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Sharing risks in agriculture; principles and empirical results

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Abstract

The risk environment of farmers is changing. For example, price and production risks are increasing and governments increasingly encourage agriculture to find private market solutions for catastrophic risks like floods and epidemic diseases. We studied risk management strategies like insurance – in which risks are shared with others – to find out whether such strategies provide opportunities for farmers to deal with the new risks with which agriculture is confronted. We concluded, on both theoretical and empirical grounds, that risk-sharing strategies do provide such opportunities. From a theoretical perspective, because risk-sharing tools are in principle advantageous to both individual farmers and society as a whole, and from an empirical perspective, because farmers already perceive risk-sharing, especially insurance, as an important strategy to manage risks. The empirical results are based on a questionnaire survey among Dutch livestock farmers. Areas are identified for further research, amongst other things, with respect to risk-sharing strategies for price risks and epidemic livestock disease risks.

Keywords: risk sharing, risk pooling, asymmetric information, systemic risks, questionnaire survey.

Introduction

Various types of risk can be distinguished. The classification of Hardaker *et al.* (1997), who differentiated between *business risks* and *financial risks*, can be used for most agricultural risks. Business risks include *production risks*, which are related to the unpredictable nature of the weather and to the uncertain performance of crops and livestock, and *price risks*, which refer to uncertainty of prices of farm inputs and outputs. Business risks furthermore include *personal risks*, like illness or death of

people who operate the farm, and *institutional risks*, which originate from uncertainty about the impact of government policies on farm profits. Financial risks refer to the risks related to the way a farm is financed.

The risk environment of farmers is changing. This is caused partly by a changing role of the government, i.e., less intervention on the one hand and more regulation on the other (Zulauf *et al.*, 1996; Ritson & Harvey, 1997; Harwood *et al.*, 1999), and partly by an increasing industrialization of agriculture (Boehlje & Lins, 1998). Examples of the changed environment include increased price risks – at least for European farmers currently producing under the price support programmes of the Common Agricultural Policy – and increased production risks due to a more regulated use of medicines, like restrictions on the use of antibiotics. Changes also occur in relation to risks of catastrophic events like floods. In the past, farmers have often been compensated for such losses by governments but now there is increasing pressure to find private-market solutions. As a result of the industrialization of agriculture, farmers are increasingly exposed to so-called contractual or relationship risks (Boehlje & Lins, 1998).

Taking more risks can increase a farmer's profit. However, like most people, farmers are generally risk averse (Harrington & Niehaus, 1999). To manage the risks they face, farmers adopt a range of strategies including on-farm measures like diversification or selecting less risky production methods, and strategies for sharing risks with others. A well-known risk management strategy by which farmers can share risks with others is to buy an insurance for specified risks (Rejda, 1998).

Given the changing risk environment, farmers need to find ways to cope with the new risks they are confronted with. In this context we studied the pros and cons of risk management strategies in which risks are shared with others. We did this from both a theoretical perspective and an empirical one. The empirical results are based on a questionnaire survey among Dutch livestock farmers.

Sharing risks

Principles of risk sharing

Risk sharing involves a contract in which risk is shared. This risk-*sharing* characteristic distinguishes this type of contract from other forms of contract. In a rental contract, like a lease contract, the farmer pays a rent to the lessor to use the resource, but has to bear all the risks (Stiglitz, 1974). In a risk-*shifting* contract, like a fixed-forward-price contract, the risk-shifter pays a kind of premium to the risk-taker and in return receives a guaranteed price.

The sharing of risks is based on the concept of pooling. The principle of pooling is that by combining independent losses in a pool, the expected total amount of losses stays the same, but the variance of individual losses decreases (Harrington & Niehaus, 1999). In addition, if the pool consists of large numbers of independent risks, the relative variation in actual loss compared with the average loss further decreases (law of large numbers; Rejda, 1998) and the party that pools the risk is able to predict average losses more accurately.

