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# REDUCING ASYMMETRIC INFORMATION BY ALTERNATIVE CROP INSURANCE SCHEMES - TESTING RISK REDUCTION OF INDIVIDUAL AND INDEX-BASED CONTRACTS

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## Abstract

We analyse farm yield, area yield, and weather index insurance contracts in terms of risk reduction for wheat farms in Kazakhstan over the period 1980-2002. In addition to the common mean-variance (MV) approach we propose a stochastic dominance approach to account for data characteristics of such insurance contracts.

Results indicate (1) the need for using both approaches, because for some insurance schemes, the mean-variance results of one-third of the farmers are not necessarily consistent with EU theory. (2) Bootstrapping shows that an expected positive variance reduction is not statistically significant for up to one-third of the farms. Both results indicate that previous methods probably overestimate the effectiveness of crop yield and weather index insurance schemes, in particular for insurance schemes with basis risk. From a practical point of view, (3) area yield insurance based on the county (rayon) yield provides higher variance reduction than reported in the literature, indicating that area yield insurance contracts might be more appropriate in Kazakhstan because of the high systemic yield risk there - an effect of exposure to drought. (4) There are no substantial differences in the results generated by means of different weather indexes. (5) However, compared to farm yield insurance with a low strike yield in order to limit moral hazard, weather index insurance can be a reasonable alternative for farmers.

## Keywords

Risk management, crop insurance, stochastic dominance, mean-variance, Kazakhstan

## 1 Introduction

Traditional insurance schemes covering crop yield risk face problems of asymmetric information. Index insurance contracts, such as area yield insurance or weather index insurance, may overcome these problems, but at the cost of generating basis risk for the farmers. Whether the remaining risk reduction for farmers through index insurance schemes is sufficient to generate substantial demand has to be analysed before selecting the best alternative and introducing it into the market. Recent discussion focuses on insurance schemes based on weather indexes for developing countries (ANDERSON, 2001; SKEES et al., 1999; VARANGIS et al., 2002; OECD, 2004). However, empirical analyses of weather index insurance schemes based on farm level data cannot be found in the literature. In addition, analyses of area yield insurance contracts use a method that is not necessarily consistent with expected utility theory, and the analyses do not allow for statistical inference among the insurance contracts.

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This paper has four objectives. From a methodological perspective, (1) we suggest second degree stochastic dominance for empirically computing the optimal hedge ratio for a risk management tool, such as crop yield insurance. (2) By bootstrapping, we search for insurance products generating statistically significant higher risk reductions for a single farmer than alternative insurance schemes. Practically, we focus on wheat production in Kazakhstan, which is especially exposed to drought in widespread areas. Thus, (3) we compare area yield insurance contracts based on regional yields aggregated on different levels and compare different weather indexes in terms of risk reduction for farm data. (4) We compare the risk reductions of weather indexes with common crop yield insurance products such as farm yield and area yield insurance.

We start by reviewing the literature, present the decision model and empirical methods to solve it before describing wheat production Kazakhstan and the data used. Then, we present the empirical results and finish with conclusions for academics and insurance providers.

## 2 Literature on crop yield insurance and weather index insurance

To find the risk reduction a farmer may generate by purchasing crop yield or weather insurance, common hedging theory is used. Most empirical analyses determine the agent's optimal hedging strategy by following JOHNSON's (1960) hedging model, based on the mean-variance (MV) approach. MIRANDA (1991) develops a general model for crop yield insurance based on JOHNSON and applies it to Kentucky soybean farms. SMITH et al. (1994) as well as MAHUL and VERMERSCH (2000) follow MIRANDA's main idea while extending the insurance schemes and applying them to wheat farmers in Montana and France.

