A prototype of an index-based margin insurance for agriculture in Austria

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Motivation and problem statement

In recent years, the portfolio of insurance products for agriculture has expanded significantly in Austria. Insurance against damages due to natural hazards like hail, frost, snow pressure, floods are now available for a large number of crops. Recently two index-based insurances were introduced to cover losses due to draught for crops and grassland. The acceptance on the market shows that farmers actually need such products and are willing to pay for them.

Representatives of farmers, however, are not yet satisfied with the current product portfolio. Their argument is that a single product that covers both production and market risks is needed. Such a product would reduce transaction cost compared to the current situation where additional contracts are necessary to hedge price risks. A revenue insurance would be an improvement compared to the current situation but farmers are mainly concerned about profits and incomes and less about yields or revenues. Therefore, an ideal insurance product would cover not only production risk and product price risks but also price risks of inputs such as fuel and fertilizer.

Moreover, many farms in Austria are relatively small and farmers are typically both managing and operating their business. These would benefit from a simple insurance product since they are extremely time-constrained, but nevertheless need to make well-informed choices whether to take up the insurance or go along with their current practice.

These considerations and the fact that two index-based products are already well established on the market made it plausible to develop a product that is simple to communicate and that can be implemented at low costs. In order to evaluate the feasibility of such a solution, a prototype was developed for the most important crops and production regions in Austria. The purpose is to identify the elements that are necessary for developing a marketable product that deals with production and market risks and that offers advantages over existing approaches.

The state of agricultural production risk management in Austria

The market of Austrian disaster risk management is characterized by the fact that private firms and the public are active but not well co-ordinated (Url and Sinabell, 2008)

With respect to agriculture, the situation is different: a single company offers a wide range of insurance products to mitigate agricultural production risks. The Austrian Hail Insurance Company (Österreichische Hagelversicherung) is a mutual insurer, founded by the Austrian insurance industry in 1947. As a mutual insurer it is not profit-oriented and thus costs can be kept low. The national government subsidizes the hail-insurance premium for all crops since 1995 and the frost-insurance premium for vine-cultures and insurable crops since 1997. The subsidy is shared equally between the federal and the Länder governments and amounts to 50% of the total premium.

An overview of the products portfolio offered by this firm shows that insurance products are available for almost all relevant production activities (Appendix I). An overview of the market volume is shown in Figure 1. Statistics on the market for agricultural production risk (Table 1) show that the market has grown significantly during the last decade and that public support has grown in a likewise manner. The annual total volume of production of agriculture in Austria was € 6.7 bn in the last five years. The sum of insured values was € 3.7 bn and shows the high market penetration.

Drought is a severe production risk in Austria. A recently introduced innovation is drought insurance for grassland and maize. The new index insurances rely on big data meteorological applications. It is planned to offer drought index insurance for winter wheat and sugar beet in 2017. For the same year it is planned to broaden the portfolio of frost and flood insurance products that were not covered so far (aiz, 2016).

Fig. 1: Market penetration of production related risk insurance in Austrian agriculture 2014
Source: Österreichische Hagelversicherung VVaG, 2016.

Table 1: Key data on the market for production related risks in Austrian agriculture

	2000	2005	2014
clients	71,897	67,866	n.a.
area, 1,000 ha	913	1,079	1,209
premium volume, mn €	45.9	53.1	96.3
farmer's losses, mn €	64.3	23.3	n.a.
premium subsidy, mn €	22	24	40
sum insured, bn €	n.a.	n.a.	3.7

Hint: The decreasing number of clients is due to structural change.
Source: Österreichische Hagelversicherung, VVaG; BMF various years.

Weaknesses of agricultural risk management in Austria and a proposal of a solution to some of them

For production related risks there is a broad portfolio of insurance products available and the rate of innovations (e.g. index-based insurances) is very satisfying from the farmers' perspective. However since price volatility has increased dramatically from 2005 farmers are concerned about price risks as well.

Until recently there were no products available that a typical Austrian farmer would use to reduce price-related risks. Only very few farmers are employing brokers for the hedging of futures contracts. Several years ago grain trade companies started to introduce price hedging products as a service for their suppliers. One of the motivations has been to strengthen the ties to suppliers and another one was to make price negotiations easier.

