

# FORECASTING MARKETS - AN INDUSTRIAL APPLICATION

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## Abstract:

In this paper we report about a first industrial application of an experimental stock market, which was designed to support project management decisions. People who work in a software development project were motivated to trade in simple real money double auction markets. The design of these markets was focused on the date the project should be finished and should help to aggregate private and semi-public information on the progress of the project more quickly than conventional management techniques. Part two of this paper presents a half year of trading in our experimental markets, a short analysis of the results and some final conclusions.

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# 1. Trading in the early months

As described in part one of this paper, we started trading in two double auction markets which were focused on a milestone deadline of a big software development project in telecommunication industry. 63 traders joined the markets and about 50 became active traders. Markets started in May and converge to a stable equilibrium within a month of trading. As Fig. 1 shows, prices in the B500 market ("Project finished at end of October? Yes - No?") drop more and more and reached the 0.4 ATS (=40 percent probability) boundary after 2.5 months. The "Verzug" market ("What delay?") fluctuated about 0.5 ATS (= meaning 2-3 weeks delay) at that time.

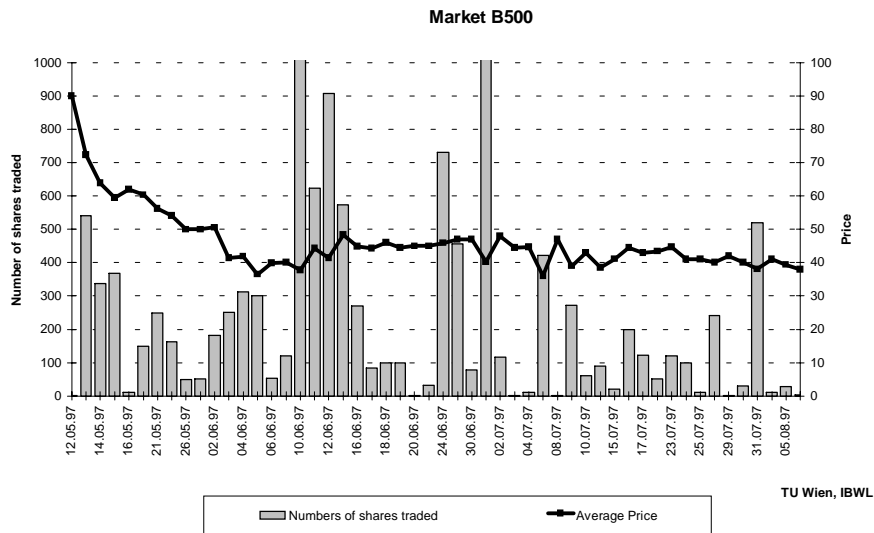


Fig. 1: Daily average market prices and quantities traded in market "B500"

