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Options for insuring Australian agriculture

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Summary

Adapting to increased climate variability will require Australian farmers to adopt new ways of thinking about risk management. Australian Government policy focuses on creating an environment of self-reliance and encourages farmers to adopt better risk management practices.

This paper does not analyse the full range of risk management options available to farmers. Instead it focuses on the potential role of insurance and related products in risk management. This paper surveys the literature on agricultural insurance, and makes conclusions in the context of current policy in Australia. The literature review is supplemented by ABARES estimates of insurance premiums for major crop types.

While agriculture faces a higher level of revenue risk than other sectors of the economy, insurance is most suitable for managing yield risk from rare and extreme events. This paper discusses appropriate options for insurance. Traditional insurance products, designed to directly protect against yield losses on an individual farm, are compared with newer index-based products that use indirect proxies, such as rainfall at a local weather station or shire-level yields, for yield losses on a farm.

Attempts to introduce traditional yield insurance products in Australia have consistently failed, but the recent introduction of index-based products shows some promise. Internationally, traditional yield insurance products are common, particularly in developed nations; however, all schemes are heavily supported by governments. In recent years, index-based products have been introduced, largely in developing countries that do not have subsidised yield insurance. India and Mexico have the most advanced schemes, but most other schemes have not yet moved past the pilot stage.

Recent studies into demand have found that appetite for insurance products by Australian farmers is generally fairly low. In the absence of significant government support, traditional insurance products are likely to be further burdened by high costs and, therefore, high premiums over and above the cost of risk, because of significant problems with adverse selection, moral hazard and systemic risks, in addition to high loss adjustment costs. Index-based products overcome most of these problems, but their effectiveness (and therefore demand) is limited to the extent that the underlying indices on which they are based are correlated with actual yields experienced on an individual farm.

The economic case for government subsidisation of premiums or underwriting of risk is not strong. However, further investigation is warranted into the role of government in the compilation and provision of information to improve shire-level yield or weather station data, or in supporting research and development of crop simulation models.

Introduction

Australian agriculture operates in uncertain climatic and market conditions. Climate change is anticipated to increase the frequency of extreme weather events, including drought. Australian farmers must constantly manage the risks of changing global market settings and volatile domestic growing conditions.

The purpose of this report is to identify and evaluate options for insuring Australian farmers against extreme climatic events, specifically multi peril crop insurance (MPCI), mutual funds, weather derivatives, yield index, and area yield insurance.

This analysis focuses on insurance for agricultural producers against yield risk for rare and extreme climatic events. These financial products are not intended as a source of government assistance to replace that currently provided under Exceptional Circumstances policy. But it is recognised that farmers may need new options to manage the risks of climate variability—this report evaluates insurance options in this context.

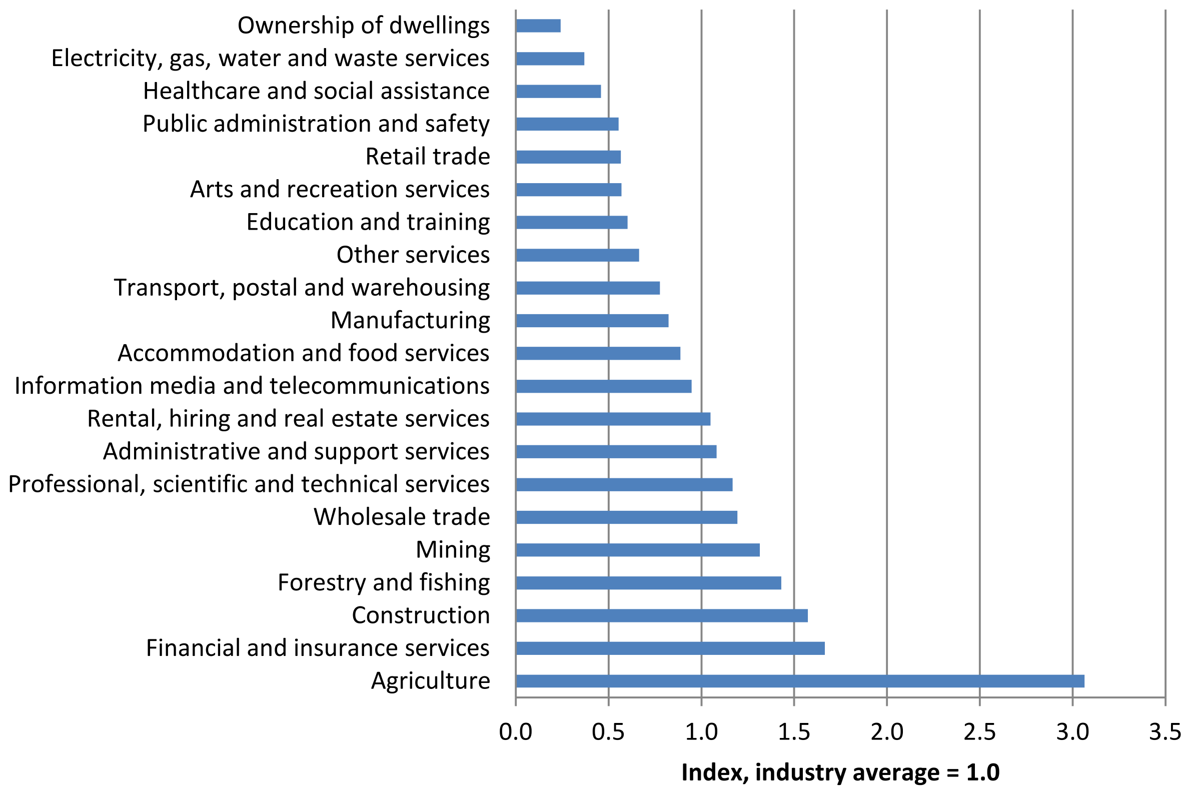
Chapter 2 describes the risks faced by Australian farmers, as well as options for agricultural insurance. Chapter 3 describes Australian and international experience with agricultural insurance. Chapter 4 describes the pros and cons of insurance options, and includes estimates of insurance premiums for yield-based insurance products. Chapter 5 discusses potential roles for the Australian Government. ABARES methodology for estimating insurance premiums is described in the appendix. Insurance industry terminologies are explained in the glossary.

1 Models for agricultural insurance

Risks faced by Australian farmers

Australian farmers face a high degree of production risk compared with other sectors of the economy. Since 1975, agriculture has exhibited the highest degree of volatility, at 3.1 times higher than the average (Figure 1). The volatility of the agriculture industry is nearly double that of any other industry.

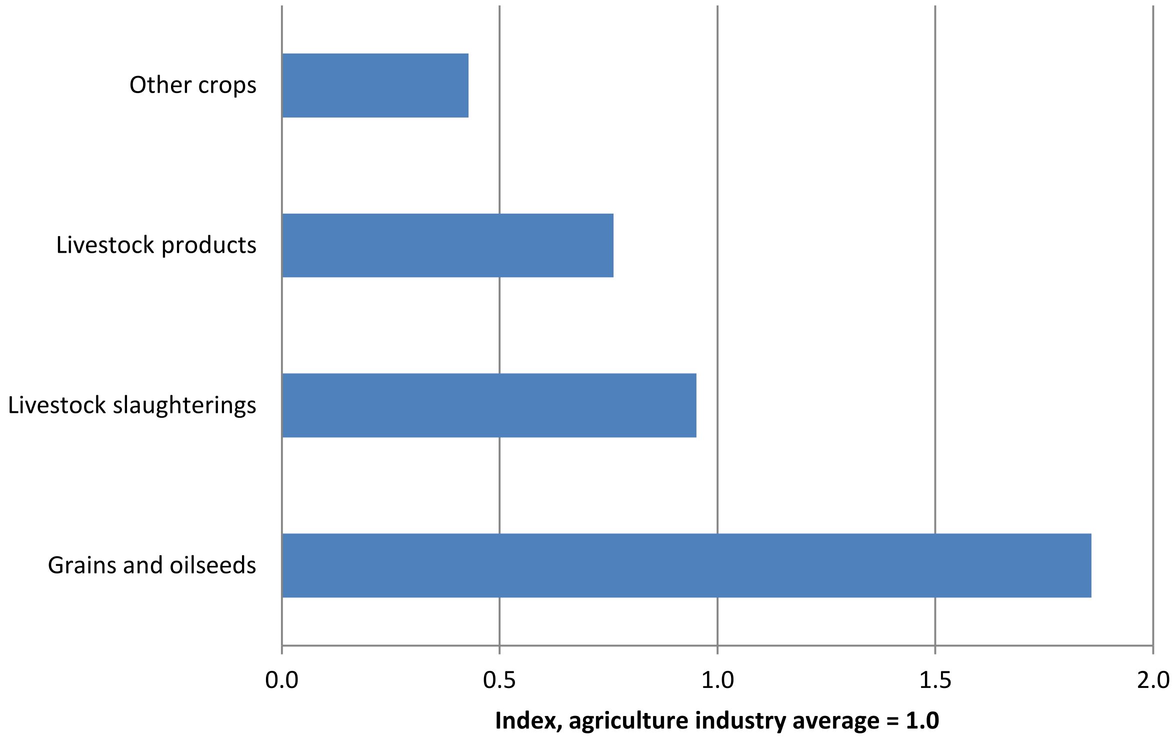
Figure 1 Industry output volatility, 1975–2011



Note: Industry volatility is calculated by taking the standard deviation of the percentage difference between actual and trend production. Trend data are estimated using a Hodrick-Prescott smoothing filter. Data are in chain volume measures.
Data source: ABS 2011

Within agriculture, there may be different degrees of output volatility across products and regions. Grains and oilseeds exhibit the highest degree of volatility in the value of farm production, at 1.8 times the average (Figure 2).