Several big trade companies in Austria are co-operatives and therefore are interested in negotiating high prices for their members.

Such products are available only for a few crops (wheat, rapeseed, corn). Many producers of piglets, pigs or milk who have gathered experience with the new products as crop producers have an interest in price hedging products for livestock as well. The recent decline of prices for these products has raised the awareness among farmers for price hedging instruments further.

Farms in Austria are small by European standards and a typical farmer has little time for managing the business since most of the time is consumed by working in the field or stable. Therefore there is an entry barrier for farmers who wish to get involved in price hedging because the learning curve is felt to be very steep. Farmers wish to have price hedging instrument at their disposal that are standardized, easy to understand and affordable. Eventually farmers are interested in stable incomes (Larcher et al., 2015). Therefore alleviating production-related risks like frost, hail or drought is improving the situation for those exposed to these risks. But many more were confronted with very volatile income streams during the last years like milk or pig producers.

In a seminal study on risk management in Austrian agriculture which was prepared to support the policy decision making process for the Health Check Reform in 2009, Sinabell et al. (2010) analyzed a general income insurance / margin insurance for Austrian farms. The idea was to switch EU farm payments from hectare-based premiums to support premiums for such a product. Livestock producers and fruit producers would have benefited considerably from such a policy at the cost of farms with large amounts of land. This proposal was not implemented but since then, the idea to insure income losses in Austrian agriculture has been further developed by a small group of persons in administration, insurance business and science.

The farm bill 2014 introduced an insurance in the US which resembles such an approach (Orden, Zulauf, 2015). The Dairy Margin Protection Program (U.S. DMPP) was established on the market in 2015 and is available for milk producers in the US to cover part of losses in income which are a result of low milk prices or high feeding costs. A minimum coverage is guaranteed by a government funded premium support. The prototype of an insurance product presented in the next chapter shares many features with U.S. DMPP. The two commonalities are (1) that indexes are used to identify losses and (2) that the insurance covers a certain share of the margin (margin = revenues – costs). Scharner and Pöchtrager (2016) recently presented a version of this scheme adapted to the Austrian situation. Because the general concept is not limited to milk production we demonstrate a similar insurance product for wheat.

Necessary conditions for an income insurance scheme in agriculture to work

Income insurance schemes are widely used in the Austrian economy but only very few of them are offered by the private market. Such products cover the payment of daily allowances in the case of illness or annuity payments for reduction in earning capacity.

The coverage of income losses is offered by the unemployment insurance which is offered by the state for all employees. Self-employed persons have the option to buy such an insurance as well.

The unemployment insurance for employees and the income insurance for self-employed persons have in common that: premiums are limited, indemnities are limited (amount and duration of payment). In order to reduce moral hazard there is a waiting period before unemployment benefits / income insurance are paid to employees who quit the job on their own initiative and self-employed persons who stop their activities. Adverse selection is controlled by the obligatory insurance for employees; self-employed persons have to stay in the system for at least eight years and must have paid into the system a certain period before they qualify for compensations. The income insurance for self-employed persons was introduced only a few years ago. Since no evaluation has been published so far, it is not known if adverse selection can effectively be controlled. The system seems to be vulnerable to adverse selection because self-employed persons in sectors with a strong seasonal pattern (tourist guides, gardeners, etc.) are more likely to buy coverage than others.

Contrary to employees and the self-employed population, an income insurance does not yet exist for farmers in Austria. However, the experience from the other schemes can be used to identify necessary conditions that must be met in order to get a working:

1. *Cost of administration:* In order to keep premiums low, administrative processes have to be highly automated, information has to be transparent and available swiftly at low costs to all involved parties.
2. *Moral hazard:* The farmers' behavior should not impact on the outcome, easily observable variables should trigger indemnities automatically.
3. *Adverse selection:* The characteristics of potential buyers of a gross margin insurance have to be known well. Contracts need to be designed in a manner that self selection supports a smooth operation of the insurance system.
4. *Concentration risks:* Livestock production (milk and pig production) is much more important than crop production in Austria. If only milk producers bought an income insurance and crop producers did not, risks for the insurer would be highly concentrated. Reinsurance premiums would be relatively high in such a case. A diversification of not related income risks would help to reduce the exposure of the insurance company.
5. *Trends in agricultural prices and input costs:* An income insurance should not impact on structural change and adaptation to unexpected market conditions but help farmers to adjust to new situations without worrying about income losses too much. This can be achieved by adjusting premiums periodically. An alternative is to block access to loss coverage for a certain period for those clients who received indemnities.

