

THESES OF DOCTORAL (PHD) DISSERTATION

UNIVERSITY OF KAPOSVÁR
FACULTY OF ANIMAL HUSBANDRY
Institute of Economy and Organisation

Leader and deputy leader of programme:
DR GYULA SZÉLES
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THE ROLE OF STOCK EXCHANGE IN PRICE FORMATION AND LIQUIDITY

Written by:
LÓRÁNT FODOR

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THE AIM AND ANTECEDENTS OF RESEARCH

I have been in connection with the stock exchange for 15 years inspired by both my department and my own interest, first as a participant of a course for brokers then as the lecturer of the subject “Stock exchange studies”. I give continuous attention to the studies and articles published in this field and I have started my own research. As a conclusion I chose the topic of my PhD dissertation from this field of research.

In my dissertation I try to achieve the following aims:

- 1 In my project I try to find connection in the temporal changes of the forward stock prices of wheat and maize and to study if there is a significant connection between the simultaneous nearby and forward prices.
- 2 Considering weather conditions mostly drought and its consequences influence the quality, quantity and profitability of agricultural production. Therefore I intend to work out an insurance-like risk management scheme.
- 3 Progress can and should be made in the marketing strategies of agricultural producers, in which I would like to give directions.
- 4 Besides the liquidity of producers, the liquidity of stock market corn deadlines is also very important. Therefore I examine the liquidity of the forward contracts of BÁT wheat and maize and I am going to evaluate it on the basis of the previous standpoint.

MATERIAL AND METHOD

The analysis of nearby and forward stock market prices

I could analyse stock market prices mainly on the basis of the data of the Commodity Exchange of Budapest, which were provided by the staff of the Stock Exchange Secretariat. Besides, I studied the yearly reports, regulations and different periodical publications of the Commodity Exchange of Budapest.

I also collected data in the Research Institute of Agroeconomics and Informatics and I established contact with the National Institute of Meteorology, the Institute of Survey and Remote Sensation, the Observatory of Solar Physics of the Hungarian Science Academy and the specialists of the Ministry of Agriculture and Rural Development.

The application of the methods of mathematical statistics has outstanding importance in order to evaluate nearby and forward stock market prices. They help to explore the connection between different incidents and to give numerical description of economic regularities.

The characteristic feature of forward stock market prices is that the prices take a reverse turn after a time. Therefore time should be shown with the application of a quadratic function. The assumptions made on the basis of the previous studies should be checked, which is possible with hypothesis examination. These are called probes or tests. With the help of the determination coefficient I got the answer for the question: How can the

progress of time determine prices in percentage. I made a further control with t-test.

Weather (drought) contract

The production of our cultivation plants is determined by several agroecological and technological factors. Among the ecological factors meteorological elements have an important role, the influence of which can be effective only tendentially with a stochastic nature. Among meteorological elements plant cultivation is mainly influenced by temperature and the useful, (available) water in the soil as a result of precipitation.

➤ The drought sensitivity of maize

The basic physiological function of maize is determined by temperature, however its big yield potential requires a lot of water. Its utilisation of water is good, however it needs a lot of water absorption for its phytomass production. It requires the biggest amount of water from tasseling to grain formation. This critical period is in July and August. In our country – unfortunately – drought occurs frequently in this period.

➤ The drought sensitivity of wheat

The water absorption of wheat is different in each phenological phase during the breeding season, which is in accordance with the dry material production. During the breeding season of winter wheat it can produce 12-15 t/ha organic matter in 260-280 days. It requires the biggest amount of water during

stooling and shoot formation (60% of all water absorption) between 10 April and 10 May.

Strategies of wheat producers-

The storage of crops, the warrant, and stock market transactions provide new decision alternatives for producers. Buyers, fodder mixing plants and mills have the same opportunities but they stand at the opposite side. I would like to deal with the aforementioned possibilities in one system and to decide which solution provides the producer with the best result.

I would like to show the comparison with 1 ton of maize assuming a starting price of 18000 Ft/t. Maize, if necessary, can be sold at the end of November, in the case of storage it gets to the market in 26 weeks in May. The stock market transaction refers to expiration in May.

The liquidity of forward corn contracts

A basic demand of production is that the enterprise should –possibly- always be solvent that is liquid. The most essential financial risks are the risks of the partner, the price of the market and the liquidity risks of the market, which must be taken into consideration at the sale of any agricultural product.

According to the data of the commodity exchange of Budapest there are not the same number of contracting for the different deadlines. Therefore I am going to examine the liquidity risk of the expiration deadline of maize and wheat contracts by processing thousands of sales data.

RESULTS

The results of the analysis of stock exchange prices

➤ The analysis of the stock exchange prices of wheat

Examining the changes of the nearby stock exchange prices of wheat in the past 11 years we can state that the trend is rising. This tendency can well be shown by a fitted quadratic function.

