Tools and polices for agricultural risk management

Ben Breen[1], Thia Hennessy[1], Trevor Donnellan[1], Kevin Hanrahan[1]

1. *Rural Economy and Development Programme, Teagasc*

Abstract

Volatility in international agricultural commodity prices has been higher since 2000 than in the previous two decades (FAO, 2011). This fact and a movement away from excessive government intervention into agricultural markets have increased focus on the need for private risk management markets and strategies. WTO green box rules and a newly emerging holistic approach to agricultural risk management undermine the use of historically popular stabilisation tools such as price support mechanisms, border protection and public intervention. This paper reviews the market tools and government policies that currently exist for managing agricultural risk. A multi-criteria analysis is adopted to critique the various risk management tools available. Tools are assessed according to criteria such as costs (by whom they are incurred), benefits (to whom they accrue), political and budgetary acceptability, feasibility, functionality and effectiveness in controlling risk. This allows for all tools reviewed to be ranked according to the various criteria. It is argued that governments should support the development of private solutions to agricultural risk and that government risk-related policies should focus on "residual risk".

Keywords: Agricultural commodity price volatility, Holistic approach to agricultural risk management, Multi-criteria analysis

JEL code: Q18, D81

*Corresponding author: ben.breen@teagasc.ie

1. Introduction

By their nature, agricultural markets are predisposed to high levels of output uncertainty and price volatility due to certain characteristics which they possess. Two in particular set the stage. Firstly, the level of agricultural output a producer can generate is highly dependent on unpredictable factors like weather patterns and animal or crop disease outbreaks over which farmers have little to no control and cannot predict. These unpredictable factors alone constitute a substantial set of risks that farmers must deal with. Secondly however, because agricultural commodities tend to have low elasticities of supply and demand, prices must adjust significantly to with changes in production or consumption in order for the market to reach equilibrium. This makes agricultural commodity prices highly volatile over time, which can make revenues generated from agricultural production highly variable from year to year.

To deal with the various risks that they face, farmers have developed a diverse set of risk management strategies at the farm-level and involving third party (market) participation. These strategies can range from actions as simple as securing an off-farm income and or on farm product diversification, to more complex solutions such as technology choices on-farm, portfolio optimisation and the use of financial derivative products to hedge output and input price risk. In addition to on-farm and market-level solutions to risk, governments also design policies to shield their agricultural sectors from various price and production shocks. In recent years however, the idea of a holistic approach to agricultural risk management has highlighted the fact that government risk-related policies can impact greatly on farmers' risk management strategies, and should therefore be implemented coherently, so as not to supersede existing on-farm strategies or "crowd out" private market solutions (OECD, 2009a; Tangermann, 2011). This is critical because it suggests that when evaluating the performance of any risk-related government policy, one must take into account, not only the effectiveness of the policy in achieving its aim, but also its impact on existent or potential on-farm and market level solutions to risk.

In this paper, we review the agricultural risk management policy literature to identify, (1.) the nature of the risks which EU agricultural producers face, (2.) the emerging policy concepts directed towards agricultural risk management within the EU and (3.) the risk management

strategies, tools and policies which will best equip EU producers and policy makers to manage agricultural risks. We then assess the performance of the various risk-related tools and policies across multiple criteria to determine their potential and applicability to current risk management initiatives within the EU.

In section 2, we outline the various types of risk that agricultural producers face and the diverse management strategies that exist to deal with them. We pay particular attention to agricultural commodity price volatility, given that is has become controversial in the aftermath of the food crisis of 2007/2008. We also review the agricultural risk and policy literature to determine recent trends in ideas about how agricultural risk should be handled at the farm, market and state level. In section 3, we look specifically at market risk management tools in action and evaluate their usage and effectiveness in different countries at various points in time. In section 4, we turn the focus to government risk-related policies and observe the performance of various initiatives historically and in different countries. In section 5, we use a multi-criteria analysis approach to determine which tools and policies under review have the greatest potential to satisfactorily fulfil the needs of producers, consumers and governments in dealing with agricultural risk effectively. The relevant criteria are determined by reference to the relevant literature and policy documentation and findings from the observation of risk management strategies in action. The concluding section offers a discussion of the results of the MCA and the literature review.

2. Agricultural risk, farmer's management strategies and government risk-related policy

2.1. Agricultural risk and uncertainty

An important distinction that exists in the agricultural risk literature is that between risk and uncertainty. Harwood *et al.* (1999) describe risk as "uncertainty that matters" and involves possible events that may effect a person's welfare. This is important, because it means that while there *must* be uncertainty for risk to arise, uncertainty does not become a risk per se until it has the potential to impact upon an individual's welfare. It is along these lines that Newbery and Stiglitz (1981) argue that producers are not truly concerned with uncertainty relating to agricultural output and prices, but rather to variability of their incomes, in other words, uncertainty is not a problem for individuals until it has an impact on welfare.

For some, agricultural risk can fall into either of two categories; business or financial (Huirne et al., 2000; Hardaker et al. 2004). Business risk includes production, market, institutional and personal risks, while financial risk arises from financing methods, such as debt. Other studies have classified risks into more diverse categories (Musser and Patrick, 2001; Baquet et al., 1997); production, marketing, financial, legal/environmental and human resource risk. To these, Moschini and Henessy (2001) add technological uncertainty. Holzmann and Jorgensen (2001) include more general types of risk, particularly to reflect the risks faced by producers in developing nations, such as natural, health, social, economic, political and environmental risk. They also refer to the systemic and non-systemic nature of risk; micro level risk is idiosyncratic and affects only an individual producer, meso risks are those that impact the community and macro/systemic risks can affect an entire region. OECD (2009a) combines the systemic and non-systemic classification of Holzmann and Jorgensen (2001) with the four sources of risk identified by Harwood et al. (as shown in Table 1.).

Table 1: Types of risk and idiosyncratic/systemic distinction

Type of risk	Micro (Idiosyncratic) risk affecting an individual or household	Meso (Covariant) risk affecting groups of households or communities	Macro (Systemic) risks affecting regions or nations
Market/prices		Changes in price of land, new requirements from food industry	Changes in input/output prices due to shocks, trade policy, new markets, endogenous variability …
Production	Hail, frost, non-contagious diseases, personal hazards (illness, death) assets risks	Rainfall, landslides, pollution,	Floods, droughts, pests, contagious diseases, technology
Financial	Changes in income from other sources (non-farm)		Changes in interest rates/value of financial assets/access to credit
Institutional/legal	Liability risk	Changes in local policy or regulations	Changes in regional or national policy and regulations, environmental law, agricultural payments

Source: OECD Secretariat, adapted from Harwood *et al*. (1999) and Holzmann and Jorgersen, 2001

2.2. Agricultural commodity price volatility

Agricultural commodity price volatility has increased since 2000 in comparison with the preceding twenty years. As a source of uncertainty that can have a major impact on a farmer's income and welfare, it constitutes a significant source of agricultural risk. As earlier stated, agricultural commodity price volatility arises primarily out of the dependency of output on unpredictable factors like weather and disease and inelasticity in the supply of, and demand for, agricultural output. Many of the more recent trends contributing to price volatility tend do so by intensifying this unpredictability of output and inelasticity of supply and demand. FAO (2011) discusses some of these recent trends at length:

(i) *Population and income growth in developing countries:* This puts upward pressure on the demand for agricultural output and threatens to reduce the supply of certain production inputs such as land and water.

(ii) *Demand for food and feed crops arising out of biofuel production*: In particular, government imposed mandates to combine set amounts of biofuels with fossil fuels, and government targets for shares of biofuels used in energy use, further increase the inelasticity of demand for food and feed crops.

(iii) *Oil prices:* Oil influences agricultural prices as it forms part of the cost of production and also influences the costs of other inputs such as fertiliser and feed. Additionally there has been increasing financial investment into agricultural commodities in recent years. Because the agricultural commodities are often part of an index which is also made up of oil commodities (and the financial investments are made in the index not the individual commodities) agricultural prices can fluctuate as oil prices do.

