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## **STATISTICAL ASSESSMENT OF EXCHANGE MARKETS REACTION ON FORCE MAJEURES**

The efficient market hypothesis is one of the dominant scientific hypotheses, which explains the behavior of exchange markets. According to this hypothesis the market is in a state of dynamic equilibrium, determined by rational behavior of economic agents. However, there are information flows, which cannot be taking into account in advance and which are able to disrupt this balance, at least for a certain period of time. We are talking about force majeure – a compelling, extraordinary circumstances that do not depend on the will and actions of participants of economic events. Classic examples of force majeure are natural and technological disasters, terrorist attacks, and unexpected economic and political events.

Information flows, which are generated by force majeure, can't be considered by market in advance because of unexpected nature of these events and can lead to significant negative consequences (financial losses, human toll, physical destruction, etc.). Taking into account that losses and consequences of force majeure can't be measured quickly, the market will need some time to process this information. Thus, the possible emergence of a temporary inefficiency in the functioning of the market can be assumed (without prejudice to the hypothesis of an efficient market). Inefficiency, in turn, opens up opportunities for additional profits from speculative trading.

In order to find out anomalies in behavior of exchange markets after force majeure we decided to use Student's t-test, which better meets the conditions of limited sampling.

The main goal of our research in the analysis of force majeure events is to identify their affiliation with the sample data for the previous period, i.e. the test of the hypothesis ( $H_0$ ) that the average values of certain variables are the same. An alternative hypothesis ( $H_1$ ) states that mean values of the sample before and after the force majeure are unequal. As a comparison population we chose the period, which includes 30 values for a particular asset.

If the calculated value of t-test did not exceed critical value, than mean values are equal and thus hypothesis ( $H_0$ ) is confirmed. Otherwise (mean value exceeds critical value of t-test) an alternative hypothesis ( $H_1$ ) is accepted and we can talk about the abnormal market reaction to force majeure event.

We test the statistical significance of the behavior of market prices volatility (the difference between the maximum and minimum prices during the trading session) during the period of force majeure. In this way we tried to prove that surge in stock price fluctuations indicates panic in the market. In turn, panic indicates loss of market stability and, as a consequence, the temporary loss of its efficiency.

Force majeure events are classified into the following categories: terrorist attacks, natural disasters, technological disasters, economic events.

Objects of our analysis are different exchange markets: foreign exchange (quotes of the currency of the affected country and quotes of USD / CHF in order to study the behavior of the currency-shelter, which is Swiss franc), stock exchange (represented by the leading stock index of affected countries), commodity exchange (quotation of gold and oil).

Our calculations of market reaction to the force majeure are shown in Table 1.

*Table 1*

**Results of the market reaction to the force majeure event by Student's t-test (percentage of events when the market lost equilibrium), %**

| Market type             | Currency exchange            |                              | Stock exchange | Goods     |           |
|-------------------------|------------------------------|------------------------------|----------------|-----------|-----------|
|                         | Currency of affected country | Currency-shelter (USD / CHF) | Stock index    | Oil       | Gold      |
| Natural disasters       | 30                           | 10                           | 50             | 20        | 20        |
| Technological disasters | 55                           | 27                           | 55             | 0         | 36        |
| Terrorist attacks       | 0                            | 11                           | 33             | 11        | 11        |
| Economic events         | 25                           | 19                           | 38             | 0         | 25        |
| <b>In average</b>       | <b>22</b>                    | <b>13</b>                    | <b>41</b>      | <b>12</b> | <b>18</b> |

Results of the study show the benefit of the efficient market hypothesis. The market equilibrium is very difficult to break. Despite the relatively large scale and suddenness of force majeure events (as we selected the most unexpected consequences of events in the world) in most cases do not lead to loss of market equilibrium. Markets quickly absorb new and unpredictable information and continue to function in it's the usual rhythm. Fluctuations, which occur in post-force majeure period, match fluctuations in stock prices during the pre-force majeure period.

The most inert market tools are oil and currency-shelter USD / CHF. Currencies of affected countries and gold show mostly the same reaction while the stock market appears to be the most inclinable to force majeure events.

Thus the results of the research confirm the validity of basic principles of the efficient market hypothesis.