Figure 2 Volatility of the value of Australian farm production, 1966–2011

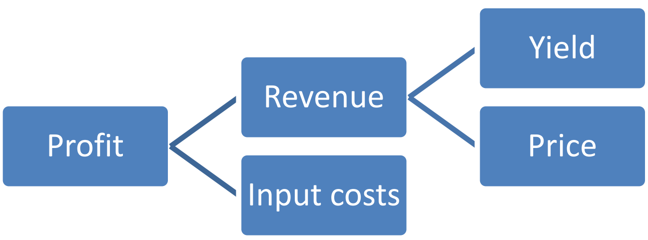


Note: Industry volatility is calculated by taking the standard deviation of the percentage difference between actual and trend production. Trend data are estimated using a Hodrick-Prescott smoothing filter. When comparing indexes in this figure with those in Figure 1, note that the volatility index for the agricultural industry has been rebased to 1.0.
Data source: ABARES 2011

The role of insurance

As with any business, farmers wish to maximise their profits while minimising their risks. There are many potential causes of risk, and different risk management options may be appropriate in different circumstances. Risks to farmer profits can be categorised as revenue risk or input cost risk (Figure 3). The focus of this report is revenue risk, of which yield and product price are components.

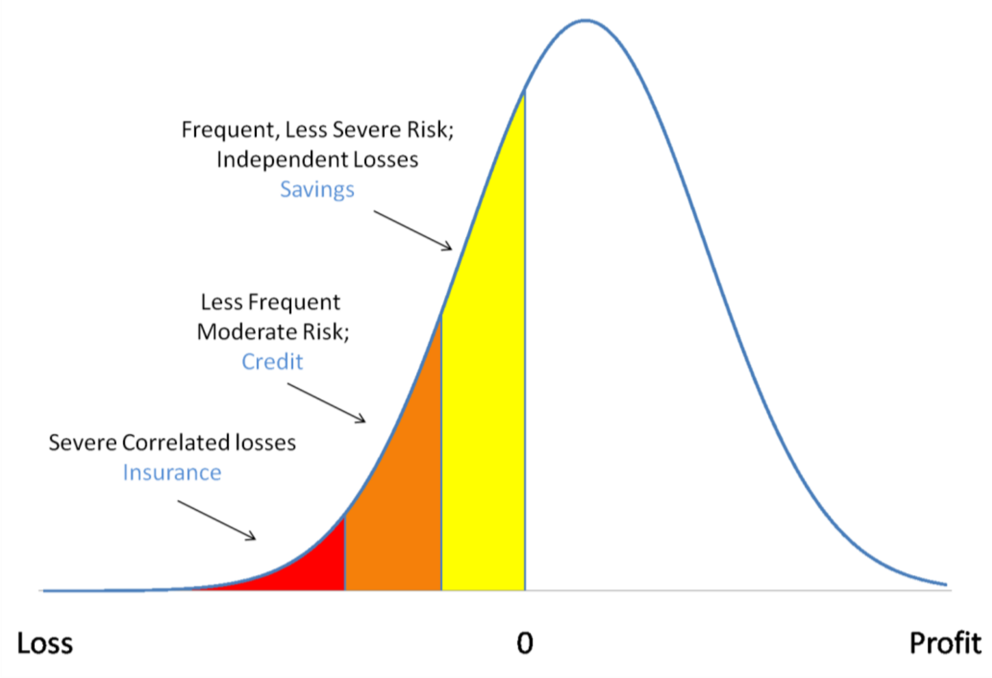
Figure 3 Risks faced by farmers



Source: ABARES

Agricultural insurance is more appropriate for rare and extreme events (Figure 4). Claims made against insurance policies frequently add to the cost of insurance by increasing the costs of loss adjustment. The cost of insurance also needs to be considered against the cost of alternative risk management practices. In particular, less significant risks may be managed more economically through savings or borrowings.

Figure 4 The role of insurance



Source: DAFWA 2011

Yield versus price risk

This analysis focuses on yield risk, as opposed to price risk, because options for farmers to hedge price risk, such as forward contracts and futures, already exist. By contrast, limited options are available for farmers to protect themselves from yield risk.

It is easier for the market to provide options to hedge price risk rather than yield risk because:

- yield risks are less systemic than price risks. They can be localised and do not affect all farmers in the same way, meaning a higher degree of customisation is required for yield risks management options
- individual farmers can easily influence their own yield levels, meaning insurers need to determine whether a yield loss was caused by a trigger event, or sub-optimal management practices. This problem is called moral hazard. By contrast, price levels are virtually beyond the control of individual farmers
- farmers generally have a better idea than insurers about their risks and expected yields. When this occurs, insurance companies are not able to distinguish between high risk and low risk farmers and price premiums accordingly. This problem is known as adverse selection. By contrast, farmers have no better information on price movements than the market.

Insurance as a risk management option

Insurance cannot provide protection against events which are almost certain to occur, such as climate change. This is because insurance is not designed to be a subsidy to farmer income, but a tool that allows farmers to reduce downside risk. However, insurance can protect against climate variability, where a farm is profitable over the long term but exhibits an undesirable level of volatility on a year-by-year basis.

Australian farmers have tools at their disposal to manage yield risk (as a component of revenue risk), including:

- diversifying crops
- geographical spread of farms across climatic regions
- improving irrigation systems and practices to improve water use efficiency
- improving access to reliable water supplies
- using climate forecasts to guide production decisions.

Nevertheless, even after employing these types of tools, yield risk may still be a problem. Farmers can also use savings and credit to smooth their incomes during moderately difficult times. But savings and credit may not be sufficient during more rare and extreme climatic events. Insurance may be useful to farmers for these low probability high impact events.

Options for insurance

The yield insurance products discussed in this section have been used in Australia or internationally. They fall into two categories: traditional insurance products and newer index-based products. The key difference between them is that payments triggered in traditional insurance are based on realised individual farmer yields. By contrast, payments under index-based products are based on other variables, such as weather or regional-level yields.

Traditional insurance products

Named peril insurance

Named peril insurance products provide farmers with protection against specific perils, such as frost, hail or fire. The effects of these perils are typically localised and, therefore, exhibit little systemic risk. Also, as the farmer has no control over the impact of these events, moral hazard is not a significant problem. These products are commercially available in Australia.

Multi peril crop insurance

Multi peril crop insurance (MPCI) is also known as yield insurance because payouts are simply based on loss of yield—the cause of the loss need not be assessed. This insurance type allows farmers to protect their crops against all weather-related events (including pests and diseases); however, in practice some specific events are usually excluded. For each crop covered under the policy, the insurer agrees with the grower on projected yield and projected value ($ per tonne). Hence, there is an agreed value on each crop covered by the policy. No such schemes operate in Australia.

Crop revenue insurance

Crop revenue insurance is similar to MPCI, but instead of providing protection against yield loss it provides protection against revenue loss. This product insures a farmer against both yield and price risk. A projected price and yield is determined when the insurance contract is entered into, and farmers are insured for production at that price.

As price protection is not the focus of this analysis, crop revenue insurance is not discussed further in this report. No such schemes operate in Australia.

Mutual funds or farmer pool

While mutual funds are not insurance products from a legal perspective, they can operate much like an insurance product. A mutual fund set up in this way would allow member farmers to pool some of their income (the premium) into an investment fund each year, with farmers being allowed to make withdrawals (the indemnity or payout) from the fund when an event triggers a loss in farm yields. No such schemes operate in Australia.

Index-based products

Farmers can use these new tools to insure against yield risk. An index may simply be a set of numbers representing a single variable, such as rainfall or temperature over a given cropping season; or a more complex calculation involving many variables, such as various climatic data or shire-level yield data that are thought to have an impact on farm yields. Types of index-based products include weather derivatives, yield index insurance and area yield index insurance.

Weather derivatives

Weather derivatives, or weather certificates, are relatively simple products based on an index representing a single variable, such as rainfall or temperature. They work in much the same way as financial derivatives; that is, they are *derived* from an underlying measurable variable.

Weather derivatives indexes are developed using data from weather stations. An index can be developed for any weather station where sufficient data exists. The farmer chooses the closest weather station to his or her farm to ensure that the weather index is the closest approximation to conditions on their farm. The weather derivative would payout if, for example, rainfall is below a pre-specified amount over a pre-specified time period. A broker designs and sells the product to the farmer. One example of a weather derivatives product, CelsiusPro, currently operates in Australia.