During my examination I not only analyse the price formation of the whole term of the stock exchange (11 years), but I also evaluate each year separately. I examined the expiration of the deadlines (August, December) and the nearby price formation and the same in the last 3 months. With Excell I had the price formation of the last old deadlines and the first new deadlines (May, August) drawn.

If we examine the forward and nearby prices of wheat in December we can state that there is a rather big difference between them and the prices in August. After the expiration of the old deadlines in May, - mostly with a big fall- the nearby prices sink into the forward prices of December or even below them. From then the two prices follow each other with little difference until the expiration in December.

➤ **The analysis of the stock prices of fodder maize**

If we examine the nearby price formation of maize in the past 12 years we can state that the prices have had continuous rising tendency despite big fluctuations. The forward prices of December have also risen with more moderate fluctuations.

The graph of the nearby and forward prices of December indicate that the forward prices follow the nearby price changes even if with a more moderate form, showing less volatility. It means that the prompt information of the market has an influence on the expectations of the later expiration but it is more moderate.

Analysing the graphs of the forward and nearby prices of maize it can be seen that the nearby prices collapse suddenly and decline in June. This is natural when the new crop gets to the market. The flow of the forward prices of December is mostly steady, the nearby prices are willing to reach them.

I had a graph drawn in order to depict the prices of July, that is the last old forward prices and that of December as the most liquid new deadline. The forward prices of the examined 11 years justify in only 6 cases the well-known statement that the old crop, because of the expenses of storage, is more expensive than the new crop. As a consequence the market does not recognise the expenses of maintenance.

Weather (drought) contract

The three most important climate factors in connection with drought are the utilised water content influenced by the amount of precipitation during the

growing season, the average temperature during the growing period and the number of the hours of sunshine during the growing season.

After considering these criteria it can be accepted that we take only the minus amount of evaporation of the precipitation into account in the stock exchange transactions. As all plants have their critical periods from this point of view a multiplication factor can be used only at these times.

We do not take the amount of water above the optimum into consideration at the monthly summary. In the case of wheat the best time seems to be August for the settlement, while in the case of wheat the best month is November. Forward or maybe option transactions can be effected for these months.

➤ **Maize drought index**

According to the data of the technical literature, in the case of maize we can assume 600 mm of water absorption during the growing season. In this way 100-100 mm go to each month (from April to September) if we share this amount proportionally. We can accept this in spite of the fact that we know that in Hungary there is almost always less rain in the most important months of the growing season, in June, July and August than maize would need. Therefore the success of the index depends on the right selection of the multiplier factor that is the decrease in the index should be proportional to the decrease in the production.

As a consequence of this, the revised precipitation of August and September – the utilized amount of water- was calculated with a multiplier four because maize is the most sensitive to the lack of water in this period. May and June

are also important but not so much as the above-mentioned period therefore the multiplier is only double. In April maize is at the beginning of the growing season and requires less water, while from September the loss of water is natural in the maize cobs that is why the multiplier is only single.

Therefore the base is 1400 points in optimal conditions.

The 500 point-difference between the 1400 points of the weather optimum (maximum yield) and the 900 points of the average weather conditions of our country give the basis of the settling of accounts. If we calculate with the 50% of the 20000Ft/t stock market price and with 100t contract, 1 base point is 200Ft.

In the case of maize the transaction would expire in November. Similarly to option transactions only the basic deposit should be advanced the settling of account would be made at the time of expiry. Therefore the index would start from 900 base points. An allowance of 2000Ft/point would be permitted either way.

➤ **Wheat drought index**

In the case of winter wheat similar logic can be followed to the maize despite the fact that its breeding season starts in the year before the harvest. Its breeding season including the growth of the green matter and its crop formation takes place later comparing it to other winter cereals and it reaches into a period which is warmer and drier in our country.

Regarding the water absorption of the plant, I determined the controlled level of precipitation in 60-60mm from March to June. I applied the multiplier factors so that winter wheat could have available water at the time of the biggest water consumption. In this way its value is single in February and June, twofold in March and May and threefold in April.

Therefore the base is 540 points in optimal conditions

Following the logic of maize I determined the balance point limit at 360 points necessary to settle the account. If the base is 20000Ft/t stock price for winter wheat, when the value of 1 contract is 2 million Ft, 1 point is 3600Ft. 360 points as a starting point means that the index can increase by a maximum of 180 points therefore in the case of a record yield the loss can be 648000Ft. In a reversed situation if the value of the index is 0 point 1296000Ft can be won. The justification of the whole speculation is determined by the price of the transactions and its proportion with the acquired alleged or real security.

The strategies of wheat producers

The risk factor that determines the success of wheat production basically is the market price influenced by a number of factors. However we must take into consideration that commercial risk taking has financial burdens and no hazarding producers can avoid it.

