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THE SELECTED PROBLEMS OF PREDICTION MARKET MANAGEMENT

Electronic virtual markets can serve as an alternative tool for collecting information spread among numerous experts. This main functionality of the electronic market is affected by many factors, e.g. participant's activity. The article offers two motivation approaches compared via participant's activity represented by both the volume of trades and the number of transactions. Further the motivation tool is proposed and implemented at the market to increase both the trade volume and the activity of market participants.

Keywords: *virtual market; motivation tools; incentive system; information collection.*
JEL Classification: C13, C83, O30.

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ДЕЯКІ ПИТАННЯ УПРАВЛІННЯ ВІРТУАЛЬНИМИ РИНКАМИ

У статті продемонстровано, як електронні віртуальні ринки можуть стати альтернативним інструментом збирання інформації від множини експертів. Функціонування віртуального ринку знаходиться під впливом низки чинників, у першу чергу, активності учасників даного ринку. Представлено два методи мотивації учасників ринку, які сприяють збільшенню обсягів торгів та кількості транзакцій. Дані інструменти підвищують активність учасників віртуального ринку і таким чином сприяють розвитку його динаміки.

Ключові слова: *віртуальний ринок; інструменти мотивації; система стимулювання; збір інформації.*
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НЕКОТОРЫЕ ПРОБЛЕМЫ УПРАВЛЕНИЯ ВИРТУАЛЬНЫМИ РЫНКАМИ

В статье продемонстрировано, как электронные виртуальные рынки могут стать альтернативным инструментом сбора информации среди множества экспертов. Функционирование виртуального рынка подвержено влиянию множества факторов, в первую очередь, активности участников данного рынка. Представлены два метода мотивации участников рынка, которые способствуют увеличению объёма торгов и количеству транзакций. Данные инструменты повышают активность участников виртуального рынка и таким образом способствуют развитию его динамики.

Ключевые слова: *виртуальный рынок; инструменты мотивации; система стимулирования; сбор информации.*

Introduction. For more than 20 years electronic virtual markets have worked as the alternative tools for collecting information spread among numerous experts. Electronic virtual markets are used for the evaluation of the success rate of the assigned forecasts – predictions. Therefore, it is also possible to come across the term "prediction market" (PM). Prediction market is a speculative market simulating the activity of stock exchange at which such titles are traded that are related to forecasting a particular event (e.g., Barack Obama will win the presidential elections for his second term of office) or those related to a value of an estimated parameter (e.g., the percentage of votes won in parliamentary elections by a given political party). The

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value of titles is given by the extent of confidence of sellers and buyers in a given event or a parameter value. Current market price can be interpreted as an estimate (forecast) of an event probability or an estimated value of parameters. This market is also labeled as an information market, decision market, or virtual market.

Prediction markets use mechanisms of classic stock markets on the basis of the information shared by individual market participants by means of the price of shares. The process of trading on PM ascertains and aggregates the true evaluation of an event by market participants as being reflected in share price. This ability of PM is based on the hypothesis of the effective markets assuming that all information available at any moment is fully reflected in a share price (Fama, 1991). With regard to this hypothesis market mechanism is the most effective tool for aggregation of asymmetrically spread information among market participants at competitive markets (Hayek, 1945).

Apparently the highest benefit in the issue of prediction markets are the studies by D. Pennock (2004) concerning the principle of the dynamic pari-mutuel markets, the studies by R. Hanson (2003; 2007) presenting the construction of combinatorial information markets and using the automatic market creator, and also the study on the use of virtual markets for predicting a new product at a market (Skiera & Spann, 2004), the studies by J. Berg and T. Rietz (2003) and J. Wolfers and E. Zitzewitz (2004; 2006). In the monograph "Information markets: A new way of making decisions" R. Hahn and P. Tetlock (eds.) (2006) present an excellent guide on the issues of prediction markets opening a number of issues and unsolved problems in this area.

The main functionality of PM, i.e. the aggregation of information, is affected by many factors. One of the most important is market liquidity. Liquidity follows the activity of market participants and trades volume. Motivation and incentive system plays the main role in support and increase of participant's activity to provide relevant information and to modify price of shares.

This motivation system can have a different structure and the question is how much this structure affects the activity of market participants.