Yield index insurance

Yield index insurance is more complex than weather derivatives, bringing together many more variables to predict farmer yield through computer modelling. Variables may include shire-level yields and climate related factors, as well as crop specific factors, such as timing of planting, crop phenology and crop management practices. The model provides a forecast for a farmer's yield based on this information. At the end of the season the model provides an updated estimate of farmer yield based on realised weather conditions. If the estimate is lower than the original forecast, the farmer receives a payout. One example of a yield index insurance product, YieldShield, currently operates in Australia.

Area yield index insurance

An area yield index, or group risk plan, fits somewhere between traditional insurance products and the newer index products. An area yield index is based on regional level yields. Farmers receive payments if average yields in their region fall below a pre-specified level, as opposed to receiving payout for a fall in their own individual yields. No such schemes operate in Australia.

2 History of insurance products

Australian experience

Named peril insurance products are common in Australia, with a number of companies providing insurance against hail, frost and fire risks. Attempts to introduce MPCI mutual fund schemes in Australia have been unsuccessful. Index-based products have recently become available, but uptake has been limited.

Wesfarmers area yield guarantee (1974–75)

In 1974–75 Wesfarmers and Western Underwriters offered an area yield guarantee scheme for Western Australian growers (MPCI Task Force 2003). Growers could also nominate cover for less than the 75 per cent of average shire yield at a reduced premium.

The scheme suffered from poor take-up by farmers and had insufficient reliable individual farm data on which to base premiums. As a result, the scheme suffered badly from adverse selection, with farmers who never made 75 per cent of the yield average keen to take on the scheme, while other farmers who never fell below this level had no incentive to take up the scheme.

CBH/AON MPCI and downgrading insurance (1999–2000)

Growers' cooperative CBH and insurer AON offered a comprehensive product that, in addition to the traditional fire and hail cover, provided crop failure and sprouting downgrade insurance to Western Australian grain growers.

Crop failure insurance was provided for a nominated value per hectare that represented the cost of replanting the crop the following season.

Sprouting downgrade insurance covered the downgrading of grains due to the sprouting of grains in the heads caused by wet weather prior to harvest. Farmers were paid the difference in value between the intended grade of delivery and the grade it was eventually accepted into.

The scheme utilised CBH's extensive grower records to develop premiums on an individual grower basis. The scheme was dropped after one year because of low demand and problems with obtaining reinsurance backing.

Macquarie Bank/Aquila weather derivatives (2001–03)

Macquarie Bank, in association with insurance firms Aquila in the United States and AXA in France, introduced weather derivatives to Australian farmers in 2001. The derivatives were based on rainfall and temperatures at weather stations across the country. Macquarie Bank stopped offering its weather derivatives products because of restructuring within Aquila.

CBH/Willis Cost of production cover (2010–12)

In April 2011 grain trader CBH and insurer Willis Australia introduced Cost of Production cover, a trial mutual fund scheme for wheat and barley growers in Western Australia. The scheme allowed participating growers to cover their production costs if their yield fell below pre-specified levels (CBH 2011a). The scheme was intended to cover growers against natural events, including drought, frost, hail, flood and fire risks.

With access to CBH's extensive grower records, the fund was able to offer individualised premiums calculated off the grower's individual production history, thereby reducing adverse selection issues. Moral hazard issues were reduced by an agreement between CBH Mutual and the growers to audit payout claims. CBH Mutual gained the backing of a global reinsurer to manage systemic risks.

Premiums were specified for 74 Western Australian shires. Farmers elected their coverage level and claims could be made if their production fell below expected levels. These levels were estimated based on the historical average production of that farmer, multiplied by their elected coverage level. Premium rates varied considerably across shires, reflecting different levels of risk (Table 1).

Table 1 CBH Mutual fund scheme premium rates for wheat

Coverage level a	Minimum premium	Maximum premium	Average premium
%	%	%	%
30	0.2	0.6	0.3
40	0.4	5.7	0.9
50	0.7	7.5	1.7
60	1.3	10.5	3.2

CBH = growers' cooperative

Note: Premium rates are a percent of expected revenue, which is assumed to be $250 per tonne of wheat. **a** Coverage level is per cent of average yield.

Data source: CBH 2011b

The scheme was withdrawn after the 2011–12 growing season primarily because of a lack of grower demand. CBH suggested that the lack of grower demand might have been due to the timing of offers in April 2011, when farmers had greater certainty regarding the coming seasons. Premiums were also said to be high because of a high probability of loss, costs associated with reinsurance, and uncertainty of actual yield distributions. CBH indicated that a lack of yearly yield data at shire level from independent sources such as the ABS increased the difficulty in obtaining reinsurance.

Primacy Underwriting Agency YieldShield (2009–present)

YieldShield is a new product offered by Primacy Underwriting Agency. Yieldshield combines traditional named peril insurance for hail and fire insurance with yield index insurance that covers against insufficient or excessive rainfall water stress, for wheat and grain sorghum.

YieldShield's water stress insurance attempts to overcome the problem of a lack of farm-level yield data by utilising crop simulation models to estimate farm level yield. The models used are Oz-Wheat and Oz-Sorghum, developed by the Agricultural Production System Research Unit as part of a joint venture between the Queensland State Government and CSIRO.

Oz-Wheat and Oz-Sorghum are agro-climatic wheat stress index models that integrate information on water deficit or surplus, historical climate data and crop specific factors of broad crop phenology and crop management practices (DPI 2008). Model outputs are generated at point scale and then aggregated to create a shire-level index. The Oz-Wheat model is run from 1 October the year before sowing in order to account for the influence of the summer fallow on starting soil moisture conditions. The Oz-Sorghum model is run from 1 April, the year before harvest.

Model input parameters for each shire—such as plant available water content, planting rain and stress index period—are selected based on the best fit when calibrated against actual shire wheat/grain sorghum yields. Data on shire yields are obtained from Australian Bureau of Statistics (ABS) datasets for 1975 to 1999 for wheat and 1983 to 1987 for grain sorghum. The shire-scale stress index value is transformed to yield per unit area through the use of the final optimised regression model for each shire. YieldShield is looking into remote sensing as an option to improve accuracy at the farm level.

In conversation, Primacy Underwriting Agency indicated that one of the organisation's primary concerns with the product is the discontinuation of ABS shire-level yield data in 1999, a key input to its modelling. Primacy suggests that government could play a role in re-establishing this data series, and in providing a government reinsurance pool.

Primacy indicated that uptake of the product has been slow, perhaps because farmers typically self-insure and buying insurance would require a change in their cash flow management practices. It was also suggested that farmers do not trust the modelling. For example, farmers told Primacy they have doubts about the shire average forecasts, and are concerned about weather stations not being close enough to their farms (basis risk). The price of the product was less of a concern.

CelsiusPro Australia weather certificates (2010–present)

CelsiusPro Australia (formerly WeatherPro) is part of Swiss company CelsiusPro AG. Founded in 2008, the company specialises in structuring and originating weather derivatives. CelsiusPro AG also operates in Europe and North America, and has clients in the energy, construction, tourism, transport, retail and agriculture sectors.

Celsius Pro's weather derivatives are based on a weather index derived from measurements at several hundred official Bureau of Meteorology weather stations across Australia. A wide variety of certificates are available for agriculture, including:

- rain day certificate—pays out a pre-defined amount for every day the daily rainfall is above farmer specified level
- dry day certificate—pays out a pre-defined amount for every day the daily rainfall is below farmer specified level
- frost day certificate—pays out a pre-defined amount for every day the daily minimum temperature is below farmer specified level
- heat day certificate—pays out a pre-defined amount for every day the daily maximum temperature is above farmer specified level
- dry season certificate—pays a pre-defined amount for every millimetre if the cumulative rainfall during a particular period is below farmer specified level up to a maximum amount
- rain season certificate—pays a pre-defined amount for every millimetre the cumulative rainfall during a particular period is above farmer specified level up to a maximum amount
- dry spell certificate—pays a pre-defined amount for every dry day occurring within a dry spell. A dry day is defined as a day for which the daily rainfall was below a specified threshold. A dry spell is defined as a minimum number of consecutive dry days.

One of the positive aspects of a weather certificates is that claims do not need to be assessed. Once the event occurs there is an automatic payout based on the data received from BOM. The data is independently sourced from the BOM who is the arbitrator in any dispute. Weather basis risk can occur between stations which needs to be noted by the person looking at these types of strategies, CelsiusPro Australia suggested the government could play a role in the construction of more weather stations to reduce basis risk. In the meantime CelsiusPro Australia is attempting to reduce basis risk by developing a system to utilise multiple weather stations that will make it possible to use triangulation to estimate weather conditions at specific coordinates.

CelsiusPro Australia indicated that it has sufficient demand for its product to maintain commercial viability. However, the main constraint on demand is that the product is new and requires some technical knowledge to understand how it works. CelsiusPro Australia suggested that obtaining reinsurance for its product was not a problem because of low systemic risks. Systemic risks are low because the product is purchased by sectors other than agriculture. For example, CelsiusPro Australia's strategic partner is major reinsurer Swiss RE which it uses as a hedge counterparty for all certificates.

