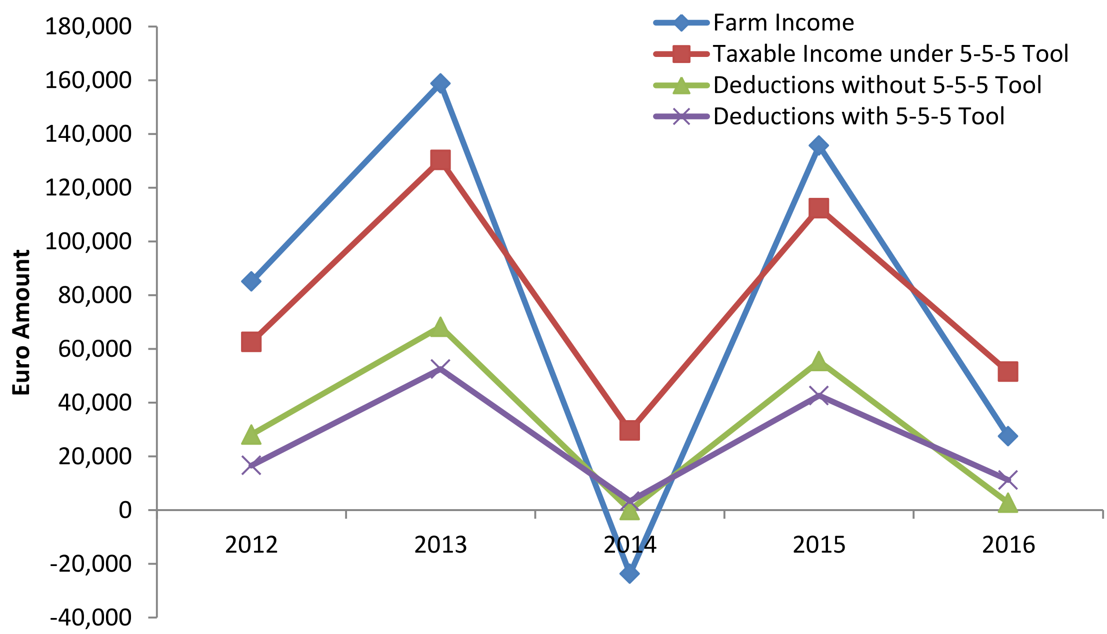
Source: Authors calculations using data from the FDC accountancy firm

FDC Farm Three

In the following, we describe the third FDC farm example in table 5.4-5. In this example, the farm experiences extremely volatile farm income. The coefficient of variation of taxable farm income is 0.88 over the five year period and therefore well above the level of volatility experienced by the typical Irish dairy farm. In the first two years of participation in the scheme, the farm allocates the maximum allowable deferred amount to the fund. In 2014, the farm experiences a severe shock in terms of farm income and money is drawn down from the fund to maintain household spending. The farm allocates additional deposits to the fund in 2015, but these are withdrawn completely in 2016, so that the pool of funds equals zero at the end of the five year period.

In this scenario, the adoption of the 5-5-5 tool is highly effective in addressing the farm income volatility over the five year period. This effectiveness is dependent on the decision-making of the farmer in allocating the maximum allowable amount to the fund in the first two years of participation in the scheme. Under the assumed decision-making, the coefficient of variation of taxable farm income declines from 0.88 to 0.49, as a result of adopting the 5-5-5 tool. Income variability remains above average, but declines significantly relative to a situation where the tool is not used. More importantly, the coefficient of variation of after-tax household disposable income declines from 0.91 to 0.37.

Figure 5.4-3: Married Farmer with no Off-Farm Income and Highly Volatile Farm Income



Source: Authors' calculations using data from the FDC accountancy firm

Table 5.4-5: Married Farmer with no Off-Farm Income and Highly Volatile Farm Income

	2012	2013	2014	2015	2016	Total deductions
Milk receipts	450,783	570,548	572,931	465,063	453,744	
Farm Income	85,081	158,809	-23,736	135,616	27,528	
Deductions without 5-5-5 Tool	*28,093*	*68,196*	*0*	*55,439*	*2,751*	154,479
Farm Income Under 5-5-5 Tool	62,542	130,282	29,559	112,363	51,479	
Deductions with 5-5-5 Tool	*16,616*	*52,506*	*3,335*	*42,650*	*11,223*	126,330
Deferred Income	22,539	28,527	0	23,253	0	
Drawn Down	0	0	53,295	0	23,951	
Pool with Interest Added	23,215	53,295	0	23,951	0	
Receipts	22,539	28,527	28,647	23,253	22,687	
Threshold	61,328	61,328	76,660	76,660	76,660	

Source: Authors' calculations using data from the FDC accountancy firm

Table 5.4-6: Summary Statistics for Farm Income FDC Example 3

	Farm Income	Farm Income under 5-5-5 Tool	After-Tax Income	After-Tax Income under 5-5-5 Tool
Standard Deviation	67,511	37,948	41,455	19,065
Average	76,660	77,245	45,764	51,979
Coefficient of Variation	0.88	0.49	0.91	0.37
Pool of Funds (inc. interest due)		Zero		

Source: Authors' calculations using data from the FDC accountancy firm

5.4.1 FDC Farms – Income Averaging

In this section, we explore the potential impact of the income averaging system in 2016 for the three FDC client farms. We compare the farm income under the conventional tax system in 2016, with the farm income under the income averaging system. The results show that the farm income in 2016 under the conventional tax system, is lower than the income calculated under income averaging for two of the three farms. This is consistent with the national trends whereby 2016 proved to be a particularly difficult year for dairy farm incomes. For one of the three farms (i.e. farm two), the farm income in 2016 is greater than the averaged income and this farm may find it beneficial to enter the income averaging system in 2016. This is a farm, which expanded significantly around the abolition of the milk quota and may not be a particularly unusual case.

Even for this very small sample, the results are mixed with respect to income averaging. If these FDC client farms had already been participating in the income averaging system, there may have been an incentive to temporarily opt-out of the income averaging system in 2016. This would have been the case for both farm one and farm three. The incentive to temporarily opt-out of averaging would have been particularly strong in the case of farm three, where the total deductions are far greater under income averaging (€23,714) relative to the conventional tax system (€2,751).

Table 5.4.1-1: Statistics for FDC Farms with Income Averaging

	Farm One	Farm Two	Farm Three
Farm Income 2016	26,313	110,007	27,528
Farm Income Under Income Averaging 2016	39,727	94,896	76,660
Deductions Under Conventional Tax System 2016	4,052	41,355	2,751
Deductions Under Income Averaging 2016	8,944	33,197	23,714
Benefit Short-term from income averaging	No	Yes	No
Benefit Short-term from temporary opt-out	Yes	No	Yes

Source: Authors calculations using data from the FDC accountancy firm

5.5 Conclusion

Irish dairy farmers require risk management tools which reduce income variability, both in terms of pre-tax and disposable after-tax income. We find that the proposed 5-5-5 tool is highly effective in reducing income variability for a number of different scenarios, including extreme examples of income volatility. The success of the 5-5-5 tool is dependent on the judgement and discipline of the farm operator in allocating sufficient deposits to the fund and this may be particularly important during the first number of years participating in the scheme. In addition, if the initial years in the scheme are periods of low income, the tool is not as effective. Farmers should consider multiple risk management tools, especially in the early years of applying the 5-5-5 tool or immediately after a large draw-down, when funds are likely to be low.