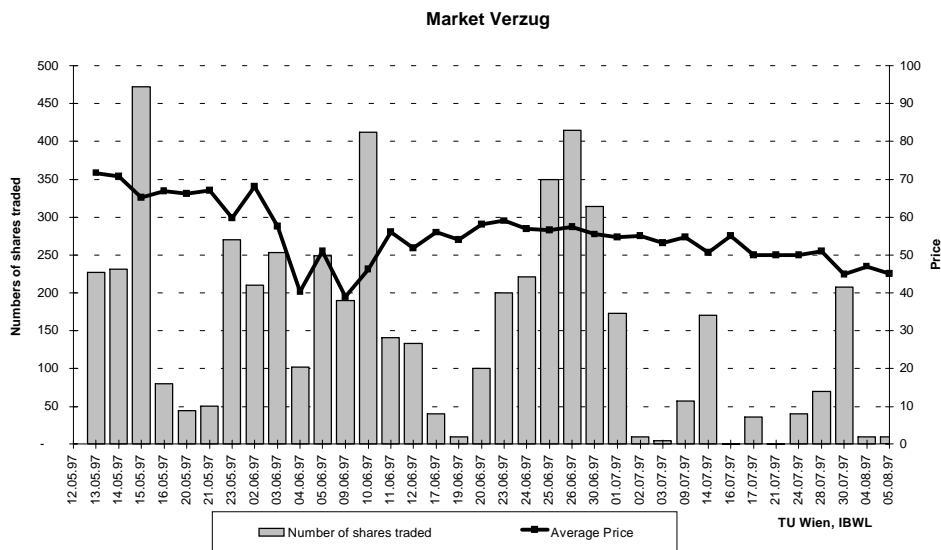


Fig. 2: Daily average market prices and quantities traded in market "Verzug"

## 2. The big break

An unforeseeable incident occurred after 3 months of trading (at August 7th). The customer of the software product announced that it was no more interested in the deadline he set for the final test series, because of some internal problems of his own. So these tests - that means also the entire milestone in project management planning - should be shifted one month into the future. This led to a rearrangement of the whole project plan. New milestones were defined and B500 became obsolete.

At that point market management decided to close both markets on a trading rule that was implemented (before the markets opened in the beginning) for such unlikely incidents. This rule said that, if for any reason an important rearrangement in the project plan must be applied, markets will be closed and shares will be bought back with the values of 0 ATS for YES shares and 1 ATS for NO shares.

This was done at August 7th. And within 1 hour two new markets were opened. They were designed quite like the previous markets, but focused at the new milestone - called M500 - and its new deadline at the end of October (week 44).

## 3. Restart with new markets

Both new markets asked the same questions as the previously closed ones:

### 1. Market/Claim (called "M500"):

"Can the project be finished in the planned time horizon?". The payoff rule was a simple Winner Takes All design. One YES share in this market paid 1 ATS if the project can be finished in time and nothing if not. The NO share then paid 0 and 1 ATS respectively.

### 2. Market/Claim (called "M500 Verzug"):

The second market was designed to predict a possible delay of the new milestone. There was a share called "Early" (or YES) and a second called "Late" (or NO). The payoff rule followed the (linear) specification:

YES:  $\max(1 - 0.2 * (\text{weeks late} + 1), 0)$  ATS      and

NO:  $\min(0.2 * (\text{weeks late} + 1), 1)$  ATS

The payoff rule of the second market was changed in a small detail from the old market, to make predictions of a premature reaching of the milestone possible.

#### 4. The last 3 months

After closing and reopening the markets with a new time horizon (with a one month shift to the future), most people may expect that market prices in the new markets must be significant higher, because much more time is available to finish work within the given timeline. But this trading behavior was not present in the data of the new markets (cf. Fig. 3 and 4). Both markets opened with prices very close to market prices of the old markets.

The "M500" price quick dropped down to approx. 0.43 ATS quick and fluctuated between 0.43 and 0.40 for more than 6 weeks, before the price level decreased even more. Trading activity was much lower than in the "B500" market and a much larger number of days without any trade could be observed. About one month before the time limit for M500 prices collapsed. More and more sell orders entered the market and nearly nobody was willing to buy YES shares. At that time the project management realized that none of the project participants believed in reaching the target in time anymore, although it was still possible to the traditional project plan which was used by management team.