International experience

As with Australia, named peril crop insurance schemes are the most widespread agricultural insurance schemes around the world. Government subsidised MPCI schemes are also widespread; however, all these MPCI schemes operate with government subsidies.

Index schemes are less common, and nearly all are at the pilot stage. Table 2 shows the results of a 2008 World Bank survey on the availability of crop insurance schemes in 65 countries.

Table 2 Availability of traditional and index-based crop insurance in 2008

Countries by development status	Number of countries	Named peril	MPCI	Crop revenue	Area yield index	Weather index
	%	%	%	%	%	%
High income	21	100	48	5	10	10
Upper middle income	18	67	72	0	11	17
Lower middle income	20	45	85	5	25	35
Low income	6	50	17	0	17	33
Total	65	69	63	3	15	22

Data Source: World Bank 2010

Traditional insurance

One of the first examples of government subsidised agricultural insurance is the US Federal Crop Insurance Program, introduced in response to major droughts in the 1930s (World Bank 2010). Between the 1950s and the end of the 1980s government subsidised MPCI grew significantly in Latin America and Asia. Subsidised programs in Portugal and Spain were introduced in 1980. In Latin America, most public sector programs were terminated by 1990 because of their poor financial results. In India, the Philippines, Portugal, Spain, and the United States, various measures were introduced to strengthen and reform national programs, for example, entering into public-private partnerships.

The World Bank found that 'Australia and New Zealand are conspicuous for the absence of government financial intervention in agricultural crop and livestock insurance' (World Bank 2010). The most common type of government intervention in agricultural insurance was to subsidise insurance premiums. In 2007 farmers in the 65 countries surveyed received $US6.6 billion in premium subsidies, 44 per cent of total agricultural premiums. The majority of premium support was for crops, 63 per cent of surveyed countries subsidised their crop premiums but only 35 per cent subsidised premiums for livestock.

Government intervention included reinsurance, with 10 per cent of reinsurance arrangements being fully provided by governments and a further 22 per cent provided through public-private partnerships. Administrative and operating costs were subsidised in 16 per cent of countries.

Other support included research and development into new products, support for public awareness, and education and training for farmers and insurance company workers.

Table 3 shows crop premium subsidy rates for the high income countries surveyed by the World Bank in 2008. Only eight of the 21 high-income countries surveyed did not provide premium subsidies for crop insurance: Australia, Czech Republic, Germany, Greece, Hungary, Netherlands, New Zealand and Sweden.

Table 3 High-income countries with subsidies for crop insurance premiums

Country	Fixed subsidy a	Variable subsidy a	Special subsidies for small and marginal farmers
	per cent	per cent	
Austria	50	0	Yes
Canada	0	0–100	No
Cyprus	50	0	No
Czech Republic	0	35–50	na
France	35	35–40	Yes
Israel	35	35–80	No
Italy	66	0	No
Japan	50	0	No
Portugal	0	45–75	No
Slovenia	0	30–50	Yes
Korea	50	0	No
Spain	0	4–75	No
Switzerland **b**	0	0	No
United States	0	35–67	No

Note: **a** Subsidy is calculated as a percentage of the insurance premium paid. **b** There is no premium subsidy in Switzerland, but some cantons provide financial support on an individual basis. Data includes named peril and MPCI insurance schemes. na Not available.

Data source: World Bank 2010

Key data collected by the World Bank (2010) on agricultural insurance in developed countries, showed that despite heavy subsidies, premiums (as a percentage of crop yield) vary from as high as 10.3 per cent in Canada to as low as 3.5 per cent in Japan (Table 4). The high degree variance in premium rates may reflect differently designed schemes; for example, different coverage ratios, differing levels of subsidisation, or differing degrees of risks faced by farmers in each country. In addition, schemes may have higher premium rates if they suffer from adverse selection. Voluntary schemes are susceptible to this problem. All the schemes in Table 4 are voluntary with the exception of Japan, where the scheme is compulsory for major crop types including wheat, barley and rice (World Bank 2010).

Loss ratios, defined as total insurance payouts as a share of total premiums, are a useful tool for understanding the price of insurance premiums over and above the cost of risk (see Chapter 4 for detail). Subsidised agricultural insurance schemes are reliant on premium subsidies to remain viable (Table 4). Producer loss ratios (total claims as a share of premium incomes excluding subsidies) that are higher than 100 per cent indicate that in the absence of premium subsidies, most of the subsidised schemes would not be collecting enough revenue to cover claims. ABARES has also calculated an adjusted loss ratio from the World Bank data to indicate what loss ratios might be in the absence of government assistance.

Table 4 Crop insurance premiums, claims, subsidies and loss ratios, high-income countries

Country	Period	Type of insurance	Total crop claims	Average premium a	Loss ratio	Producer loss ratio b	Average premium subsidy	Other subsidies c	Adjusted loss ratio d
			US$m	%	%	%	%	US$m	%
Canada	2003–07	multi peril crop insurance	3 158.0	10.3	74	186	52	312.5	69
Italy	2003–06	multi peril crop insurance, named peril	728.9	7.6	57	147	61	0	57
Japan	2003–05	multi peril crop insurance	1146.7	3.5	90	184	51	286.2	73
Korea	2003–07	multi peril crop insurance, named peril	168.2	7.8	74	108	30	80.5	55
Portugal	2003–07	multi peril crop insurance (no drought)	16.3	6.7	29	88	67	0	29
Spain	2003–07	multi peril crop insurance, named peril	1 744.3	5.7	83	244	66	0	83
United States	2003–07	multi peril crop insurance	15 887.1	9.1	70	170	59	9121.0	50
Australia	2003–07	named peril	69.9	na	52	52	0	0	52
Czech Republic	2003–05	named peril	42.7	na	51	51	0	0	51
Germany	2003–05	named peril	374.3	1.1	81	81	0	0	81
Hungary	2003–07	named peril	98.2	na	86	86	0	0	86
Sweden	2003–07	named peril	5.2	na	40	40	0	0	40
Switzerland	2003–07	named peril	269.4	na	115	115	0	0	115

Note: **a** Average premium rate charged to farmers **b** Producer loss ratio equals total crop claims divided by producer premium. Producer premiums represent the non-subsidised portion of premiums paid by farmers. **c** Includes administrative and operating expense subsidies and government settled claims. Includes administrative and operating expense subsidies are 2007 only and multiplied by the number of years to estimate period total. **d** Adjusted loss ratio equals total crop claims divided by the sum of total premium plus other subsidies. na Not available.

Data source: World Bank 2010

Index-based insurance

Index insurance is uncommon in developed countries because of the dominance of MPCI products. In recent years the World Bank has supported the development of index insurance products in developing countries, with trial schemes underway in a number of countries. Mexico and India are the only countries to have moved beyond pilot programs (Barnett & Mahul 2007).

Mexico's drought index insurance product is primarily marketed to state governments and has been available since 2001. In India, weather index insurance was introduced in 2003 and is primarily marketed to small farmers. In 2005–06, 250 000 policies were sold in India, with a premium volume of $US20 million (Barnett & Mahul 2007). In both countries, technical support (including product design, rating and implementation) provided by the World Bank was required to facilitate the offering of index products.

3 Product comparison

This section compares insurance options in terms of costs, likely premium rates and possible demand from farmers. These factors are then considered in the context of commercial viability.

The cost of insurance

The price of insurance (the premium) should equal the cost of providing the insurance plus insurance company profits. In principle, the cost of an insurance contract is based on the relationship (Skees 2008):

$$\text{Cost of insurance} = \underbrace{\text{cost of the risk}}_{\substack{\text{actuarially}\\ \text{fair premium}}} + \underbrace{\text{administrative costs}}_{\substack{\text{Information costs,}\\ \text{loss adjustment}\\ \text{and delivery costs}}} + \underbrace{\text{cost of ready access to capital}}_{\text{Cost of reinsurance}}$$

The cost of risk

The cost of risk includes the actuarially fair (pure risk) premium, which represents the expected claims the farmer will make over the life of the contract. It can also be thought of as the amount farmers would have to put aside each year to self insure. Insurance companies calculate the cost of the risk using data on historical losses, in addition to their perception of any change in the risks occurring into the future. They may also include extra loadings for ambiguity, for example, the affects of climate change on yield risk may be difficult to predict.

While the cost of risk is a good indication of the level of risk that farmers face, other factors weigh heavily into the price of agricultural insurance schemes. The cost of risk is something that, in the absence of insurance, the farmer is already implicitly paying for by saving in the good years to pay for the bad years.

In general the cost of risk should not determine the viability of an insurance scheme. Even a risk-neutral farmer should be willing to obtain insurance at this price.

Administrative costs—traditional insurance products

The administrative costs include information costs used to minimise loss adjustment costs, asymmetric information and other operating expenses. Loss adjustment may be significant when assessing large, geographically dispersed farms.

Asymmetric information occurs when one party in an agreement has more information than the other. In agricultural insurance, the farmer has more information than an insurer on his or her risks and management practices, which can lead to adverse selection and moral hazard.

Asymmetric information is a significant problem in agricultural insurance because controlling for it can be very expensive. In order to price insurance premiums correctly insurers need to understand the risks faced by individual farmers, at an individual farm level. Farmers know their own cost of risk, but insurers do not and this information would be costly for them to obtain.