Implementation of a prediction market. The proposal and implementation of PM are very important parts of the market process. They play the key role in the security of correct functionality of the market, the accuracy of predictions and aggregation of information. In the proposal of PM it is possible to follow the universal structure of common prediction market.

1. The structure of the prediction market. The proposal of the universal structure of PM can be found, for example, in B. Skiera and M. Spann (2004). The creators of prediction markets must decide on the contents of the items in the following 3 areas:

- ***the choice of the forecast target*** (forecast; pay function; terms of trading; access: open or closed to public);
- ***the structure of the financial market*** (type of auction; time of trading; short-term trading: Yes or No; type of orders; trading fees; limiting positions, limiting prices);
- ***the motivation system for participation in the market and of the incentives to provide relevant information*** (structure of a start-up portfolio/subsidies; providing loans; system of incentives; non-monetary awards; use of the real money or play money; time interval; dependence of awards on the activity of the participant).

One of the main functions of PM, aggregation of information and prediction, is conditioned by a sufficient number of active market participants. It can be seen that unlike the "classic" statistical methods of research even a smaller number of respondents may be sufficient. Even though, the quantity of players and their activity is a key factor for relevancy, topicality and correctness of the gained information as well as for the accuracy of the examined predictions. A larger group of players assumes a broader scope with regard to the information provided. In the same way, a low level of participants' activity can negatively influence predictions and these are only decided by a small group with a limited level of information.

Motivation tools for active participation in PM.

1. The existing motivation tools. The right functionality of a prediction market – the accurate forecast – depends on the number of active market participants, i.e. the volume of trade. Therefore, it is necessary to motivate market participants to increase their trading activities. In other words, the correct proposal and implementation of all the system of incentives is crucial for the success of the market. In the history of prediction markets these problems have been dealt with in various ways.

R. Hanson (2003; 2007) proposed and described an automatic market maker (AMM) which enables a buyer (or a seller) trade without the necessity of the online presence at a market. AMM implements the orders from participants to buy (or to sell) automatically and it automatically sets the price of assets. The AMM application includes an important phenomenon of the market scoring rule (MSR) which was for the first time in AMM introduced by R. Hanson (2007). The disadvantage of using AMM is the risk of funds loss that the AMM "pumps" into the system.

The dynamic pari-mutuel market maker (DPM) is another solution proposed by D. Pennock (2004). Pari-mutuel represents a system of stakes that only redistributes some withdrawn investments among winners. The principle of DPM links the advantages of the continuous double auction (CDA) and the principle of the pari-mutuel market. This way it removes the disadvantage of the low liquidity CDA and also the problem of the pari-mutuel market which does not enable to respond to new information by the price change (participants deposit their stakes as a lump sum payment and then they wait for the result – see horse racing betting). DPM also solves the problem of the risk on the side of PM operator in case of using AMM. The problem of low level activity of traders with regard to their absence is also dealt with by the introduction of records and keeping book orders (BO).

2. Two different types of motivation system. The main aim of the research is to find a suitable motivation and incentives system that would support market trading and increase market liquidity. Two different motivation systems of market participant's award were proposed.

- In the first group (marked FIPV1) each participant received award with respect to the amount of play money, earned in market trading. This award could be transferred to points and these points contribute to the final course evaluation. 242 persons were in the group, 74 of them registered to the system and 42 of them were actively trading (at least one transaction was realized).
- In the second group (marked ZAKT) only 3 best participants according to the amount of earning play money were awarded. The award was the evaluation "A" in the

main activity of the whole course. 14 persons were in this group, 13 of them registered to the market system and everyone was an active trader.

Two characteristics were observed for each participant in both groups: ***volume of trades*** **(VT)** and ***number of transactions*** **(Tr)**, categorized according to the group (FIPV1 or ZAKT). There were calculated the values ***mean*** or ***median*** for both characteristics with respect to the spread of values. Further the ***standard deviation*** **(STD)** was determined.

Next the normality is tested in both groups. The main question "What group members are more active in trading?" is answered with the tests of alternative hypothesis about the difference of mean (median) values in both groups for the two observed characteristics. The methods for approval or rejection of hypothesis are selected to detected spread of values and the data normality test. The tests should have to approve whether the volume of trades or trading frequency are statistically significantly higher in the first group than in the second one. That is also the way to approve group members are more motivated to trade.