MIRANDA assumes a farmer who can only choose the crop insurance coverage level. Since exogenous production decisions and costs, a certain output price, and a fair insurance premium are assumed, farmer's $i$ utility is maximised by minimising his revenue variance $Var[\pi_i]$ where $\pi_i$ is the insured revenue

(1) $\pi_i = y_i + z_i\, n - z_i\, E[n]$,

where $y_i$ is the farm yield per area unit, $z_i \geq 0$ is the coverage level chosen by the farmer, $n$ is the indemnity payment, $E[\ ]$ is the expectation operator, and the output price is set to unity. Because revenue is a linear combination of the farm yield and indemnity payments, the combination's variance is minimised for the coverage level $z_i$* per area unit, which equals the negative linear estimator of regressing the farm yield on the indemnity payments. Thus, $z^* = -Cov[y_i,n] / Var[n]$ (JOHNSON). The indemnity payment $n$ is defined as $n = Max[x_t - x, 0]$, where $x$ is an index. It is an area (farm) yield in case of area (farm) yield insurance and it is a weather index in the case of weather index insurance. In case of a farm yield insurance $x_t$ should be less than the expected yield and $z_i$ should be less than one to ensure a deductible and a coinsurance, respectively to reduce moral hazard incentives.

Empirical analyses of weather index insurance for farm level data are, to the best of the authors' knowledge, not known. SKEES et al. (2001), report a reduction of 29 % of the aggregated regional revenue risk measured by the coefficient of variation of a portfolio of several crops measured by their regional yield in 17 Moroccan provinces. VEDENOV and BARNETT (2004) as well as KARAUIHE et al. (2006) analyse weather based insurance contracts for regional corn, cotton and soybean yields in two US counties and for corn only in South Africa, respectively.

We think that the previous literature should be extended in two ways. First, we propose choosing the optimal coverage level based on second degree stochastic dominance (SSD) because the MV approach can be inconsistent with expected utility (EU) theory if the data distributions of the risky choices do not fulfil the so called LS [location-scale] condition (SINN, 1980; MEYER, 1987). The LS condition is fulfilled if two cumulative distribution functions (with and without insurance, or with different coverage levels) only differ in their mean and standard deviation. However, the LS condition cannot hold if insurance payments are added to a crop revenue distribution because insurance payments are truncated (e.g. MAHUL and VERMERSCH). In addition, there is empirical evidence that crop yield distributions do not fulfil the LS condition, either (e.g. SHERRICK et al., 2004; NORWOOD et al., 2004; RAMIREZ et al., 2003). The SSD approach does not suffer from these data problems. Second we apply bootstrapping, because statistical inference is absent from the empirical crop insurance analyses presented above. Consequently, nothing is known about the statistical liability of the literature results, thus former analyses cannot discriminate between different insurance schemes in a statistically significant manner.

## 3 Model and Methods

We present the SSD approach and explain the need for applying bootstrapping.

A risky alternative *I* described by the cumulative distribution function *G(w)* is said to dominate another risky alternative *II* described by the cumulative distribution function *H(w)* by SSD, if

(2) $$\int_{-\infty}^{x} H(w)dw \geq \int_{-\infty}^{x} G(w)dw \qquad \text{for all } x \in \Re \text{ and at least one strict inequality.}$$

If an agent's utility is concave in *w*, SSD is consistent with expected utility (e.g. MOSCHINI and HENNESSY, 2001). To obtain the optimal SSD coverage level $z_i$**, we apply Levy's stochastic dominance precondition ["If two options (of wealth distributions) have the same mean, then the one with the greater variance cannot dominate" (p. 572)] and can modify the unrestricted variance minimisation of the MV approach to

(3) $$\min_{z} \; Var[\pi_i] \quad s.t. \quad G(\pi_i) \succ H(y_i),$$

where *G(.)* and *H(.)* are cumulative distribution functions and '$\succ$' means "second degree stochastic dominant over".

To solve (3) we assume a range of coverage levels the farmer can choose from, and compute $\pi_i$ for each *z*. The optimal coverage level *z*** is chosen from all *z* according to (3)[1]. However, another problem exists. If H is *not* SSD over G, we do not know which alternative is preferred by an agent. Thus, SSD is sometimes not a good decision-making tool because paranoiac risk aversion is not excluded. Therefore, "it is quite possible for any two distributions that neither one stochastically dominates the other," (MOSCHINI and HENNESSY, 2001: 96). Hence, we suggest using both the common MV approach and the SSD analysis.