Taking the example of maize, one of the busiest product of the Commodity Market of Budapest, I would like to demonstrate the most important strategies of producers by a model calculation as follows:

➤ **Spot transaction**

In this case maize can be sold at 18,000 Ft/t on the physical spot market. For the sake of comparison the income should be increased by the current deposit rate. In this way we can count on the interest revenue of **819Ft/week**. In this case the further changes of the price in either direction do not have an influence on the result.

➤ **Forward transaction based on a private storage capacity**

Producers who have their own storage capacity can decide on a forward transaction even for a deadline in May. If the price of maize exceeds storage expenditure, extra income is generated. The higher the price rises, the more favourable the speculation is. The expenditure emerged is as follows:

$$40\text{Ft/t/week} \times 26 = 1040\text{Ft/t/26 weeks}$$

➤ **Forward sale based on rented storage capacity**

(Without taking a warrant)

The producer, who does not possess storage capacity, still he wants to insure the extra income of the price of the maize in May chooses this solution. A store next to the drier is usually available for the producers who can grasp this opportunity. Therefore I did not calculate delivery expenditure.

Expenditures:

Load and unload:	440Ft/t	(2 x 220Ft/t)
<u>Cost of storage:</u>	<u>1040Ft/t/26 weeks</u>	<u>(40Ft/t/week)</u>
Summa:	1480Ft/t/26 weeks	

➤ Operative storage applying a warrant

If the store of the producer is accepted by the public warehouse, his maize is kept in his premises and there is no transport expenditure. The commercial bank that accepts the public warehouse or the warrant gives credit up to the 2/3 of the value of goods.

Expenditures:

Loss of income:	1040 Ft/t/26 weeks	(40 Ft/t/week)
Fee of warrant:	305 Ft/t/26 weeks	240 Ft/t/1-13 weeks 5 Ft/t/14-26 weeks
Fee of credit assessment (0.5%)	90 Ft/t/26 weeks	From the price of 18,000 Ft/t
Quality test:	109.65 Ft/t/26 weeks	With a reduction of 15%

Subsidies:

Subsidy of storage:	-260 Ft/t/26 weeks	FVM* decree of 46/2001
Interest (100% subsidy)	0 Ft	FVM decree of 6/2000 (26/02)
Yield of credit:	-810 Ft/t/26 weeks	Deposit rate of 9%

Balance: 474.65 Ft/t/26 weeks

*FVM = Ministry of Agriculture and Rural Development

➤ Public warehouse storage

Producers who do not have a suitable place for rented storage or only the guarantee of public storage is acceptable for them can invoke the safety of public storage. The acceptable distance of transport cannot be more than 30km. According to this the calculation is as follows:

Expenditure:

Transport by road:	360 Ft/t/30km	12 Ft/t/km
Fee of disposal:	1222 Ft/t/26 weeks	47 Ft/t/week x 26
Load and unload:	610 Ft/t	305 Ft/t x 2
Quality test:	145 Ft/t	
Fee of risk:	257.4 Ft/t/26 weeks	0.055%

Interest income:

Deposit rate:	-810 Ft/t/26 weeks	Interest of 9%
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Balance: 1784.4 Ft/t26 weeks

➤ **Option transaction**

The main possible strategies are the put (sales) option based on private storage, the put option based on rented storage, the put option combined with operative storage and warrant and the put option with public warehouse storage. A different logic is also possible, when the producer does not spend on put option but he sells call (buying) option.

The algorithm of the calculation based on buying put option:

Expenditure:

Loss of income	1040 Ft/t/26 weeks	(40 Ft/t/week)
Fee of warrant:	305 Ft/t/26 weeks	240 Ft/t/1-13 weeks 5 Ft/t/14-26 weeks
Fee of credit assessment	90 Ft/t/26 weeks	From the price of 18,000 Ft/t
Quality test:	109.65 Ft/t/26 weeks	With a reduction of 15%
Fee of put option:	1000 Ft/t	

Subsidies:

Subsidy of storage:	-260 Ft/t/26 weeks	FVM* decree of 46/2001
Interest (100% subsidy)	0 Ft	FVM decree of 6/2000 (26/02)
Yield of credit:	-810 Ft/t/26 weeks	Deposit rate of 9%

Balance: 474.65 Ft/t/26 weeks

*FVM = Ministry of Agriculture and Rural Development

Calculation based on the sale of call option:Expenditures:

Loss of income	1040 Ft/t/26 weeks	(40 Ft/t/week)
Fee of warrant:	305 Ft/t/26 weeks	240 Ft/t/1-13 weeks 5 Ft/t/14-26 weeks
Fee of credit assessment (0.5%)	90 Ft/t/26 weeks	From the price of 18,000 Ft/t
Quality test:	109.65 Ft/t/26 weeks	With a reduction of 15%

Subsidies, income:

Option bonus:	-1000 Ft/t/26 weeks	
Subsidy of storage:	- 260 Ft/t/26 weeks	FVM*decree 46/2001
Interest (100% subsidy):	0 Ft	FVM decree 6/2000 (26/02)
Yield of credit:	- 810 Ft/t/26 weeks	Deposit rate of 9%

Balance: 525.35 Ft/t/ 26 weeks

*FVM = Ministry of Agriculture and Rural Development

To sum up, the question is whether there is any difference between each version in order to reduce the quantity, quality and financial risks of the different yield of different years. How much should the price rise to have a real chance of recovering the extra expenses.