(iv) *Low stocks relative to use:* Drawing down stocks of agricultural produce in response to major market demand increases or supply shortages can offset extreme price changes, thus low stocks reduce the capacity of governments to manage the market. Expectations of depleted stocks can also cause rapid price increases.

(v) *Climate Change:* While unexpected weather patterns already contribute to supply variation and thus price volatility, climate change may lead to more frequent and extreme events that will impact supplies unpredictably.

(vi) *Changes in the geographical distribution of production:* In an environment of rising demand for agricultural products (due to population and income

increases in developing countries) regions not previously responsible for contributing noticeably to global supplies have expanded production. However these regions are associated with less stable yields than regions with more suitable production conditions, indeed this is precisely *why* they were not historically large suppliers to begin with. The unstable nature of the yield of these regions contributes to supply fluctuations and thus price volatility.

(vii) *Policy and Purchase decisions of governments, institutions and private parties:* Government policies such as export restrictions and reactionary strategies by governments, institutions and private traders such as hoarding can lead to extreme price fluctuations as excessive quantities of product are removed from global supplies. Since these actions are precautionary in nature and not based on fundamentals, they can cause transitory price hikes which drive price in the opposite direction once the positions are reversed and supply flows back on to the global market.

(viii) *Fluctuating Currency Prices:* This is a principal source of volatility in any international markets, no less agricultural, and exchange rate risk is a major contributor to unforeseen changes in the price of inputs and outputs.

(ix) *Financial Bubbles:* Financial products can reduce price volatility for producers by allowing them to "take a position" which will offset the impact of input and output price fluctuations. However at the beginning of 2000 commodity derivative markets were deregulated to allow institutional investors such as hedge funds, pension funds and investment banks to trade agricultural derivatives. Trading by such parties can lead to speculative bubbles and price movements which are not derived from supply and demand fundamentals. There is an ongoing debate about the extent to which agricultural price volatility since 2000 has been affected by the speculation of financial institutions and the need for increased regulation. Assuming such return to regulation does not occur, there is increased risk of extreme price volatility via speculative financial activity.

(x) *Policy Changes:* In recent years there has been increased focus on the need for developing countries to develop their own agricultural sectors and to reduce their increasing dependence on cheap (usually subsidised) imports from developed countries by introducing border protection. To that end, there is mounting humanitarian pressures to reduce export refunds on agricultural

products in developed countries. Additionally, EU customs duties on imported agricultural products are set to be reduced in a 'tiered' fashion to avoid developing countries having to bear the brunt of international price volatility (Chatellier, 2011). Price support in the EU CAP has been gradually phased out through successive CAP reforms, meaning that producers in Europe are now more exposed to international market price volatility than they have been in the past. The historical approach in the EU of stabilising domestic markets by distorting international trade is difficult to defend and sustain, and means that the EU (and other protected markets) which once were shielded from world price volatility are now more exposed. This exposure is likely to grow as the relevant political processes evolve.

It is clear that in the current political climate, where agricultural commodity price volatility is rising and the employment of trade distorting government regulations such as price support and import/export tariffs/subsidies is becoming increasingly unpopular, agricultural producers in Ireland and the EU can benefit from private market solutions to price risk. Many of the market instruments that exist to do this are not novel or new, but are underutilised within the EU due to its history of using extensive price stabilisation programmes. As EU farmers' exposure to price uncertainty increases, and as the risk of significant welfare impacts grows, farmers are likely to be more disposed towards market solutions which address price risk. We now look at some of the market instruments that exist to deal with price risk and refer to examples of their use in other countries.

2.3. Risk management strategies

The OECD (2009a) classification in Table 1 offers a general description of the types of risks which agricultural producers face, and the extent of their reach through the agricultural system. The extent to which a risk is systemic has important implications for how it can be managed (Tangermann, 2011). Holzmann and Jorgensen (2001) further distinguish risk strategies into three categories; reduction, mitigation and coping. Risk reduction means reducing the likelihood of the occurrence of an uncertain event which would negatively affect welfare. Risk mitigation involves minimising the negative impact an event may have on welfare once it occurs. Risk coping involves dealing with an event once it has occurred and usually means reducing consumption (therefore negatively effecting welfare).

These responses can then be adopted across three institutional levels, farm, market or government. The more systemic a risk, the higher up the institutional scale will be the capacity to deal with it (Tangermann, 2011). For example, farmers may have the capacity to deal with small losses simply by accepting them as business risk, or handle greater losses by employing risk sharing methods and product diversification. At a higher level of systemic risk, farmers can spread their cooperative efforts spatially through the use of mutual funds to cope with production risks, or use market instruments and insurance to handle price and production risk respectively. At some point, a risk becomes so systemic that the capacity of market forces or farmers themselves to deal with the relevant losses are exceeded, at which point, there is scope for government involvement. Drought, widespread contagious diseases and significant and persistent negative price trends are all examples of what is sometime called "catastrophic" risk. This is known as "residual" risk, and constitutes that risk which remains in existence even in an environment of effective farm risk management strategies and effective markets for risk management. Some of the risk management strategies that exist at different institutional levels institutions are shown in Table 2.

Table 2: Risk management strategies across institutions

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

Source: OECD Secretariat based on Holzmann and Jorgensen (2001) and OECD (2001).

2.4. The holistic approach to agricultural risk management

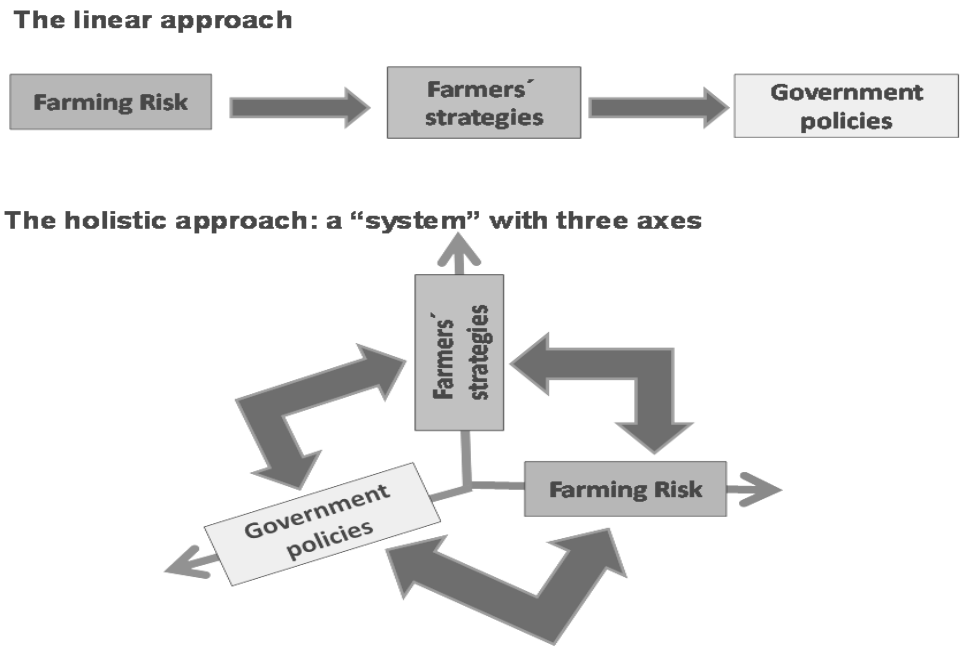
Under the holistic approach to risk management, a risk management system can be seen as a set of complex relations between the original sources of risk, the available tools and strategies to deal with them, and government measures (OECD, 2009a). This means that risk, farm/market management strategies and government policies should not be evaluated in isolation, but in the context of how they fit into the overarching risk environment and management system. Kimura, Antón and LeThi, (2010) show that for empirical data on farm-level incomes, due to diversification and the covariance of risk factors, the variance of farm incomes is less or even half that of what it would otherwise be. According to Tangermann (2011), this suggests that governments should not deal with risks in isolation, but concern themselves with a broader view of the overall pattern and implications of risk affecting farmers. In the same way that Harwood *et al.* (1999) suggest risk is "uncertainty that matters" (because it impacts farmers' welfare) governments should focus on variability in the incomes and margins that farmers experience rather than prices and yield. While managing prices and yield fits into this agenda, the bottom line should be a focus on income stabilisation. This latter conclusion ties in with the findings of Newbery and Stiglitz (1981) which indicate that farmers are more concerned with income variability than with variation in prices or yield.