For statistical inference, we propose the bootstrapping method because the form of the yield distributions is not known. Bootstrapping is a re-sampling method from the data at hand (i.e. empirical distribution with N observations) to approximate the true distribution of any parameter being estimated from the data. The parameter estimation is frequently repeated from samples (i.e. bootstrap samples) with N observations drawn randomly with replacement from the empirical distribution, which, thus, must be generated from independent and identically distributed (iid) observations. For more details see EFRON and TIBSHIRANI (1993). Alternative tests for stochastic dominance from the literature are either parametric (KAUR et al., 1994) or they assume large samples (ANDERSON, 1996; DAVIDSON and DUCLOS, 2000). A nonparametric test of KLECAN et al., 1991 (cited in ROOSEN and HENNESSY, 2003) requires more than fifty observations in each distribution. Simulation results suggest that a permu-

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[1] The mean-Gini approach can provide an analytical solution for (3) if *G* and *H* intersect at most once (SHALIT AND YITZHAKI, 1984). Since we want to avoid any assumptions on the distributional forms of the risky choices reliably, and because of the high basis risk of area yield instruments for some farms, it is not appropriate to restrict our analysis to an MG approach. See LIEN AND TSE (2002) for a literature review of the MG approach in futures hedging.

tation test procedure proposed by TOLLEY and POPE (1988) is less powerful than bootstrapping.

## 4 Wheat Production in Kazakhstan

Wheat is by far the most important commodity produced in Kazakhstan: in 2004, 78 % of its total crop area was sown with wheat (INTERFAX, 2005). Kazakhstan is the eighth largest world exporter of wheat, with a share of the world market that ranges from 2 to 3 %. The use of less intensive technologies and the challenges of the market during economic transition have increased uncertainty and risk in wheat production. Kazakhstan is not only the producer with the greatest distance to any port but also one with considerably lower and more fluctuating yields due to drought. The coefficient of variation of national wheat yields for the period 1980-2004 is more than twice as high compared to other competitors with somewhat similar total areas planted with wheat, such as Canada, France, Germany and Spain.

## 5 Data

Yield data was collected by means of farm surveys and covers 84 large grain producers in eight counties in four regions, from 1980 – 2002. In 2002, the farms' wheat areas differ between a few hundred and more than 40,000 hectares. The considered farms represent 7.3 % of the national wheat area in 2002. In five counties, the share of total wheat area represented by the farms surveyed accounts for more than 70 %. In addition to farm data, the study uses official statistics on national and regional yields (REGIONAL STATISTICAL OFFICES, 2003/2004 and NATIONAL STATISTICAL AGENCY, 2004) as well as weather data from nine weather stations in the considered counties. Wheat areas in the selected counties differ from less than 50,000 hectares to more than 300,000 hectares. In 1998, a year of great drought, the weighted average yield amounted to only 0.40 tons, which is 46 % of the average yield from 1980 – 2002 (see Table 1 for descriptive statistics).

**Table 1: Descriptive statistics for selected farms**

| | | | Variance reductions for different products (in %) | | | |
|---|---|---|---|---|---|---|
| Farm No | Expected Yield (2002) 0.1 t/ha | Variance (1980-2002) 0.1 t²/ha² | rayon (100 %) mean-variance | rayon (100 %) SSD | Selyaninov (100 %) mean-variance | Selyaninov (100 %) SSD |
| 1 | 6.00 | 3.76 | 0.589 | 0.589 | 0.658 | 0.658 |
| 6 | 8.47 | 18.30 | 0.629 | 0.629 | 0.528 | 0.528 |
| 11 | 7.71 | 29.06 | 0.382 | 0.382 | 0.495 | 0.495 |
| 16 | 7.50 | 31.92 | 0.532 | 0.532 | 0.455 | 0.455 |
| 21 | 2.18 | 11.23 | 0.608 | 0.608 | 0.425 | 0.425 |
| 26 | 5.90 | 8.87 | 0.498 | 0.498 | 0.408 | 0.403 |
| 31 | 8.06 | 24.40 | 0.613 | 0.613 | 0.390 | 0.390 |
| 36 | 2.39 | 7.65 | 0.558 | 0.558 | 0.360 | 0.212 |
| 41 | 5.66 | 5.75 | 0.498 | 0.498 | 0.316 | 0.316 |
| 46 | 6.12 | 13.75 | 0.454 | 0.454 | 0.292 | 0.290 |
| 51 | 16.72 | 56.32 | 0.436 | 0.396 | 0.217 | 0.000 |
| 56 | 20.81 | 14.79 | 0.058 | 0.000 | 0.185 | 0.156 |
| 61 | 5.97 | 12.05 | 0.219 | 0.199 | 0.141 | 0.000 |
| 66 | 3.50 | 18.26 | 0.385 | 0.385 | 0.117 | 0.000 |