The 5-5-5 tool allows farmers to retain monies in the account for a maximum five year period, but it is advisable that farmers do not wait for the full five years to elapse prior to drawing down funds. Farmers should consider drawing down funds when the income is significantly below the normal expected level of farm income. The 5-5-5 tool provides a great deal of flexibility for farmer decision-making and the farmer can make decisions about the precise income thresholds, above which deposits are made and below which funds are drawn down.

There is however, a potential for farmers to make judgement errors in applying the tool and this poses challenges for the industry and policymakers in designing the tool. In analysing the 5-5-5 tool, we should not place too much weight on the savings in taxation, USC and PRSI. The money in the fund must be drawn down within five years of being deposited and this means that such money will eventually be subject to taxation, USC and PRSI. The 5-5-5 tool can have a limited impact on income variability when the pre-tax farm incomes do not change tax brackets from year to year.

In this chapter, we considered the income averaging system, but find that it is limited in its capacity to reduce household income volatility. The rules surrounding the off-farm employment are particularly restrictive. The 2017 budget reforms allow farmers to opt-out temporarily from the income averaging system for one year and this is a positive reform. In many cases however, the farm is vulnerable to a scenario where the income is low in the fifth year of the averaging period and more so where there are consecutive years of low income. The option of a temporary opt-out provides farmers with an opportunity to postpone problematic income scenarios. The repayment of instalments can however pose problems in subsequent years, if the household income does not recover significantly. The 5-5-5 tool encourages the long-term management of income risk and is effective in reducing income uncertainty, especially where combined with other appropriate risk management tools.

6. Revenue and Margin Insurance

6.1 Introduction

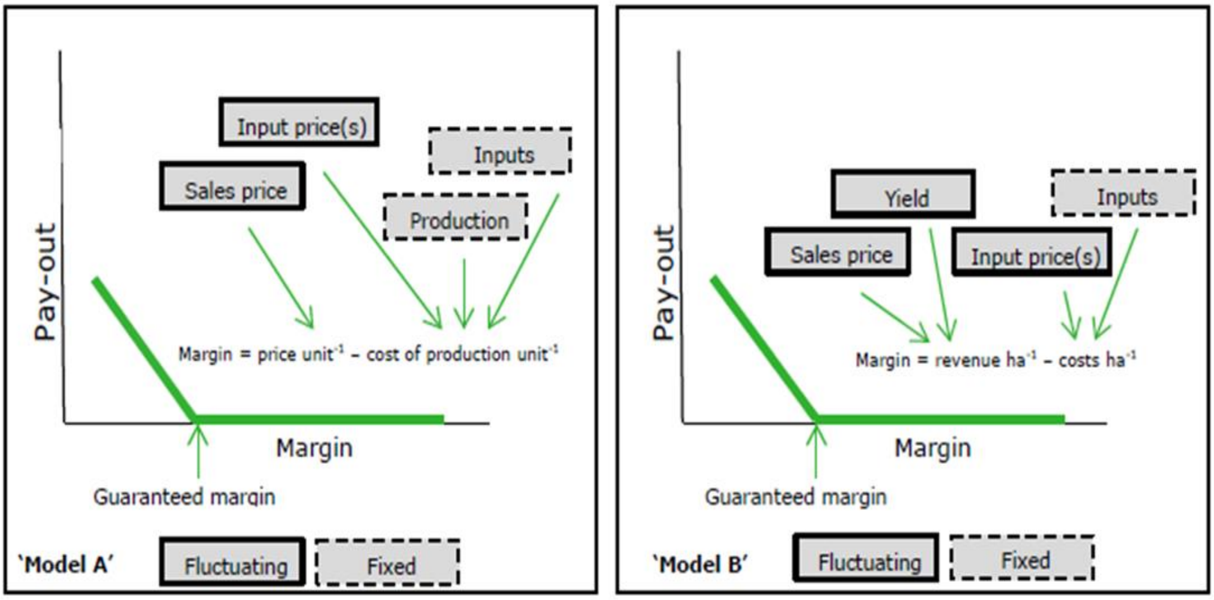
At present there are no revenue/margin insurance products available to Irish dairy farmers. In the US the Livestock Gross Margin Insurance Plan for Dairy Cattle (LGM-Dairy) was introduced in 2008, and the Margin Protection Program for Dairy (MPP-Dairy) has been available since 2014. A comprehensive review of the operation of these tools in the US is presented in Appendix 1. As discussed therein, neither tool has been considered a success in their current form and have been subject to substantial revision in the recent Bipartisan Budget Act of 2018, adopted by US Congress on February 9th 2018.

Margin insurance is a relatively new type of insurance covering the revenue of a commodity minus its costs of production. Designing farm-specific gross margin insurance is data intensive as data are required on sales prices, input prices, and quantities (i.e., inputs and production). Moreover, moral hazard may be an issue, as these data are largely determined by the insured. Using regional or national-based data and triggers can alleviate these issues, but may create other concerns such as basis risk and misinterpretation at farm level. This approach is used in MPP, where farmers have been critical for precisely these reasons, leading to the substantial recent reform mentioned above.

Van Asseldonk and Meuwissen (2017) present two models of margin insurance. Their first model, Model A in figure 6.1-1, focuses on market volatility, by considering fluctuating sales and input prices. It covers the margin between sales price and costs of production. Besides the input price, e.g. for animal feed, the other parameters of costs of production (i.e. amount of inputs required and volume produced) are kept fixed. Pay-outs are triggered when the actual margin is lower than the guaranteed margin. The size of this pay-out is based on the difference between the guaranteed margin and the actual margin.

In the second model ('Model B' in figure 6.1-1) both market and yield volatility are considered. The insured margin is now based on the difference between revenues and costs. To estimate costs, the amount of inputs is fixed e.g. based on normative values. A third margin insurance concept potentially covers both market and yield volatility, with none of the parameters being fixed. This constitutes the concept underlying the income stabilisation tool as outlined by the European Commission.