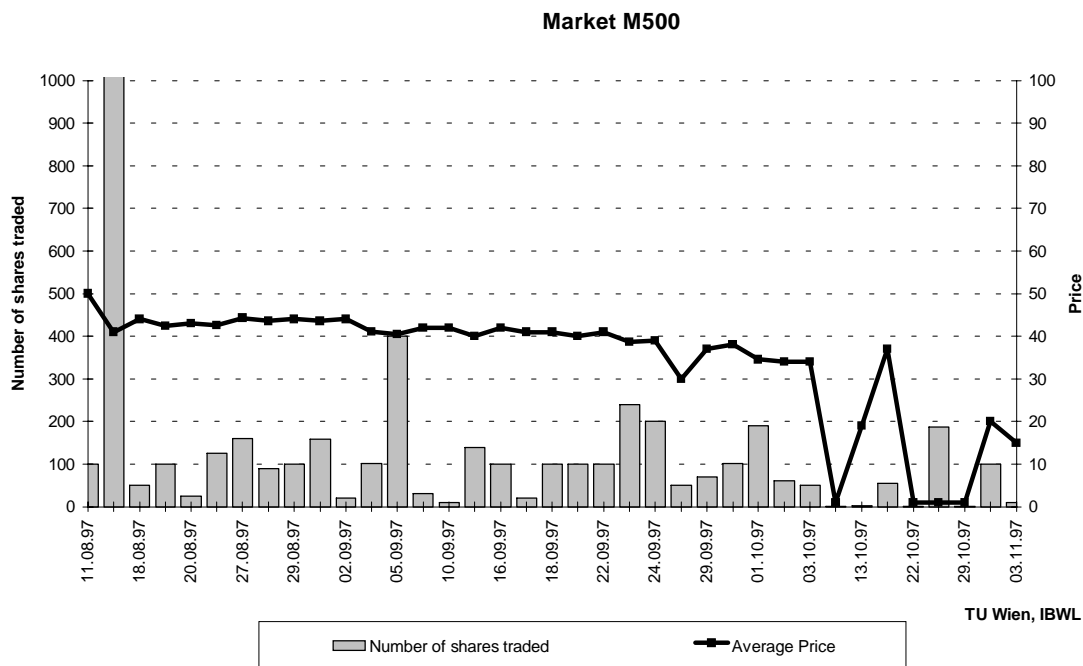


Fig. 3: Daily average market prices and quantities traded in market "M500"

In the end the market was closed after of week 44, when the project manager announced that the milestone time limit was not reached. So each YES share paid 0 ATS and the NO shares paid 1 ATS each.

The "M500 Verzug" chart shows a similar image: low trading activity and long periods of no contracts. Especially in September and October trading became more and more an exception. The market was closed in week 46, one day after the milestone "M500" was reached. The payoff for the shares followed the payoff rules with 0,4 ATS for YES and 0,6 ATS for NO shares.