Farms are sorted according to variance reductions with Selyaninov insurance (mean-variance approach). Every fifth farm is depicted

Source: Own estimations

To reflect the yield variability appropriately, data must be de-trended. While MIRANDA, as well as MAHUL and VERMERSCH, account for linear time trends, we have longer yield time series from a transition country. In the case of Kazakhstan, the former state and collective farms were downsized and transformed into cooperatives, limited liability partnerships, joint stock companies and private family farms. Thus, wheat yields are adjusted for third-degree polynomial time trends and for structural breaks.

There is no structural break in the national yield at the significance level of 5 %. Structural breaks of oblast yields, however, prevail in two of the four considered oblasts. In each of these oblasts, structural breaks are identified in one rayon each. Structural breaks are found in 21 of 84 farms, in most cases the structural breaks have occurred in 1991 and 1992, but also in 1997-1998. We can apply bootstrapping to only 71 farms because of autocorrelation.

## 6 Insurance instruments

We evaluate three main groups of insurance products: farm yield insurance (FYI), area yield insurance (AYI) and weather-based index insurance (WBII). The analysis considers area yield insurance and futures with three levels of aggregation (national, state (oblast) and county (rayon)) . WBII products are based on three indices: a simple rainfall index, as well as two drought indices developed by scientists from the former Soviet Union.

First, SELYANINOV, 1958 (quoted in SHAMEN, 1997) developed an index based on precipitation and temperature. He introduced the so-called hydro-meteorological coefficient (*HTC*):

(4) $$HTC_i = 10\frac{\sum R}{\sum T},$$

where $\Sigma R$ is cumulative precipitation in mm during year $i$ with an average daily temperature ≥ 10 $^0C$ and $\Sigma T$ is the sum of average daily temperatures in degrees Celsius in the same year.

Second, PED (1975) (quoted in SHAMEN) suggested measuring drought by means of an index ($S_i$), which considers, in addition to precipitation *(R)* and temperature *(T)*, soil moisture *(Q)*:

(5) $$S_i = \frac{\Delta T}{\sigma_T} - \frac{\Delta R_i}{\sigma_R} - \frac{\Delta Q_i}{\sigma_Q},$$

where $\Delta T$, $\Delta R$ and $\Delta Q$ are differences between the long-term averages and the respective value in year $i$. $\sigma_T$, $\sigma_R$ and $\sigma_Q$ are the long-term coefficients of variation.

To improve the performance of the selected indices, BOKUSHEVA (2005) modified them by using monthly data[2]. Since soil moisture is a parameter related to soil cultivation intensity, which could induce moral hazard problems, the PED drought index was modified by replacing soil moisture data by data on cumulative precipitation in the period from September to May. The yearly values of the three indexes $x_i$ are computed following equations (6) to (8).

Rainfall index

(6) $$x_i^{Rain} = w_{May}R_i^{May} + w_{June}R_i^{June} + w_{July}R_i^{July} + w_{August}R_i^{August} + w_{Sept-April}R_i^{Sept-April}$$

Modified Selyaninov drought index

(7) $$x_i^{Sel} = w_{May}R_i^{May} + w_{June}\frac{R_i^{June}}{T_i^{June}} + w_{July}\frac{R_i^{July}}{T_i^{July}} + w_{August}\frac{R_i^{August}}{T_i^{August}} + w_{Sept-April}R_i^{Sept-April},$$

[2] Since plants' resistance to drought varies during growth phases, monthly data provide a basis for a more precise assessment of wheat yield dependency on weather conditions in the individual years.