Insurance companies can overcome the problem of asymmetric information at a cost. They can:

- collect the required data at great expense to themselves
- calculate the cost of risk at a regional level and assume the rate is the same for all farmers of a particular crop type in that region.

It is too expensive for private insurance companies to collect data, such as historical farm yields or monitor farmer management practices. No verifiable data exists at the farm level in Australia, and many years of data are required to assess the risks.

MPCI and mutual fund schemes that failed in Australia attempted to calculate the cost of risk at a regional level. The main problem with this approach is that only the riskier farmers, who know that their cost of risk is higher than the regional average, have an incentive to join. This is called adverse selection. The other problem is moral hazard, meaning that insurance companies cannot be sure that farmers are employing the best management practices.

The moral hazard problem can be managed by introducing excesses. The farmer has an incentive to employ best management practices if he or she has to pay a share of the costs when an insured event occurs.

Administrative costs of index-based insurance products

Index based insurance products solve the problem of information asymmetries and therefore cost less to administer. They do not pay claims based on individual farm yields, but rather on an index derived from other information, such as weather or shire-level yields.

Individual farmers do not have better information than insurers on weather patterns or on shire-level yields, which minimises the problem of adverse selection. Additionally, the farmer's management practices cannot affect the chance of a payout in these schemes, minimising the problem of moral hazard. Loss adjustment is also a low cost as the insurer simply determines whether a payout is necessary based on weather station data or model output.

Other costs may be introduced in these schemes, particularly model development costs and, potentially, higher marketing costs because of the more complex nature of these products.

The cost of ready access to capital

The cost of ready access to capital adds further cost to the price of agricultural insurance. The insurer must have the capacity to pay for losses that exceed income from premiums in some years. This can be a problem with systemic risks, for example when many clients make claims at once because of a widespread drought.

Insurance companies cannot deal with this type of risk very well. Insurance companies generally deal with their counterparty risks by diversifying the risk among a large pool of clients, with premium revenue from those clients not claiming in any given year offsetting losses from those clients who do claim. When the risks are systemic, insurers may not be able to diversify them away and they may suffer unacceptable losses in a single year. Insurance companies can deal with this by transferring some of their risk to reinsurers who operate on a global scale, but they in turn charge their own premiums, which add to the price of insurance.

Quantitative estimations for the cost of insurance

ABARES estimations

ABARES has estimated insurance premiums by using farm survey data to estimate the cost of risk and applying assumptions around:

- administrative costs and ready access to capital costs (loss ratio)
- specifications of the insurance scheme (coverage level and excess).

ABARES estimates would be applicable to an area yield insurance scheme or an MPCI or mutual fund scheme that is based on regional yields.

An important assumption to note is that ABARES has assumed a compulsory scheme (or a scheme that would not face adverse selection). Lower levels of take-up would increase the pure risk values because of the effect of adverse selection. Insufficient data is available for ABARES to measure the effect of adverse selection, but research by the Western Australian Government suggests that adverse selection may increase premium rates by a multiple of between 2 and 6, when compared with a compulsory scheme (MPCI Task Force 2003).

Using ABARES farm survey data, this report estimates pure risk for wheat, canola and lupins in 21 broadacre regions across Australia. Pure risk is the main component of the cost of risk, which may also include ambiguity loadings. These crops were chosen because they are the largest produced from grains, oilseeds and legumes crop-type categories. ABARES has insufficient data to estimate pure risk for horticulture.

Loss ratios from overseas schemes may offer a rough guide to potential loss ratios under an Australian agricultural insurance scheme. It is important to account for all forms of government subsidies in calculating loss ratios. The lowest adjusted loss ratio for countries is estimated at around 30 per cent and the average is 60 per cent (Table 4). These rates, as well as a no cost (100 per cent loss cost) were assumed in the ABARES estimates for viable premiums.

To demonstrate the range of potential premium rates, ABARES has estimated premiums with an upper estimate of 30 per cent loss ratio and zero per cent excess, a 60 per cent loss ratio and 30 per cent excess, and a lower estimate of 100 per cent loss ratio and 50 per cent excess.

The loss ratio and the excess are assumed to affect the premium rate in a linear fashion. For example, a 30 per cent excess reduces the premium by 30 per cent, and a 30 per cent loss ratio increases the premium by 1/(loss ratio), which equals 333 per cent. In a real world scenario, loss ratios are likely to be affected by the excess, because the amount claimed effectively changes but the total administrative costs should remain the same. For simplicity this issue has not been accounted for in this analysis.

Premium estimates were made for an insurance scheme that guarantees farms a crop yield equal to a 25 per cent, 40 per cent and 60 per cent coverage level of the long-term average crop yield for the region/crop group of interest. A lower coverage level limits payouts to less frequent, more catastrophic events, while a higher coverage level includes more frequent, less severe events. Farms with crop yields that fall below the coverage level threshold receive a payout equal to the difference (Table 5, Table 6 and Table 7). For example, under a scheme with 25 per cent coverage, a farmer would only get a payout when their yield falls below 25 per cent of their average yield, and they would only receive a top up to that 25 per cent. Estimates are not provided for region/crop groups for which there were less than 100 observations. Details on the methodology used in this analysis are given in the appendix.

Table 5 Estimated premiums for a compulsory insurance scheme, by region and coverage level, 30 per cent loss ratio, no excess

Region	Wheat			Canola			Lupins		
	25%	40%	60%	25%	40%	60%	25%	40%	60%
New South Wales									
Far West	8.3	19.0	37.0	na	na	na	na	na	na
North West Slopes and Plains	6.0	13.7	26.0	na	na	na	na	na	na
Central West	7.3	15.3	32.0	10.3	19.7	38.0	17.3	32.0	55.7
Riverina	7.7	14.3	28.3	13.3	20.7	38.0	10.3	21.3	47.0
Tablelands	4.0	13.0	24.0	na	na	na	na	na	na
Victoria									
Mallee	3.0	8.3	21.3	12.3	19.0	36.3	10.0	22.7	44.7
Wimmera	4.3	10.0	23.3	6.7	13.3	27.7	15.3	25.0	45.3
Central North	4.7	11.3	26.7	10.0	20.3	38.3	9.0	16.7	36.3
Southern and Eastern Victoria	2.3	8.3	21.0	5.0	17.3	33.0	10.7	19.0	37.7
Queensland									
Eastern Darling Downs	8.0	14.3	31.0	na	na	na	na	na	na
Darling Downs and Central Highlands	6.3	16.0	30.3	na	na	na	na	na	na
South Queensland Coastal—Curtis to Moreton	5.3	10.0	6.3	na	na	na	na	na	na
South Australia									
North Pastoral	10.0	19.3	41.0	na	na	na	na	na	na
Eyre Peninsula	2.0	5.7	16.0	9.3	21.0	41.0	5.3	12.3	29.7
Murray Lands and Yorke Peninsula	2.3	5.3	16.0	2.7	10.0	26.0	8.7	15.7	34.3
South East	3.0	7.7	20.0	4.3	12.0	23.3	7.0	14.0	29.7
Western Australia									
Central and South Wheat Belt	0.3	1.7	7.3	2.7	7.3	17.3	2.3	7.7	17.0
North and East Wheat Belt	1.7	4.3	13.0	5.0	21.7	27.3	4.7	14.0	28.7
South West Coastal	0.7	2.7	6.0	0.3	1.3	5.3	0.3	2.0	11.0
Tasmania									
Tasmania	4.0	8.3	19.0	na	na	na	na	na	na

Note: na Not available. Premiums are a per cent of agreed crop value. The premium rates are based on ABARES estimates for pure risk multiplied by 1 divided by the loss ratio, and then multiplied by 1 minus the excess. Regions are ABARES Australian broadacre regions.

Data source: ABARES estimates

Table 6 Estimated premiums for a compulsory insurance scheme, by region and coverage level, 60 per cent loss ratio, 30 per cent excess

Region	Wheat			Canola			Lupins		
	25%	40%	60%	25%	40%	60%	25%	40%	60%
New South Wales									
Far West	2.9	6.7	13.0	na	na	na	na	na	na
North West Slopes and Plains	2.1	4.8	9.1	na	na	na	na	na	na
Central West	2.6	5.4	11.2	3.6	6.9	13.3	6.1	11.2	19.5
Riverina	2.7	5.0	9.9	4.7	7.2	13.3	3.6	7.5	16.5
Tablelands	1.4	4.6	8.4	na	na	na	na	na	na
Victoria									
Mallee	1.1	2.9	7.5	4.3	6.7	12.7	3.5	7.9	15.6
Wimmera	1.5	3.5	8.2	2.3	4.7	9.7	5.4	8.8	15.9
Central North	1.6	4.0	9.3	3.5	7.1	13.4	3.2	5.8	12.7
Southern and Eastern Victoria	0.8	2.9	7.4	1.8	6.1	11.6	3.7	6.7	13.2
Queensland									
Eastern Darling Downs	2.8	5.0	10.9	na	na	na	na	na	na
Darling Downs and Central Highlands	2.2	5.6	10.6	na	na	na	na	na	na
South Queensland Coastal—Curtis to Moreton	1.9	3.5	2.2	na	na	na	na	na	na
South Australia									
North Pastoral	3.5	6.8	14.4	na	na	na	na	na	na
Eyre Peninsula	0.7	2.0	5.6	3.3	7.4	14.4	1.9	4.3	10.4
Murray Lands and Yorke Peninsula	0.8	1.9	5.6	0.9	3.5	9.1	3.0	5.5	12.0
South East	1.1	2.7	7.0	1.5	4.2	8.2	2.5	4.9	10.4
Western Australia									
Central and South Wheat Belt	0.1	0.6	2.6	0.9	2.6	6.1	0.8	2.7	6.0
North and East Wheat Belt	0.6	1.5	4.6	1.8	7.6	9.6	1.6	4.9	10.0
South West Coastal	0.2	0.9	2.1	0.1	0.5	1.9	0.1	0.7	3.9
Tasmania									
Tasmania	1.4	2.9	6.7	na	na	na	na	na	na

Note: na Not available. Premiums are a per cent of agreed crop value. The premium rates are based on ABARES estimates for pure risk multiplied by 1 divided by the loss ratio, and then multiplied by 1 minus the excess. Regions are ABARES Australian broadacre regions.