Figure 6.1-1: Margin insurance covering market risk ('Model A'), and a combination of market and yield risk ('Model B')



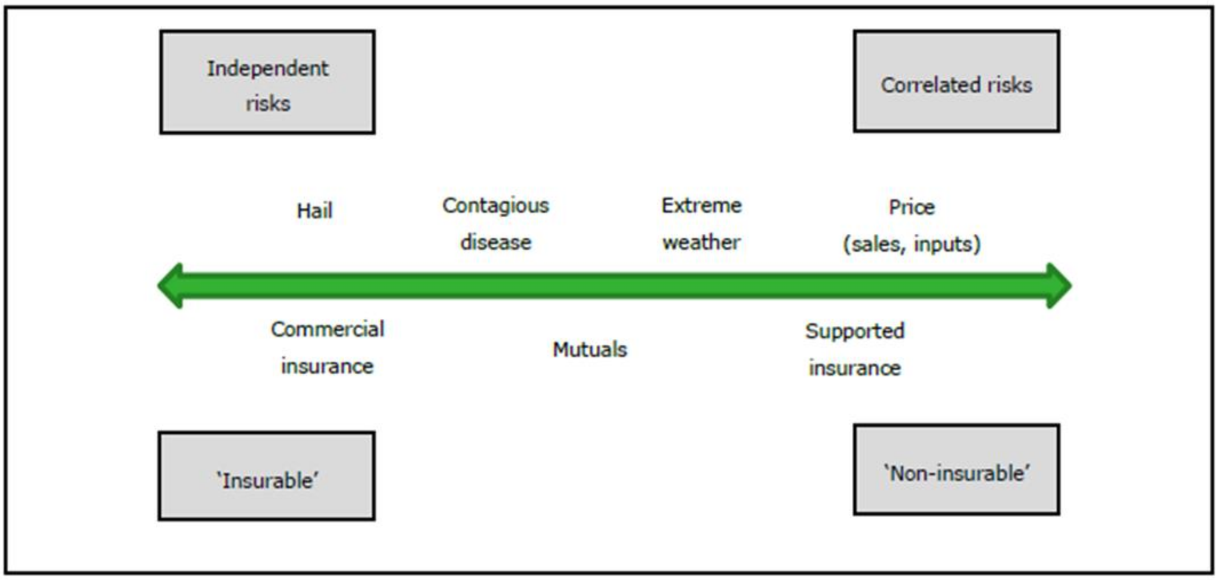
Source: Van Asseldonk and Meuwissen (2017)

From an Irish dairy perspective establishing the level of yields is likely to be problematic. Yield fluctuations in milk production can be seen as more of a husbandry issue than for crops (for which weather-related events cause the greater part of the fluctuation). This implies increased moral hazard for the insurer.

6.1.1 Role of Public Sector

The risks associated with dairying in Ireland are largely systemic (i.e. milk prices and input costs tend to rise and fall for all famers simultaneously). This implies that traditional reinsurance capacity may not be sufficiently available for a margin insurance type programme. For this reason, some form of public-private partnership may well be necessary to encourage insurers to enter this market. This is illustrated in the right-hand side of 6.1.1-1, i.e. highly correlated (systemic) risks are generally regarded as not insurable through the commercial market. Therefore, this is an area where governments frequently intervene in order to enhance the supply of insurance and to promote insurance markets for risks that are potentially tradable, but where the market has not developed. This lack of development may be due to market failures and/or informational inefficiencies. Support of this nature can be provided in some cases through different private-public partnership arrangements. This can facilitate at least some of the insured's willingness to pay and co-finance protection that could otherwise fall within the sole responsibility of the public sector, such as the case of disaster relief.

Figure 6.1.1-1: Insurability of agricultural risks



Source: Van Asseldonk and Meuwissen (2017)

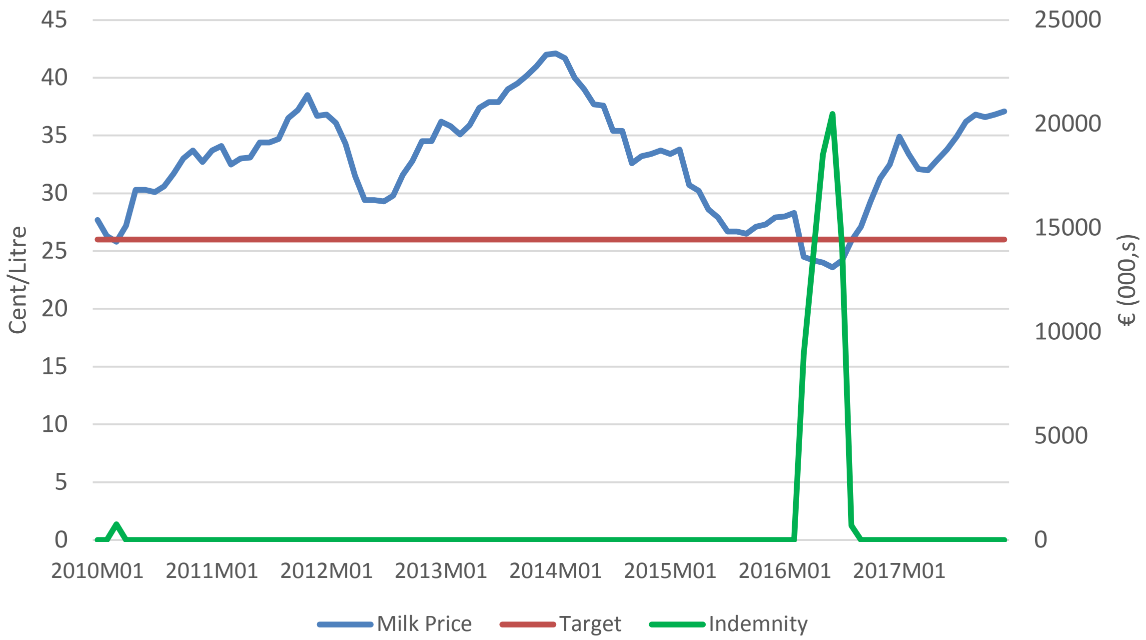
Such partnerships provide incentives for price transparency, including collection and dissemination of information on output and input price levels and market price drivers such as stock levels. Price transparency potentially enhances the development of futures markets, which in turn, can either be directly used by farmers to cope with price risk or can provide price indexes e.g. margin insurance. The availability of price information can also positively help contract negotiations along the supply chain. There is also a role for government in supporting and facilitating farmer education and training in the use of information and price risk management instruments.

6.2 Revenue Insurance

From an Irish perspective, it is possible to provide an initial estimate of the cost of simple revenue/margin insurance products. These are now presented, with the strong caveat that more accurate costings would require a large scale study based on actuarially sound methods and detailed simulations.

In the following section the indemnities associated with different target price levels are calculated. For the purpose of this exercise the price of a standardised litre (3.7% fat and 3.3% protein as published by the CSO) is taken as the underlying asset against which the policy is written. Target levels of cover from 26 cent to 36 cent per litre of milk are considered. For each target milk price, the indemnity (compensation) that would have arisen is calculated. The analysis covers the period from January 2010 to December 2017. In Figure 6.2-1, we see the outcome where a target price of 26 cent is selected. Note the green line (monthly indemnity) is measured on the secondary y-axis. The seasonal nature of milk production in Ireland means that the indemnity for each month is calculated as the price discrepancy between the target and standardised price times the volume for that month.

Figure 6.2-1: The monthly standardised milk price, target price (26 cent) and monthly indemnity.



Source: CSO and own calculations

At a target of 26 cent per litre there would have been a tiny indemnity payment in March 2010 and more substantial payments from March to August 2016. Averaged over the entire sample period, this would have resulted in an average indemnity per month of 0.164 cent per litre. In table 6.2-1, one can see that the indemnity rises in an almost exponential manner as the target increases and would lead to average indemnities of 4.23 cents per litre if a target level of 36 cent had been selected throughout.