Modified Ped drought index

$$(8) \qquad x_i^{Ped} = w_{June}\frac{\Delta R_i^{June}}{\sigma_{R^{June}}} + w_{July}\frac{\Delta R_i^{July}}{\sigma_{R^{July}}} + w_{August}\frac{\Delta R_i^{August}}{\sigma_{R^{August}}} - w\frac{\Delta T_i^{June-August}}{\sigma_{T^{June-August}}} + w\frac{\Delta R_i^{Sept-May}}{\sigma_{R^{Sept-May}}},$$

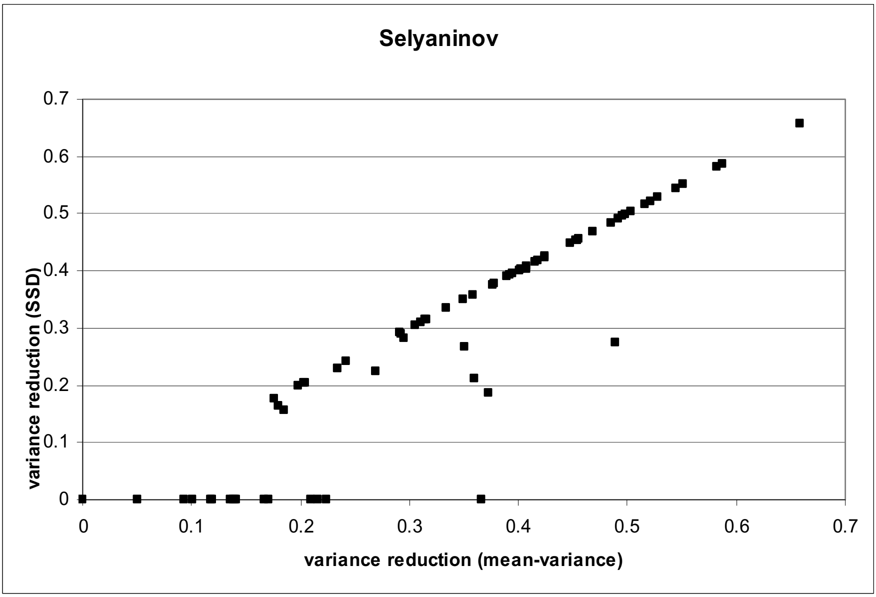
where $R$ is the cumulative precipitation and $T$ is the average daily temperature in a specified period, $i$ is a year index and each $w$ represents a weighing factor, obtained from linear regressions of the right-hand side variables using farm yields as the dependent variable.

## 7 Results

First, we show the optimal decisions for the combination of the SSD and the MV approach. Second, we present the results from the area yield insurance schemes based on the national yield, oblast and rayon yields, respectively. Third, we show the results for the three analysed weather indexes. Finally, we compare the performance of a farm yield insurance, an area yield insurance, and a weather index by means of bootstrapping.

Graph 1 highlights the need to use both, the SSD approach and the MV approach. Nearly one-third of the farms yield a variance reduction by means of MV, which is not necessarily consistent with expected utility theory for hedging with the SELYANINOV weather index with the strike value equalling its expected value. However, we find different results mostly for farms with low variance reductions. Above an expected variance reductions of 40 %, both variance reduction of the MV and the SSD approach are equal except for one farm.

**Graph 1: Comparison of variance reductions by mean variance and by SSD approach**




26 of 71 farms differ more than 1 %-point in their variance reduction by mean-variance and stochastic dominance optimisation, respectively

Source: Own estimations

Turning to area yield insurance contracts, the last row in Table 2 confirms the need to use both, the MV and the SSD approach for area yield insurance, too. Between 10 and 18 of the farms do not realise variance reduction by means of area yield insurance based on the national, the oblast, or the rayon yield with the SSD approach. Not surprisingly, rayon yield insurance outperforms the other area insurance schemes in terms of average relative variance reduction (42 % for the MV approach and 40 % for the SSD approach) and number of farms with a positive (non-zero) expected variance reduction. It is somewhat striking that the national yield insurance may outperform the oblast insurance, since oblast yields should be more closely related to the farm yields than higher aggregated national yields. The average relative variance reduction of rayon insurance is somewhat higher than the relative variance reductions by means of a regional wheat yield that MAHUL and VERMERSCH report for a selection of 20 out of 124 wheat farms in northern France. The average relative variance reduction by means of the national wheat yield in our analysis (28 %) seems to be substantially smaller than that of MAHUL and VERMERSCH. BREUSTEDT (2004) reports a substantially smaller average relative variance reduction for 767 German wheat farms of 22.5 % for county yield insurance.

