

READING THE SIGNS OF ORDER BOOK AND PRICE MOVEMENTS

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A report for



DEUTSCHE BÖRSE
GROUP

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Contents

- 4 How to dodge surprise price movements
- 5 How the methodology works
- 6 Effectiveness of alerts
- 7 Risk Alerts in action

How to dodge surprise price movements

Seemingly unpredictable price movements and their corresponding risks pose major challenges for investors and traders. These moves can be caused by a multitude of factors, e.g. unexpected macro events such as the Chinese currency devaluation in August 2015 or the placing or withdrawal of large orders by high-frequency trading firms. Interestingly, these events and the dynamics around them can be identified and measured using standard order book and trading statistics. These statistics could be included in traders' risk management modelling to provide early detection of any unusual movements. Deutsche Börse has developed a model to do just that.

Deutsche Börse Risk Alerts

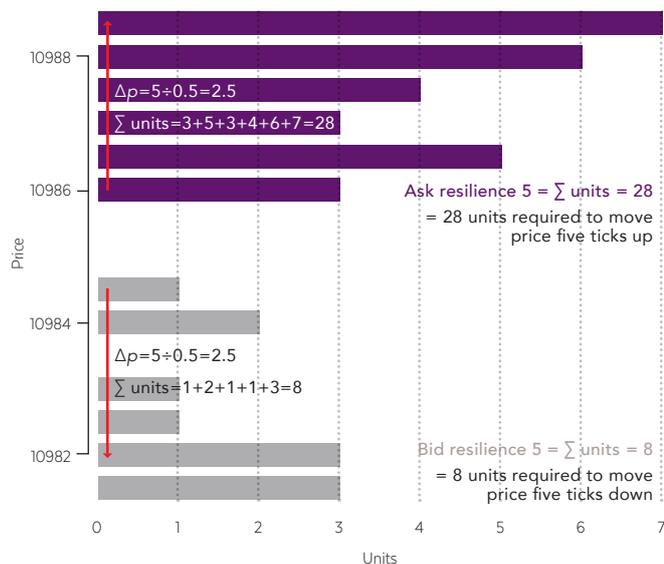
In November 2015, Deutsche Börse released 'Risk Alerts', a new analytic that supports traders in identifying extraordinary price and order book movements that might affect their capacity to execute a trade. Whether their eye is on alpha or reducing market impact, the new data, part of Deutsche Börse's real-time analytics product line, will 'ping' the user in the event that strong deviations from a 'normal' trading state are detected. Alerts are calculated for the most liquid Eurex (front month) futures: DAX, EURO STOXX 50 and Euro-Bund. Three metrics are used to establish the state of trading: current price range, bid-ask spread and order book resilience.

Defining order book resilience

Deutsche Börse's order book resilience measures the robustness of the order book against one-sided, high-volume orders. The higher the order book resilience, the more robust the order book. Order book resilience is defined as the trade volume that would be required to move the execution price by more than a specified number of ticks. For the purpose of calculating order book resilience, Deutsche Börse uses 5, 10 and 20 ticks with the measure being determined and reported independently for the bid and ask sides of the market.

In the below example, the order book resilience measure of '5' is determined for an order book situation of the DAX future. The tick size of this instrument is 0.5. Given this tick size, the order book resilience '5' determines the volume that would be necessary to move the price of the sell-side by more than 2.5 points (5 x 0.5). As the current best ask is 10986, all levels up to price 10988.5 would have to be cleared. In the given example, this means three units @10986, five units @10986.5, three units @10987, four units @10987.5, 6 units @10988 and 7 units @10988.5. All together 28 units would be required and the order book resilience '5' is of the size 28 for the ask-side. On the bid side, it would take only a buy-triggered trade of eight units to move the price by more than five ticks.

Figure 1 – Calculation of order book resilience 5
Fictitious example for DAX future with tick size 0.5



How the methodology works

Deutsche Börse’s alert system informs traders in real-time, when certain trading metrics move outside of typical parameters. The intention is to prevent the traders being caught off guard - thereby losing money - by increasing their capacity to detect the more extreme situations.