Examples of risk-sharing strategies

Risk-sharing tools differ in the type of risk shared (e.g. price versus production risk), the party with whom the risk is shared (e.g. a colleague farmer versus a contractor), and whether the risk is shared directly or indirectly (e.g. production versus insurance contract). Major forms of risk-sharing contracts include:

1. Share tenancy (also called share cropping or share lease). Share tenancy is a land lease under which the rent paid by the tenant is a contracted percentage of the value of output per unit of time. As a rule, the landowner provides land and the tenant provides labour; other inputs may be provided by either party (Cheung, 1969). Nowadays, share tenancy is less widely used; it often has been replaced by the wage system on the one hand and by full land rental contracts on the other (Stiglitz, 1974). Reasons indicated by Stiglitz (1974) for this decline include the development of capital markets (providing landlords and workers with other opportunities to diversify their portfolio), and the increasing capital intensity and technological change in agriculture, implying a need for stronger incentives (rental system) or stronger supervision (wage system).
2. Production contracts. Production contracts typically give the contractor considerable control over the production process. Contractors enter production contracts to ensure timeliness and quality of commodity deliveries. A guaranteed market access, ensured access to capital and lower variability of incomes are important reasons for farmers to enter such contracts. Production contracts are widely used in the broiler industry, and are becoming increasingly important in egg and hog industries (Harwood *et al.*, 1999; Henessey & Lawrence, 1999).
3. Marketing contracts. Marketing contracts are agreements between a buyer and a producer that set a price or outlet for a commodity before harvest or before the commodity is ready to be marketed. The producer usually remains fully responsible for the management decisions during the production process. The most commonly used marketing contract is the fixed forward-price contract. With this type of contract farmers can completely eliminate the price risk. Other forms of marketing contracts share the price risk between the buyer and seller of the contract (Harwood *et al.*, 1999). Hedging on futures markets is rather similar to a fixed forward-price contract, except for (i) futures contracts are standardized contracts that are widely traded (i.e., prices are more competitively determined), and (ii) under a futures contract, delivery of the commodity normally does not take place (Hardaker *et al.*, 1997).
4. Insurance. With insurance the insured typically pays a premium to the insurer and receives an indemnity payment from the insurer once an insured loss occurs. The insurer is the party that pools the risks, but risks are still shared among the insured. This sharing of risks amongst insured manifests itself by additional premium assessments or dividend payments at the end of the policy period, or by premium adjustments at the beginning of the next policy period, all depending on the actual loss experience of the insurance pool (Rejda, 1998). Insurance is widely available for personal risks (e.g. life insurance) and for production risks like hail (Hardaker *et al.*, 1997).

5. Financial leverage. Financial leverage is defined as the use of debt capital and other fixed-obligation financing relative to the use of equity capital (Robison & Barry, 1987). Lenders pool the risk of loan defaults over many clients.
6. External equity financing. Equity investors receive a share of the returns of the firm in which they invested equity (Lowenberg-DeBoer *et al.*, 1989). Investors pool the risk of the firm making low or negative returns over a diversified portfolio. Irwin *et al.* (1988) argue that investments in farm real estate are potentially attractive to investors because the performance of such investments is not highly correlated with the performance of a share market portfolio. However, the availability of equity financing in general production agriculture is limited because of, amongst other things, the principal-agent problem and high monitoring costs (Collins & Bourn, 1986; Lowenberg-DeBoer *et al.*, 1989). Crane & Leatham (1995) argue that there are opportunities for wider use of external equity financing in agriculture by means of profit- and loss-sharing contracts.

Asymmetric information

The larger the number of pooled independent risks, the more accurately the party that pools the risks is able to predict the average losses and the amount of money (e.g. an insurance premium) needed for dealing with these losses. However, asymmetric information between risk-sharing parties – like between insurer and insured or between lender and client – can lead to established premiums being insufficient to cover the losses (Harrington & Niehaus, 1999).