**Table 2: Variance reduction for different area yield insurance products**

| area yield insurance (strike yield = expected yield) 71 farms | national | | oblast | | rayon | |
|---|---|---|---|---|---|---|
| | mean-variance | SSD | mean-variance | SSD | mean-variance | SSD |
| relative variance reduction (mean) | 0.29 | 0.25 | 0.29 | 0.23 | 0.42 | 0.40 |
| coverage level (mean) | 1.33 | 1.05 | 1.04 | 0.67 | 1.10 | 1.00 |
| farms with expected positive variance reduction | 70 | 53 | 71 | 54 | 70 | 61 |

Source: Own estimations

The results for the weather index insurance schemes in Table 3 confirm the need for combining both approaches in the same manner as above. The performance of the analysed indexes are quite similar; their relative variance reduction is around 30 %, thus it is very similar to the relative variance reduction of the national yield insurance.

**Table 3: Variance reduction for different weather indices**

| weather index insurance (strike value = expected value) 71 farms | rainfall | | Selyaninov | | Ped | |
|---|---|---|---|---|---|---|
| | mean-variance | SSD | mean-variance | SSD | mean-variance | SSD |
| relative variance reduction (mean) | 0.33 | 0.29 | 0.34 | 0.29 | 0.31 | 0.27 |
| coverage level (mean) | 1.40 | 1.06 | 1.38 | 1.04 | 1.18 | 0.91 |
| farms with expected positive variance reduction | 71 | 56 | 71 | 55 | 71 | 56 |

Source: Own estimations

In Table 4 we summarize a comparison of an area yield insurance (rayon) and weather index insurance (SELYANINOV index) both with a strike level of 100 % of the expected yield, and a farm yield insurance with a strike yield of 75 % of the expected yield, which is equal to US standard farm yield insurance. First, the risk of facing a 25 % yield shortfall is substantial for the wheat farms in Kazakhstan, i.e. all farms have faced at least one yield shortfall above

25 % in the analyzed time period. The relative variance reduction is highest for rayon yield insurance for both the MV and SSD approach.

**Table 4: Comparison of farm yield, area yield, and weather index insurance**

| insurance (strike yield in % of expected value), 71 farms | farm (75%) | | rayon (100%) | | Selyaninov (100%) | |
|---|---|---|---|---|---|---|
| | mean-variance | SSD | mean-variance | SSD | mean-variance | SSD |
| relative variance reduction (mean) | 0.34 | 0.34 | 0.42 | 0.40 | 0.34 | 0.29 |
| coverage level (mean) | 1.00 | 1.00 | 1.10 | 1.00 | 1.38 | 1.04 |
| farms with expected positive variance reduction | 71 | 71 | 70 | 61 | 71 | 55 |

Source: Own estimations

In Table 5 we have counted the number of farms that can generate a significantly higher variance reduction with one of the insurance schemes compared to others. By means of the MV approach, rayon (SELYANINOV) insurance is preferred to the farm yield insurance by 23 (6) farmers, while 5 (8) farmers prefer farm yield insurance to rayon (SELYANINOV) insurance. The SSD approach provides another result. None of the farms significantly prefer either rayon insurance or SELYANINOV insurance to farm yield insurance, while 4 farmers prefer farm yield insurance to one of the other schemes.