What makes a good alert?

In order for a measure to make a good alert it should have the following properties:

- ▶ The system should be continuously available in trading hours.
- ▶ In normal trading situations there should be weak or no correlation with price movements, so that false positive alerts are not triggered when activity is within normal parameters.
- ▶ The user should be given an alert in adequate time to act prior to strong price changes (see figure 2)

Figure ii – Measure precedes sudden price movement

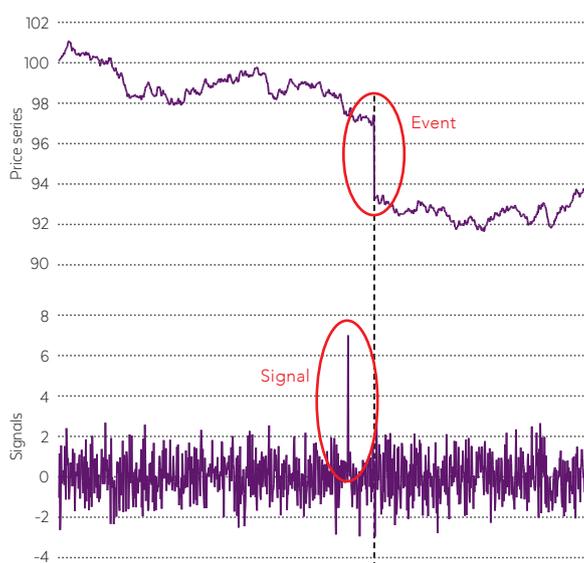


Figure 2:

Top: Price series shows a sudden price decrease.

Bottom: Measure signals event prior to price move.

Based on the fact that extraordinary order book compositions can lead to strong price movements, signals are derived from order book statistics as low probability or 'tail' events based on their statistical distribution (see figure 3). An alert is generated if the current value exceeds a certain threshold for a low probability event by occurring more frequently than once a day or once in 10 trading days.

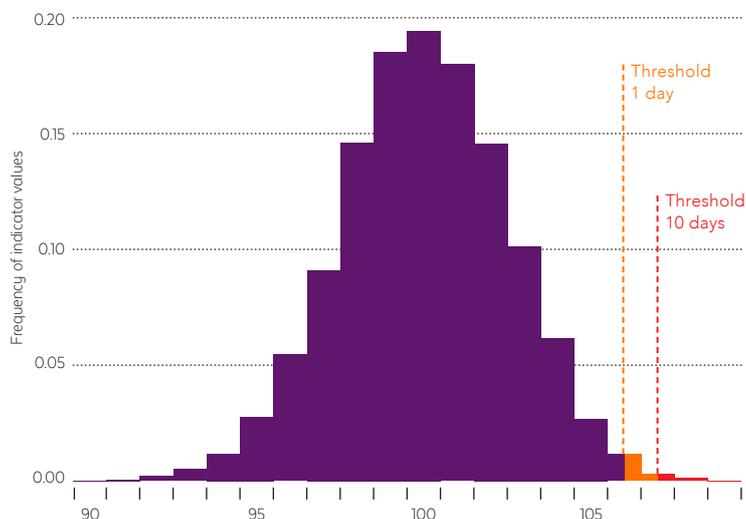
Deutsche Börse’s risk alerts are based on the following measures:

Price range – Change of traded price over the current second. This measure is not a direct order book measure but rather a proxy for current volatility.

Bid-ask spread – Current, most granular bid-ask spread. This probes the top of the order book as relatively large trades clear the upper levels of the order book and/or quotes on top of an already thinned out order book are removed.

Order book resilience – For a definition see page 4. While the bid-ask spread is only sensitive to the top of the order book, this measure probes the whole order book as larger orders may easily exceed first level volumes and thus affect the whole order book. Small values indicate changes across multiple levels of the order book or 'thin' order books across several levels.