A product that is placed on the market and successful over long periods has to have finely-tuned features that address all the elements listed above. For the prototype of a farm income insurance in Austria these features have not yet been fully developed. The concept presented in the next chapter addresses the first two elements: cost of administration and moral hazard. It is based on existing data sources that are maintained for other purposes and therefore most of the data are available at low costs. It uses wheat production in Austria as an example but the method is developed for all major crops, for milk, piglet and pig production. The concept can therefore be expanded to reduce concentration risks as well.

The concept of an index based income insurance

The core of the new product is a calculation of standard gross margins. Almost every Austrian farmer is familiar with this method and farm advisory services offer sophisticated online tools that implement this concept (AWI, 2016). In addition, many farmers are organized in working groups promoted by the Chamber of Agriculture where they meet in order to compare the gross margin results and cost break downs of their farm and learn from the peers performing above average.

In order to calculate the premiums the volatility of input prices (fuel, fertilizer), of output prices, of yields and the cost structure needs to be known. Volatility of output prices and input prices can be observed on the market and detailed statistics are readily available. To deal with the production risk is the core business of any crop insurance and therefore is well known to incumbent insurance companies.

The cost structure and the relative weight of each cost item is not yet know that well. For this purpose, INCAP (index-based costs of agricultural production) was developed. The data set is designed to make such analyses possible by covering all relevant production activities of the Austrian agricultural sector (Heinschink et al., 2016a,b). Data derived from INCAP can be used as a tool for examining risks in Austrian agriculture, such as fluctuations of activity-specific gross margins. It can also be used to evaluate farm-specific incomes or incomes at sector level (Sinabell, Heinschink, Tribl, 2016).

The data used for INCAP are not based on cost accounting data of farms but are derived from many sources. INCAP is originally an engineering data set. The quality of the results and their validity is scrutinized using data from farmers in accounting working groups from a major production region (Heinschink et al., 2016a).

Figure 1 shows an example of results derived from INCAP, the gross margin for quality wheat over a period of nine years. Specific management data and spatial information is given in the right pane of the figure. Prices of outputs and inputs are from annual statistics and yields are the average of the region under consideration. Like in other index based products, observations in the field are used to trigger the incidence of a coverage and in combination with market observations gross margins can be used as another index.

For the example shown in Figure 2, the assumption was made that management is not altered during the period of observation. Revenues range from €452 to €1,010/ha, total variable costs from €415 to €635/ha and gross margins from €61 to €449/ha. The fluctuations in gross margins are easily traced back to the changing yields, output prices and respective cost items.