Asymmetric information includes *moral hazard* and *adverse selection*. These terms are explained here for insurance. In case of adverse selection, exposure units most at risk buy more insurance than other units but the extent to which this happens may not be known *a priori* to the insurer. With moral hazard, exposure units change their behaviour in a manner not predicted by the insurer after having bought an insurance, for instance by becoming more careless (Arrow, 1996). Ways to reduce problems of adverse selection and moral hazard include:

1. Underwriting. Before a risk-sharing contract is brought into effect, both parties try to gain insight into each other's risk. In case of insurance, insurers generally impose an obligation of disclosure in the insurance contract, requiring the insured to inform them about any factors that can lead to above-normal risk; if the insured fails to disclose relevant facts, the contract can be invalidated. Based on such information, insured are classified and premiums are differentiated for different classes of risk (Rejda, 1998). Related to the use of debt capital, significant loan losses in the USA in the 1980s have led to agricultural lenders increasingly emphasizing the credit quality and the management of the credit risk in their loan portfolios. This has resulted in a growing use of risk-adjusted interest rates, differential loan limits, security requirements, and loan supervision requirements (Miller *et al.*, 1993). Such measures can result in considerable transaction costs (Arrow, 1996).
2. Contract specifications. A risk-sharing contract can include 'rules of behaviour'. For sharecropping, Stiglitz (1974) states that "a contract may not only specify the

hours of labour to be provided, but also something about effort, degree of control, and amount of supervision". Milgrom & Roberts (1992), in a more general context, state that monitoring and verification are remedies against moral hazard. As with underwriting, considerable costs can be involved.

3. Deductibles. With deductibles, the insured pay some specified amount of losses themselves, which reduces fraud and encourages loss prevention (Rejda, 1998). By using deductibles, the extent to which farmers can share risks is reduced. In this respect Arrow (1992) argues that if without the use of such tools as deductibles there would be a complete absence of risk shifting, it might be best to use the tools and have at least some shifting of risk. Arrow (1992) regards insurance as a risk-shifting tool. In this paper we consider insurance as a risk-sharing tool with the insurer as intermediary. According to Vaughan & Vaughan (1996) both definitions are useful. The first reflects the individual's perspective, the second that of society.
4. Indemnification based on an objective, transparent index. Using an index reduces adverse selection because information regarding an index is more generally available and more reliable. It reduces moral hazard, because an individual farmer cannot influence the height of the index. It furthermore reduces transaction costs, because losses need not to be verified per individual. Indemnification based on an index, however, only provides sufficient risk protection to individual farmers if an index can be found that is highly correlated with farmers' loss experiences (Miranda, 1991).
5. Local organizations. Risk-sharing pools that are locally oriented are likely to face less severe problems of asymmetric information (i.e., lower costs of monitoring and verification), because the risk-sharing parties have a more direct relationship with each other (Milgrom & Roberts, 1992). However, local pools have more difficulties in dealing with systemic risks (see e.g. Anderson & Hazell, 1994).

If problems of asymmetric information are severe and cannot be dealt with (at acceptable costs), sharing the risk becomes inefficient.

Systemic risks

The extent to which risks are stochastically independent is another important issue when considering the pooling of risks. Pooling independent risks reduces the variance of losses. For example, if systemic (i.e., positively correlated) risks are pooled, the variance of losses decreases less. By pooling completely systemic risks, variance does not decrease at all (Harrington & Niehaus, 1999). Risks that are completely systemic, like prices and interest rates, can be efficiently dealt with on exchange markets. The so-called 'in-between risks', i.e., risks that are neither completely independent nor completely systemic (Skees & Barnett, 1999), are more problematical. Examples include drought affecting crop yields over a large area and widespread epidemics of livestock diseases. Organizations that pool such risks face higher costs of pooling because of the need to hold substantial reserves in case systemic events occur (Doherty, 1997).

In order to prevent such increases in the cost of pooling, governments are often financially involved in insurance schemes for 'in-between' risks. The Standard Reinsurance Agreement for crop insurance in the USA is an example in which governments subsidize the insurance premiums as well as the administrative costs and the reinsurance (Goodwin & Ker, 1998). In general it is argued that with events like widespread floods or droughts such government involvement is more efficient than *ad hoc* disaster assistance, but that it still involves inefficiencies (Barnett, 1999). Skees & Barnett (1999) propose some, more market-based solutions to deal with these inefficiencies. Furthermore, developments in capital markets, notably the increasing 'securitization' of reinsurance, provide opportunities to reduce the need for government involvement in insuring risks with systemic characteristics in the future (Jaffee & Russell, 1997).