Figure iii: Schematic distribution of order book measure



Effectiveness of alerts

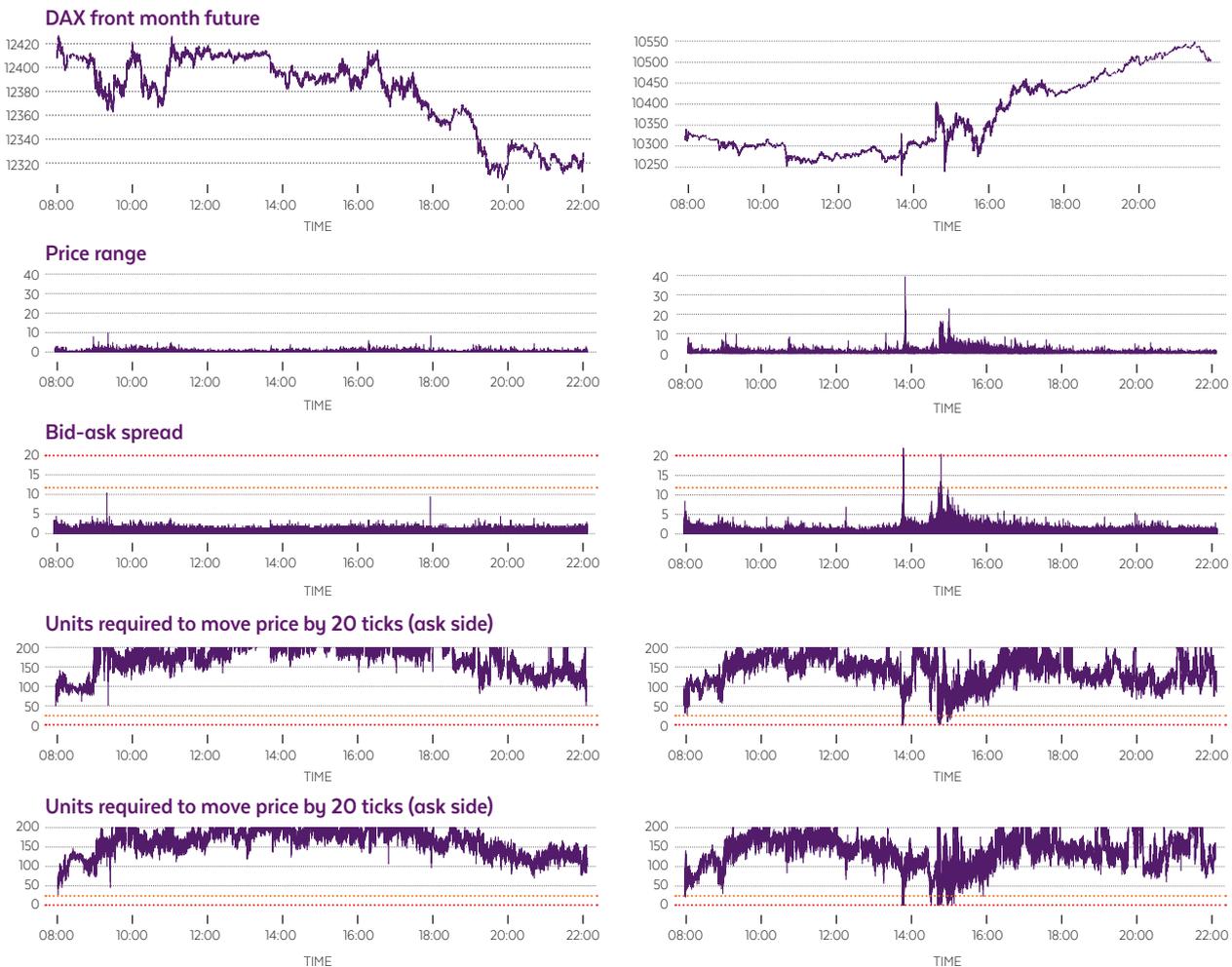
— Thresholds used to generate the low probability alerts are selected as “event happening once per trading day / once per 10 trading days”

Effectiveness of alerts

The efficiency of the measures used to derive risk alerts is demonstrated in figure 4. The fact that the key figures do not lead to alerts in normal trading situations is shown in the left side of figure 4, where

the price evolution of a ‘normal’ trading day is shown in comparison to the selected measures. Neither the ‘once per trading day’ nor the ‘once every 10 trading day’ thresholds are breached. In the right side of figure 4, the same content is shown for a trading day with large price movements. On this day (22 January 2015), the ECB released an interest rate decision around 2 pm. As a result, one can observe that for all 3 measures employed, the “once per day” and in parts the “once per 10 days” threshold was triggered.