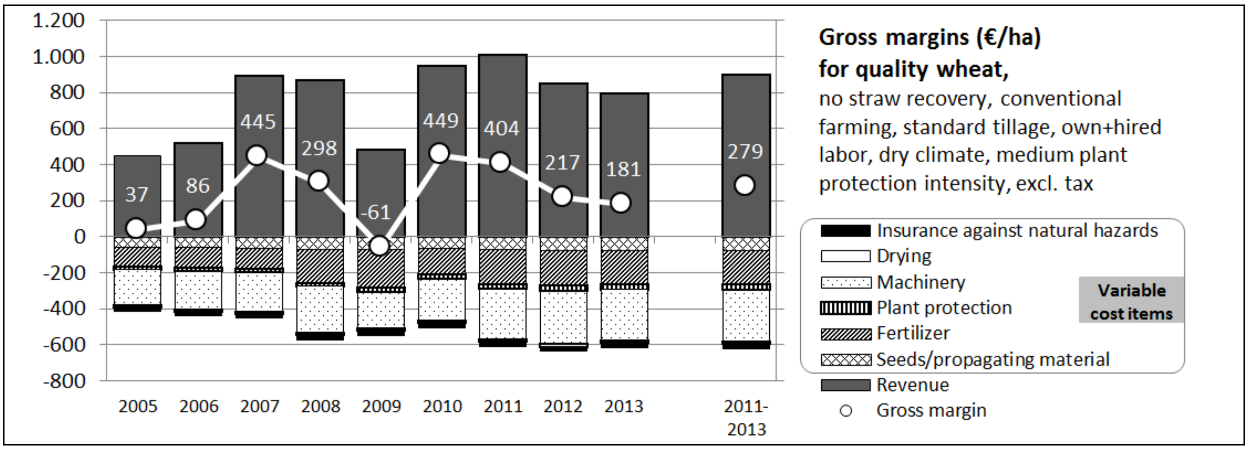

Figure 2: Gross margin time series for a specific quality wheat production activity (€/ha)
Source: Own figure

A prototype of a margin insurance scheme for wheat producers in Austria

The concept developed in the previous chapters is now applied to an example for a gross margin insurance for wheat producers in Austria. The main elements are show in Figure 3. The data are representative for the whole country. Austria is a small country but production conditions are very heterogeneous. Similar calculations as the one shown in Figure 3 can be made for any district and for any production system (standard tillage, minimum tillage, organic production, etc.).

The pattern of revenues and costs in Figure 2 and Figure 3 are resembling each other but are for different products. In figure 3 all types of wheat are aggregated and numbers represent weighted averages. The upper line (blue) is the average price of wheat in Austria over a period of 16 years. The dashed brown line indicates the standard production costs (seed, fertilizer, machinery, energy, plant protection). The light brown area is the margin (revenue minus costs) before deducting any 'margin insurance' premiums. The dark brown area represents the insurance payout that accrue when the margins fall below 120 € /ha. Prices of outputs and inputs are not observed on farms but taken from public sources that are accessible to anyone.

It is not difficult to calculate the fair premium with hindsight like is done here and shown in Figure 3. In order to keep things simple, the assumption was made that a public fund is sponsoring the insurance by covering administrative costs and re-insurance premiums (together approximately 20%). The premium accrued over the period (indicated by the red dashed line) therefore equals the indemnities that are used to compensate any shortfall of margins below 120 € per hectare. This figure is chosen arbitrarily and is designed as a choice variable for the farmer buying such an insurance. If government in addition fully supports the premium the total cost are 59 € per hectare in this example. For comparison only, the average direct payment in Austria per hectare of utilized agricultural land was 258 € in 2015.