Table 7 Estimated viable premiums for compulsory insurance scheme, by region and coverage level, 100 per cent loss ratio, 50 per cent excess

Region	Wheat			Canola			Lupins		
	25%	40%	60%	25%	40%	60%	25%	40%	60%
New South Wales									
Far West	1.3	2.9	5.6	na	na	na	na	na	na
North West Slopes and Plains	0.9	2.1	3.9	na	na	na	na	na	na
Central West	1.1	2.3	4.8	1.6	3.0	5.7	2.6	4.8	8.4
Riverina	1.2	2.2	4.3	2.0	3.1	5.7	1.6	3.2	7.1
Tablelands	0.6	2.0	3.6	na	na	na	na	na	na
Victoria									
Mallee	0.5	1.3	3.2	1.9	2.9	5.5	1.5	3.4	6.7
Wimmera	0.7	1.5	3.5	1.0	2.0	4.2	2.3	3.8	6.8
Central North	0.7	1.7	4.0	1.5	3.1	5.8	1.4	2.5	5.5
Southern and Eastern Victoria	0.4	1.3	3.2	0.8	2.6	5.0	1.6	2.9	5.7
Queensland									
Eastern Darling Downs	1.2	2.2	4.7	na	na	na	na	na	na
Darling Downs and Central Highlands	1.0	2.4	4.6	na	na	na	na	na	na
South Queensland Coastal—Curtis to Moreton	0.8	1.5	1.0	na	na	na	na	na	na
South Australia									
North Pastoral	1.5	2.9	6.2	na	na	na	na	na	na
Eyre Peninsula	0.3	0.9	2.4	1.4	3.2	6.2	0.8	1.9	4.5
Murray Lands and Yorke Peninsula	0.4	0.8	2.4	0.4	1.5	3.9	1.3	2.4	5.2
South East	0.5	1.2	3.0	0.7	1.8	3.5	1.1	2.1	4.5
Western Australia									
Central and South Wheat Belt	0.1	0.3	1.1	0.4	1.1	2.6	0.4	1.2	2.6
North and East Wheat Belt	0.3	0.7	2.0	0.8	3.3	4.1	0.7	2.1	4.3
South West Coastal	0.1	0.4	0.9	0.1	0.2	0.8	0.1	0.3	1.7
Tasmania									
Tasmania	0.6	1.3	2.9	na	na	na	na	na	na

Note: na Not available. Premiums are a per cent of agreed crop value. The premium rates are based on ABARES estimates for pure risk multiplied by 1 divided by the loss ratio, and then multiplied by 1 minus the excess. Regions are ABARES Australian broadacre regions.

Results are expressed as a percentage of agreed crop value, which is estimated based on historical average yields for that region. The dollar premium amount for an individual farmer can then be easily estimated. For example, under a 60 per cent loss ratio and 30 per cent excess scheme, a wheat farmer in Central West New South Wales who expects to yield one tonne of wheat at $250 per tonne would pay a premium of $6.50 per tonne for 25 per cent coverage, or $28.00 for 60 per cent coverage. If they had a bad season and only produce 0.2 tonnes of wheat, they would receive a payout from the insurer of $8.75 net of their excess if they took the 25 per cent coverage, or $70.00 net of their excess if they took the 60 per cent coverage.

Estimates show that risks, and therefore premium rates, vary considerably across regions and crop types. For example, in the 60 per cent loss ratio and 30 per cent excess scheme with 25 per cent coverage, across all regions premium rates ranged from 0.1 per cent to 3.5 per cent for wheat farms, 0.1 per cent to 4.7 per cent for canola farms, and 0.1 per cent to 6.1 per cent for lupin farms. This variation across regions is likely to be the result of differing degrees of exposure to climatic conditions.

Risk varies across crop types within a given region. For example, for an insurance scheme in Central West New South Wales with 60 per cent loss ratio, 30 per cent excess and 25 per cent coverage, wheat cropping farms would need to pay 2.6 per cent of the long-term average crop yield, while canola farms in the same region would need to pay 3.6 per cent and lupin farms would pay 6.1 per cent of the long-term average crop yield. This kind of variation is more likely to be a result of certain crop types being inherently riskier than others, for example being more susceptible to climate variability.

Premium rates vary considerably with a change in the assumptions of loss ratio and excess rates. For example, a wheat farmer in Central West New South Wales in an insurance scheme with 30 per cent loss ratio with no excess and 40 per cent coverage would pay a premium rate of 15.3 per cent. If a 60 per cent loss ratio and 30 per cent excess are assumed, the farmer would pay a premium of 5.4 per cent; if no loss ratio with a 50 per cent excess are assumed, the farmer would pay only 2.3 per cent.

Multi Peril Crop Insurance Project estimations

Other studies into premiums have been done by Ernst & Young (2000) for the Multi Peril Crop Insurance Project (MPCI Project), sponsored by the Australian Government, and the Multi Peril Crop Insurance Task Force in (2003), sponsored by the Western Australian Government.

The MPCI Project team calculated premiums at the statistical local area level, across grain growing regions of Australia for wheat, barley, lupins and canola. They assumed a 50 per cent loss ratio in their analysis for viable premiums, a coverage ratio of 40 percent, and excesses of 40, 50 and 60 per cent. For a 50 per cent excess, average viable premiums (as a percentage of agreed crop values) across the regions analysed were estimated at between 4.0 and 9.2 per cent for barley, between 2.1 and 7.9 per cent for wheat, and between 6.8 and 13.9 per cent for canola (Table 8).

Table 8 Estimated viable premium rates, by region—MPCI Project estimates

Region	Excess	Premium rates		
		Barley	Wheat	Canola
	%	%	%	%
Central and South West Queensland/ North West New South Wales	40	13.9	10.8	na
Central and South West Queensland/ North West New South Wales	50	9.2	6.6	na
Central and South West Queensland/ North West New South Wales	60	5.6	3.6	na
North East New South Wales/ South East Queensland/ New South Wales and Victorian Slopes	40	6.8	7.9	21.2
North East New South Wales/ South East Queensland/ New South Wales and Victorian Slopes	50	4.2	5.0	13.9
North East New South Wales/ South East Queensland/ New South Wales and Victorian Slopes	60	2.4	2.9	8.4
Central New South Wales/South Australia and Victorian Border/Wimmera	40	7.5	7.2	10.6
Central New South Wales/South Australia and Victorian Border/Wimmera	50	4.7	4.5	6.8
Central New South Wales/South Australia and Victorian Border/Wimmera	60	2.7	2.5	4.0
South Australia Mid North/South Australia and Victorian Mallee	40	6.4	6.1	na
South Australia Mid North/South Australia and Victorian Mallee	50	4.0	3.7	na
South Australia Mid North/South Australia and Victorian Mallee	60	2.3	2.1	na
Western Australia	40	6.7	4.2	na
Western Australia	50	4.2	2.4	na
Western Australia	60	2.5	1.3	na

MPCI Project = Multi Peril Crop Insurance Project

Note: na Not available. Premiums are a per cent of agreed crop value.

Data source: Ernst & Young 2000

Differences between these and ABARES results may be due to different years of data used in the analysis, or different region specifications, coverage ratios, loss ratios or excess rates.

Even at the viable premium rates (Table 8), the MPCI Project team did not believe that insurers would take on an MPCI scheme without some form of government intervention, such as compulsion for all farmers to buy insurance, premium subsidies or reinsurance assistance. The MPCI Project team believed that government intervention was required because of limitations on the availability of data for premium rating analysis and the potential for adverse selection and moral hazard.

MPCI Task Force estimations

The MPCI Task Force (2003) calculated premiums for wheat for eight shires in Western Australia. One advantage of this study over the previous MPCI Project study (2000) was that the consultant had access to historical data on individual farm level yields held by major Western Australian grain cooperative CBH. With this additional data they were able to assess the effect of adverse selection by calculating premiums with different take-up rates.