Another issue highlighted by the holistic approach is the interrelatedness of private risk management strategies, government policy and the variability of critical agricultural variables. Instead of a static relationship, where farmers respond with management strategies to various risks and government policy supplements these efforts (and there are no crossover or feedback effects), the OECD (2009a) asserts a more dynamic and interrelated situation where; "when certain events or measures of variability of relevant farming variables are observed, they already reflect the actions taken by the farmer to manage risk *and* the government measures and regulations that affect both farming risk itself and availability of risk management tools".

Simply put, it is difficult to determine the level of risk that exists in the system, because the observed level of riskiness is partially determined by farmers' risk management strategies and government policy. At the same time, farmers' management strategies, risk tools and risk markets will be affected by the extent and nature of government risk-related policy. In turn, government risk-related policy is a response both to the agricultural risks that exist, and farmers' strategies to deal with them. This three-way dynamic and evolving relationship is

demonstrated in Figure 1. Of particular relevance is the existence of a "crowding out" effect, whereby private solutions and market responses to agricultural risk are prevented from developing because excessive government risk-related policies stifle demand from farmers for private risk management solutions.

Figure 1.Two approaches for the analysis of agricultural risk management



Source: OECD (2009a)

As Figure 1 shows, there is a continuous feedback effect going on between risk, management strategies and policies. According to OECD (2009a), "the availability, development and use of each instrument or strategy is determined to a great extent by the whole system that includes the nature of the risks, the extent to which they are correlated, farmers' endowments and preferences, market developments and government actions".

Under the holistic approach, because risks and responses to them across different institutional levels are thought to be interrelated, no individual tool or policy can be analysed in isolation. Thus, when we attempt to determine the "best" tools, as is the case in a multi-criteria analysis, it is important to distinguish between the boundaries, functions and risk for which different tools are responsible. For example, Tangermann (2011) argues that frequent and limited losses are part of the normal business environment and should be tolerated or dealt with using on-farm risk reduction, mitigation and coping strategies. Less frequent losses

however may be potentially large and off-putting enough that farmers do not wish to bear the risk alone, in which case, they can avail of market based mechanisms for mitigating risk. In the case of catastrophic or "residual" risk, which is at a scale that market instruments like insurance and derivatives cannot deal with (leading to market failure in the case of insurance, and welfare impacts in the case of long term price trends), there is a case for government intervention. The key argues Tangermann, along the lines of the holistic approach, is that public policy should leave as much space as possible for private activity and market solutions. Only in the case of extremely systemic or residual risk, where intelligent on-farm and community risk strategies are beyond their capacity, should there be a role for government risk-related policy. In the course of our review of various risk management tools and policies, we pay particular attention to these considerations. We analyse tools not only for their ability to achieve the immediate goal of risk reduction, but also for their capacity to do this specifically for the level of systemic risk for which the institution in question is responsible. For example, in the case of government policies we ask, do they deal specifically with residual risk and leave marketable and farm-level risks in the hands of individual farmers, farming organisations and private markets?

3. Risk management at the market level

In this section we review market tools from various countries that have been designed to deal with agricultural risk. We do not focus on farm level strategies of risk management in this review as these are outside the scope of the paper, being highly diverse in nature and requiring in-depth knowledge of farming processes. We assess market instruments for their capacity to manage price and production risk whereas later, in section 4, government policies are also assessed for their capacity to fit into a holistic risk management approach, that is, one in which government policies target residual agricultural risk and avoid the crowding out of private market risk management strategies.

3.1. Price risk and agricultural derivatives

Generally, farmers are price takers and there is little they can do to reduce the likelihood of price movements which negatively affect their incomes. However, farmers can mitigate the impact of price movements on the volatility of their incomes by transferring the risk of price instability to a third party. One way of doing this is through the use of market instruments called derivatives. A derivative is a security with a payoff explicitly tied to the value of some underlying variable. Thus an agricultural derivative that hedges a farmer's price risk would

simply increase in price as the price of the underlying agricultural commodity (which the farmer produced) decreased, thereby protecting the farmer from negative price changes that effected the value of his/her output (and income). Many different types of derivatives exist, but four in particular are of note for agricultural producers.

3.1.1. Forward contracts

An agricultural forward contract is an agreement to purchase/sell a specific quantity of an agricultural commodity at a specific price and time in the future. This price can be fixed, or in line with futures markets (Schaffnit and Chaterjee, 2010). A disadvantage of forward contracts is that farmers must forego potentially higher market prices than stipulated in the forward contract, if prices rise significantly. Forward contracts also bear counterparty risk, that is, the risk that the farmer will default on delivery or the buyer will default on payment. A very important disadvantage of a forward contract is that irrespective of production conditions, the farmer must deliver the set quantity of product agreed in the contract on the set date at the set price (unless provisions for various production risks are stipulated in the contract). Given an event which reduces output significantly, a farmer may have to buy up the some or all of the quantity of the commodity specified in the contract at the market price and sell it at the price agreed in the contract (which may be less than the market price). The farmer would thus suffer two negative impacts to his/her income and a greater welfare loss would be experienced than in a scenario *without* the use of a forward contract. This type of scenario can be avoided by using forward contracts on only a fraction of projected output, using contracts which make allowances for extreme production events and by the use of insurance to better manage exposure to production risk.

In Ireland currently, forward contracts are used by Dairygold (a food processor) and its supplying tillage farmers for wheat, barley, oats, oilseed rape, beans and peas. In 2012 it was reported that significant price increases were being foregone by producers due to extreme price volatility and upward price movements following contract agreement dates (*Irish Independent*, 2012).

In addition, some farmers, hit by depressed yields in 2012, had to buy commodities back at inflated market prices and sell them on to processors to satisfy the terms of their forward contracts.

On the dairy side, the most extensive providers of forward contracts in Ireland are Glanbia, Ireland's largest milk processor. The Index Linked Fixed Milk Price Scheme which Glanbia offer their suppliers is a fixed price contract and provides a 3-year fixed price for their output. It is "index linked" in the sense that the 3-year fixed price is based on the value of farm inputs (Buckley, 2009). Because the scheme factors projected input prices into determining the price of output to be offered in the contract, it more directly targets income variability and offers producers the opportunity to stabilise their margin. Given the assertion of Newbery and Stiglitz (1981) that producers are not truly concerned with uncertainty relating to agricultural output and prices, but rather to variability of their incomes, this seems a positive adaptation of the forward contract.

In the U.S., MacDonald and Korb (2011) find that while contract coverage varies widely among producers of field crops, and while most (63%) use no contracts, those who do usually contract substantial shares of production. Farms that do use contracts tend to be considerably larger and contribute a larger share to overall production. Corn, rice, soybeans, and wheat together accounted for 41 percent of all marketing contract revenues in the U.S. in 2008. MacDonald and Korb (2011) also find that contracts covered 90 percent of poultry and egg production in 2008, as well as 68 percent of hog production and nearly 54 percent of dairy production.