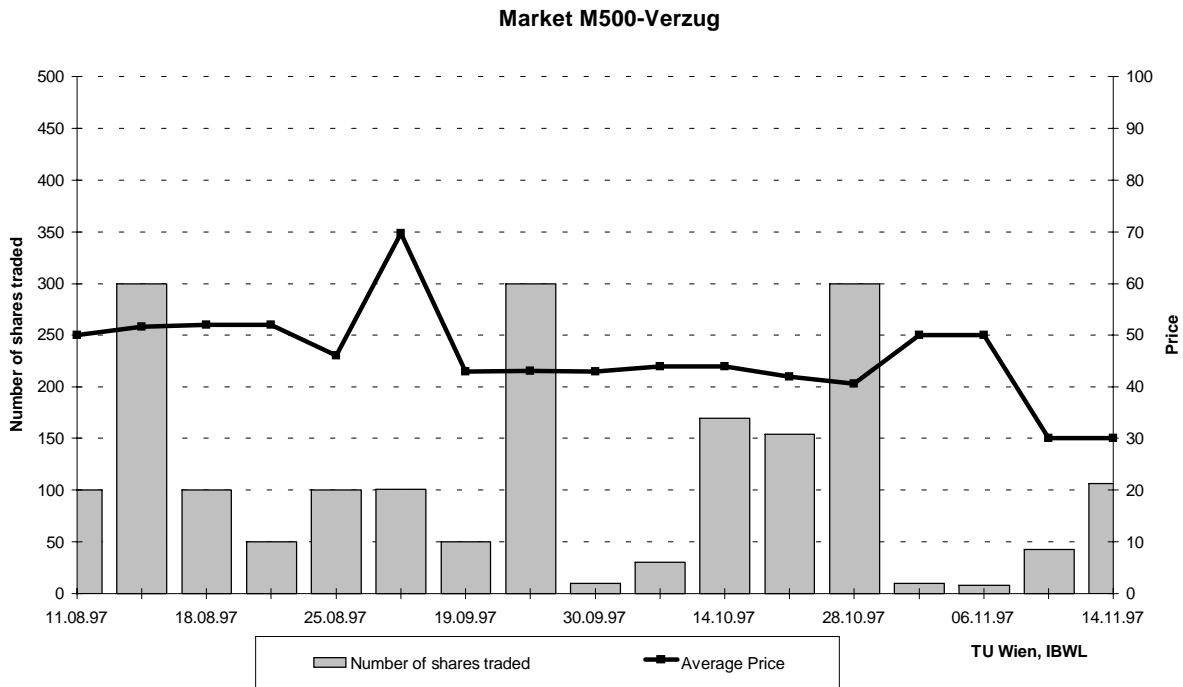


Fig. 4: Daily average market prices and quantities traded in market "M500 Verzug"

## 5. Analysis

There were a couple of events noticed by the project management, which could generate new information for the traders:

- Week 28: new unknown software tools must be used, will increase expenditures
- Week 29: M310 and M410 partially postponed 3 weeks
- Week 30: capacity problems in test facilities become public
- Week 31: problems with the M500 deadline in 2 of 12 fields become public
- Week 32: official shift B500 to M500 by customer
- Week 34: delivery delay problems with some suppliers (1 month)
- Week 36: problems with the M500 deadline in another field become public
- Week 38/39: test preparations finished
- Week 40: heavy problems in one of the fields, M500 heavily endangered, crisis, M300 reached (6 weeks delayed)

- Week 41: test status only 6%, M410 reached (2 weeks delayed)
- Week 44: test status jump to 60%
- Week 45: test status jump to 79%
- Week 46: reaching M500 at Thursday

Compared with the price charts, these events seemed to have no or very low influence in the price finding process. That effect can be explained with the long time information diffusion process within the project. Most of the events listed above can be observed by the traders a quite long period of time before they became "common public" knowledge. So market participants anticipated such information before their official announcement. Note that this was just the reason why this markets were run!

In general it looks like traders generated a good and stable forecast after only one month of trading (in the original "B500" and "Verzug" markets). The rest of the time the fluctuations in market prices were only in very small dimensions and without big peaks and bubbles. Especially the forecasting potential in the "M500 Verzug" markets seem to be quite impressive. After only 1 month of trading and more than 3 months before the scheduled deadline the market predicted a delay of 2-3 weeks. In the end - and after the rough reconstruction of the project plan - the actual delay turned out to be 13 days (11 workdays).

Market participants can be divided up into 3 main groups:

- a small group of perhaps 12 people earning profits of 40 to more than 300 percent
- a main group of 33 people (13 of them complete inactive traders) from 30 to -30 % return on capital
- at least 18 people who lost more than 30% of the money endowment.