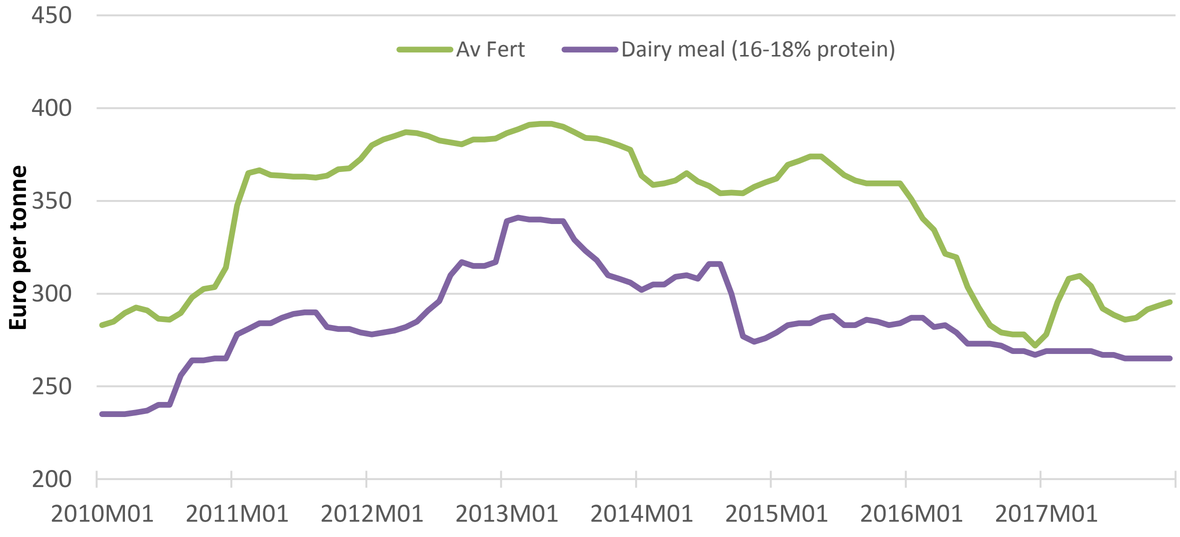
Table 6.2-1: Protection level and estimated indemnities for a simple milk revenue insurance product.

	Cent/Litre										
Target Protection	26	27	28	29	30	31	32	33	34	35	36
Payout	0.16	0.29	0.48	0.72	1.00	1.37	1.78	2.26	2.84	3.50	4.23

Source: Own Calculations

It should be noted that this does not reflect the full cost of the insurance, as no allowance is factored in for administration costs and profit for any underwriter. It is difficult to estimate the cost of either component, but the US experience shows that for some schemes the former can be in the neighbourhood of 20% of total costs. It should be noted that additional costs of €75 million would add approximately 1 cent to each of the indemnity values reported in Table 6.2-1. In order to estimate a cost for margin insurance, it is first necessary to define the margin. This could be milk price minus feed, energy cost and fertiliser cost or any combination of these. Regardless, it has to be acknowledged that all these costs are in themselves highly variable over time. This variability is reflected in Figure 6.2-2 where we can see fertilizer prices peaking at approximately €390 a tonne in 2013, before dropping to €280 in late 2016.

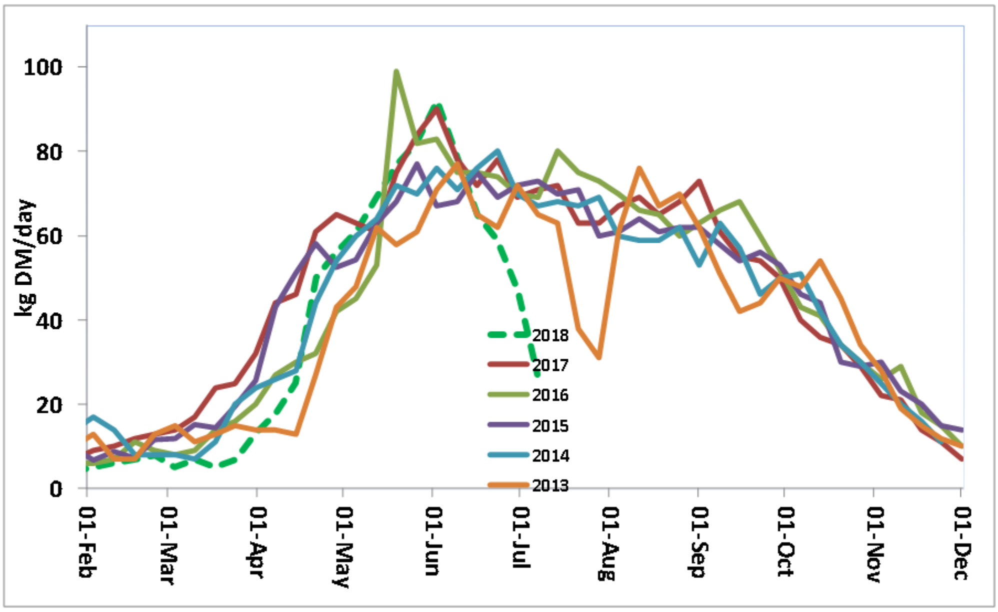
Figure 6.2-2: Selected input prices 2008 to 2017.



Source: CSO Note Av Fert is simple average of CAN and UREA prices

However from the perspective of calculating an insurable margin, it is the usage of these inputs which is perhaps key. In the US, premium and payments are based on a standard feed to milk conversion ratio, thus making calculations straight forward. However in a grass based system such as Ireland this calculation is not so easy. In figure 6.2-3, we can see that grass growth in Ireland is highly variable both across the year and from year to year.

Figure 6.2-3: National Grass Growth Curve for Teagasc Dairy Research Farms 2013-2018



Source: PastureBase Ireland, Teagasc.

This variability dictates the quantity of feed used and fertiliser applied. As such, any margin analysis is speculative, but the work of Flynn (2016) is informative in an Irish context.

6.3 Review of Flynn (2016)

Flynn (2016) explores the effectiveness of a margin protection scheme in addressing the margin and income volatility facing Irish dairy producers.

The early chapters of the thesis provide a literature review on the sources of risk in dairy farming, factors contributing to increased risk, the consequences of risk for farm investment and potential risk management tools. Particular attention is paid to the US Dairy Margin Protection Programme, introduced in the US Farm Bill in 2014. The main research question in the thesis is how effective such a programme would be in an Irish context.

Quantitative Analysis

Flynn uses monthly CSO aggregate milk, feed and fertiliser prices and feed and fertiliser conversion rates per litre of milk produced derived from Teagasc NFS data from specialist dairy farms covering the period 2010-2014. Using these conversion rates and monthly CSO agriculture price data, monthly milk production margins are calculated for 1986 to 2015. The US margin protection programme is based on milk and feed costs only, however, Flynn adapts this to the Irish situation using three margin estimates, (i) milk price less feed costs only, (ii) milk price less feed and fertiliser costs and, (iii) milk price less all direct costs, as estimated using proxies from the NFS. Flynn's analysis assumes that margin protection would take effect when margins fell below a certain trigger. Margin support triggers are based on the previous five year rolling average margin levels, using 4 different trigger levels (100%, 90%, 80% and 70%). The objective of the analysis was to assess how often margin support would be required, i.e. when support was triggered, how much it would cost to provide the margin protection and what premium would need to be charged to farmers to cover the cost.