3.1.2. Futures markets

Schaffnit and Chaterjee, (2010) define a futures contract as a forward contract which is traded on an organised exchange (and not over the counter) and standardised in terms of quantity, quality, and delivery time and location. In order for the exchange to operate efficiently and with high liquidity, futures contracts must have some specific characteristics. Generally, the delivery price of all futures contracts on an exchange update as the price environment changes, meaning delivery prices across contracts are equal. The adjustment of the contract delivery price is known as the marking to market. Buyers and sellers of futures contracts must hold a margin account. When price movements move in a market participant's favour, money

is added to their margin account, and vice versa. Market participants are thus required to ensure that they hold enough capital in their margin account to satisfy their commitment to the trade and can cover any losses that arise. Unlike forward contracts, where the agreement is usually between a producer and a buyer/processor and the intention is to physically deliver the commodity at the date of settlement, futures markets can be used to hold short term positions without any intention of physically delivering the commodity at the date of settlement. Instead producers can simply undo the hedged position by entering into a futures contract that takes the opposite position as the initial price hedge and sell their product through their normal trading channels. So if a farmer sells a futures contract on the exchange at the start of the season (bets price will fall), he/she can then buy a futures contract (bet price will rise) later in the season before he intends to deliver his product to market. The nature of the hedge means that futures markets significantly reduce counterparty risk, however, basis risk, which is the difference between the futures price and the cash price, still exists. This means that if a farmer sells a futures contract, he/she will have to forego price rises for the commodity until another contract is bought to reverse the original position.

In the U.S., the Chicago Mercantile Exchange (CME) offers futures contracts in many agricultural commodity types across categories such as grains and oilseeds, livestock, dairy, lumber and soft commodities (CME, 2013). In terms of the effectiveness of these instruments in allowing U.S. producers to manage price risk, McKenzie and Singh (2011) used Value at Risk (VAR) analysis to determine the benefits of using futures contracts for stored agricultural produce during USDA report days. The VAR metric reports the worst expected loss over a given time interval under normal market conditions. McKenzie and Singh (2011) found that hedging the price of stored grain over USDA report days using futures to be extremely important and beneficial from a risk management perspective. For example, storing unhedged corn over USDA report days in North Central Illinois resulted in potential losses of 6.76%, 1% of the time. In contrast, hedging corn over USDA report in the same region resulted in potential losses of only 2.28%, 1% of the time.

In the EU the use of futures contracts are more limited. Europe's primary futures exchange the EUREX provides futures contracts for several agricultural commodity types; butter, potatoes, whey, hogs, piglets and skimmed milk powder.

3.1.3. Options

An option is the right but not the obligation to buy or sell a certain quantity of some underlying asset at a specific price at a specific date (or sometimes at any point in time over a specific time period). An option is therefore essentially a futures contract without basis risk, since if a farmer has purchased an option to sell a certain quantity of his/her produce at some point in the future, but the price of the underlying commodity rises, the option need not be exercised and the farmer can benefit from any positive price movements. If the price of the underlying commodity does fall below an agreed threshold, the farmer can exercise his/her right to sell the produce at the superior price stipulated in the option. Usually however, options, like futures, are traded on an exchange and a farmer would simply need to sell his put options to other participants in the exchange. The farmer could then sell produce using the normal trading channels. The revenue generated from the sale of the options would constitute the hedge against negative price movements for the underlying commodity. Options require a premium be paid to the trade-counterparty as an incentive to bear this downside price risk. A further advantage of options is that because the holder of an option is not compelled to exercise it, a negative production event which reduces a farmer's output will not require him/her to have to buy commodities back at inflated market prices to satisfy the terms of, for example, a forward contract.

Events like those in 2012 (*Irish Independent,* 2012) whereby Irish tillage farmers were forced to buy up commodities at inflated prices to meet the requirements of their forward contracts could be avoided with the use of options.

In the US, 15.1% of corn farms used options as a price risk management strategy in 2008, followed by a 13.8% share of soybean farmers and 13.3% in wheat MacDonald and Korb (2011). In Europe, the use of options for hedging agricultural price risk is more limited. According to OECD (2009b) the literature is not conclusive about the effectiveness of option contracts in reducing farming risk. Schaffnit and Chaterjee (2011) posit that this may be due to the cost of premiums on options, which if high enough, can cancel out the price stabilising benefits. Options were blamed for the excessive volatility of grain prices around the Great Depression, and they were banned in the United States between 1936 and 1981 (OECD 2009b).

3.1.4. Swaps

Swaps are of particular relevance for producers of agricultural commodities which are not sold at one point in the year, but regularly throughout the year, such as is the case in the dairy

sector. Swaps, in particular the industry standard *plain vanilla swap*, are used as a mechanism for turning a series of variable-level payments into a series of fixed-level payments. A plain vanilla interest rate swap for example involves one party swapping fixed interest rate payments with payments from a second party based on a floating rate of interest. Payments are based off of a notional principle agreed by both parties at the start of the swap. In a sense, a swap is like a series of forward contracts. The party in receipt of the fixed payments is eliminating the risk of downside variability, but is also foregoing the benefit of any possible upside.

In the U.S., calendar and bullet swaps can be attained from the Chicago Mercantile Exchange for commodities such as corn, wheat and soybean derivatives, live cattle and hogs. However calendar swaps are designed to allow speculative investors to profit from market volatility and are of no use for hedging a producer's price risk. In a bullet swap, the holder of the swap makes a single payment (based off of many payments which varied over the life of the swap) in an exchange for regular fixed payments. In New Zealand, the national stock exchange (NZX Ltd.) is developing dairy swaps that will reduce price and currency volatility for New Zealand diary farmers (*Bloomberg*, 2012). Auckland-based Fonterra Cooperative Group Ltd., the world's largest dairy exporter, pays its suppliers on a monthly basis. By using swaps, where suppliers are granted fixed payments over the year instead of payments that vary due to price and currency volatility, the 10,500 New Zealand dairy producers who supply Fonterra Cooperative Group Ltd. will significantly increase the stability of their revenues.

3.2. Production risk and insurance

Production risk arises from factors such as weather patterns, pests, disease, flooding, fires and personal hazards. The primary means by which farmers can deal with production risk is insurance. However, the insurance market is characterised by an asymmetric information problem, because farmers have highly specialised and specific information about variables relating to their production and yield, and because insurers will often not have access to that same information. Where asymmetric information is present the potential for adverse selection exists. Adverse selection arises when some of those least likely to require insurance decide not to take out insurance. This then means that the probability of a risk event materialising among the insured population is higher than for the population as a whole. Since insurers lack information to be able to accurately assess the risk profile of the insured

to be profitable, insurance companies then have to charge farmers higher insurance policy premiums than would be required if the full population obtained insurance and this impacts adversely on the demand for insurance. Unless there is a substantial market demand for policies, insurance companies cannot pool policy holders and diversify production risks. A further concern which arises in insurance markets is the issue of moral hazard, where the insured changes their attitude or behaviour in relation to risk in response to the fact that they have obtained insurance against that risk arising. Moral hazard can affect the probability of a risky event occurring, which may necessitate higher premiums or the inclusion of a premium excess, both of which may make insurance less attractive to prospective buyers.

Demand for insurance is also affected by the relative cost of alternative strategies such as diversification and financial management and many governments are unwilling to ignore the ex post demand by farmers for monetary compensation from the tax payer following a disaster, which erodes demand for insurance even further since insurance may be viewed in these circumstances as an unnecessary cost to the farmer (OECD 2009).

Since adverse selection and the crowding out effect of government intervention in times of crisis both reduces demand for agricultural insurance, a solution could be to increase the demand for insurance by reducing premium costs (reducing adverse selection) and decreasing the reservation price farmers are willing to pay (reduce crowding effect). Contrary to this, one way in which governments attempt to get around the problem of adverse selection and unaffordable premiums for farmers is to subsidise the premiums that farmers pay to insurance companies. An example of this is the U.S. crop insurance programme which was first initiated in 1930, but was expanded under the Federal Crop Insurance Act of 1980. While it was designed to overcome the problems leading to market failure, Glauber (2007) argues that the U.S crop insurance programme did not overcome the issues of moral hazard and asymmetric information. Of the same scheme, the US Government Accountability Office (GOA, 2007) identified fraud, waste and claimed that the government payment resulted in excessive rents being paid to insurance companies. From the perspective of effectiveness and budgetary feasibility, Tangermann (2011) posits a superior course of action for governments to be assistance in the creation of long-term databases on risk, coverage, and indemnities etc. that help in reducing information asymmetries thereby improve the functioning of the private insurance market.