The observed data allows analysing other demanded characteristic of participants' behaviour and comparing it within both groups. This characteristic describes the uniform distribution of transactions among the participants in case each participant uniformly contributes information to the market. This is measured by the value of standard deviation of the number of transactions in both groups (homogeneity of variance). These standard deviations are compared and their difference is tested as alternative hypothesis.

3. The results of the realized tests. In this part the results of the proposed tests are presented. Figures 1 and 2 depict the observations' distribution for volume of trades, and Figures 3 a 4 depict the distribution of the transactions' number.

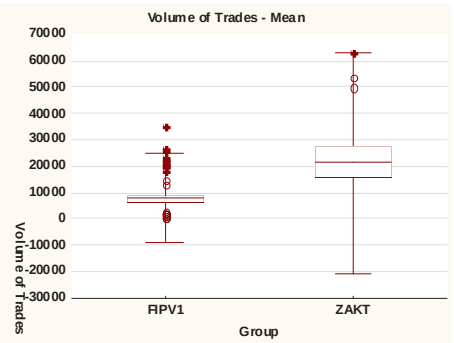

Figure 1. **Mean and standard deviation of VT,** *developed by the author*

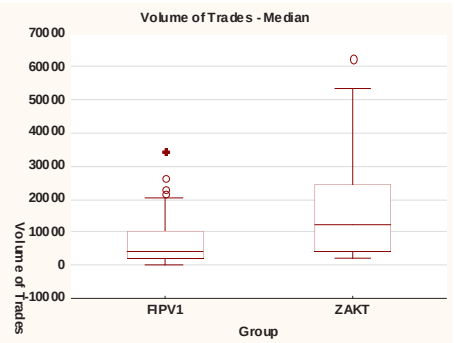

Figure 2. **Median and main quartiles of VT,** *developed by the author*

The analysis indicates the outliers and extreme values in the data. In the normality test for the number of transactions the null hypothesis was rejected (FIPV1: p-value = 0.0000, ZAKT: p-value = 0.0176), by the same way in the normality test for the volume of trades the null hypothesis was rejected (FIPV1: p-value = 0.0000, ZAKT: p-value = 0.0159). All the tests were realized on the significance level $\alpha = 0.05$. The data in both groups and both measurement (VT, Tr) are not well-modelled by a normal distribution. The results affect the selection of next realized tests of char-

acteristics difference. The median was selected as a representative of samples in both groups (Table 1), especially with respect to the spread of values for trades volume. The normality of samples in both groups and with both characteristics was rejected and that's why the Mann-Whitney's non-parametric test was used for the differences between median values of both groups.

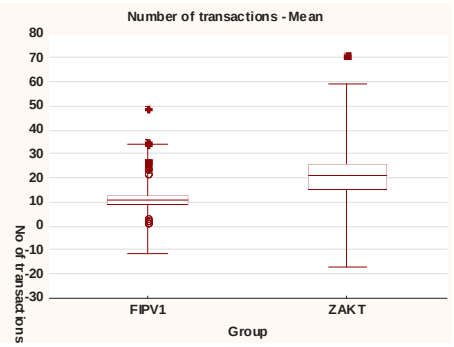

Figure 3. **Mean and standard deviation of Tr,** *developed by the author*

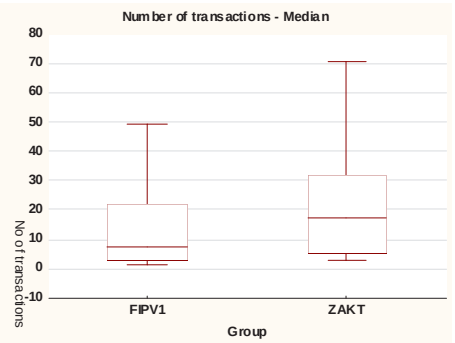

Figure 4. **Median and main quartiles of Tr,** *developed by the author*

Table 1. **Characteristics according to the groups,** *own*

Group/Data	N	VT		Tr	
FIPV1	42	4320.5 2005 – 9487	7634.16 8412.44	7 3-22	11.07 11.48
ZAKT	13	12490 4100 – 24364	21299.62 20949.18	17 5-32	20.77 19.22

For trades volume this test rejected the null hypothesis in favour of the alternative one about the difference of medians (p-value = 0.012209 on the significance level $\alpha = 0.05$). In the case of the number of transactions the null hypothesis was not rejected and difference of medians was not proved (p-value = 0.071424 on the significance level $\alpha = 0.05$).

