Box 15

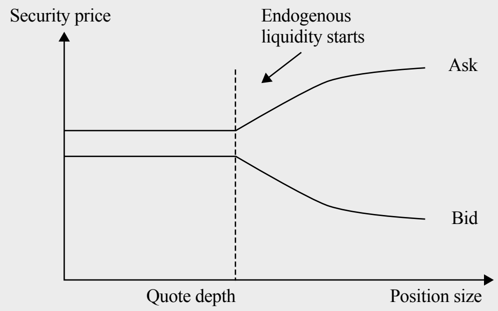
MARKET LIQUIDITY RISK MEASUREMENT

Market participants need to be aware of the implications of trading in markets that are not liquid at all times, that is, markets in which they cannot liquidate positions at going market prices. For example, the recent market turmoil was characterised by a drying up of liquidity in some key financial segments. Credit risk instruments in particular were badly hit by this sudden increase in market liquidity risk. The fall in market liquidity had repercussions in terms of funding liquidity, with some financial institutions becoming unable to fund their illiquid collateral positions. Market participants therefore need to be able to estimate liquidity risk and manage it, especially in situations of market turbulence.

Two main notions of market liquidity exist, exogenous liquidity and endogenous liquidity. Exogenous liquidity relates to the ability of a trader to execute a trade order at little or no cost. Exogenous liq uidity is given and is independent of the trader's actions. It is a function of the market and depends on factors such as the frequency and size of trades, the number of traders in the market or the cost of transacting. Markets vary greatly in their exogenous liquidity: markets such as the FX market and the major stock markets are normally highly liquid. However, perfect liquidity is never attained, even in those markets, as liquidity fluctuates and can diminish dramatically in situations of stress. Endogenous liquidity relates to the fact that valuation losses can arise due to a large sale in a given liquidation time period. Endogenous liquidity risk is mainly driven by the size of the position: the larger the size, the greater the endogenous illiquidity. A good way to understand the liquidity implications of the size of the position is to consider the relationship between the liquidation price and the total size of the position held. This relationship is depicted in Figure A. If an order to buy or sell is smaller than the volume available in the market at the quote (i.e. at the left of the quote depth mark), then the order transacts at the quote. In this case the market impact cost, defined as the cost of immediate execution, will be half of the bid-ask spread. In this scenario, the trade only possesses exogenous liquidity risk and no endogenous liquidity risk. However, if the size of the order exceeds the quote depth, the cost of market impact will be higher than half of the spread. In such a situation the difference between the market impact and half of the spread is the endogenous liquidity risk.

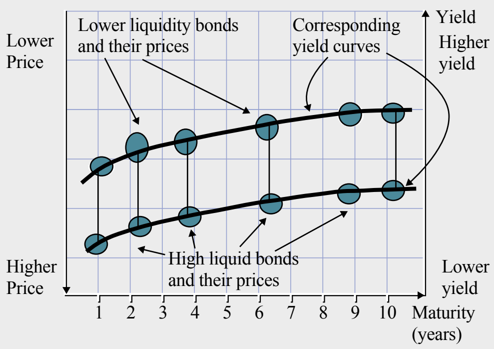
There are various approaches to estimating liquidity risk. These estimation methods vary in their degree of sophistication and implementation complexity and there is no single "best" method. For example, some methods are geared towards estimating exogenous market liquidity, whereas others focus on endogenous liquidity. What is important is that the methods used conform to common perceived features of market liquidity risk (e.g. that the market liquidity risk should fall as the liquidation horizon rises), that the models used are calibrated on real or empirically plausible data (e.g. bid-ask spread data) and that the methods are stress tested.

Figure A Relationship between position size and liquidation value. Exogenous vs. endogenous liquidity risk



Since no consensus has emerged on the best way to deal with market liquidity issues, a sensible recommendation for risk managers is to make use of the different approaches to highlight possible liquidity risk vulnerabilities.

Figure B Yield curve differentials as a liquidity risk indicator



Ultimately, market risk measures such as value-at-risk need to be adjusted to account for market liquidity risk. If a risk manager is only interested in exogenous liquidity risk because, for example, the market offers high liquidity with sufficient depth at both bid and ask quotes, then the simplest way to incorporate liquidity risk into a liquidity-adjusted VaR is in terms of a bid-ask spread that is assumed to be constant. The liquidity-adjusted VaR would simply incorporate a liquidity cost into the basic VaR equal to half the bid-ask spread multiplied by the size of the position to be transacted. This approach is easy to implement and requires few inputs, but the assumption of a constant bid-ask spread is not highly plausible and it takes no account of any other liquidity factors. A more plausible approach is to assume that the bid-ask spreads show some random behaviour around a mean value spread.

The two approaches described above assume that prices are exogenous and therefore ignore the possibility of the market price responding to own trading. This would not apply, however, in situations in which the trader is forced to transact a large amount of an asset, possibly from one single issue or when the market has little or no depth. In such cases the liquidity-adjusted VaR needs to take into account endogenous liquidity risk considerations as well as exogenous ones. Some models have been proposed for modelling endogenous liquidity (e.g. Jarrow and Subramanian, 1997).[1] However, these approaches usually rely on models where the key parameters are unknown and difficult to gauge due to a lack of available data. Sometimes this type of formal model is proxied by more practical approaches which rely on some definition of the relevant liquidation horizon, which is the expected average liquidation time needed to liquidate the position without depressing the market price. The relevant liquidation horizon is dependent on a combination of variables, such as, for example, the joint score of bid-ask spreads, outstanding volume, frequency of new issues, average issue size or, in the case of fixed-income instruments, the yield spread between the issue in question and a risk-free highly liquid issue (see Figure B). The lower the market liquidity characteristics of the instrument based on those indicators, the higher the liquidation horizon required in order to avoid depressing the market price and thus the higher the associated market risk due to the longer liquidation horizon.

Risk managers should not only look at ways of estimating market liquidity risk in normal market conditions using some of the approaches described above, but should also consider how both trading transactions and proper mark-to-market valuations could be impeded in crisis situations. Typically, a disrupting event, such as a credit risk event, will occur that leads to a large price fall. In such situations, market participants become worried and bid-ask spreads increase dramatically. In the worst case, asset price discovery becomes impossible

1 See R. Jarrow and A. Subramanian (1997) "Mopping up liquidity", *Risk*, December.

and liquidity dries up completely at the moment when market operators need it most. Liquidity risk assumptions that hold true under normal market conditions can break down in a stress situation. Risk managers should therefore analyse related risk factors that often arise in such situations. In the wake of a negative credit risk event, for example, risk managers should analyse risk factors such as the interaction of credit risk and market risk factors, the discreetness and interdependency of credit events and the complexities associated with credit enhancements, liquidity provision arrangements, credit guarantees, etc. In such cases scenario analysis becomes the best tool at the disposal of risk managers to understand all of the possible interactions and ramifications of a loss of market liquidity. However, as ever, the results of scenario analysis are subjective, and the value of the analysis is dependent on the quality of the assumptions and scenarios employed.