Results

The period of 2006 to 2015 was modelled. Results showed that margin volatility had increased in recent years and that margin variability was higher than the variability in milk price over the same period, indicating that feed and fertiliser price variability also increased significantly over this period, augmenting the margin variability faced by producers.

The results of the model show that at the 70% trigger point, margin support would have been applied for only four bi-monthly periods in the 2006 to 2015 period, whereas under the 100% trigger scenario the subsidy would have been triggered for up to twenty-eight bi-monthly periods out of a total of sixty. The simulations indicate that if the 100% trigger was applied, the cost of the margin scheme could have been between €890m-€960m for this ten year period 2006-2015, while the cost for the 70% trigger scenario for the same period would have been between €28m-€104m. These different costs would also be reflected in the premium which would apply to each level of margin coverage. So in considering a measure which would use the 100% trigger for the direct cost margin scenario, participants could have to pay a premium per litre of milk covered of 1.8c/ltr for this level of coverage.

The model also simulates 80% and 90% trigger levels and Flynn concludes that it is perhaps this level of margin coverage that may be considered the most appropriate level in order to provide some certainty to producers, without incentivizing farmers to over produce.

Policy Recommendations

Flynn concludes that a tiered coverage approach for a margin scheme may be feasible. For example, the 70% trigger scenario might be considered a level of coverage for a catastrophic shock/risk and could be available without premium for all producers, as the premium calculation for this 70% trigger is almost zero based on the model. While the 80% or 90% trigger scenarios might be more appropriate for basic coverage level. If the mechanism had the objective of seeking to address 'market risks', such coverage could be funded through farmers paying premiums.

Flynn also highlights the level of funding currently provided to dairy producers through direct payments and raises the question of whether some of this funding could be set aside to cover the costs of a margin protection scheme which would kick in low margin/low income years, thus having a bigger impact on smoothing year to year income variability than current direct payment levels, which remain relatively static from year to year, even in years where there are significant positive and negative variations in income.

6.4 Conclusion

At present there are no revenue/margin insurance products available to Irish dairy farmers. In the US the Livestock Gross Margin Insurance Plan for Dairy Cattle (LGM-Dairy) was introduced in 2008, and the Margin Protection Program for Dairy (MPP-Dairy) is available since 2014, however neither tool has been considered a success and have seen substantial revision in the recent Bipartisan Budget Act of 2018. It is hoped that these revisions, including a substantial reduction in premia, will increase uptake and address the concerns of US dairy farmers regarding these tools.

Margin insurance is a relatively new type of insurance, covering the revenue of a commodity minus its costs of production. Designing farm-specific gross margin insurance is data intensive as data are required on sales prices, input prices, and quantities (i.e., inputs and production). Moreover, moral hazard may be an issue, as these data are largely determined by the insured. As the risks associated with dairying in Ireland are largely systemic, some form of public-private partnership may well be necessary to encourage insurers to enter this market.

Based on a simplified example, which excludes administration and development costs, indemnity costs rise in an almost exponential manner as the target price increases. Given the substantial administration and development costs incurred in the US, it is most likely that any insurance type product offered to Irish dairy farmers would require very significant subsidisation. In our analysis, we have not assessed the mechanism for the subsidisation of an insurance scheme. We therefore cannot draw firm conclusions about how best to fund subsidisation, in the event of an insurance scheme being implemented with the aid of state subsidies.

Flynn (2016) found that if the 100% trigger was applied, the cost of the margin scheme could have been between €890m-€960m for this ten year period 2006-2015, while the cost for the 70% trigger scenario for the same period would have been between €28m-€104m. He concluded that a tiered coverage approach for a margin scheme may be feasible. Flynn also raises the question of whether some of the direct payment funding could be set aside to cover the costs of a margin protection scheme, which would kick in during low margin/low income years, thus having a bigger impact on smoothing year to year income variability.

7 Conclusions and Potential Areas for Future Work

We have analysed the financial effect of a number of risk management tools on farm income for specialist dairy farmers in Ireland. We conclude that Irish dairy farmers should have a toolbox of risk management tools available to them, as multiple risk management tools are required in the management of income variability. There is essentially no silver bullet in the effort to reduce farm income variabilities and the farmers' choice of tools will change from year to year as circumstances change. This means that farmers require education regarding the adoption and application of tools, in terms of how and when to apply them. Ultimately, there are as many potential risk management strategies as there are farmers.

Among the various risk management tools, we have examined the role of forward contracting. We estimate the extent to which forward pricing tools have been used by Irish dairy farmers, the factors affecting adoption and the potential impact on average annual milk price. These results might be used to target educational programs toward non-adopters. Using Teagasc NFS data from 2016, we find that Irish dairy farmers would have been better off by over 1 cent a litre if they adopted forward contracting for 20% of their milk production. These results would be different in other years, and it must be borne in mind that the overall objective of fixed milk price schemes is to reduce income volatility rather than to 'beat the market'. This modelling exercise has identified a method by which Teagasc NFS data can be used to track the impact of forward contracts on actual milk price paid and the impact on income volatility can be examined in future projects.

We have shown that direct support makes a considerable contribution to income on dairy farms and this varies sharply between farms and over time. While acknowledging that support is decoupled, it is clear that the value of support, when measured against the level of volume of milk produced, has been on the decline over the last decade. It is also clear that analysis based on average income data tends to mask the income difficulties of producers with higher production costs, whose dependence on support payments as a supplement to their market based income has been far higher than in the average case. The farms with relatively low support relative to production levels are arguably more exposed to price and production risk and will have greater need for alternative risk management tools, such as forward contracting and/or savings accounts. We find some evidence that the farms which do not enter into forward contracts have a relatively higher share of the direct payment in their farm income relative to those farms which adopt the forward contracts.

Taking a forward view, the decline in the value of support, when expressed in per litre terms, can be expected to continue as milk production increases. Furthermore, if the overall level of support falls as a result of CAP reform, this will accelerate the decline in the value of support payments per litre and increase the exposure of farms to income variations associated with market and production related volatility.

Irish dairy farmers require risk management tools which reduce income variability both in terms of pre-tax and disposable after-tax income. We find that the Dairy Research Ireland proposed 5-5-5 tool is highly effective in reducing income variability for a number of different scenarios, including extreme examples of income volatility. The success of the 5-5-5 tool is dependent on the judgement of the farm operator. Farmers should consider using multiple risk management tools, especially in the early years of applying the 5-5-5 tool or immediately after a large draw-down, when funds are likely to be low.

The 5-5-5 tool provides a great deal of flexibility for farmer decision-making and the farmer can make decisions about the precise income thresholds, above which deposits are made. In analysing the 5-5-5 tool, we should not place too much weight on the savings in taxation, USC and PRSI. The money in the fund must be drawn down within five years of being deposited and this means that such money will eventually be subject to taxation, USC and PRSI. The 5-5-5 tool can have a limited impact on income variability when the pre-tax farm incomes do not change tax brackets from to year. Furthermore, there is always the potential for farmers to make errors of judgement in applying the tool. This may include the error of retaining monies in the account for too long of a period. Beyond the clear need for education and training in the application of the tool, it is important that industry and policymakers design the precise terms and conditions of the tool, while keeping in mind the potential for farmer error.