Equipping farmers and private markets to manage risk independently is consistent with a holistic approach to agricultural risk management, but it is also important to understand the limitations of insurance markets, at which point, the agricultural risk in question becomes residual. OECD (2009a) points out four conditions that must hold in market for risk to be insurable:

- The corresponding risks for different agents have to be independent or idiosyncratic. Risks that are highly correlated cannot be easily pooled and can generate large potential losses with very large liabilities for the insurer. These large scale liabilities are very difficult and expensive to re-insure.
- There must be information available or some method to estimate the probability of the risky event occurring and to evaluate the financial costs associated with each event. An estimate of the distribution of risk is needed in order to be able to calculate the correct premium.
- Information has to be widely available among the agents in the market so that the potential for moral hazard and adverse selection is minimised.
- The probability of occurrence needs to be in a ―medium‖ range: if it is too high the premium will not be affordable; if it is too low it will not be possible use the record of occurrences to estimate the likely distribution as accurately as possible.

According to OECD (2009b) there are few agricultural risks that meet these conditions; crop yields are not truly independent, but correlated to some degree across producers, because they depend on similar events such as weather patterns and the level of disease/pests that arise. Hazards such as hail or frost are more spatially independent. Furthermore, some insurance schemes for animal disease do exist in some countries, such as Spain and Germany.

In Ireland, the main provider of farming insurance is FBD insurance plc. Livestock insurance exists for loss of or injury to livestock as a result of fire, lightning, explosion, aircraft and earthquake. Insurance is also available for the deterioration of stored milk, and insurance for damage caused to roots, potatoes and poultry when caused by fire, lightning, explosion, aircraft, riot, civil commotion, malicious damage, impact, earthquake and subterranean fire. Clearly, many of these risk types constitute idiosyncratic or "one-off" events, often with an extremely low probability of occurrence. Insurance for yield variability or loss of livestock

due to more systemic factors such as weather patterns and disease however is non-existent. This then is a clear cut case of market failure, but one which may not be resolvable by improving insurer's access to information or reducing government compensation for production losses.

4. Risk management at the government level

In this section we review government policies from various countries that have been designed to deal with agricultural risk. We focus on government methods for mitigating and coping with agricultural risk and omit methods for reducing it as these lie outside the scope of the paper. We assess policies for their capacity to fit into a holistic risk management approach, that is, one in which government policies target residual agricultural risk and avoid the crowding out of private market risk management strategies. Beyond that, we focus on their capacity to deal with both price and production risk and also consider trade distortion and budgetary costs associated with different policies.

4.1. Price and Income stabilisation methods

4.1.1. Price support

EU policy has historically relied heavily on price intervention schemes to protect its agricultural sector from international agricultural commodity price fluctuations. The reality for such policies is that their potential to be employed as stabilization tools in the future will be heavily influenced by the international policy agenda. Matthews (2010) summarises the issue:

"Stabilising prices domestically means shifting this instability to world markets. As a result, WTO disciplines limit the actions that an individual country can take to stabilise prices for its own farmers in the interests of creating a global public good – a more stable world market – for all its member countries"

The process of CAP reform has greatly reduced the use of these market intervention tools. Matthews (2010) points out that the availability of such management measures to deal with market instability will be further restricted in the future given a successful Doha Round WTO agreement. While the Doha Development Agenda failed to conclude multilateral trade talks

by the end of 2011 (Kleinmann et al., (2011); Schwab (2011)), a future reduction in customs duties on agricultural products according to a 'tiered' formula was agreed upon, along with calls for an end to all export subsidies by the end of 2013 (Chatellier, 2011). These developments are not intended to completely undermine the capacity of countries to pursue price stability, but to prevent *extreme* market interventions and the trade distortions they cause. The single Common Market Organisation (CMO) (Council, 2007) and the 2008 CAP Health Check (Council, 2009) mean a number of centralised stabilisation tools remain available. However, stabilising support to domestic farmers in the future is likely to be compelled to comply with international trade agreements.

4.1.2. Border controls

Import tariffs and export subsidies are both restricted under the Uruguay Round Agreement on Agriculture (URAA) but can be adjusted within certain bounds. This means that when the international market prices for imported agricultural inputs/outputs rises, EU tariffs on those imports can be temporarily reduced, smoothing input/output price volatility for EU farmers. This may dampen costs and competition for EU farmers but props up EU demand for the product, allowing prices on world markets to rise further, thus contributing to the potential for a food crisis in developing countries. Export subsidies on the other hand can be used to stabilise the price of domestic outputs given a decrease in their international market price. However, in the past this has led to artificially low priced EU-subsidised exports out-competing, and stifling the development of, domestic agricultural production in developing nations (Schaffnit et al., 2010). In recent CAP reforms, ceilings have been placed on total permissible expenditure on export subsidies and the total permissible quantity of subsidised exports.

4.1.3. Public intervention

Direct public intervention takes place through intervention purchasing and sales. The former is used to exert an inflationary effect on a falling market price, while the latter suppresses price rises. Given predetermined price thresholds, governments can buy up and store certain agricultural outputs (common wheat, butter and milk powder) when world prices are low and use these stocks to ease price increases when prices swing in the other direction. *Indirect* price support in the form of Aid for Private Storage (APS) can also be used to increase

private storage of certain agricultural outputs during period of low prices which later can be sold at higher market prices. Processing aid can be used as a mechanism to increase internal consumption and counter cyclical policies can be used to boost demand for certain products.

The EU agricultural budgetary crisis of the 1980s occurred because price support mechanisms and border protection led agricultural production to exceed demand to the point that stocks had to be bought up through public intervention, or exported to the world market, often through support from export subsidies. These policies became financially and politically unsustainable at an EU level and undermined the agricultural sectors of the countries importing lower priced European produce. Such policies simply constituted a passing of price volatility on to international markets.

4.1.4. Deficiency payments, counter-cyclical payments and income stabilisation methods

These are agricultural domestic supports, paid by governments to producers of certain commodities and are based on the difference between a target price and the domestic market price or loan rate, whichever is the less. Tangermann (2011) notes that they are still available in a number of developed countries particularly the US. As these payments are directly output related, they are highly trade distorting.

Counter cyclical payments are made on the basis of output in a historical reference period and are not tied to farmers' current production. Payments are usually the difference between some target price and the actual market price. Tangermann (2011) argues that while this type of vehicle is less trade distorting than deficiency payments, it offers significant production incentives because they reduce price risk, and therefore encourage producers to ignore negative market signals.

Tangermann argues that because mechanisms like deficiency and counter-cyclical payments incentivise increased production, they are not only trade distorting, but run counter to a holistic approach to agricultural risk management. Too much price protection from governments undermines the development of private risk markets and on-farm risk management strategies. A superior means of stabilising agricultural producers' incomes is to avoid compensatory schemes for price and yield and to focus on the income level itself. In particular Tangermann sites Canada's income stabilization programmes and evolving instrumentation as specific examples. Under the most recent scheme (AgriStability in

combination with AgriInvest) there is graduated system of compensation relating to the level of income decline in any given year relative to the farm's reference level such that:

- If income falls below the reference by 15% then the fall is considered part of normal business risk and farmers can withdraw from the AgriInvest account. This account will have been paid into both by themselves and matching government contributions.
- If income is between 85% and 70% of the farm's reference, government payments cover 70% of the decline below the 85% threshold.
- If income falls to less than 70% of the farm's reference, the government pays 80% of the additional income decline.

This scheme has a well designed tiered format for compensating agricultural producers when extraordinary circumstances affect their income. The final stage, where higher payments are made, is reserved for a "disaster" situation when income is heavily affected, while avoiding the "crowding out affect" at normal levels of business risk and losses. The capacity of this scheme to fit into a holistic approach is not fully taken advantage of however due to the existence of compensatory payments even for income reductions which would be consider at the level of normal business risk (given a 15% fall in income). Tangermann (2011) describes this deficiency as a "support payment" and also points out that a whole regime of other risk management policies in Canada mean there is overlap and incoherence between this scheme and other measures. Despite this, the scheme is a good example of what can be achieved if such measures are implemented in a policy environment which is conducive to a holistic approach.