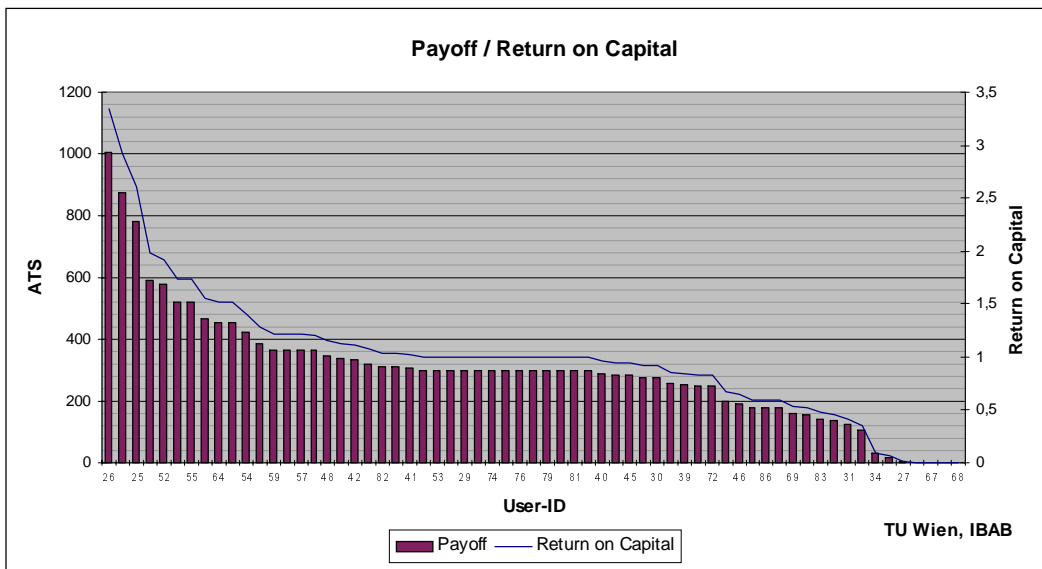


Fig. 5: overall trader profits

When we compare some trading data from the "M500" and "M500 Verzug" markets, trading behavior depending on weekdays shows a very dissimilar picture. In "M500" (see Fig. 6) we found most shares traded in the middle of the weeks (wednesday), while in "M500 Verzug" (Fig. 7) on wednesdays not a single trade occurred. One reason of the very different trading activity levels may be the much lower amount of shares traded in the "M500 Verzug" market, which produces a much more volatile distribution of trades through time.

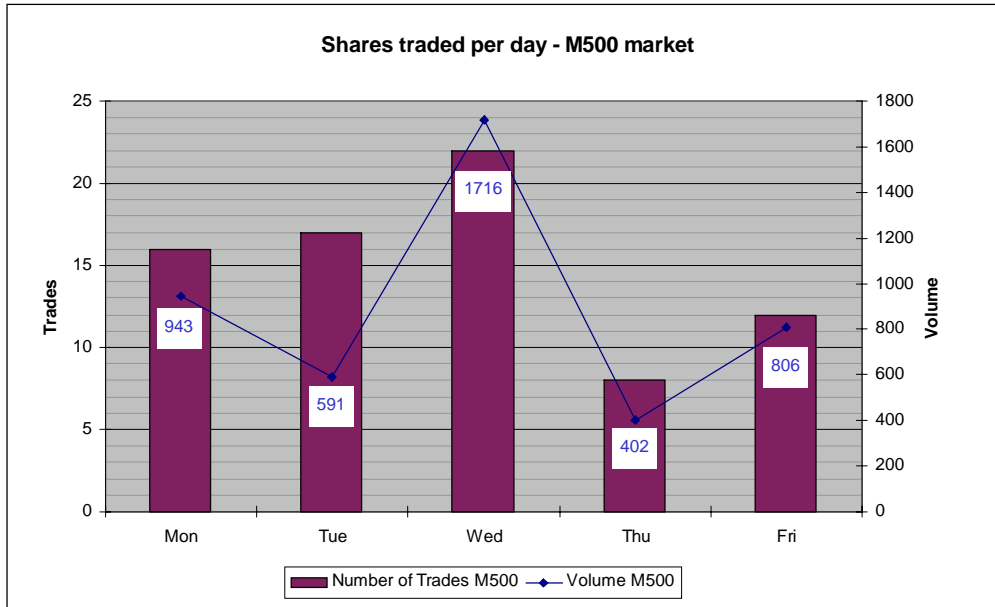


Fig. 6: Trades per day (M500)