The test of homogeneity of Tr variance rejected the null hypothesis in favour of alternative hypothesis about the difference of variances in both groups (p-value = 0.013845 on the significance level $\alpha = 0.05$). The Levene's test was used, because it is less sensitive to departures from normality. The group FIPV1 proves more uniform distribution of transactions among the market participants (STD = 11.47934). In the group ZAKT (STD = 19.218714), on the other hand, STD and the comparison with group FIPV1 indicate the activity of small participants group. In this case the participants are motivated with being at the first 3 places; other members of group are not so active. Figure 5 depicts the number of transactions for every participant, identifying the extreme value in the group ZAKT in one observation only. The number of transactions of other participants is mutually comparable. Despite this observations the quartile spread in both groups approve the statement on bigger activity differences in the ZAKT group.

The stated results indicate bigger activity of the ZAKT members with regard to the trades' volume, however the bigger activity of this group with respect to trading frequency was not approved. It seems the motivation system of ZAKT more supports

trade according to the amount of investing source and by that the system more affects the share price. The question is how to increase the trades volume in the group FIPV1 and at the same time to support the volume of trades in the ZAKT group.

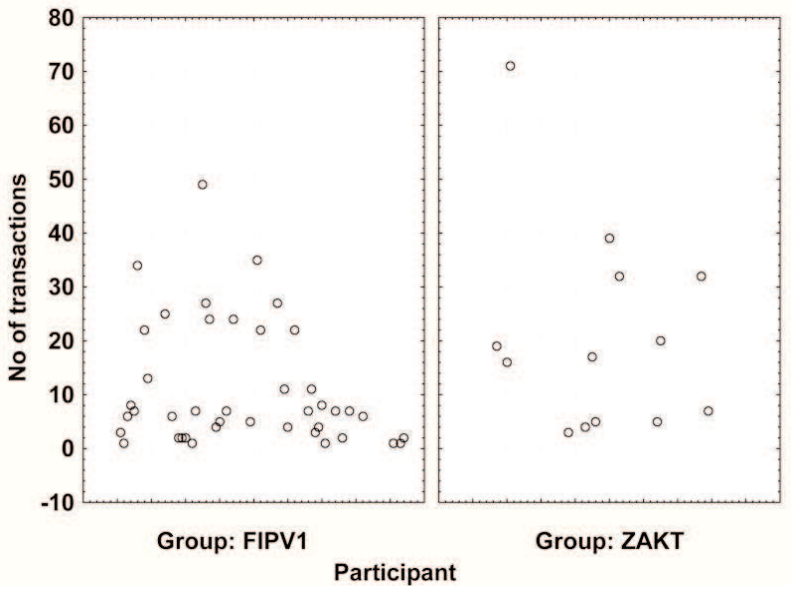

Figure 5. **Comparison of the number of transactions for each participant in both groups,** *developed by the author*

The proposal of PM *inflation* as a motivation tool for PM participants. The previous part indicates less volume of trades for FIPV1. The motivation system in this group awards each member`s virtual play currency transferred to points contributed to the final evaluation of participant.

In the case of FIPV1 the registration connected with gaining the start-up points allowance may be enough for the participant as it is sufficient for definitive acquisition of a non-monetary award. Any other activity is not necessary. Participants endowed with such a start portfolio may have a tendency to stick to the initial endowment ("status quo bias") or their willingness to accept greatly exceeds their willingness to pay ("endowment effect") (Kahneman, Knetsch & Thales, 1991). The logical solution of this situation is either to increase the level of the point limit for acquiring non-monetary award or to decrease the initial allowance of the start-up points.

In this part the introduction of an inflation factor is proposed. This factor would decrease the value of free uninvested money (points) on the accounts of the participants as one of the possible motivation tools applicable for the above case.

The motivation incentive that will be called the ***PM inflation*** in the following text is not a classic case of inflation. It is a tool that, in PMs, decreases the value of free money on the traders' accounts and makes them invest free money into the market. The size of PM inflation depends on the ratio of free and invested funds and it motivates participants invest their free funds into the assets at a market. This way the volume of trades is increased as well as market liquidity and as a consequence the

value of the inflation ratio is decreased and thus the participant protects his/her points.