4.1.5. Tax income smoothing

The taxation system can be used as an income stabilisation tool by allowing producers to calculate their tax levels over consecutive years as opposed to each year individually, thereby avoiding sudden drops in their income in any one year. Essentially, producers are compensated for falls in income in bad years by allowing them to offset these income reductions against the amount of tax they must pay in good years. OECD (2009) and OECD (2011b) discuss various examples of tax smoothing schemes in different countries.

5. Multi-criteria Analysis of risk management tools and polices

The purpose of the multi- criteria analysis (MCA) is to briefly summarise the strengths and weaknesses of various market and government risk related tools and policies and then rank

them accordingly. A number of key criteria were decided upon and each tool was evaluated along the following general lines:

0 = in conflict with the criterion

1= weak fulfilment of the criterion

2 = moderate fulfilment of criterion

3 = complete fulfilment of the criterion

When the criterion in question would have negative implications for tool or policy in question, such as a cost or undesired risk created by a tool/policy, the rating takes a negative value, lowering the ranking of the tool/policy. In almost all cases only 3 levels of distinction (0 to 2) were used in the scale, but for costs the scale ranged from 0 to 3.

The MCA is made up of two steps. Failure to meet certain criteria is grounds for dismissing some tools or policies from further evaluation. Given known EU policy objectives, evidence from the literature, and taking account of the ongoing debate on EU agricultural stabilisation policy, it is therefore possible to rule out certain management tools and policies from further analysis

	Criteria upon which all tools and policies are evaluated							Additional criterion for government. policies
	Acceptability		**Effectiveness**		**Operationality**		**Cost**	**Holistically orientated**
	Budgetary feasibility	WTO compatible	Managing risk	Resolving market failure	Ease of implementation	Flexibility/adaptability		
	Tools/policies must have a sustainable cost structure. Unsustainably costly government. tools fail this criterion	WTO green box rules are critical of government stabilisation tools that distort trade and are out of favour	Each tool must satisfactorily manage the risk for which it is designed	Any tool/policy for reducing market failure be cost efficient and achieve its aim	There must be realistic potential for a tool to be implemented.	Given the dynamic and changing nature of agricultural markets, it is desirable that a tool have the capacity for adaption over time	Lesser costs are more desirable and must also be equitable	Regardless of the effectiveness of a government. Policy at managing risk, its function should be to tackle residual risk. The capacity for a tool to be structured to avoid crowing out receives a score of 0 (i.e. no crowding out affect)
	Pass/Fail	Pass/Fail	Scale: 0 to2	Pass/Fail	Scale: 0to 3	Scale: 0to 2	Scale: 0to -3	Scale: 0 to 2
	n/a	n/a	Ineffective	n/a	Impossible	Inflexible	Zero cost	Yes
	n/a	n/a	Limited	n/a	Difficult/barriers	Limited	Effective	To an extent
	n/a	n/a	Effective	n/a	Highly feasible	Highly flexible	Acceptable	No
	n/a	n/a	n/a	n/a	n/a	n/a	Infeasible	n/a

Table 3: Various criteria by which tools and polices were evaluated

	Additional criteria for market risk management tools			
Criteria	**Creation of additional risk types**			
Sub- criteria	Basis	Counter-party	Systemic	Compounded production risk
Description of each criterion	Risk that spot price and futures price do not converge	Risk of contract counterparty defaulting on delivery of cash/product	Risk of collapse of entire market due to exposure across entire system	Risk that farmer will have to satisfy contractual agreement and supply output despite a failure in production i.e. buy in at inflated market prices
Rule	Scale: 0 to-2	Scale: 0 to-2	Scale: 0 to -2	Scale: 0-to -2
0	Risk in question is in not associated with this tool			
-1	Risk in question somewhat associated with this tool			
-2	Risk in question highly associated with this tool			

Table 4: Additional risk-related criteria by which market tools were evaluated

since they do not constitute a viable working solution to the problem of agricultural risk. This allows the focus of the MCA to be directed exclusively toward tools which are deemed to be more compatible with EU agricultural policy objectives. Those tools which meet these initial criteria can then be evaluated according to the more critical criteria. The criteria used in the analysis and the action applied to each criterion (whether to fail or pass and how to scale a tool/policy) are shown in Tables 3 and 4. Note that while some criteria apply to all tools and policies in the analysis, others are specific to market risk management tools or government risk related policies.

Numerous agricultural risk management tools and policies were discussed in the literature review and those selected for inclusion in the MCA are shown in Table 5.

Table 5: Government and market risk management tools and policies

Government Policies	**Market tools**
Support programmes	Forward contracts
Price support	Futures markets
Export subsidies and import tariffs	Options
Deficiency payments	Swaps
Counter-cyclical payments	Insurance markets
Government funded insurance schemes	Mutual Funds
Cyclical income based stabilisers	

5.1. Criteria, scales and ranking

5.1.1. Acceptability

The tools that failed to be deemed as acceptable under this MCA criterion were:

- Support programmes
- Price support
- Export subsidies
- Import tariffs
- Deficiency payments

All of these tools failed on the grounds of budgetary infeasibility and WTO incompatibility. All of these criteria are linked and relate to trade distortion. One of the primary tools used in the CAP in the past was guaranteed institutional prices for EU agricultural producers. Furthermore, in order to protect domestic production from imports, import tariffs were used. This meant that economic signals to producers (price drops) were prevented, thus excess production emerged on the domestic market. To re-establish equilibrium, public intervention and export refunds (which meant low priced produce being exported to the world market) were employed. Given continuing excess production across many agricultural sectors, the budgetary costs of maintaining equilibrium became unsustainable and the negative impact on the agricultural sectors of developing nations became highly controversial leading to the creation of the WTO green box rules. For these reasons, the above tools fail this stage of the criteria analysis and do not receive further treatment. Deficiency payments are specifically designed to smooth producer output price variability but are highly trade distorting and inferior to cyclical payments and income stabilising policies in this regard. All other remaining tools in the analysis were deemed to be acceptable in that they do not distort trade in this way.

	Benefit	***Operationality***		***Cost***	***Additional risk types (market tools)***				***Holistically orientated (government tools)***	***Total scaling***
	Effectiveness in managing relevant risk type	*Ease of implementation*	*Flexibility and adaptability*		*Basis*	*Counter-party*	*Systemic*	*Compounded production risk*		*Ranking*
Insurance markets	*1*	*3*	*1*	*PI (-2) PP (-2)*	*0*	*-2*	*-1*	*0*	*n/a*	*-2*
Mutual funds	*1*	*2*	*1*	*PP(-2)*	*0*	*-2*	*-1*	*0*	*n/a*	*-1*
Forward contracts	*2*	*2*	*1*	*0*	*-2*	*-2*	*-1*	*-2*	*n/a*	*-2*
Futures	*2*	*1*	*2*	*PP (-1)*	*-1*	*-1*	*-2*	*-1*	*n/a*	*-1*
Options	*2*	*1*	*2*	*PP(-2)*	*0*	*-1*	*-2*	*0*	*n/a*	*0*
Swaps	*2*	*2*	*1*	*0*	*-2*	*-2*	*-1*	*-2*	*n/a*	*-2*
Tax income smoothing	*1*	*2*	*2*	*PB (-2)*	*n/a*	*n/a*	*n/a*	*n/a*	*2*	*5*
Counter cyclical programmes	*2*	*2*	*2*	*PB(-2)*	*n/a*	*n/a*	*n/a*	*n/a*	*0*	*4*
Income stabilising regimes	*2*	*2*	*2*	*PP(-1)*	*n/a*	*n/a*	*n/a*	*n/a*	*2*	*7*

Table 6: Results of multi-criteria analysis

5.1.2. Benefit

Government funded insurance programmes fail this stage of the criteria analysis and do not receive further treatment. This follows the findings of Glauber, (2007), GOA (2007) and Tangermann (2011) that the U.S. government crop insurance scheme failed to deal with the problems of moral hazard and adverse selection effectively. These schemes have also been associated with excessive rents and corruption (GOA, 2007).