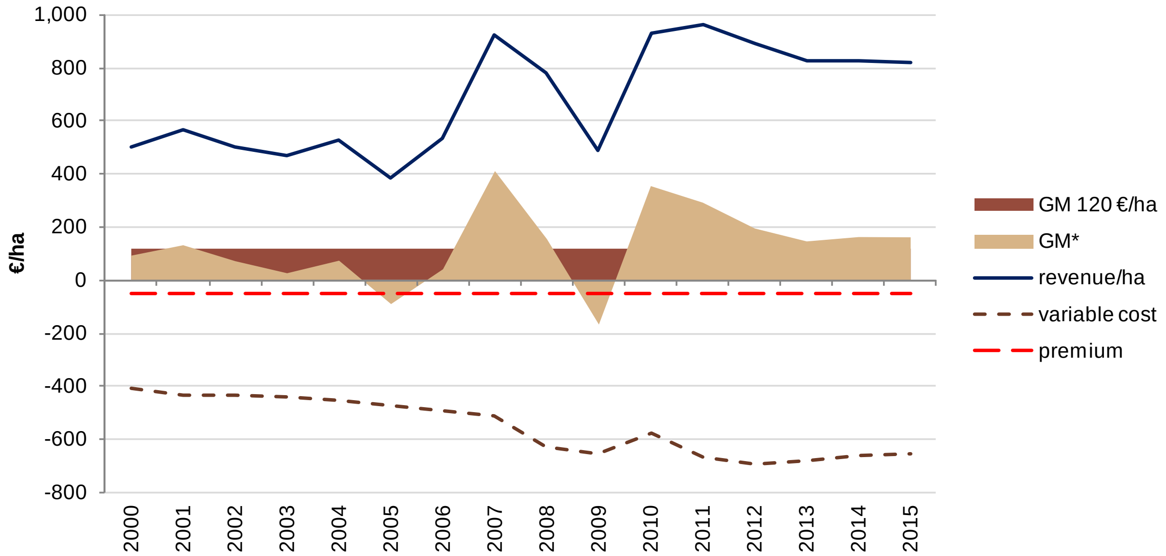

Fig. 3: An ex-post calculation of an index based margin insurance scheme (€/ha) with minimum margin of 120 € hectare.

Source: Own figure

Remark: The assumption is made that administrative costs and re-insurance is covered by a farm programme. If government in addition fully supports the premium the total cost per hectare are 59 € per hectare. The average direct payment in Austria per hectare utilized agricultural land was 258 € in 2015.

In order to evaluate production risks in Austria usually a period of 10 years is taken. The period chosen here is much longer and this was done deliberately. Figure 3 clearly shows that trends in agricultural prices and input costs are a severe problem for calculating adequate premiums in advance. This may be the reason that such insurance products as the one presented here do not yet exist in Austria.

Apart from trends it is important to have in mind that a margin calculation includes more than one variable. As shown in Table 2 and Table 3, the level of covariance between the time series involved is sometimes very high. The statistical properties of the margins under consideration need therefore to be explored in detail in order to better understand the underlying data generating processes.

Discussion and outlook

This paper presents core elements of a new insurance product that allows farmers to insure against price risk of both, input and output prices. Several additional steps need to be made before a product can be developed that is placed on the market. After concluding the data validation phase it is necessary to define the details of the sub-indexes that enter the formula and the details of premium calculation and the specification of the product that shall be placed on the market. To evaluate the acceptance on the market for such a product is probably the most important step before its launch. The European Innovation Partnership offers a chance to support the development of such a product because supports cooperation between science, industry and farmers in order to develop new products like the one presented in this paper.

A noteworthy advantage of the margin insurance presented here is that it can be easily combined with any other production risk insurance. Very risk averse farmers therefore have the opportunity to fine tune their risk mitigating measures by combining different insurances.

An important aspect not touched in this paper is the legal one. It is not yet examined if national or EU legislation limits the scope of detail or any variant of implementation of such a product. It also has to be checked whether public support for such an insurance may be granted or not. It may be advisable to do this in order to save re-insurance premiums at least during the phase of gaining experience and building up the necessary reserves. In such a case it will be necessary to check conformity with WTO commitments. Given the fact that a very similar scheme is operated in the USA there is a certain likelihood that conformity is given.

The results shown in this paper are based on the assumption that technology (apart from yield increases due to genetical improvements) does not change. Such an assumption may be justified for some short periods but is certainly inadequate for longer ones. In order to account for technological change it will be necessary to make technical parameters explicit and to explore their change over time.

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Annex I: Statistical properties of time series of prices of agricultural outputs and inputs

Table 2: Covariance matrix of percentage changes of agricultural output and input prices in Austria

	maize	rapeseed	wheat (feeding)	wheat (bread)	fertilizer N 28%	complete fertilizer	diesel
maize	1,00	0,00	0,08	0,12	0,04	0,18	0,12
rapeseed	0,00	1,00	0,32	0,31	0,16	0,27	0,06
wheat (feeding)	0,08	0,32	1,00	0,62	0,15	0,13	0,03
wheat (bread)	0,12	0,31	0,62	1,00	0,17	0,22	0,01
fertilizer N 28%	0,04	0,16	0,15	0,17	1,00	0,48	-0,04
fertilizer 20/20/20	0,18	0,27	0,13	0,22	0,48	1,00	0,02
diesel	0,12	0,06	0,03	0,01	-0,04	0,02	1,00