The implemented *PM inflation* decreases the daily nominal value of free points of traders. This process is illustrated by the following formula:

$$CM(t+1) = CM(t) \times (1 - R_f / 360), \quad (1)$$

where $CM(t)$ – current free points on the participants' accounts before the adjustment of inflation for a given period; $CM(t+1)$ – free points on the participants' accounts after the adjustment of inflation for a given period; R_f – inflation ratio.

With regard to the described reasons and setting the sources of PM inflation, the inflation ratio is constructed according to the formula:

$$R_f = \max(0, (TC - TD) / TS - 1), \quad (2)$$

where TC – the total volume of free funds on all the accounts; TD – total demand = the number of demanded shares x the buying price; TS – total supply = the total value of newly issued shares (number x the current price) + the total value of the shares kept (number x the current price).

In the next part the functionality of the *PM inflation* introduction on the case of particular implementation of electronic virtual prediction market is demonstrated.

1. Application of PM inflation to experimental prediction market. The electronic virtual prediction market under the name FreeMarket (FM, 2010) has been implemented and actively operated at the Faculty of Economics, University of West Bohemia in Pilsen since November, 2007. Up to now about 1,200 users have been registered in the system. 2,200 new titles (events) have been issued in the system since 2007. Shares (events) are divided into 4 areas: politics, sport, entertainment and economics.

The portfolio of each participant in the FreeMarket system is started up by the initial allowance of 10,000 points (money units) upon registration. After launching the system of transferring the points into the study course credits some problems arose that caused the non-functionality of the system, namely in the issue of forecast quality. The main problem was the ***low activity of the system participants***. The majority of market participants (students of financial courses) only registered in the FreeMarket and by this act their activity in the system was finished. These students were happy with the allotted 10,000 start-up points and then they had no further need to trade at the market. To remove this situation that was negative from the point of view of the functionality of the virtual market it was necessary to find a next motivation tool that would make a passive market participant trade, and, at the same time, guarantee that the point limit for accrediting the final bonus would not be increased.

The described participants' behavior lead to the consideration that it is necessary to penalize only those sources of market participants that remain non-invested on the accounts of such participants. Therefore, a sort of "inflation" was introduced into the system whose theoretical description is stated in the previous section. In the following text the practical implications of the PM inflation in the FreeMarket system is presented.

On October 11th, 2007 the first information about the inflation in the FreeMarket system was brought into open. The value of the inflation ratio R_f was published every day. Within a month period the inflation decreased from the initial value of 296% to mostly zero level. The development of the PM inflation in the FreeMarket system during the test period is illustrated in Figure 6.