**Table 5: Pairwise comparison of farm yield, area yield, and weather index insurance**

| | 71 farms | strike level (of expected value) | farm insurance 75% | rayon insurance 100% |
|---|---|---|---|---|
| mean-variance | rayon insurance | 100% | 23 / 5 | |
| | selyaninov index | 100% | 6 / 8 | 3 / 31 |
| SSD | rayon insurance | 100% | 0 / 1 | |
| | selyaninov index | 100% | 0 / 3 | 0 / 1 |

First (second) number of a pair indicates number of farms that get a significantly higher (95 % probability) variance reduction with the instrument in the row (column) than with the instrument in the column (row).

Source: Own estimations

## 8 Conclusions

We analyse farm yield, area yield insurance contracts and weather index insurance contracts in terms of risk reduction for wheat farms in Kazakhstan over the period 1980-2002. We use the common mean-variance approach and a stochastic dominance approach. By means of bootstrapping we investigate whether a farmer prefers one insurance scheme to another.

Results indicate (1) the need for using both approaches, because for some insurance schemes, the MV results of one-third of the farmers are not necessarily consistent with EU theory. (2) Bootstrapping shows that an expected positive variance reduction is not statistically significant for up to one-third of the farms. Both results indicate that previous methods probably overestimate the effectiveness of crop yield and weather index insurance schemes, in particular for insurance schemes with basis risk. From a practical point of view, (3) area yield insurance based on the rayon yield provides higher variance reduction than reported in the literature, indicating that area yield insurance contracts might be more appropriate in Kazakhstan because of the high systemic yield risk there - an effect of exposure to drought. (4) Empirical results indicate that area yield insurance should be based on the rayon yield instead of the higher aggregated oblast or national yield. (5) There are no substantial differences in the results generated by means of different weather indexes. (6) However, compared to farm yield insurance with a low strike yield in order to reduce asymmetric information problems, in particular, moral hazard, weather index insurance is a reasonable alternative for farmers, particularly, if considering transition circumstances with limited availability and reliability of farm-level data.

## References


ANDERSON, G. (1996): Nonparametric Tests of Stochastic Dominance. In: Econometrica 64 (5): 1183-1193.

ANDERSON, J.R. (2001): Risk Management in Rural Development. A Review. Rural Background Strategy Paper 7. World Bank, Washington D.C..

BOKUSHEVA, R. (2005): Crop Insurance in Kazakhstan: A Qualitative and Quantitative Assessment of Insurance Products (Preliminary Results). Discussion Paper 76, Institute of Agricultural Development in Central and Eastern Europe, Halle (Saale).

BREUSTEDT, G. (2004): Effiziente Reduktion des Produktionsrisikos im Ackerbau durch Ertragsversicherungen. Dissertation. Kiel.

DAVIDSON, R. and J.-Y. DUCLOS (2000): Statistical Inference for Stochastic Dominance and for the Measurement of Poverty and Inequality. In: Econometrica 68 (6): 1435-1464.

EFRON, B. and R.J. TIBSHIRANI (1993): An Introduction to the Bootstrap. New York.

INTERFAX (2005): Food and Agriculture Report XIV, Issue 15 (698).

JOHNSON, L.L. (1960): The Theory of Hedging and Speculation in Commodity Futures. In: Review of Economic Studies 27 (3): 139-151.

KARUAIHE, R.N., H.W. WANG and D.L. YOUNG (2006): Weather-Based Crop Insurance Contracts for African Countries. Contributed Paper for the International Association of Agricultural Economists Conference, Gold Coast, Australia.

KAUR, A., B.L.S.P. RAO and H. SINGH (1994): Testing for Second-Order Stochastic Dominance of Two Distributions. In: Econometric Theory 10: 849-866.

KLECAN, L., R. MCFADDEN and D. MCFADDEN (1991): A Robust Test for Stochastic Dominance. Massachusetts Institute for Technology. Mimeo.

LEVY, H. (1992): Stochastic Dominance and Expected Utility: Survey and Analysis. In: Management Science 38 (4): 555-593.

LIEN, D. and Y.K. TSE (2002): Some Recent Developments in Futures Hedging. In: Journal of Economic Surveys 16 (3): 357-396.

MAHUL, O. and D. VERMERSCH (2000): Hedging Crop Risk with Yield Insurance Futures and Options. In: European Review of Agricultural Economics 27 (2): 109-126.