Three different models for insurance were analysed:

- individual yield insurance—that would trigger payouts based on loss of yield at the individual farm level.
- area yield insurance—that would trigger payouts based on how far an individual farm's actual yield fell below the expected yield of the shire (note that this definition differs from that used elsewhere in this report).
- revenue insurance—that would trigger indemnities based on farm level revenue loss.

The study concluded that there was insufficient data to overcome 'extreme adverse selection problems' in the area yield insurance model, suggesting that additional data on variation in wheat quality and price from individual farms would be required. The individual yield insurance model had other issues, as the study assumed variability was the same for all farms within a shire. The report noted that 'without a risk classification system, adverse selection would still be detrimental to the feasibility of the insurance scheme'.

The MPCI Task Force assumed coverage levels of 40 and 65 per cent, loss ratios of 60 and 70 per cent and a 30 per cent excess (Table 9). Premium rates were estimated based on compulsory/random take-up of the scheme (to reduce adverse selection) and compared with non-compulsory/non-random take-up (to maximise adverse selection). There was a considerable degree of variation of premiums between the shires. The MPCI Task Force observed that, compared with compulsory schemes, low take-up rates/maximum selection increase premium rates by a multiple of between 2 and 6.

Differences between MPCI Task Force and ABARES results may reflect different years of data used in the analysis or different region specifications or coverage rates.

Table 9 Average premium rates, eight Western Australian shires—MPCI Task Force estimates

Take-up rate %	40% coverage	65% coverage
10	3.2	9.0
20	2.2	7.0
30	1.6	5.8
40	1.3	4.7
100 (compulsory)	0.5	2.5

Note: Multi Peril Crop Insurance (MPCI) Task Force estimates. Premium rates are a per cent of agreed crop value. Results are for a 60 per cent loss ratio.
Data source: MPCI Task Force 2003

Farmer demand for insurance: empirical evidence

In the past the existence of government support through the Exceptional Circumstances policy may have suppressed farmer demand for insurance, discouraging the development of commercial insurance products. As elements of the policy are withdrawn, demand for insurance may increase.

A farmer’s decision to buy insurance will be determined by weighing up the price of insurance against the costs of alternative risk management strategies, such as Farm Management Deposits, crop diversification, off-farm income or through utilising savings or borrowings, and the farmer’s attitudes to risk. In addition to these factors, basis risk would also affect farmer demand for index insurance products because it means that the product is less applicable to individual farm conditions.

Traditional insurance products

Farmer demand may be estimated by surveying farmers’ willingness to pay for insurance at a given viable premium rate. Conducting surveys is beyond the scope of this report, but other studies have done this.

The MPCI Project (Ernst & Young 2000) estimated a take-up rate of MPCI of 18 per cent after three years at viable premium levels. This take-up rate was deemed to fall ‘far short of that [what] the various stakeholders would deem viable from their individual perspectives’ (Ernst & Young 2000). It was concluded that without ‘extensive Government support’ the scheme would not be viable. The MPCI Project found that a viable scheme would require government to assist in start-up costs, provide a 25 per cent premium subsidy, and provide reinsurance backing.

The MPCI Task Force (2003) did not attempt to assess likely farmer demand for agricultural insurance. Based on discussions with the insurance industry, the task force indicated that market penetration of around 40 per cent of WA farmers would be required for viability.

In addition to the two MPCI studies into agricultural insurance, low demand for agricultural insurance can be demonstrated from previous attempts to introduce MPCI and other products into the Australian market—all have suffered from low uptake by farmers.

Index-based insurance products

A feature of index-based insurance is that payouts are not determined by actual losses for an individual farm, overcoming the problem of information asymmetries and lowering administrative costs. However, basis risk can be a problem with these products when payouts may not be strongly correlated with farmer yields. High levels of basis risk would have a dampening effect on farmer demand for these products.

For weather derivatives, basis risk is likely to be higher the further the weather station is from the farm. Additionally, basis risk may be present where the underlying index does not reflect all the variables that affect farm yield. For example, the farmer may be protected only against rainfall, but other variables, such as temperature, may affect crop yield.

Yield index insurance attempts to reduce basis risk by basing the insurance product on a combination of factors that may affect farm yield. But this comes at the cost of developing complex, data-intensive models.

Area yield index insurance also has the advantage of low levels of asymmetric information, assuming that the farmer has no better information on regional level yield than the insurer.

Basis risk may be very high in this product because risks at the region level do not reflect risks faced at the farm level.

As index insurance products are very new on the market, assessments of the demand for index-based insurance products in Australia have been limited to date. Tamas Molnar (2010) of YieldShield has done some work on assessing demand for yield index products in Australia. Molnar interviewed 44 farmers engaged in dryland wheat production, largely in New South Wales and Queensland. He found that while farmers showed interest in the product, the complexity of the product and lack of trust in the concept is likely to limit farmer uptake. Interviewees also expressed concern about the distance of weather stations from their farms and considered the price of the product to be relatively high.

Internationally, experience with index insurance products is also limited, with few examples of mature markets. Most are in pilot stage and based in lower and middle income countries. The World Bank Commodity Risk Management Group has been piloting index schemes in developing countries since 2003. Murphy and colleagues (2011) note that although demand has been low for many index insurance pilot programs, there has been encouraging growth in others. They suggest a few reasons for low demand:

- people tend to underestimate the likelihood of catastrophic events and thus undervalue insurance
- immediate needs are prioritised over insurance in low income households in developing countries
- lack of familiarity with insurance and misconceptions about how it works
- when estimating the pure premium rate, insurers compensate for a lack of data with ‘ambiguity loads’, which increases the price
- index markets will take time to mature.

Implications for commercial viability

Significant evidence exists in Australia and internationally to suggest that traditional insurance products are not commercially viable in the absence of government subsidisation. High premium rates are likely to dampen farmer demand and interest from insurers and reinsurers is likely to be low because of problems with adverse selection, moral hazard and systemic risk.

Index-based products overcome many of these problems, but add the new problem of basis risk, which will reduce farmer demand. Efforts are being made by existing market participants to reduce these problems. Overall, these products are much more likely to be commercially successful than traditional insurance products. While costs tend to be lower for index insurance products, this benefit may be partially offset by higher basis risk and thus lower desirability for those products (Table 10).

Table 10 Product comparison, selected insurance price and demand factors

Product	Administrative costs			Reinsurance costs	Farmer demand
	Adverse selection	Moral hazard	Loss adjustment	Systemic risk	Basis risk
Named peril	Low	Low	Moderate	Low	Low
multi peril crop insurance **a**	High	Manageable	High	High	Low
multi peril crop insurance **b**	Low	Manageable	High	High	Low
Mutual fund **a**	High	Manageable	High	High	Low
Mutual fund **b**	Low	Manageable	High	High	Low
Weather derivative	None	None	Low	Manageable	High
Yield index	None	None	Low	Manageable	Moderate
Area yield index	Low	Low	Low	Manageable	High

Note: **a** Voluntary scheme. **b** Compulsory scheme. The only important difference between the mutual fund and multi peril crop insurance schemes is that mutual fund schemes do not need to make a profit.

4 Role for government

Government intervention in private markets might be economically justified if private markets fail to provide a socially optimal level of goods and services; that is, where there is evidence of market failure. As discussed in this report, asymmetric information and systemic risk drive up the cost of insurance. They may also be sources of market failure in the operation of the agricultural insurance market.

The existence of market failure does not necessarily mean government intervention is warranted. Intervention would only be justified if the policy response increases the net wellbeing of the community; for example, if the benefits of increased participation of farmers in the agricultural insurance market outweigh the costs to taxpayers of the government intervention.

Beyond the in-principle arguments about market failure, it is worth considering whether insurance schemes are sufficiently valuable to society to warrant government intervention. For example, governments require people to be covered by health insurance. However, any support from government needs to be considered in the context of the many other risk management options available. If governments provided support for insurance instead of for other risk management options, these alternatives would be less attractive to farmers.

Examples of government intervention that may improve the viability of agricultural insurance products include direct subsidisation of premiums, compilation and provision of data to reduce information asymmetries, making schemes compulsory for all farmers to reduce adverse selection and providing or supporting reinsurance. Other examples may include research and development into new insurance models, such as index insurance, and training of farmers in the use of index-based products. Government intervention should be tailored to suit the type of insurance product. Table 11 provides a summary of potential roles for government and an indication of the effectiveness of each. A full assessment would need to include the costs of intervention.

Table 11 Potential roles for government

Product	Potential role for government	Effectiveness
Named peril	Not required—already commercially available	Not applicable
Multi peril crop insurance	Subsidise premiums	Expensive to government, distorts market incentives
	Make compulsory	Distorts market incentives (benefits riskier farmers)
	Provide farm level data	Expensive, demand may still be insufficient
	Provide reinsurance	Will not solve the market failure
Mutual fund	Same as MPCI	Same as multi peril crop insurance
Weather derivative	Increase number of weather stations	May reduce basis risk and improve farmer demand
Yield index	Increase number of weather stations	May reduce basis risk and improve farmer demand
	Invest in model development	Will overcome a major cost, but demand remains uncertain
	Recontinue shire-level data	May improve viability, but will not overcome basis risk
Area yield	Recontinue shire-level data	Farmer demand may still be low because of basis risk

Source: ABARES

Premium subsidies

Direct premium subsidies are the most common method of government intervention into agricultural insurance markets worldwide. The problem with this approach is that it addresses only the symptoms and not the cause of the market failure.

