Modeling and Managing Liquidity Risk

by Gary G. Venter

Much of the current crisis can be traced to models that failed to adequately reflect risk, both in housing costs and complex financial instruments. Even if historical home-price data had never recorded changes like those realized recently, data from other bubbles, from tulip bulbs on, could have been used. It was not clear that housing was in a bubble, but bubble scenarios should have been in the models. Those model issues need to be, and are being, addressed, but here the focus is on liquidity risk.

Regardless of the underlying causes, liquidity problems can be magnified by market price disruptions, and these effects should be included in risk models. Such modeling needs to postulate a mechanism. Morris and Shin (2004) model "liquidity black holes" as arising from price movements and common trading strategies of short-term investors:

> "liquidity black holes have the feature that they seem to gather momentum from the endogenous responses of the market participants themselves. Rather like a tropical storm, they appear to gather more energy as they develop. Part of the explanation for the endogenous feedback mechanism lies in the idea that the incentives facing traders undergo changes when prices change. Market distress can feed on itself. When asset prices fall, some traders may get close to their loss limits and are induced to sell. But this selling pressure sets off further downward pressure on asset prices, which induces a further round of selling, and so on. Portfolio insurance based on dynamic hedging rules is perhaps the best known example of such feedback."

Certainly market disruptions predated the widespread use of dynamic hedging, but not recognizing such mechanisms can overstate the protection these strategies provide, and result in more reliance on them and an understatement of the risk of increasing leverage. Dynamic hedging strategies need to be updated to include the possibility that the called-for trades cannot be completed as prescribed.

Typical ERM modeling emphasizes the risks to asset and liability values, but the current crisis has made it clear that liquidity risk has the potential to sharply undermine a company's financial position over and above price risks. Future ERM modeling will have to address liquidity risk as well as the existing price and value risks.

Basic liquidity risk is the chance of not having the funds available to pay liabilities due. But being forced to post collateral could be another type of liquidity risk, even if that collateral is technically an asset. More broadly speaking, realizing losses because of forced sale of immature assets, and even loss of investment opportunities due to cash constraints, could be included under the rubric of liquidity risk. With a severe market disruption, liquidity problems can be exacerbated when normally liquid assets become illiquid. These possibilities can all be reflected in model scenarios.

Liquidity management has features in common with capital management. Maintaining a stock of *liquid* assets can provide a liquidity cushion. Also matching cash flows of assets and liabilities, or at least some portion of them, can help manage liquidity risk. Contingency funding plans are a useful part of liquidity risk management as well, where less liquid assets are to be used as loan collateral. However this strategy may fail to work under a market disruption unless lines of credit are secured in advance, as even collateralized loans may become unavailable. Specifying the liquidity of various assets and liabilities in the model formulation and evolving them over time can incorporate liquidity into risk scenarios. For instance, Das and Hanouna (2009) discuss a few measures of liquidity.

Property-liability insurers use reinsurance as a cost-efficient substitute for capital, but in a disruptive event, reinsurance prices and availability can change sharply. Management of this risk could include having contingent capital sources in place, as well as including reinsurance terms that can expand coverage, such as additional rein-

statements. Again dynamic modeling should include the possibility of such liquidity issues arising.

Modeling liquidity risk can start with stress tests. The current market is one example of a stress scenario. A convergence of adverse asset, liability and credit availability situations can be postulated and the cash flows projected along with the value changes. Probabilistic scenario generation requires asigning probabilities to the stress scenarios and including them in a larger simulation. Having a model that predicts occasional market dislocations, such as Morris and Shin's, can help incorporate liquidity events in the scenarios. Certainly there is an interaction between price movements and liquidity movements that can be taken into account.

Such modeling can quantify the impact of liquidity risk on capital adequacy. Part of the problem is recognizing off-balance-sheet cash needs that can arise in a market disruption, such as collateral requirements, embedded options, refunds due to ratings down-grades, etc. This also emphasizes the utility of dynamic ERM models—models that include response strategies to various events. Dynamic ERM models can also benefit from the framework of timeline simulation, where events are simulated in order of occurrence and time stamped (see Kreps, 2009). What is now important in models is to have scenarios and responses take into account the possibility that other players are following the same strategies; liquid assets may become illiquid; off-balance-sheet commitments might be triggered, etc. Models for these possibilities and the interaction of price and liquidity are appearing in published theory, but nailing down reasonable probabilities for liquidity and corresponding pricing events could be an area of research for some time to come.

References

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