Introducing new risks

Risk-sharing contracts by themselves can lead to the introduction of new risks. With reference to financial leverage, Hardaker *et al.* (1997) illustrate that an increase in the financial leverage in financing a farm magnifies the impact on net income of variability of farm returns.

New risks related to production contracts include the risk of contractors requiring the upgrading of buildings and other infrastructure not expected by the farmer, and the uncertainty about prolongation of a contract (Boehlje & Lins, 1998; Harwood *et al.*, 1999).

In relation to marketing contracts, farmers may not be able to fulfil the quality or quantity requirements of a contract. Poor weather, for example, can lead to low yields, forcing producers who contracted a large proportion of their crop to buy a 'replacement' crop at an uncertain cash price to meet the terms of delivery on their forward contract (Quiggin & Anderson, 1979).

If the costs related to such new risks are larger than the benefits of using the strategy, sharing the risks becomes inefficient.

What are the benefits of sharing risks?

For the farmer

It is generally assumed that farmers are risk averse, i.e., they are willing to pay a premium to reduce exposure to risk. If farmers can trade away part of the risks on their farm at an acceptable cost, the expected utility for the farmer will increase (Arrow, 1996; Harrington & Niehaus, 1999).

Although sharing risks can increase the utility for the farmer, the latter is not likely to share all risks. It is (largely) up to each individual farmer to decide which risks and which part of these risks to share. Factors that can influence this decision include a farmer's degree of risk aversion, the costs involved in risk sharing, the relative size of a risk, the correlation of the risk with other risks, other sources of indem-

nity, a farmer's perception of the nature of risk, and a farmer's income and wealth (Barry *et al.*, 1995; Hardaker *et al.*, 1997; Harrington & Niehaus, 1999).

Also important for the farmer's decision about which risks to share and which ones to bear is that this decision is part of the overall risk management problem he faces when selecting a risk-efficient portfolio of on-farm and off-farm risky instruments. Thus, for example, a decision about whether to insure against a particular risk, and if so to what extent, cannot be properly made without reference to other risky choices.

The above statements imply that there are no universal rules about which risks to share and which ones not. Only in a few cases it is not completely up to the farmer which risks are managed and by what type of strategies. For example, when a loan is contracted, lenders could require that farmers use one or more risk management strategies like crop insurance and forward contracting (Harwood *et al.*, 1999).

For society

Sharing risks can also have a number of potential advantages for society as a whole.

1. If two individuals freely enter a contract, both of them must be better off, i.e., there must be an increase in utility for both. The sum of many such contracts makes that society is better off, unless other individuals are injured in some way (Arrow, 1992).
2. The possibility of sharing risks permits individuals to engage in risky activities, which they otherwise would not undertake. That way, the expected return to society is increased over what would prevail if individual agents were constrained to accept only those risks they could afford to bear themselves (Arrow, 1992; Hardaker *et al.*, 1997; Rejda, 1998).
3. If farmers can trade away part of their risks so that they can move closer to the point of expected profit maximization – but not fully because there are costs involved – the result is a more socially desirable allocation of resources (Myers, 1988).
4. If farmers need to put less effort into on-farm methods of avoiding risks, they might well be able to use their resources more efficiently, which in turn implies greater overall efficiency in resource use (Hardaker *et al.*, 1997; Rejda, 1998).
5. Trading away risks is likely to result in more stable farmers' incomes. More stable incomes are likely to lead to more stable expenditures on farm inputs and family consumption, thereby implying more stability for rural businesses with possible flow-on benefits for society as a whole, for example through more rural employment. Moreover, it seems likely that more stable farm incomes contribute to the viability of rural towns since there appears to be a degree of irreversibility in the provision of retail and service activities in such communities. A downturn in farm incomes and hence in spending by farm families leads to the closure of some local businesses and to the withdrawal of government and commercially provided services. Such lost facilities are seldom fully replaced when farmers' incomes later recover (Hardaker *et al.*, 1997).
6. More stable rural incomes for farmers (and other rural businesses) mean more reliable repayment of loans. This could be reflected in improved access to credit or

lower borrowing costs, implying increased productive investment in the rural sector (Hazell, 1992; Hardaker *et al.*, 1997).