MEYER, J. (1987): Two Moment Decision Models and Expected Utility Maximization. In: The American Economic Review 77 (3): 421-430.

MIRANDA, M.J. (1991): Area-Yield Crop Insurance Reconsidered. In: American Journal of Agricultural Economics 73 (2): 233-242.

MOSCHINI, G. and D.A. HENNESSY (2001): Uncertainty, Risk Aversion and Risk Management for Agricultural Producers. In: Handbook of Agricultural Economics 1A: 87-153.

NATIONAL STATISTICAL AGENCY (2004): Almaty.

NORWOOD, B., M.C. ROBERTS and J.L. LUSK (2004): Ranking Crop Yield Models Using Out-of-Sample Likelihood Functions. In: American Journal of Agricultural Economics 86 (4): 1032-1043.

OECD (2004): Rural Finance and Credit Infrastructure in China. Paris.

PED, D.A. (1975): O Pokazatele Zasuch i Izbyutochnogo Uvlashneniya (Drought Index). Working papers of the USSR's Hydrometeorology Centre 156: 19-38.

RAMIREZ, O.A., S. MISRA and J. FIELD (2003): Crop Yield Distribution Revisited. In: American Journal of Agricultural Economics 85 (1): 108-120.

REGIONAL STATISTICAL OFFICE OF AKMOLINSKAYA OBLAST (2003): Kokshetau.

REGIONAL STATISTICAL OFFICE OF AKTOBINSKAYA OBLAST (2004): Aktobe.

REGIONAL STATISTICAL OFFICE OF EAST KAZAKHSTAN OBLAST (2004): Ust-Kamenogorsk.

REGIONAL STATISTICAL OFFICE OF KOUSTANAISKAYA OBLAST (2004): Koustanai.

ROOSEN, J. and D. HENNESSY (2003): Tests for the Role of Risk Aversion on Input Use. In: American Journal of Agricultural Economics 85: 30-43.

SELYANINOV, G.T. (1958): Zasuchi v SSSR, ih proishoshdeniye, povtoryaemost I vliyanie na uroshaj (Drought in the USSR: Its Origin, Frequency and Effects on Yield). Hydrometeoizdat, Leningrad: 5-30.

SHALIT, H. and S. YITZHAKI (1984): Mean-Gini, Portfolio Theory, and the Pricing of Risky Assets. In: The Journal of Finance 39 (5): 1449-1468.

SHAMEN, A.M. (1997): Ob Issledovanii Zasushlivih Yavlenij v Kazakhstane (Research on Drought in Kazakhstan). In: Hydrometeorology and Ecology 2: 39-56.

SHERRICK, B.J., F.C. ZANINI, G. SCHNITKEY and S.H. IRWIN (2004): Crop Insurance Valuation Under Alternative Yield Distributions. In: American Journal of Agricultural Economics 86: 406-419.

SINN, H.-W. (1980). Ökonomische Entscheidungen bei Unsicherheit. Tübingen.

SKEES, J., P. HAZELL and M. MIRANDA (1999): New Approaches to Crop Yield Insurance in Developing Countries. EPTD Discussion Paper 55. International Food Policy Research Institute (IFPRI), Washington.

SKEES, J., S. GOBER, P. VARANGIS, R. LESTER and V. KALAVAKONDA (2001): Developing Rainfall-Based Index Insurance in Morocco. Policy Research Working Paper 2577. World Bank.

SMITH, V. H., H.H. CHOUINARD and A.E. BAQUET (1994): Almost Ideal Area Yield Crop Insurance Contracts. In: Review of Agricultural Economics 23 (1): 75-83.

TOLLEY, H.D. and R.D. POPE (1988): Testing for Stochastic Dominance. In: American Journal of Agricultural Economics 72: 693-700.

VARANGIS, P., J.R. SKEES and B.J. BARNETT (2002): Weather indexes for developing countries In: R.S. Dischel (ed.): Climate Risk and the Weather Market. Risk Books, London.

VEDENOV, D.V. and B.J. BARNETT (2004): Efficiency of weather derivatives as primary crop insurance instruments. In: Journal of Agricultural and Resource Economics 29 (3): 387-403.