It is easy to see why subsidies may result in sub-optimal outcomes. A subsidy in one sector will be at the expense of another; capital will flow out from other sectors in which insurance is not being offered and into those in which insurance is being offered (Skees et al. 2008).

Subsidised insurance may also impede farmer adaptation to climate change. For example, a farmer with subsidised crop insurance may be encouraged to produce crops that are not well suited to local market or environmental conditions (Skees et al. 2008), perhaps producing water-dependent crops in areas that suffer from frequent droughts.

Even with the existence of a subsidised MPCI scheme, disaster assistance may still be required. For example, the United States has the largest crop insurance scheme in the world but has failed to replace disaster assistance.

Premium subsidies simply represent a transfer of wealth from taxpayers to farmers. They distort market prices and incentives, causing farmers to make sub-optimal decisions. According to the World Bank (2010) 'premiums should be risk-based and differentiated so that each buyer pays a premium sufficient to cover his own expected loss and expense costs as well as a profit loading to compensate the insurer for bearing insurance risks'.

With risk-based premiums, farmers bear the full costs of their risk-generating activities and thus have incentives to engage in risk mitigation and avoid risky activities. Subsidised agricultural insurance premiums erode the market signals that farmers receive, and encourage them to over invest in risky activities. As a result, losses from adverse weather events tend to be higher, resulting in higher costs to governments and taxpayers.

Compilation and provision of information

Carefully directed subsidies that address the cause of market failure may be economically justified if the government can provide the service at a lower cost to society than the private sector. The OECD (2008) notes that, 'it is not clear if general subsidies solve the market failure, except in the case that they are linked to arrangements that improve efficiency in the use and distribution of information'.

Government intervention in this case could be in the research and production of missing information or through facilitating arrangements for sharing information that would otherwise be asymmetrically distributed between farmers and insurers. This is known as the 'public goods' argument for government intervention; this logic could also be applied to government support of the provision of crop yield models.

Further investigation into the costs of this type of government intervention may be warranted. For example, consultation with market participants and providers of data used to construct index-based insurance products, such as the ABS and the Bureau of Meteorology, could shed light on the feasibility of this option.

Reinsurance

Supporters of government assistance in reinsurance argue that government has significant financial resources and is thus able to better provide the capital necessary to finance systemic risk. Systemic risk is a potential source of market failure in agricultural insurance, but the case for government intervention here is not entirely clear. Miranda and Glauber (1997) argue that if ‘systemic risk, not asymmetric information, is the primary cause of market failure, then cost-efficient remedies for market failure may be available in the form of area yield reinsurance or exchange-traded area yield options’.

However, many risks can be diversified across international reinsurers, and the argument would be ‘more accurately phrased in terms of the cost of reinsurance rather than whether reinsurance can be obtained at any price’ (World Bank 2010).

It is difficult to justify government providing reinsurance to MPCI or mutual fund schemes, which have inherent systemic risk problems. More easily justified is a role for government in facilitating the development of index insurance or weather derivatives, which reduce the problem of systemic risk.

Government regulation

Government may also intervene in the market for agricultural insurance by making a scheme compulsory for all farmers. This option will overcome the problem of adverse selection, as low risk farmers will be forced to join the pool. However, like the premium subsidy scenario, a compulsory scheme will not address the underlying information asymmetry problems. Instead, forcing farmers to participate in an insurance scheme that prices premiums at the shire level would result in distorted market price signals.

The downside of a compulsory scheme is that it will simply cause a transfer of wealth between farmers, making high-risk farmers better off at the cost of low-risk farmers. The only way adverse selection problems can be resolved is if premiums are based on farmers' individual risk profile, which is costly to administer.

Conclusion

The high levels of catastrophic risk faced by farmers (for example, from climate variability) have been of concern to governments in Australia and internationally for many decades. The inability of private markets to provide all the tools necessary for farmers to manage this risk has been used to justify government intervention in agricultural insurance markets internationally. Australia is one of the few countries to maintain a strong farming sector in which many of these tools are absent. This view is reinforced by recent studies that indicate a low demand for yield insurance from Australian farmers.

The failure of traditional insurance products to achieve commercial viability stems from the inability of private markets to solve the problems of asymmetric information and systemic risk. International experience shows that unless these underlying problems are addressed, subsidisation of agricultural insurance schemes may become an ongoing cost burden to government and will not lead to commercially viable insurance markets.

In recent years index-based insurance products have begun to emerge that provide a model for insurance that circumvents the problem of asymmetric information. While these tools may represent a low-cost solution to agricultural insurance, markets for these products have yet to mature and their long-term viability is yet to be confirmed.

While there is evidence to suggest that there is no economic case for government subsidisation of agricultural insurance premiums and, to a lesser extent, support reinsurance, government intervention may be justified on other grounds. There may be a case for government intervention that addresses market failures by, for example, providing additional data or assisting in the development of new index-based insurance tools. More research is required to make a clear recommendation.

Appendix Estimates and methodology

This analysis of pure risk premiums for a traditional insurance scheme uses farm level data collected by ABARES for the annual Australian Agricultural and Grazing Industries Survey, from 1989 to 2011. Survey results are compiled into 31 Australian broadacre zones and regions.

Premiums are calculated for an insurance scheme that guarantees farms a crop yield equal to 25 per cent, 40 per cent and 60 per cent of the long-term average crop yield for the region/crop group of interest. Farms with crop yields that fall below this threshold receive a payout equal to the difference in revenue. Excesses of 0 per cent, 30 per cent and 50 per cent were assumed. A higher (lower) excess would reduce (increase) premium rates proportionally to the increase (decrease) in the excess. It is also assumed that all farms in the sample participate in the scheme. Estimates are not provided for region/crop groups for which there were less than 100 observations.

It should be noted that the premiums are calculated directly using the empirical or observed distribution. This is in contrast to parametric approaches used in the literature where a theoretical distribution is assumed and fitted to the observed data.

The three steps in this methodology are:

1) Calculate the long-term average (mean) crop yield for the region/crop group of interest by taking a weighted average of all observations for the region/crop group over the entire sample period.

2) Identify observations with crop yields less than 25 per cent, 40 per cent and 60 per cent of the long-term average crop yield and determine the amount paid to these farms based on crop yield and farm size.

3) Calculate the total amount paid out for the sample and divide this by the total number of hectares sown in the sample. This gives the average payout per hectare of crop sown and therefore the premium required to make the scheme viable.

Calculated pure risk premiums reflect all variation that occurs in the collected sample. This includes variation over time resulting from potential variability in climate and technological development. It also includes static variation across farm types that which may affect crop yield, such as farm size and management practices. For these reasons, the estimated pure risk premium rates should be interpreted as an estimate of the long-term average premium that would be required to make the scheme commercially viable, in the absence of insurance company profits and administrative and other costs.

Glossary

adverse selection	When the insurer is unable to distinguish between high risk and low risk farmers. With adverse selection, insurance becomes a better buy for high risk farmers, who receive higher payouts relative to premiums paid. If insurance companies cannot distinguish between high risk and low risk farmers they may need to increase premiums to ensure profitability.
basis risk	May occur if payouts from an insurance product do not perfectly correlate with individual farmer yields. For example, if insurance payments are based on weather conditions rather than realised yield levels, farmers may receive payouts when a weather event is triggered even if they have experienced no loss in yield. Conversely, the farmer may not receive payment if they have a yield loss but the weather event has not been triggered.
counterparty risk	Risk that the other party in an agreement will default.
coverage level	Level at which insurance payments are triggered, usually represented as a percentage of long-term average yields. For example, a coverage ratio of 25 per cent means that a claim can only be made if the realised yield is 25 per cent of the long-term average.
excess	Percentage of an insurance claim that is withheld by the insurer.
information asymmetry	When the insurer does not have access to all the information needed. For example, if the insurer does not have reliable data on historical yields of individual farmers, they are not able to understand the level of risk an individual farmer faces. Information asymmetry leads to problems of adverse selection and moral hazard.
loss ratio	Ratio of insurance payouts to premiums collected by the insurer.
moral hazard	When farmers can influence the likelihood of an insurance payout. For example, they may make riskier decisions by not using pesticides, knowing that they would receive a payout if the crop fails.
pure risk premium	Farmer's probability of loss multiplied by his or her expected loss. Effectively the amount a farmer would have to put away each year to self insure.
systemic risk	Risk that an event may affect many farmers at once, such as a widespread drought, causing a large number of simultaneous insurance claims. For an insurance company to remain solvent during a systemic event, it would need to set aside sufficient capital, adding to the cost of insurance. Alternatively, the insurer may acquire reinsurance from a sufficiently large global reinsurer who can better manage that risk. The reinsurer will charge their own premium, also adding to the cost of insurance to the farmer.

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