In this report, we have considered the income averaging system but find that this is very limited in its capacity to reduce household income volatility. The rules surrounding the off-farm employment are particularly restrictive. The 2017 budget reforms allow farmers to opt-out temporarily from the income averaging system for one year and this is a positive reform. In many cases, the farm is vulnerable to a scenario where the income is low in the fifth year of the averaging period and more so where there are consecutive years of low income. The option of the temporary opt-out provides farmers with an opportunity to postpone problematic scenarios. The repayment of instalments can however pose problems in subsequent years if the household income does not recover significantly. The 5-5-5 risk management tool encourages the long-term management of income risk and is effective in reducing income uncertainty especially where combined with other appropriate risk management tools.

At present there are no revenue/margin insurance products available to Irish dairy farmers. In the US the Livestock Gross Margin Insurance Plan for Dairy Cattle (LGM-Dairy) was introduced in 2008, and the Margin Protection Program for Dairy (MPP-Dairy) was introduced in 2014. However neither tool has been considered a success and have seen substantial revision in the recent Bipartisan Budget Act of 2018. It is hoped that these revisions, including a substantial reduction in premia, will increase uptake and address the concerns of US dairy farmers regarding these tools.

Margin insurance is a relatively new type of insurance covering the revenue of a commodity minus its costs of production. Designing farm-specific gross margin insurance is data intensive as data are required on sales prices, input prices, and quantities (i.e., inputs and production). Moreover, moral hazard may be an issue, as these data are largely determined by the insured. As the risks associated with dairying in Ireland are largely systemic, some form of public-private partnership may well be necessary to encourage insurers to enter this market.

Based on a simplified example, which excludes administration and development costs, indemnity costs rise in an almost exponential manner as the target price increases. Given the substantial administration and development costs incurred in the US, it is most likely that any insurance type product offered to Irish dairy farmers would require very significant subsidisation.

Flynn (2016) found that if the 100% trigger was applied the cost of the margin scheme could have been between €890m-€960m for this ten year period 2006-2015, while the cost for the 70% trigger scenario for the same period would have been between €28m-€104m and concluded that a tiered coverage approach for a margin scheme may be feasible. Flynn also raises the question of whether some of the direct payment funding could be set aside to cover the costs of a margin protection scheme which would kick in low margin/low income years thus having a bigger impact on smoothing year to year income variability.

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9 Appendices

A. A brief review of Livestock Gross Margin Insurance Plan for Dairy Cattle (LGM-Dairy) and The Margin Protection Program for Dairy (MPP-Dairy).

The US offers an interesting case study regarding the roll out and adoption of insurance in the dairy farm sector. At present two insurance type products are available to US dairy farmers, the Livestock Gross Margin Insurance Plan for Dairy Cattle (LGM-Dairy) and The Margin Protection Program for Dairy (MPP-Dairy). Both products are described and evaluated below.

Livestock Gross Margin Insurance Plan for Dairy Cattle (LGM-Dairy).

The Livestock Gross Margin Insurance Plan for Dairy Cattle (LGM-Dairy) is a risk management tool which was introduced in 2008. It was developed by Iowa Agricultural Insurance Innovations LLC and policies are sold by private insurance agents overseen by USDA's Risk Management Agency (RMA). It enables dairy producers to purchase insurance against decreases in gross margins as measured by the value of milk price minus feed costs. LGM-Dairy uses Chicago Mercantile Exchange Group (CME) futures prices for corn, soybean meal, and milk to determine both the expected gross margin and the actual gross margin. So it should be noted that this plan does not use farmgate/market prices in its calculations.

A key feature of this insurance product is the calculation of the premium as being actuarially fair. An actuarially fair premium is one for which the calculated premia are expected to result in the total of premiums paid over a long period equalling the total cost of indemnities paid out plus reasonable administrative costs. For RMA approved products, the Administrative and Operating (A&O) costs of a private insurer are actually paid separately. USDA directly reimburses insurers for A&O costs. Novakovic (2012) estimated that A&O costs were approximately 20% of the total premium for the early years of the scheme but their actual cost is probably closer to 22%10. The USDA is also required to add 3% to this "actuarially fair" premium in order to build a reserve to cover future potential underwriting losses.

From December 2010, the USDA began subsidising premiums. However, this limited the capacity of the LGM-Dairy insurance program. Funds allocated to the livestock insurance programs offered by the Federal Crop Insurance Corporation (FCIC), including LGM-Dairy, have been legislatively capped at $20 million per reinsurance (fiscal) year[11],[12]. As this figure ($ 20 m) includes administrative and operating (A&O) subsidies, it could potentially be depleted quite quickly in any year. For example for 2011 this ceiling was reached by March, 4 months

[10] https://www.rma.usda.gov/data/m13/index.html

[11] Note the USDA offer a suite of Livestock policies including LGM Swine, LGM Cattle and Livestock Risk Protection (LRP).

[12] Note the RMA allocated additional funding to the Livestock Gross Margin for Dairy Cattle (LGM-Dairy) plan of insurance for the December 26, 2014, sales period.

into the reinsurance year. The following year it was exhausted after two months. It has continued to be a constraint in most years since.

The premium paid by the farmer is driven by the CME futures contract prices for Class III milk, corn and soybean meal. The volatility of these prices are also factored into the calculation of the premium. The specific volumes (milk and feed) chosen by the producer and deductibles that can be elected by the producer also influence premium. The deductible rises in 10 cent/cwt increments up to $2 per cwt. Those who choose a $0 deductible receive a lower premium subsidy (18 percent) than those who choose the highest deductible of $2 (50 percent). As a result of all of these factors, the premium is liable to change every month. The premium is due at the end of the coverage period. While there is no minimum volume that can be insured the maximum amount is 24 million pounds per year and LGM - Dairy is sold on the last business Friday of each month.

To determine a farm specific premium, the RMA uses the historical statistical relationship between the commodity prices associated with a particular contract offering. The RMA then generates 5,000 random sets (collections) of these prices. These 5,000 sets of prices are used to represent the long-run actual prices. Next the farm specific LGM-Dairy contract is compared with each of the 5,000 simulated instances. A comparison is then made between each of these 5,000 values and the Total Contract Gross Margin Guarantee. Each comparison is used to determine whether an indemnity would have been generated for that particular. From the above 5,000 comparisons, the RMA then determines the average indemnity of these 5,000 values. The average indemnity plus 3% is then set as the contract specific premium.

The indemnity at the end of the insurance period is the difference, if positive, between the gross margin guarantee and the actual gross margin. If the actual gross margin is less than the expected gross margin (minus the deductible) for the insurance period, an indemnity may be payable dependent on the deductible chosen and premium due. Table 1 presents a summary of the performance of this insurance product between 2009 and 2016. Since 2009, dairy farmers have paid just less than $58 million in premiums. The USDA subsidy is an additional $45.5 million. In addition, the USDA has paid probably in the region of $20 million directly to insurers to cover their administrative and operating costs (A&O), Novakovic (2012). During this period farmers have received indemnities of just over $34 million.