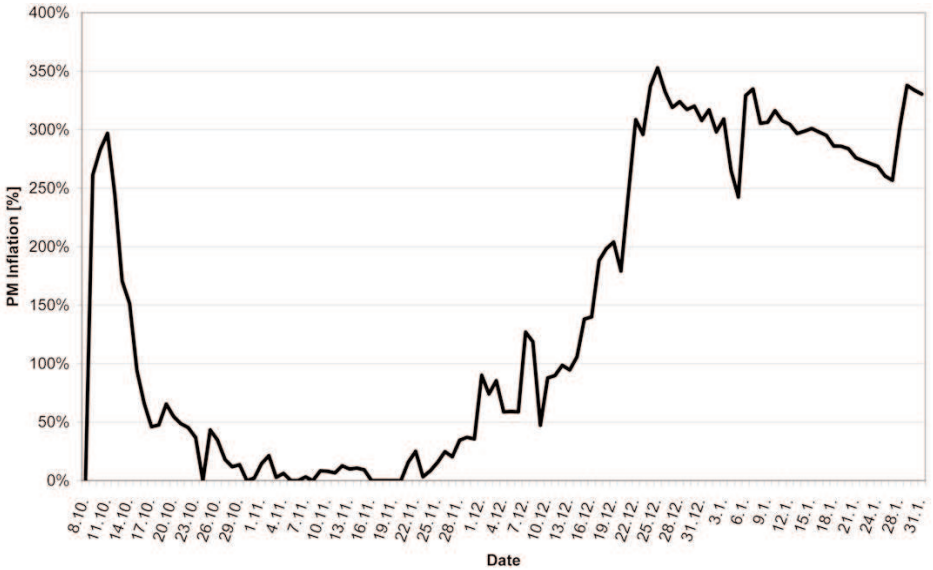

Figure 6. **PM inflation for the test period,** *developed by the author*

As obvious from Figure 6 there was a significant decrease of inflation after publishing the information about introducing inflation into the system after October 11th. The figure also shows the repeated inflation increase at the end of the period when the majority of market participants transferred their free funds into the course credits and finished trading. A part of free funds was withdrawn from the system but the influence of the trading orders decrease was too strong.

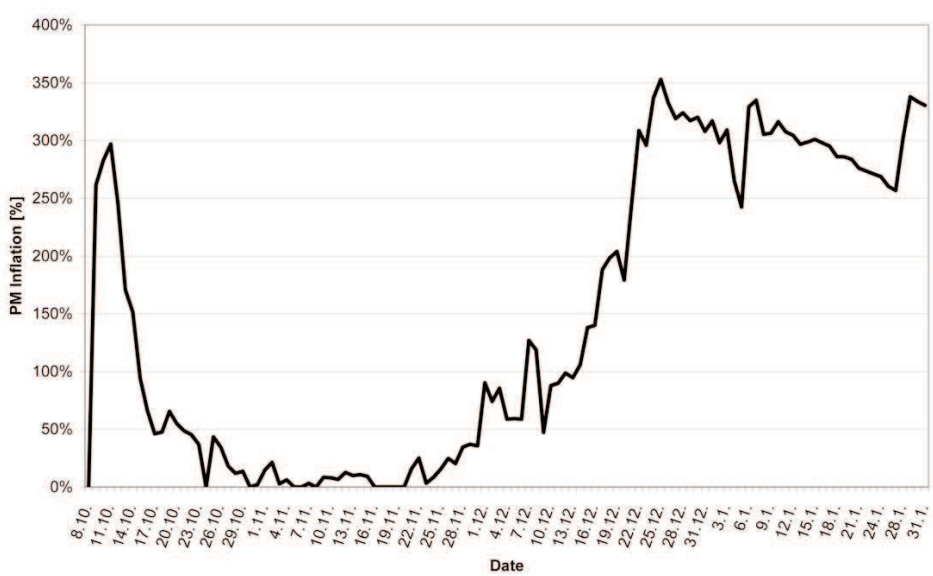

Figure 7. **The standardized volume of trades in the period with inflation,** *developed by the author*

Figure 7 shows the development of trades which is standardized with regard to the number of active market participants in the test period with inflation, when inflation was introduced after October 11th.

As obvious from Figure 7, in relation to the period with inflation there is a significant increase of the trades volume after October 11th, when PM inflation was introduced into the system.

Conclusion. The contribution deals with the topic of electronic virtual markets that can serve as an alternative tool for collecting information that may be spread among numerous experts. Market participants use the accumulated information for further trading.

Participants' activity represented by the volume of trades and the number of transactions seems to be an important factor for right functioning of the market. For this reason the right setting of the motivation system supporting participants' activity, which is one of the prediction market quality indicators, seems to be the key factor in the structure of the prediction market.

Two different motivation systems are presented and compared on two groups of market participants. The comparison of trades volume indicates bigger activity in the group with 3 best traders awarded compared to the group with every active participant awarded. The comparison of transactions number in both groups didn't show any difference in trading frequency. With regard to trades volume the system of "3 best awarded" seems to be more motivational for traders. On the other hand, the analysis of variance homogeneity of transactions number shows that the system of spreading awards supports the uniform participation of all traders on trading more.

A new type of motivation incentive is proposed and described which is based on a certain kind of penalization of free (not placed at the market) funds (points) of individual participants. If a market participant wants to keep the amount of the gained funds at the market, he/she has to have them placed in an issued title for all the time period up to the fixed closing of trades and to monitor market behavior and, if needed, to respond to any new information. The above system of motivation which is called PM inflation was implemented in an electronic virtual prediction system called FreeMarket, actively operated at the Faculty of Economics, University of West Bohemia in Pilsen. It is obvious that the introduction of PM inflation into the system positively influences the trades volume at the market and consequently the market quality.

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