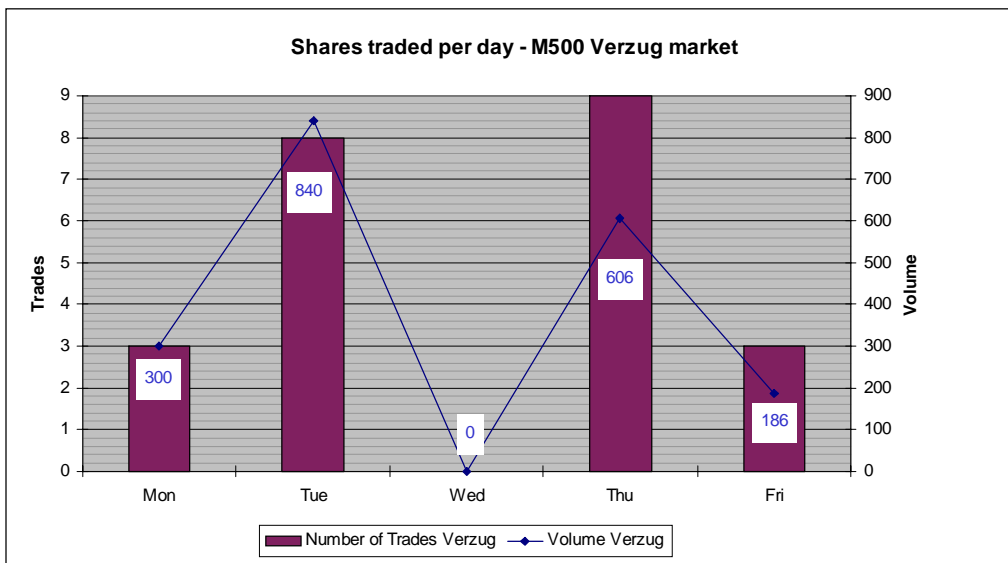


Fig. 7: Trades per day in "M500 Verzug"

When we compare trading per time of day, we find a typical "office time" distribution in both markets. Peaks of trading in the morning and at lunch time. Lets call it "coffee break trading behavior". One indicator that one of the goals the project managements set in the beginning,

namely improvements in intra project communication really seems to have taken place. And additional, that participants didn't spent much of their valuable and most productive work time for trading.