Source: own estimates time series provided based on Statisitk Austria

Table 3: Covariance matrix of levels of agricultural output and input prices in Austria

	maize	rapeseed	wheat (feeding)	wheat (bread)	fertilizer N 28%	complete fertilizer	diesel
maize	1,00	0,78	0,89	0,90	0,54	0,59	0,71
rapeseed	0,78	1,00	0,87	0,84	0,77	0,80	0,87
wheat (feeding)	0,89	0,87	1,00	0,96	0,67	0,68	0,76
wheat (bread)	0,90	0,84	0,96	1,00	0,61	0,62	0,73
fertilizer N 28%	0,54	0,77	0,67	0,61	1,00	0,94	0,78
fertilizer 20/20/20	0,59	0,80	0,68	0,62	0,94	1,00	0,80
diesel	0,71	0,87	0,76	0,73	0,78	0,80	1,00

Source: own estimates based on time series provided Statisitk Austria

Annex II: Agricultural risk insurance portfolio in Austria in 2016

Activity / Risc	Ø 2010/15 Mio. € basic prices	risk																					
		Hail	Consumer's risk due to hail	Hail induces fusarium infestation	Frost	Drought	Re-cultivation	Storm	Drift	Siltation (mud)	Flooding	Predation	Sprouting	Snow damage	Additional hassle and rot	Spoilage	Heavy rain	Death	Dead birth	Animal epidemics	Death failure of ventilation	Technical defects	Fire
Wheat	261	X			X	X			X	X	X	X	X										
Barley	114	X			X	X			X	X	X	X	X										
Oats	15	X			X	X			X	X	X	X	X										
Rye	29	X			X	X			X	X	X	X	X										
Spelt		X							X	X	X	X	X										
Triticale		X			X	X			X	X	X	X	X										
cereal mixtures		X			X	X			X	X	X	X											
Vetches	43	X				X			X	X	X	X											
Emmer					X	X																	
Single corn					X	X																	
Sorghum						X																	
Grain maize		X		X		X		X	X	X	X	X		X									
Silage maize	321	X		X		X		X	X	X	X	X		X									
Green maize		X						X	X	X	X	X		X									
Seed maize		X				X	X	X	X	X	X	X		X									
Potatoes	78	X			X	X	X		X	X	X	X											
Horseradish		X							X	X	X	X											
Sugar beet	107	X					X		X	X	X	X											
Forage beet		X							X	X	X	X											
Oil pumpkin		X				X	X		X	X	X	X											
Oil pumpkin propagation						X																	
Rape	57	X			X				X	X	X	X											
Sunflower	19	X				X		X	X	X	X	X											
Soy Bean	37	X				X			X	X	X	X											
Horse Bean		X				X		X	X	X	X	X											
Linseed (oilflax)		X							X	X	X	X											
Field peas		X							X	X	X	X											
Chickling peas		X							X	X	X	X											
Turnip rape seeds		X							X	X	X	X											
Sweet lupines		X							X	X	X	X											
Mustard seeds		X							X	X	X	X											
Fodder radish		X							X	X	X	X											
Poppyseed		X	X						X	X	X	X											
Two and more cut meadows		X				X	X		X	X	X	X											
Two and more cut pastures		X				X	X		X	X	X	X											
Clover		X				X	X		X	X	X	X											
Clover-Grass		X				X	X		X	X	X	X											
Lucerne		X				X	X		X	X	X	X											
Forage grasses		X				X	X		X	X	X	X											
Other forage plants		X					X		X	X	X	X											
Fruits		X						X						X									
Fruit trees		X						X						X									
Apples		X			X	X																	
Pears		X			X																		
Pome fruits	233	X																					
Stone fruits		X																					
Shell fruits		X																					
Soft Fruits		X																					
Strawberries		X	X		X																		
Elderberries		X																					
Grapes	508	X			X										X								
Horticulture																							
Glasshouse		X						X			X			X		X						X	X
Plastic greenhouse	567	X						X			X			X		X						X	X
Tunnels		X						X						X		X							
Vegetables outdoor		X	X		X				X		X												
Ornamental Plants		X			X			X			X					X	X						
Tree nursery		X			X			X			X			X		X							
Cattles	892																	X	X	X			
Hail/Storm Plastics		X						X															
Milk production	1110																			X			
Pigs	789																			X	X		
Horses	1																	X					