Table A-1: LGM- Dairy Selected results from FY 2009 to FY 2016

Commodity Year	Total Premium ($)	Subsidy ($)	Quantity (CWT)	% of National Pool*	Indemnity ($)	Loss Ratio
2009	287,201	-	401,680	0.02	718,035	2.50
2010	781,589		1,872,499	0.10	280,566	0.36
2011	25,012,757	10,735,652	46,172,815	2.35	64,738	0.00
2012	19,143,689	8,861,771	40,474,408	2.02	1,395,079	0.07
2013	16,873,156	7,656,348	34,178,852	1.70	2,666,303	0.16
2014	11,591,953	4,966,934	27,739,076	1.35	3,655,529	0.32
2015	22,331,035	10,174,431	48,721,339	2.34	16,716,577	0.75
2016	7,183,785	3,142,041	20,064,453	0.94	8,718,573	1.21
Total	103,205,165	45,537,177	219,625,122	1.37	34,215,400	0.33

Source: USDA Summary of Business Report Generator

* Own calculation ** Indemnity/Total Premium

At its peak in 2011 2.35% of the national milk pool was covered, however for the entire period this falls to 1.37%. Again we should bear in mind the ceiling of $20 million for livestock insurance during this period. The loss ratio shows that the policies led to underwriting gains in six of the eight years with approximately 33% of premiums paid out as indemnities over the entire period. This would appear to be low given that it includes an eight year period thus representing a long cycle for the policy thus balancing favourable years with unfavourable.

LGM-Dairy is very similar to using a bundled options strategy. In a bundled options risk management strategy the producer can use Class III milk put options to create a milk revenue floor (minimum) and feed (corn, soybean meal) call options to establish a feed cost ceiling (maximum). The “bundling” of the put and call options allows the producer to establish an income over feed floor (minimum). While farmers could use options as these are freely traded in the US LGM-Dairy is the easier and more intuitive choice for the following reasons. It is heavily subsidised and does not require daily margin requirements. Contract size using bundled options strategies is limited to increments of 200,000 lb of milk, 5,000 bushels of corn, and 100 tons of soybean meal while LGM-Dairy has a completely flexible contract size. The cost of an LGM-Dairy policy is the policy premium, and is known before entering into the contract. The use of options require an established contract with a commodities broker.

From an Irish perspective, the roll out of an LGM-Dairy type product would face many challenges. Irish milk production is largely grass based unlike the US where corn and soya meal are the primary feed inputs. No derivatives contract exists for the price of grass thus the calculation of a guaranteed margin would be impossible. Likewise no future/options contracts based on the Irish milk price are available at present. It should be noted that the European Energy Exchange (EEX) have planned to launch an EU milk price contract in August 2018. The Irish milk price as reported to the Milk Market Observatory (MMO) will form part of the settlement reference price for this contract but there will be basis risk from an Irish farmer perspective. So while this proposed milk contract, and established EU feed contract for soya, wheat and barley may make the development of an EU type LGM-Dairy contract possible. However the US experience suggests that such a product would be expensive to administer and without substantial premium subsidy unlikely to succeed. From an Irish perspective, an index based grass forage insurance product may be worth exploring.

The Margin Protection Program for Dairy (MPP-Dairy)

The Margin Protection Program for Dairy (MPP-Dairy) is a voluntary risk management program for dairy producers authorized by the 2014 Farm Bill through to December 31, 2018. It is an insurance type product since as the premium is fixed and set in advance it is not strictly an insurance product. With a typical insurance product we would expect the premium to change as the underlying circumstances change. The MPP-Dairy offers protection to dairy producers when the difference between the all milk price and the average feed cost (the margin) falls below a certain dollar amount selected by the producer. The all milk price is the average price of milk marketed in the United States as reported by the National Agricultural Statistics Service (NASS). The “margin” is then calculated as the difference between the national all milk price and the national average feed cost. The average feed cost is calculated by using the sum of (1.0728 times the price of corn per bushel + 0 .00735 times the price of soybean meal per ton, plus 0.0137 times the price of alfalfa hay per ton). Dairy farmers may purchase coverage on 25 to 90 percent of their milk production history in five percent increments.

For this product catastrophic (CAT) coverage of a $4 margin at a coverage level up to 90 percent of the established production history requires no premium payment, but the dairy operation must pay the $100 administrative fee. For increased protection, dairy operations may annually select a percentage of coverage from 25 to 90 percent of the established production history in 5 percent increments and a coverage level threshold from $4.50 to $8 in 50 cent increments. The cost of cover for these increments is presented in Table A-2.

Table A-2: Premium Cost and Level of Coverage

Coverage Level (Margin) per cwt.	Tier 1 Premium for 2016-2018	Tier 2 Premium for 2014-2018
	Covered production history less than four million lbs.	Covered production history more than four million lbs.
$4.00	None	None
$4.50	$0.010	$0.020
$5.00	$0.025	$0.040
$5.50	$0.040	$0.100
$6.00	$0.055	$0.155
$6.50	$0.090	$0.290
$7.00	$0.217	$0.830
$7.50	$0.300	$1.060
$8.00	$0.475	$1.360

Source USDA RMA

Enrolment in MPP-Dairy shows a clear pattern of reduced participation and in particular participation at the higher levels of coverage (Table A-3:). This table shows the number of operations covered at the different margin levels.

Table A-3: Dairy Operators by Coverage level

	$4.00	$4.50	$5.00	$5.50	$6.00	$6.50	$7.00	$7.50	$8.00	Total
2015	10,888	136	741	505	3,828	6,457	502	1,430	261	24,748
% of Total	44.0	0.5	3.0	2.0	15.5	26.1	2.0	5.8	1.1	
2016	19,864	108	482	357	1,991	2,307	169	236	149	25,663
% of Total	77.4	0.4	1.9	1.4	7.8	9.0	0.7	0.9	0.6	
2017	18,807	30	116	70	490	704	35	41	21	20,314
% of Total	92.58	0.15	0.57	0.34	2.41	3.47	0.17	0.20	0.10	

Source USDA

The 24,748 of licensed dairies enrolled in MPP-Dairy for 2015 coverage represent circa 55% of National licensed dairies at that time. By 2017 this had dropped to 49% of dairy operations. In 2015, 56% purchased coverage above the $4 catastrophic level. By 2016 this has dropped to 22.6% and to less than 7.5% by 2017.

In 2015, 142 billion pounds of milk was covered representing circa 68% of national production Table 413. This climbed to 75% in 2016 but is forecast to drop to circa 65% in 2017. 38.5% of

[13] While one may initially expect this to be higher given the low administrative fee of $100 we must remember enrolment is capped at 90% of historic production and some farmers use alternative risk management tools such as LGM-Dairy, forward contracts and dairy derivatives. As operators seek cover at higher margins it is likely they cover less than the 90% ceiling. A small minority also choose to use no tools.

the milk covered in 2015 was above the $4.00 margin level. By 2017 just over 2.25% was above the $4 level.