7. If farmers are able to trade away (part of) the disastrous risks they face, the resilience (or sustainability) of farms increases, which can mean less human, animal and environmental distress after the occurrence of disasters like severe floods or droughts (Anderson & Hazell, 1994). This, however, is only true if moral hazard is dealt with properly. Otherwise, farmers could, for example, pay less attention to the prevention of disease outbreaks, leading to an increase in the number of disasters occurring, or pay less attention to their stock during droughts, leading to more instead of less animal distress.

It is interesting to note that Hardaker *et al.* (1997) raised the issues mentioned in this section in a different context, in which they discuss why governments intervene in agriculture.

Farmers' perceptions of risk and risk management: empirical results

To be able to better assess the possible role of risk-sharing tools for farmers in the light of a changing risk environment, insight is needed into the 'current state of affairs'. To this end, a survey of attitudes towards risk sharing of Dutch livestock farmers was carried out.

In 1997 a mail questionnaire survey was carried out among 2700 Dutch livestock farmers. The survey included questions about the socio-economic characteristics of the farmers, and about their perceptions of the importance of various sources of risk and risk management strategies including both on-farm strategies and strategies in which risks are shared with others. Perceptions were measured on Likert-type scales ranging from 1 (not relevant) to 5 (very relevant) (see e.g. Churchill, 1995).

Results presented here are based on 647 returned questionnaires. A total of 737 questionnaires were returned, but small farms (< 20 NGE) and farms in which livestock accounted for less than one-third of the total NGE were excluded from the analyses. (The abbreviation NGE is a Dutch standard for farm size (Anon., 1998). 20 NGE equals about one third of a full labour unit.) Of the 647 farms included in the analyses, 376 farms (58%) were classified as cattle farms, of which over 99% were dairy farms. Of the remaining farms, 170 (26%) were classified as pig farms, 20 (3%) as poultry farms, and 81 (13%) as mixed livestock farms.

Sources of risk

Twenty-two different sources of risk were considered. Table 1 groups the sources of risk according to the classification of Hardaker *et al.* (1997). The table shows the number of scores given per source of risk, the percentage distribution of respondents over the categories 1 to 5, the average scores, and the overall rank. Averages and rank are calculated per source of risk as well as per group. The averages per group are weighted averages.

Table 1. Number of scores (n), percentage distribution of respondents over categories (1: not relevant, 5: very relevant), average score and overall rank for the different sources of risk in the questionnaire survey.

Groups and related sources of risk	n	1	2	3	4	5	Average score[1]	Overall rank
		----------		%		----------		
Price risks							*(4.14)*	*(1)*
Meat price	390	1	3	11	24	61	4.41	1
Milk price	433	3	2	10	27	58	4.34	3
Crop price	154	23	20	23	14	20	2.88	18
Personal risks							*(3.59)*	*(2)*
Death of farm operator	620	5	4	13	25	53	4.16	4
Health situation of farm family	629	3	5	23	34	35	3.92	6
Disability/health of farm operator[2]	633	6	10	24	30	30	3.70	8
Family relations (e.g. divorce)	615	13	7	19	5	36	3.65	9
Division of tasks within farm family	612	23	23	38	12	4	2.52	21
Institutional risks							*(3.50)*	*(3)*
Environmental policy	635	2	8	23	35	32	3.85	7
Animal welfare policy	631	5	12	26	34	23	3.57	10
Value of production rights	625	11	12	24	30	23	3.44	12/13
Elimination of government support	630	11	20	9	23	17	3.14	16
Production risks							*(3.37)*	*(4)*
Epidemic animal diseases	632	2	3	8	28	59	4.40	2
Technical results fattening animals	363	3	4	17	31	45	4.12	5
Consumer preferences[3]	618	6	12	29	36	17	3.47	11
Production costs	611	4	16	33	34	13	3.36	14
Milk yield	423	8	16	34	25	17	3.26	15
Non-epidemic animal diseases	625	8	20	39	24	9	3.07	17
Crop yields	165	25	22	21	16	16	2.76	19
Technology	574	32	27	29	10	2	2.22	22
Financial risks							*(3.02)*	*(5)*
Changes in interest rates	629	8	12	8	31	21	3.44	12/13
Ability to redeem loans	619	28	22	23	16	11	2.60	20