Table 6 shows the performance of each tool across the various criteria. Note that the criterion "additional risk types" applies only to market tools and "holistically orientated" applies only to government policies.

Insurance markets were deemed to have only limited effectiveness given their lack of capacity to handle the impact of catastrophic natural events on production and mutual funds mirrored this. Particular government policies, namely, tax income smoothing, counter cyclical programmes and income stabilisation regimes, all preformed well given their capacity to avoid trade distortion and crowding out while still offering producers protection from extreme declines in income. Other price risk management market tools being highly specific and effective in their function received a rating of 2.

5.1.3. Operationality

(i) Ease of implementation

Many tools scored highly in this regard because there are few barriers to their implementation. Where a market tool scored 2, it is because education and training is required in order to create the market knowledge required to ignite the demand for certain market risk management tools. Some market risk management tools are already in use however, such as forward contracts, and are growing in popularity without government training programmes. Indeed, it is largely the processing sector which has taken the lead in educating their main suppliers in terms of how these contracts function, as the contracts are mutually beneficial. In the case of futures and options markets, large institutional investors are required to establish liquid trading platforms, thus these tools were deemed to be difficult to implement, at least at the national level in the medium term. Mutual funds scored 2 as it would require substantial government involvement to establish a mutual fund with sufficient scale across Europe to be

sufficiently geographically diversified to genuinely be able to handle systemic weather and disease risk.

(ii) Flexibility and adaptability

Insurance markets were deemed to have limited flexibility and adaptability primarily because of their incapacity to deal with adverse selection effectively; mutual funds mirrored this. Improvement in this regard would reduce the likelihood of market failure and increase the capacity of the market to deal with production risk. As argued in the literature review and by Tangermann (2011), their may be a role for government in this area with respect to improving database information on those seeking insurance. Forward contracts were also deemed to have limited flexibility and adaptability because of the limited potential they offer producers to buy and sell these contracts after they have been entered into. By contrast, futures and options markets can be traded on highly liquid exchanges and accordingly these tools were thus deemed to be satisfactorily flexible and adaptable. All government policies scored highly as they have the potential to be adapted according to stabilisation objectives. It is likely however in practice that once institutionalised, regimes may be difficult to adjust and could be inflexible in this regard, but the challenge for future government policy relating to agricultural risk management, if it is to be holistic in nature, will be to overcome such political pressure.

5.1.4. Costs

Costs were distinguished according to the institutional level at which they impacted; public budget (PB), private industry (PI) and producers and processors (PP).

Insurance markets were deemed to have acceptable costs (-2) to represent those markets that do exist, but could not be given a highly cost effective ranking (-1) because of the costs associated with adverse selection, in which insurance companies face unacceptably high payout costs and pass this onto farmers with low production risk, via excessively high premia to maintain profitability. Essentially, agricultural insurance markets are generally costly to the point of market failure. In terms of cost, mutual funds scored similar to Insurance markets. All market based price risk tools were deemed to be highly cost effective, apart from options. This is because buyers of options must pay a premium for factoring out the downside price risk of their position. Tax income smoothing received a cost rating of (-2) for the public budget category because it constitutes a loss of revenue to the exchequer but may be an

effective tool for contributing toward the management of multiannual price volatility. Counter-cyclical programmes were given a ranking of -2 because it is possible that, if sensibly implemented as part of a holistic approach, they can have an acceptable cost level. Income stabilisation regimes, when evaluated, were considered to have a more acceptable cost level (-1) because they target income and, therefore, do not incentivise excessive production to the same extent as counter-cyclical payments.

5.1.5. Additional risk types

Risk management tools manage price and production risk by transferring it from one party to another. In doing this, other risks can arise. These risks are sited in Table 4.

Swaps and forward contracts both scored poorly in terms of basis risk due to the fact that there is little the involved parties can do to reverse a position as the price of an underlying commodity deviates away from the contract's settlement price. The revenue foregone by the holder in cases of extreme price movements can therefore be substantial. Futures maintain some of this exposure, but as part of a highly liquid trading exchange, the position can easily be reversed. Insurance markets are highly associated with counterparty risk, especially in the event of catastrophic events that effect production and therefore score poorly for this risk type. Mutual funds are scored similarly; the potential to cover participants' losses rests on the capital capacity of the fund, which will depend on its scale. Forward contracts and swaps are also highly unfavourable in terms of counterparty risk and also score poorly. While futures and options can technically carry the same risk, it is offset by liquid exchanges in which the position can be quickly reversed, thus these tools scored well for this risk type. Systemic risk is also an issue in insurance markets and mutual funds, as well as all other market price risk management tools to varying degrees (see scores in Table 6). The main offenders for compounding production risk are again, forwards and swaps; again because they offer little to no flexibility in reversing out of the position.

Certain steps which producers, policy makers and regulators can take to offset such risks may deem such shortcomings tolerable and less of an issue than initially appears. These issues are discussed in the following two sections

5.1.6. Holistically orientated

The ability of a government policy to fit into a holistic approach means that it should be coherent with a risk management system where farmers and private markets are empowered

to manage risks independently of government intervention, stepping in only to resolve residual risk. This is therefore one of the criteria by which we evaluate government policies.

Income stabilisation regimes, like the Canadian AgriStability programme faired well in this analysis. As argued by Tangermann (2011), it gave some interesting insights into how a risk-related government compensation programme can be structured to facilitate producers when events, of various intensity (catastrophic, less severe and normal), affect producers' incomes. Tax income smoothing, because again, it is directly linked to income and therefore welfare, has potential for maximum welfare benefits and possibly less trade distortion and less of a crowding out affect. Counter cyclical payments did not score so highly because, contrary to the previous two policies, payments are directly linked to prices.

5.2. Rankings

As argued in the holistic approach, there is no single best tool to manage agricultural risk. Instead agricultural risk management is an issue of coherence; tools and policies should fit together to deal optimally with the type of risk for which they are designed. In that vein, we have structured our ranking of tools according to which type of risk, residual or marketable, a tool or policy is intended to deal with. The relative ranking of tools assessed in section 5.1 are shown in Table 7.

Marketable risk			***Residual risk***		
Tool	**Risk type**	**Ranking**	***Policy***	**Risk type**	**Ranking**
Options	*Price*	*1*	***Income stabilising regimes***	*Price and production*	*1*
Forwards	*Price*	*2*	***Tax income smoothing***	*Price and production*	*2*
Futures	*Price*	*2*	***Counter cyclical programmes***	*Price*	*3*
Mutual funds	*Production*	*2*			
Insurance Markets	*Production*	*3*			
Swaps	*Price*	*3*			

Table 7: Ranking of tools/polices according to risk types

Of the tools designed to deal with marketable risk, options fair the best in the MCA. This is because, while only slightly superior or equivalent to other price risk management tools in terms of flexibility and effectiveness, options suffer much less "additional risk" such as basis, counterparty and compounded production risks and this is a very important aspect of derivatives when deciding which to use. The advantages come with a premium which farmers must pay and actual preference in reality would depend on the risk aversion of different producers. A further problem that exists with this instrument is the lack of options available for agricultural commodities in Europe.

Insurance ranked poorly because it is associated with very high costs to both the private market and producers and processors, representing the extent of market failure associated with agricultural insurance markets. It could be argued that this undermines much of the effectiveness that insurance markets may have in the management of agricultural risk. In our review of insurance in Ireland, no insurance for the impact of systemic risks like weather patterns and disease could be identified. Swaps and forward contracts faired badly because they exhibit almost all the additional risk types. In reality however, a poor or high ranking does not negate the usage of a tool; there may be instances where a futures contract or swap would outperform options and better suit the specific needs of particular producers at particular times. Under a holistic approach, various market instruments should be employed in a variety of ways, in unison with on-farm risk management strategies. However the ranking is a useful way of neatly underlining some of the positives and negatives associated with different tools. It also shows the absolute lack of private-market production risk solutions that are available to producers and the importance of government residual risk policies in that regard.