It is reasonable to make a computer programme to solve the marketing strategic models of the producers and the efficiency of the connecting rational decisions. In this way the result of the possible alternatives that base the decisions are not continual, it is often restricted to “yes” or “no”. Presumably we have to be prepared for optimalization and not for the heuristic method, where the broker changes the conditions several times looking for the answer for the “what happens if“ type questions.

The liquidity of the deadlines of the stock exchange (maize, wheat)

Besides their liquidity producers who appear on the stock exchange find the stock exchange also important as it guarantees them to find a partner for their transactions. It can be evaluated on the basis of the sales data of each deadline. There are significant deviations of quantity between the deadlines. In the case of wheat it ranges from 40% to 2%, in the case of maize it ranges from 30% to 5%. Therefore if we want to increase liquidity the rational selection of the months suitable for transactions and the decrease of their number is also necessary.

On the basis of the above-mentioned I come to the conclusion that liquidity could be increased and there could be a more proportional turnover between each deadline if both maize and wheat were only 4 deadlines. These could be March, June, September and December.

CONCLUSIONS AND SUGGESTIONS

Nearby and forward prices at the stock exchange

- It is statistically verified that the quadratic parabola function is suitable to characterise the expiration of stock prices at two thirds of the nearby and forward prices. The shorter interval is examined the more exact result can be reached.
- My examinations justified that the process of time determines prices significantly but I could not find any periods that could predict future price formation reliably.
- All stock prices were very volatile. Therefore we can draw the conclusion that unfavourable price changes must be not only accepted and calculated but their effects should be eliminated by e.g. efficient stock transactions and probably extra profit should be made.

The elimination of the effects of unfavourable weather conditions (drought)

- The risks of the producers deriving from the unfavourable effects of weather conditions influence the production of agricultural producers more and more.
- The reliability of the predictions of the National Service of Meteorology (OMSZ), on which economic decisions can be based, cannot exceed 21 days. This interval is too short therefore it cannot be used in effect.

- As there is no efficient means to ward off drought in the real sector defence is necessary. It can be solved in the financial and stock exchange sector by introducing the wheat and maize drought index on the stock market that was prepared by me.
- I suggest that the research into the methods of prediction should be speeded up.

The marketing strategies of cereal producers

- At present agricultural producers still have two possibilities to manage their financial risks, resulted from the price changes of maize and wheat after harvest, for example by the sales strategies and stock exchange transactions introduced here.
- As a consequence of this several strategic solutions are possible the main varieties of which were shown here in the form of model calculations in order to compare them.
- Generally speaking, selling cereals right after the harvest is not a favourable solution only producers without a store or in short of money turn to it.
- Those producers who decide for a later sale, “operative storage or public warehouse storage make it possible to reduce price risks by applying stock market transactions and they can also get a lombard loan.

- In the optional strategy it is possible to get the income at the transaction by selling the call option. Computers can make the realisation decisions of the producers, which are shown in the strategic models separately. I suggest doing further research into this -partly computing- problem because it would have a practical advantage if we get the order and the result of each model.

The liquidity of stock market deadlines (maize, wheat)

- In the forward market of the commodity exchange in Budapest it occurs every year that the turnover of some deadlines is so low that it affects liquidity. It means that the risk of liquidity increases the most sensitive thing in the stock market: the risk of price.
- In order to stop this liquidity domino I suggest 4 deadlines for both the maize and wheat and their distribution should be equal. These months should be March, June, September and December.

NEW SCIENTIFIC RESULTS

- 1 It is practically impossible to influence the effects of drought on the quantity and quality of the yield of cereals but the risk of profitability could be decreased by using my wheat and maize drought index.

According to the practice of the stock exchange there is a Budapest parity of cereal products. Together with the introduction of the drought index I suggest a separate West and East Hungarian parity.

- 2 I connected the process of cereal cultivation with the different types of transactions – examining it from the point of view of sales- in order to eliminate or reduce the risks due to the change of prices and to gain the maximum income, which shows the decision points of a manifold process.

- 3 The realisation decisions of the producers should be ranked by “what happens if” type heuristic computer method in one system instead of the optimisation (LP) method. The great advantage of the computer method is that infinite number of alternatives can be chosen in an objective way.

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