Table A-4: Production History Eligible for Payment (million pounds)

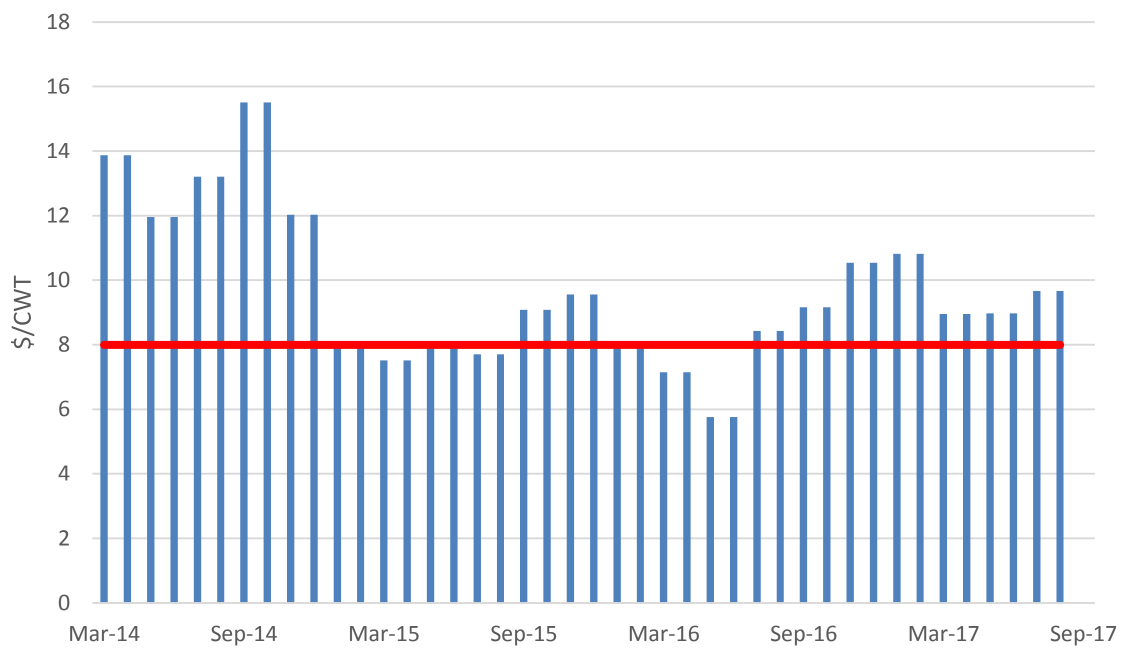
	$4.00	$4.50	$5.00	$5.50	$6.00	$6.50	$7.00	$7.50	$8.00	Total
2015	87,382	426	5,747	2,368	24,591	17,119	826	3,020	583	142,063
% of 2015 Total	61.5	0.3	4.0	1.7	17.3	12.1	0.6	2.1	0.4	
2016	140,195	238	3,109	850	9,161	4,798	248	389	223	159,210
% of 2016 Total	88.1	0.1	2.0	0.5	5.8	3.0	0.2	0.2	0.1	
2017	134,724	62	893	101	874	1,076	34	53	28	137,843
% of 2017 Total	97.74	0.04	0.65	0.07	0.63	0.78	0.02	0.04	0.02	

Source USDA

Taken together Tables 3 and 4 indicate that there has been a greater enrolment by larger operations in MPP-Dairy and even these large operators have cut the level of cover to the minimum $4 level in most cases.

Operators receive a margin protection payment whenever the average actual dairy production margin for a consecutive two-month period is less than the coverage level threshold selected by the participating dairy operation. From Figure 1, we see MPP made program payments in the spring of 2015 and the first half of 2016. While the margin fell to $5.76 per hundredweight in May-June 2016 the pay-out was low as only 9.3% of milk was covered at $6 or above.

Figure A-1: MPP-Dairy Margin per Pay Period ($/CWT)



Source: USDA

The decline in MPP participation outlined above can possibly be explained by the following. National average MPP feed costs have declined by more than 20% percent since the program was introduced and due to high inventory levels and are unlikely to rise significantly in the short term. As such farmers anticipating these lower prices may have been disinclined to hedge their margin. While milk prices are significantly lower than at the introduction of the program in 2014 MPP has offered little protection because the safety net is based on the margin and not the price of milk. The combination of lower milk and feed prices meant that the MPP margin did not fall substantially below the coverage levels available. For the 2015 and 2016 coverage years, American Farm Bureau Federation AFBF estimates that dairy farmers paid approximately $100 million in premiums and administrative fees, and received just $12 million in program payments. In addition, it is felt that the references prices are not fully reflective of the prices faced by the majority of farmers and MPP also does not consider other cost issues, which also vary by region. Another problem is that the margins are calculated in two-month increments. So a poor month could be averaged with a good month. However, if the margins were calculated one month at a time, the farmer would have had a pay-out for the poor month but not the good month. Perhaps most telling is the following quote from Congressman Collin Peterson "When I asked producers in my district why they didn't sign up, the routine response was, 'If we aren't going to get any money out of the program, why should we participate?'14.

Producers enrolled in MPP-Dairy are prohibited by law from participating in the LGM - Dairy program at the same time. However due to the growing dissatisfaction, with MPP-Dairy in particular, producers can now opt out of their final year commitment to MPP-Dairy and sign up to LGM-Dairy if they wish for the 2018 insurance year. In addition the Bipartisan Budget Act of 2018, adopted by Congress on February 9th, made other significant changes to the dairy safety net reflecting growing farmer discontent with the existing safety net. Indeed the new legislation instructs the USDA to reopen the 2018 MPP-Dairy sign-up process and allow dairy farmers, those who signed up previously and those who did not, to make new elections.

Specifically this Act introduces the following changes

- The $100 enrollment fee will be waived for farmers who meet USDA criteria as "beginning, limited resource, disadvantaged or military veteran farmers."
- Second, the dividing line between the lower Tier 1 premium rate and the Tier 2 premiums is raised from 4 million pounds of milk covered per year to 5 million pounds.
- Third, the premium rates in Tier 1 have been substantially lowered. Beyond making the $4.50 and $5 coverage free of any buy-up premiums, the rates at all other levels are lowered between 40 and 70 percent. That makes higher-price coverage levels more attractive for farmers.

[14] https://hoards.com/article-19316-congressman-highlights-fixes-for-mpp-dairy.html

- It now will pay indemnities on a monthly basis
- The Act removes the $20 million annual cap on all livestock insurance, including the Livestock Gross Margin-Dairy program.

From an Irish perspective the roll out of an MPP-Dairy type product would face some of the challenges outlined above regarding the roll out of an LGM-Dairy type program. Irish milk production is largely grass based and no reference price or contract exists for the price of grass. The choice of a national milk price would need to be agreed and this price finalised and reported more quickly than at present. If a feed element is to be included then both reference quantities and prices would have to be agreed. Given the diverse usage of feedstuffs between farms and between years this would be a difficult task. Finally based on the US experience a product of this nature may need significant subsidies or loss underwriting by the CAP or at national level. The costs associated with a run of low margins could be very substantial.