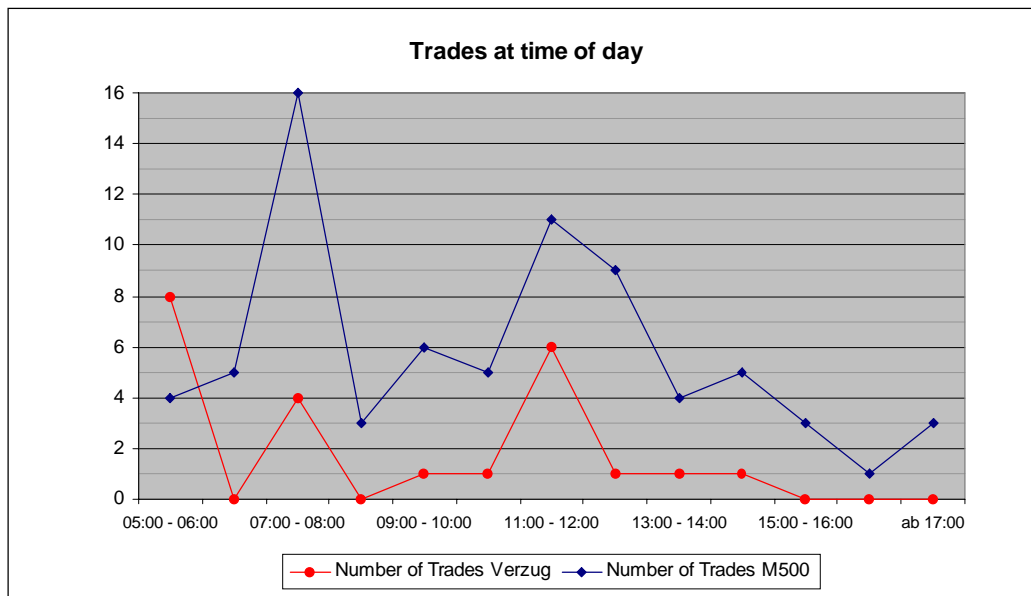


Fig. 8: Trades at time of day in M500 and M500 Verzug<sup>3</sup>

## 6. Market participants opinions

### 6.1. The Participants

From the 63 traders who assigned the market only 50 became active traders. 23 of them earned profits and 27 suffered losses. The best 4 traders at least doubled their cash, the worst 5 lost nearly their whole investment. After the experiment was finished an exit poll was made among the participants to find out more about their behaviour, problems, suggestions, etc.

### 6.2. Demographic Data

We got answers in the exit poll from 44 traders. 45% of the traders answered that they made overall profits in the markets, 55% mentioned that they suffered losses. However, the question "Will you participate in similar markets in the future again?" 86% answered they will. Hence it seems that motivation among market participants was quite high, although many of them lost (some) money this time.

<sup>3</sup> add one hour to the time axis (markets didn't move to daylight saving time)



### 6.3. Problems

Approx. 1/4 of the traders mentioned that they had problems with the use of the market. Especially all women reported problems! Most problems occurred in the beginning, when the new participants had problems in understanding the design and rules of the markets and the use of the WWW based user interface. Many of these problems were solved by just using the markets (trial & error), but a better and more extensive training and introduction for new traders was suggested by many participants. It turned out that there were no major problems after this start phase until markets were closed and reopened in August (see Fig. 9). Many traders described the emergency payoff rule (all Yes shares paid nothing) as unfair and demanded other methods of handling such events. But market management was bounded to the official payoff rule which was announced for such cases (in the beginning of the experiment) and so some traders lost not only money but also their motivation for further trading in the reopened markets.

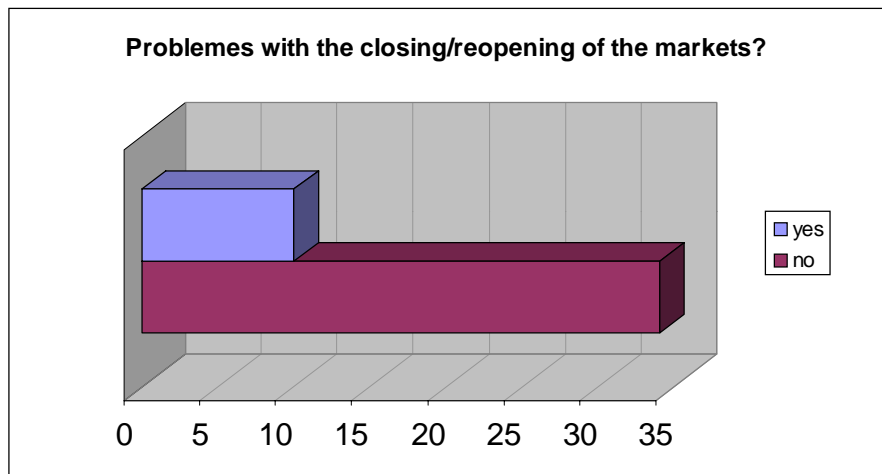


Fig. 9: Problems caused by the reopening of the markets in August

### 6.4. Suggestions for Improvement

There are four major suggestions for improvements which result from the exit polls and various discussions with participants and within the management group:

- The reported problems in the introduction phase must be solved by a better and more clearly structured presentation of the markets (short introduction lecture, online documentation, FAQs, phone support, ...) and maybe training of new participants in some demos or special training markets.

- Implementation of simple, clear and fair rules to handle unforeseeable incidents (like external decisions which affect the project)
- Improvements in communication between project management and market participants, e.g. a kind of newsletter or a special news webpage dealing with news, rumors, official statements from the project management, status reports, ...
- Create more possibilities to enter/leave markets during lifetime. Especially new interested participants should be allowed to join the markets as traders at any time.