[1] The average scores (in parentheses) for groups of risks are weighted averages.
[2] Including farm workers.
[3] Factor analysis carried out by Meuwissen *et al.* (2001) showed that this source of risk could be assigned to the risk factor 'production'.

Of the five categories of risk distinguished, price risks were perceived as most important (Table 1). Financial risks were least important. Considering the 22 sources of risk separately, Table 1 shows that, besides meat and milk price, 'epidemic animal diseases' and 'death of farm operator' were also perceived as important. In the categories of 'institutional risks' and 'financial risks' none of the included sources was perceived as really important. Note, however, the large dispersion of answers given for sources like 'value of production rights' and 'ability to redeem loans'. The high score for 'epidemic animal diseases' is likely to be positively influenced by the large epidemic of Classical Swine Fever at the time the survey was held. Also the cases of Bovine Spongiform Encephalopathy (BSE) at that time could have affected the score, although BSE is not an epidemic disease.

Table 2. Number of scores (n), percentage distribution of respondents over categories (1: not relevant, 5: very relevant), average score, and overall rank for the different risk management strategies in the questionnaire survey.

Groups and related strategies	n	1	2	3	4	5	Average score[1]	Overall rank
		---------- % ----------						
Risk-sharing strategies							*(3.16)*	*(1)*
Buying business insurance	576	2	2	11	31	54	4.34	2
Buying personal insurance	571	4	4	18	29	45	4.06	3
Price contracts for farm outputs	457	36	13	17	18	16	2.65	6
Price contracts for farm inputs	464	37	14	17	19	13	2.58	7
The use of futures markets	445	69	12	13	4	2	1.58	12
On-farm strategies							*(2.47)*	*(2)*
Producing at lowest possible costs	591	0	0	4	23	73	4.66	1
Applying strict hygienic rules	578	2	4	25	31	37	3.97	4
Increase solvency ratio	522	10	7	33	27	23	3.44	5
Spatial diversification	509	49	14	17	12	8	2.16	8
Off-farm investment	514	44	20	21	10	5	2.14	9
Enterprise diversification	514	50	16	18	9	7	2.06	10
Off-farm employment	506	54	16	17	8	5	1.96	11

[1] The average scores (in parentheses) for groups of risk management strategies are weighted averages.

Risk management strategies

In the questionnaire survey 12 risk management strategies were considered. Table 2 presents an overview of the strategies, grouped into 'strategies in which risks are shared with others' and 'on-farm risk management strategies'. The number of scores given, the percentage distribution of answers over the categories 1 to 5, the average score, and the overall rank are shown per strategy.

In general, risk-sharing strategies were perceived as more important risk management strategies than on-farm strategies (Table 2). On a per strategy basis, producing at lowest possible costs, and buying business and personal insurance (in this order) were perceived as most important. Although on average, price risks were perceived as the major source of risk (Table 1), risk-sharing strategies to deal with price risks were not perceived as important. Nevertheless, answers given for price contracts show a relatively high variation. The use of futures markets was perceived as the least important risk management strategy.

The answers given for risk-sharing strategies were studied in more detail. Tests for statistically significant differences ($P \leq 0.05$) were carried out for farmers with different age, education, gross farm income, type of farm (cattle, pig, poultry, mixed), form of ownership (sole proprietorship; partnership between husband and wife; between brother and sister; between children and parents; combination of children, husband/wife, and parents), availability of successor (distinguished categories included: yes, no, don't know), and farm size.