Of the tools designed to deal with residual risk, income smoothing regimes ranked highest because apart from being effective in dealing with residual risk, they have the greatest capacity to avoid the crowding out of the private sector and on-farm management strategies. This is also true of tax income smoothing. Counter cyclical payments, while still having merit, are purely price based and therefore more likely to distort trade. It must be pointed out that the success of a government risk-related policy will depend heavily on the way in which it is implemented. For example, according to OECD (2009), two thirds of all farm support in the OECD area was provided in the form of risk-related payments from 2002-2007. Even in the

example given for income stabilisation regimes (the Canadian AgriStability programme), the first tier of payment kicked in at only a 15% fall in income. At this level, the payment constitutes support and not a risk-related pay off.

6. Conclusion/discussion

A recent rise in the level of agricultural commodity price volatility may have fuelled debate about how farmers can manage their exposure to agricultural risk, but recent policy trends towards reduced government intervention in agricultural risk management are of equal importance. As government policies like price supports, border controls and public intervention become constrained by international trade agreements, new solutions for the stabilisation of agricultural markets must be considered.

This paper carried out a review of various market tools and government policies designed for the management of agricultural risk. Given the recent impetus for empowerment of farmers to manage risk independently and for the development of private risk management markets, particular focus in the review was placed on agricultural derivative products and insurance markets. Derivative products have the capacity to offer farmers and processors considerable protection from price volatility, but it is important that their limitations and the extra risks with which they are associated such as systemic, basis and counterparty risk are fully understood by agricultural producers who use them. There is a risk that such tools may be employed by producers without sufficient knowledge to do so optimally. This lack of knowledge about how best to employ these tools can result in extreme losses of income and impact negatively on welfare. In addition to further education of producers who may use these tools, considerable support from government at the EU level may be required to establish futures and options exchanges with sufficient liquidity to be effective. In particular there is a lack of diversity in Europe in the types of agricultural commodities for which options can be purchased.

In addition to the aforementioned risks associated with derivative products, policy makers must also consider the limitations of these tools. For marketable risks (in this case price volatility) they will be of use, but in the event of long term price trends that negatively impact farmers' incomes, such tools offer no protection. Price trends constitute residual as opposed to marketable risk. Under the holistic approach to risk management, there is scope for

government policy and tools that compensate producers for income-affecting events which intelligent on farm risk management strategies and efficiently operating risk management markets can do nothing about. Another example of residual risk is systemic production risk, like widespread weather patterns such as drought and contagious diseases affecting livestock and crops. Because of asymmetric information, moral hazard and adverse selection, the cost of insurance policies to both insurers and farmers often lead to market failure. While examples of insurance on livestock, crops and farm property do exist, compensation is often associated with non-systemic risks like fire, hail and personal injury. Once risks become systemic, they generally become too costly to ensure. Thus price trends and systemic production risk make up the bulk of residual risk which, under a holistic approach to agricultural risk management, governments must address.

The results of the multi-criteria analysis suggested that income stabilisation regimes, such as the Canadian AgriStability scheme, were the superior mechanism for offering farmers protection from systemic, residual and catastrophic risks without crowding out private market solutions to marketable and normal agricultural risk. This is achieved by staggering/increasing compensatory payments to farmers as the scale of income declines increase. However, given findings in the literature that many risk-related government payments to producers end up taking the form of support payments, it is vital that any such income stabilisation regimes are implemented with a holistic approach in mind. This means that farmers should not be compensated for small losses, should be only partially compensated for losses from risks that are marketable (to ensure demand available market tools is supported) and are more fully compensated for residual risks for which there exist no market or on-farm solutions and where therefore, there can be no crowding out affect. In the future, many issues will have to be addressed if risk is to be managed across the three institutions (farm, market and government) in a holistic sense. One such issue will be diagnosing what constitutes a "catastrophic risk". Ambiguity in this regard, combined with political pressure to provide support payments to producers (though risk-related channels) will undermine the ability of such instruments to peg payments to residual risks (instead becoming support payments).

Future work in this area should attempt to to quantify the impact of government risk-related policies on the development of private risk-management markets and on farm risk management strategies. Discrete choice methods analysing the characteristics of producers that avail of market tools for price risk management may also be of interest to policy makers.

References

Baquet A, Hambleton R, and Jose D (1997) *Introduction to Risk Management*. USDA Risk Management Agency.

Bloomberg news. (2012) NZX Developing Milk Hedge for Farmers as Currency Offsets Gains. Available at: http://www.bloomberg.com/news/2012-09-06/nzx-developing-milk-hedge-for-farmers-as-currency-offsets-gains.html

Buckley (2009) The Role of Dairy Futures Markets & Other Price Risk Management Mechanisms in the EU Dairy Industry. A report for Nuffield Ireland farming scholarships. Co. Tipperary, Ireland.

CME group. (2013) Agricultural product slate. Available at: http://www.cmegroup.com/trading/agricultural/#sortKey=9&sortOrder=descending&SortType=number&FilterOn=//lcpcProductTO[cpcproduct/product_group + 'Agricultural']&PageStart=1&vertindex=0&page=agricultural

FAO OECD et al. (2011). Price Volatility in Food and Agricultural Markets: Policy Responses, Food and Agricultural Organization.

GAO (2007) Crop Insurance: Continuing Efforts Are Needed to Improve Program Integrity and Ensure Program Costs are Reasonable, *Testimony before the subcommittee on general farm commodities and risk management*. Committee on Agriculture, House of Representatives.

Glauber J (2007) Double Indemnity: Crop Insurance and the Failure of US Agricultural Disaster Policy. *AEI Agricultural Policy Series: The 2007 Farm Bill and Beyond. Washington DC*. American Enterprise Institute.

Hardaker JB, Huirne R, Anderson JR, and Lien G (2004) *Coping with risk in agriculture*. CABI Publishing.

Harwood J, Heifner R, Coble K, Perry J and Somwaru A (1999) Managing Risk in Farming: Concepts Research and Analysis. *Economic Research Service: Agricultural Economic Report 774*. USDA

Holzman and Jorgensen (2001) Social Risk management: A New conceptual framework for social protection, and beyond. *International Tax and public Finance* 8:529-556.

Huirne, RBM, Meuwissen M, Hardacker JB and Anderson JR (2000) Risk and risk management in agriculture: an overview and empirical results. *International Journal of Risk Assessment and Management* 1: 125-136.

Irish Independent News. (2012) Sharks cashing in on crop scare are causing markets mayhem. Available at: http://www.independent.ie/business/farming/sharks-cashing-in-on-crop-scare-are-causing-markets-mayhem-26889817.html

MacDonald J and Korb P (2011) Agricultural contracting update: Contracting in 2008. *EIB*-72. U.S. Dept. of Agriculture, Econ. Res. Serv.

Moschini G and Hennessy DA (2001) *Uncertainty, risk aversion, and risk management for agricultural producers*. Chapter 2 in Gardner and Rausser (2001) Iowa State University.

Musser WN and Patrick GF (2001) *How much does risk really matter to farmers?* Chapter 24 Just and Pope (2002) Kluwer academic publishers, Massachusetts.

Newbery DM and Stiglitz J (1981) *The Theory of Commodity Prices Stabilization*, Oxford: Oxford University Press.

OECD (2009a) Managing Risk in Agriculture: A Holistic Approach. OECD, Paris.

OECD (2009b) Risk management in agriculture – A holistic conceptual framework. *Working Party on Agricultural Policies and Markets*. March 2009. Paris.

OECD (2011a) Synthesis Report on Risk Management in Agriculture. Document TAD/CA/APM/WP(2011)4FINAL. Paris: OECD.

Schaffnit Chatterjee C (2010). *Risk management in agriculture. Towards market solutions in the EU*. Deutsche bank Research

Tangermann S (2011) Risk management in Agriculture and the Future of the EU's Common Agricultural Policy. *ICTSD*, Issue Paper No. 34, Geneva