## 7. Conclusions

After all we can summarize, that although the setup of this experiment suffered an unhappy change in market design caused by an external reason the results show a satisfying forecasting potential. Trading behavior of the participants followed a quite comprehensible path. They anticipated new information, rumors and personal feelings long before official sources published official statements. However the experiment also showed us, that introduction of traders, fair market rules, large number of participants, good motivation and frank official information policy should improve results in future experiments. The success of this first experiment leads to a repetition (which is going on just now) in a second experiment within Siemens Austria, which also should answer the question if a methodology like this can be used to predict shifts in estimated expenditures of large software projects.

## 8. Bibliography

- *Berg, J., Forsythe, R., Rietz, T.:* What Makes Markets Predict Well? Evidence from the Iowa Election Markets, College of Business Administration, University of Iowa, forthcoming in Essay in Honor of Reinhard Selten, Springer Verlag 1996
- *Forsythe, R., Lundholm, R.:* Information Aggregation in an Experimental Market, in: *Econometrica*, Vol 58 No.2, March 1990, p. 309-347
- *Forsythe, R., Nelson, F., Neumann, G., Wright, J.:* Forecasting Elections: A Market Alternative to Polls, in: Thomas R. Palfrey, *Contemporary Laboratory Experiments in Political Economy*, Ann Arbor: University of Michigan Press, 1991b, p. 69-111
- *Forsythe, R., Nelson, F., Neumann, G., Wright, J.:* Anatomy of an Experimental Political Stock Market, in: *The American Economic Review*, December 1992, p. 1142-1161

- *Friedman, D., Sunder, S.:* Experimental Methods, A Primer for Economists, Cambridge University Press, 1994
- *Grossman, S.:* On the Efficiency of Competitive Stock Markets Where Trades Have Diverse Information, *The Journal of Finance*, May 1976, p. 573-585
- *Grossman, S.:* The Existence of Futures Markets, Noisy Rational Expectations and Informational Externalities, *Review of Economic Studies*, 44, 1977, p. 431-449
- *Grossman, S. J., Stiglitz, J. E.:* On the Impossibility of Informationally Efficient Markets, *The American Economic Review*, June 1980, p. 393-408
- *Hayek, F. A.:* The Use of Knowledge in Society, in: *The American Economic Review*, Vol. 35, September 1945, p. 519-530
- *McCabe, K. A., Rassenti, S. J., Smith, V. L.:* Designing "smart" computer-assisted Markets - An Experimental Auction for Gas Networks, in: *Papers in Experimental Economics* p. 678-702, Vernon L. Smith, Cambridge University Press, 1991
- *Oliven, K., Rietz, T.:* Suckers are Born but Markets are Made: Individual Rationality, Arbitrage, and Market Efficiency on Electronic Futures Market, Working Paper, University of Iowa, 1995
- *Ortner, G., Stepan, A., Zechner J.:* Political Stock Markets - The Austrian Experience; *ZfB Ergänzungsband* 4/95, Dezember 1995, p. 123-136
- *Ortner, G.:* Firmeninterner Aktienmarkt als Projektmanagement Tool, *Siemens pse-aktuell* 5/97, S. 16, Siemens PSE Wien, Dezember 1997
- *Ray, R.:* Idea Futures: Wetten auf die Zukunft, *gid impuls* 2/1997, p. 44-51
- *Smith, V. L.:* Microeconomic Systems as an Experimental Science, in: *The American Economic Review*, December 1982, p. 923-955
- *Smith, V. L.:* Bidding and Auctioning Institutions: Experimental Results, in: *Papers in Experimental Economics*, Cambridge University Press, p. 106-127, 1991a
- *Smith, V. L.:* Markets as Economizers of Information: Experimental Examination of the Hayek Hypothesis, in: *Papers in Experimental Economics* p. 221-235, Vernon L. Smith, Cambridge University Press, 1991b