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Designating market maker behaviour in limit order book markets

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A B S T R A C T

Financial exchanges provide incentives for limit order book (LOB) liquidity provision to certain market participants, termed designated market makers or designated sponsors. While quoting requirements typically enforce the activity of these participants for a certain portion of the day, an argument that liquidity demand throughout the trading day is far from uniformly distributed is made, and thus this liquidity provision may not be calibrated to the demand. Furthermore, it is propose that quoting obligations also include requirements about the speed of liquidity replenishment, and then a recommendation that use of the Threshold Exceedance Duration (TED) for this purpose be considered. To support this argument a comprehensive regression modelling approach using GLM and GAMLSS models to relate the TED to the state of the LOB and identify the regression structures that are best suited to modelling the TED is presented. Such an approach can be used by exchanges to set target levels of liquidity replenishment for designated market makers.

1. Introduction

Financial exchanges have different modes of operation, or market models, for different assets. This is often determined by an asset's liquidity in the prevailing period, and an exchange will endeavour to choose a market model that facilitates trading in the asset. As an example, the electronic trading system Xetra, operated by Deutsche Börse, offers continuous trading for the most liquid assets, and the same mode of operation is offered for the second most liquid category of assets, but supplemented with a 'Designated Sponsor', who has market-making obligations. Other securities, such as structured products, feature a single market maker, while the less liquid assets are traded instead in 'continuous auction' mode, which features a specialist.

The classification of assets in most electronic exchanges is performed according to their liquidity which is averaged over a particular period of time (typically quarterly). For assets which feature a Designated Sponsor (termed a Designated Market Maker in other exchanges), there are requirements regarding the maximum spread, minimum quote size and the

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effective trading time. In return for fulfilling their quoting obligations, Designated Sponsors receive a full reimbursement of the transaction fees incurred.

In this paper, we argue that in order to ensure high-frequency liquidity provision, exchanges need to consider not only the average liquidity over time, but also the time required for liquidity to be replenished, which we will explain and quantify as an indication of liquidity resilience. This is because large orders are increasingly being partitioned by execution algorithms into multiple smaller tranches, and traders take advantage of liquidity replenishment to improve execution. For instance, it is noted in Chlistalla et al. (2011) that the average order size is one-eighth of that of fifteen years ago, in terms of number of shares, and one-third in dollar value.

Such replenishment is swift when market liquidity is resilient, and the effect of resilience on e.g. optimal execution has been considered in the past in the models of Obizhaeva and Wang (2012) and Alfonsi et al. (2010). However, these models generally considered resilience to be constant or have a very simple parametric form. Thus, they failed to attribute the resilience characteristics to interpretable features of the limit order book structure.

The model of Panayi et al. (2014) instead introduced a new notion of resilience explicitly measuring the time for liquidity to return to a previously-defined threshold level. This approach was agnostic to the particular class of liquidity measure considered, and could therefore accommodate volume-based, price-based and cost-of-return-trip-based measures. They showed that resilience was not constant, but was instead related to the state of the LOB. This allowed them to understand the effect of different LOB structural explanatory variables on the resilience metric constructed, and as part of this, they considered a regression based specification. In particular, they considered simple log-linear regression structures to relate the response (the duration of liquidity droughts) to instantaneous and lagged limit order book structural regressors intra-daily.

Using Level 2 LOB data from the multi-lateral trading facility Chi-X, we have access to the state variables considered by Panayi et al. (2014), and can therefore consider this notion of resilience further in the study undertaken in this manuscript. We significantly extend their resilience modelling framework to allow for additional structural features, as well as a greater class of distribution model types to better explain and capture the liquidity resilience features of a range of assets intra-daily. In particular, we consider two classes of regression models which allow for more general resilience model dynamics to be captured and more flexible distributional features to be explored, ultimately improving the fit and forecast performance of the models. Firstly, we have Generalised Linear Models, or GLMs, which typically assume a conditionally specified exponential family of distributions for observation assumptions for the response, in our case the exceedance times over a liquidity threshold. The second class is that of Generalised Additive Models for Location, Shape and Scale, or GAMLSS, which relax this assumption and can consider a wider, general distribution family with the limit order book regressors entering not just into the location/mean relationship through a link function, but also into the shape and scale parameters directly. This informs the skewness and kurtosis of the liquidity profiles and the resilience of the liquidity in settings of liquidity leptokurticity and platokurticity.

It is critical to develop these new modelling approaches, as they provide a directly interpretable modelling framework to inform exchanges and market making participants of the influence different structural features of the LOB for a given asset will have on affecting instantaneously within a trading day the local liquidity resilience. They thus provide insights into how best to manage and design market making activities to improve resilience in markets. Our results reveal that considering the more flexible Generalised Gamma distribution assumption within a GAMLSS framework, with multiple link functions to relate the LOB covariates to the different distribution parameters, improves the explanatory performance of the model. On the other hand, the simpler Lognormal specification also achieves respectable explanatory power and its estimation is more robust.

We also statistically assess the significance of the explanatory variables in greater detail, and across datasets for companies from 2 different countries. We find that, in agreement with empirically observed market features, a larger deviation of the liquidity from a given resilience threshold level would be associated with a longer deviation from that level of liquidity (liquidity drought). On the other hand, a larger frequency of such deviations from a liquidity threshold level would be associated with swifter returns to that level (shorter duration liquidity droughts). Using the proposed liquidity resilience modelling framework we can also determine the regimes under which we are likely to see different structural features in the resilience behaviour.

Our results indicate that resilience considerations should also be a factor when deciding the quoting requirements for exchange-designated liquidity providers, such as the aforementioned Designated Sponsors. That is, along with the requirements for maximum spread and minimum volumes, they should be subject to additional requirements for liquidity replenishment, ensuring that throughout the trading day, the LOB returns swiftly back to normal levels. As we have shown that liquidity resilience is dependent on the state of the LOB, exchanges can use the modelling approaches we have proposed, in order to determine the appropriate level of liquidity replenishment requirements, given prevailing market conditions. In addition, liquidity providers may use the model to determine the best response to a liquidity drought.

1.1. Contributions and structure

In this paper we make the following contributions. Firstly, we argue that exchanges need to consider not only the average liquidity over time, but also the time required for liquidity to be replenished, which we will explain and quantify as an indication of liquidity resilience. To achieve this the second contribution involves extending the model proposed in Panayi et al. (2014) which introduces a new notion of resilience explicitly measuring the time for liquidity to return to a previously-