Figure 4: Risk alerts in normal versus extraordinary trading situations

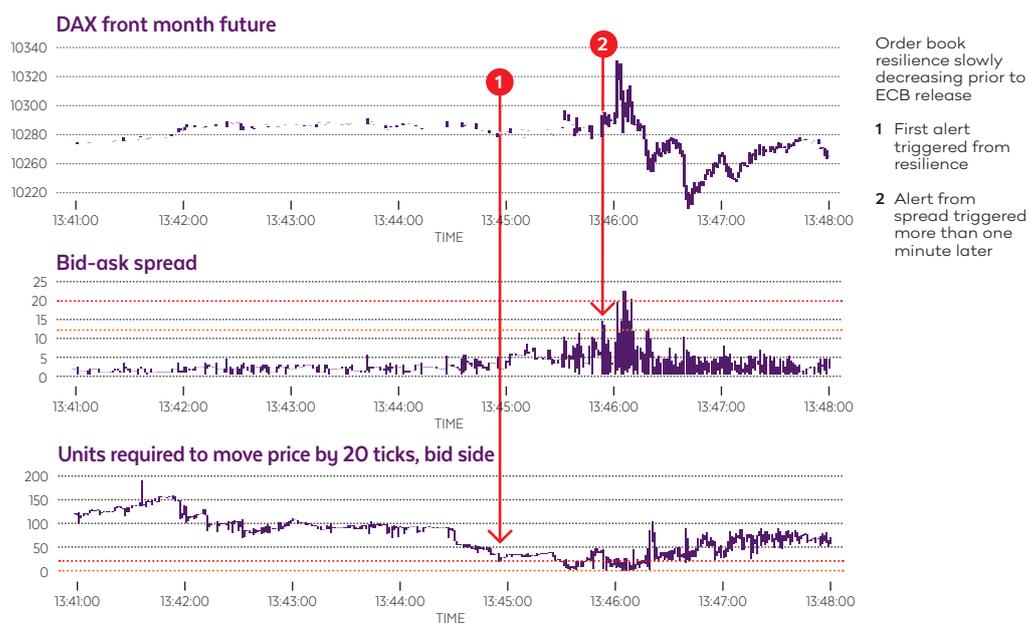


Comparison of generated risk alerts for a ‘normal’ trading situation (left) and a trading situation leading to ‘extreme’ price movements (right).

From top to bottom: Evolution of prices; price range of current second; bid-ask spread; the ask-side order book resilience (20) and bid-side order book resilience (20), including the respective thresholds.

— To demonstrate the sensitivities of the different alerts, figure 5 depicts a deep dive into the evolution of price, bid-ask spread and order book resilience around the ECB interest rate announcement on 22 January 2015. One can observe slowly decreasing order book resilience prior to the ECB release. The 1-day threshold is triggered seconds prior to the release, while the respective threshold defined via the bid-ask spread is triggered more than one minute later, indicating that the strong price movement happened on the back of a thinned out order book.

Figure 5: Alert comparison on 22 January 2015



Comparison of the sensitivities of alerts based on bid-ask spread and order book resilience around the price spike – with subsequent decline – around the ECB interest rate announcement on 22 January 2015.

Risk Alerts in action

The reaction time needed to respond to an alert is in milliseconds, making these alerts useful for automated traders, be they long-only buy-side traders or alpha-seeking proprietary trading firms. Deutsche Börse’s Risk Alerts could be used as valuable input to stop/suspend a trading algorithm and get out of the market when a risky situation arises. The product could also be used as ongoing input to internal risk management systems or trading strategies.

For more information, please go to: www.mds.deutsche-boerse.com > Information > Analytics

