Forced Liquidation of an Investment Portfolio*

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Following the crisis that surrounded the downfall of long-term capital management (LTCM) in 1998, Myron Scholes raised an important and timeless problem: how should an investment manager liquidate a portfolio when competitors in the market trade to profit from one's misfortune? Specifically, he stated:

> In an unfolding crisis, most market participants respond by liquidating their most liquid investments first to reduce exposures and reduce leverage. ... However, after the liquidation, the remaining portfolio is most likely unhedged and more illiquid. Without new inflows of liquidity, the portfolio becomes even more costly to unwind and manage.
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> (Scholes 2000)

This problem, which I call the Scholes liquidation problem, is ubiquitous during unstable financial periods. Indeed, in the recent financial crisis, banks incurred large losses during the forced contraction of their balance sheets, as access to short-term financing through repo markets dried up (e.g., Adrian and Shin 2008; Brunnermeier 2009). A systemic deleveraging process propagated through the banking sector, in which careful liquidation became tantamount to preserving wealth and surviving the storm.

Previous work by Carlin, Lobo, and Viswanathan (2007) analyzes a simplified version of this problem: in an economy in which one asset is traded, how should a distressed participant sell off his holdings

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when there are predators in the market who can trade against him? In that paper, the asset is traded at the price

$$P_t = U_t + \gamma X_t + \lambda Y_t.$$

The first term is the expected value of future dividends, which is modeled as a martingale stochastic diffusion process with zero drift. The second and third terms partition the price impact of trading into permanent and temporary components. As described in Carlin, Lobo, and Viswanathan (2007), the permanent component of liquidity refers to a change in the price that is independent of the rate at which the asset is traded. This impact is likely to be high when the amount of asymmetric information associated with the asset is high or ownership of the asset in the market is concentrated. The temporary component of liquidity measures the instantaneous, reversible price pressure that results from trading. This component is likely to be high when the asset is thinly traded or there is a paucity of counterparties in the market.

In equilibrium, predators practice a "race-and-fade" strategy in which they first race the distressed trader to the market, but then reverse their trades to secure their profits. The amount of predation in the market, and hence the price volatility that ensues, is a function of both γ and λ. When the $\frac{\gamma}{\lambda}$ ratio is high, there is more price volatility. This occurs because there are greater incentives to predate when someone in the market needs liquidity. Indeed, when γ is high, there is a greater benefit to racing others to the market since predators would like to capture the profits associated with the permanent component of liquidity. Additionally, when λ is low, the cost of predation is also low because less surplus is given up during trade to long-term traders who form the competitive fringe in the market.

The analysis in Carlin, Lobo, and Viswanathan (2007) has important policy implications, especially if it is socially optimal to avoid price volatility. Specifically, their results shed light on how liquidity injection into the market impacts price volatility. From the discussion presented already, it should be clear that any policy change that decreases γ or increases λ should decrease both predation and price volatility. For example, when the government guarantees a residential mortgage-backed security, this decreases the requirement for investors to consider the monitoring incentives present during the origination of the loans. Such a decrease in asymmetric information should lower the permanent component of liquidity, and therefore decrease price volatility. In contrast, injecting liquidity in the form of lowering λ may increase price volatility. For example, establishing an entity whose mission is to purchase securities in the market will decrease the temporary impact of trading. Such a move may have the unintended consequence of increasing predatory activity and price volatility.

These implications are also central in the model posed by Chu, Lehnert, and Passmore (2009). Their work explores a multidimensional extension of Carlin, Lobo, and Viswanathan (2007) in which the prices of the assets in the market are given by the vector P_t, where

$$P_t = U_t + \Gamma X_t + \Lambda Y_t.$$

The three components of prices have the same interpretation, with one main difference: there are cross-price elasticities associated with trading each of the assets. That is, Γ and Λ are matrices in which the off-diagonal entries represent the permanent and temporary effects that trading in one asset has on the prices of other assets.

The work by Chu, Lehnert, and Passmore (2009) explores the effects that these cross-price elasticities have on predation, liquidity provision, and the policies outlined above. For example, they explore in detail the case in which there are two traders and two assets: one illiquid and the other liquid. They compare cases in which one trader is distressed and is exogenously required to liquidate either the illiquid asset or the liquid asset. In particular, they characterize the effects of such liquidation on trading in the alternate asset. They show that when an illiquid asset is sold in the market, the distressed trader will buy more of the liquid asset to improve the liquidity of their portfolio. Of course, the nondistressed trader will do the same to take advantage of price movements in both assets. The cross-price elasticities between the two assets determine the equilibrium rate of trade that is optimal for the distressed trader, given that they face adversity in the market from the nondistressed trader.

This advance does get us one step closer to understanding the solution to the Scholes liquidation problem, but does not allow us to address it directly. Specifically, the problems posed by Carlin, Lobo, and Viswanathan (2007) and Chu, Lehnert, and Passmore (2009) exogenously assume that there is a specific asset that needs to be liquidated. The model by Chu, Lehnert, and Passmore (2009) does explore the effect that this liquidation has on other assets in the portfolio. However, we still do not know how a trader chooses which assets to sell during a liquidation. That is, the equilibrium solution should endogenously describe which assets should be traded, given their effects on other assets.

One parsimonious way to approach this might be to model a distressed trader who chooses his trading strategies to generate a particular quantity of cash, given the cross-effects noted above. In such a setting, multiple assets might be bought or sold, but the goal would be to preserve value in the remaining portfolio, given that other traders are present who wish to again capitalize on the misfortune of the distressed trader. This is a more realistic, albeit more complicated, problem. Hopefully, though, with such an approach, the Scholes liquidation problem might be tackled. Characterization of this profound problem would have important academic and practical implications. Indeed, the derivation of this solution is ongoing work.

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