Differences were tested with non-parametric Kruskal-Wallis H tests (Conover, 1980). Linear regression was used only for farm size; farm size was the only metric

variable. Variables such as number of cows and hectares were all transformed into NGEs. By using regression it is assumed that standard parametric procedures are appropriate for independent variables that are in the form of Likert-type scales (see also Patrick & Musser, 1997).

Statistically significant differences were found for farm type and form of ownership. Pair-wise comparisons between different farm types and forms of ownership were carried out with Mann-Whitney U-tests (Conover, 1980). Because of the multiple testing of the data, the significance level was adjusted by using the Bonferroni test (Winer *et al.*, 1991). This implies that the significance level was divided by the number of categories distinguished, resulting in a significance level of $P \leq 0.0125$ (0.05/4) for farm types, and of $P \leq 0.01$ (0.05/5) for form of ownership.

Price contracts for farm inputs and for farm outputs were deemed more important by respondents from poultry farms than by respondents from the other types of farm. Price contracts for farm outputs were perceived as more important by respondents from pig and mixed farms than by those from cattle farms.

Respondents from farms with sole proprietorship and farms owned by parents and children perceived buying business insurance as less important than respondents from farms with an ownership consisting of some combination of children, husband/wife, and parents.

Linear regression was also used to test whether the respondents who perceived a particular type of risk as more important also assigned more importance to strategies to manage this risk. Such relationships were tested for the perception of price risks and price-risk management strategies, the perception of personal risks and personal insurance, and the perception of production risks and business insurance. (Institutional and financial risks showed no logical relationships with any of the risk-sharing strategies in the survey.) For price risks, no statistically significant ($P \leq 0.05$) relationships were found. For the personal risks 'death of farm operator', 'health situation of farm family', and 'family relations' a direct relationship was found with the perceived importance of personal insurance. For the production risks and business insurance, such a relationship was found for 'epidemic animal diseases' and 'milk yield'.

Conclusions and future outlook

In a context of changing risk environment for farmers, the objective of this paper was to review the pros and cons of risk-sharing strategies. It can be concluded, on both theoretical and empirical grounds, that risk-sharing strategies provide opportunities for dealing with the new (and the old) risks with which agriculture is confronted. Theoretically, risk-sharing tools are in principle advantageous to both individual farmers and society as a whole. Empirically, farmers already perceive risk-sharing strategies (especially insurance) as important strategies to manage risks.

Future outlook

From this study the following areas for further research in the field of risk-sharing strategies became apparent:

1. From the literature it is clear that arrangements such as production contracts are growing increasingly important because they ensure farmers' access to capital. However, the use of production contracts also involves some risks, such as unexpected requirements imposed on contractors. Further research into various forms of external equity financing for farmers (without the risk mentioned for production contracts) seems worthwhile, especially given the increasing industrialization of agriculture.
2. The empirical results indicate that factors like farm type and form of ownership influence farmers' perceptions of risk-sharing strategies. Further research on such factors would be useful for developers and sellers of risk-sharing strategies in order to better tune their products, services and marketing strategies.
3. Empirical results show that there is a mismatch between farmers' perceptions of price risks and the perceived importance of risk management strategies to deal with price risks. In particular, futures markets were not perceived as relevant. Research is needed to clarify whether there is a lack of understanding by farmers of currently available strategies like futures trading, or whether current products for risk sharing do not fulfil farmers' needs. In the first case there is a need for education. In the second case current products need to be adapted or new products developed. Given the indicated importance of insurance schemes, insurers may be able to develop and successfully introduce schemes that cover price risks.
4. The livestock farmers in the sample assigned a high priority to epidemic animal disease risks. Combined with the direct relationship that was found for the perceived importance of this risk and the perceived importance of business insurance, this seems to point at a need for insurers to develop and promote new products in this area. Promotion is especially important because epidemic animal disease risks are 'low-probability-high-consequence risks'. People generally underestimate such risks and have difficulties in recalling them. With respect to both price risks and epidemic disease risks, research is needed to examine issues of asymmetric information and the systemic character of these risks.

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