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SUMMARIES

Market Microstructure Applications to Investment Management

Ananth Madhavan, Barclays Global Investors
Speaker

In his presentation, Ananth Madhavan discusses how market microstructure is relevant to the world of investment management. Investment managers care about three things: abnormal returns or alpha, risks or beta, and costs. Market microstructure plays an important role in all three of these elements through liquidity and transaction costs.

There is growing theoretical evidence that liquidity matters in asset pricing. Liquidity affects asset prices in two ways. First, investors require higher expected returns for assets that are more costly to trade, thus the level of liquidity in a particular asset is important for asset prices. Second, liquidity has been shown to be a risk factor which enters into a factor return model. Furthermore, it appears that there are two sources of liquidity betas. Liquidity betas arise, on one hand, because there is commonality in liquidity, thus investors require compensation for holding illiquid stocks when the market as a whole is illiquid. On the other hand, assets whose returns are highly correlated with market liquidity also carry a premium.

There is also growing empirical evidence that liquidity matters in asset pricing. For instance, studies have linked changes in liquidity to security prices and asset returns, examined differences in the pricing of illiquid restricted stocks, illiquid OTC derivatives, and different share classes internationally, examined illiquidity based anomalies, and examined how momentum effects and drift anomalies are related to the time-series of liquidity measured from price impact. In particular, in a study by Ronnie Sadka, a liquidity augmented CAPM is found to be a substantial improvement in explaining the pricing of momentum and post-earnings announcement drift portfolios. Furthermore, there is evidence that the major declines in quant funds in early August 2007 were triggered by the liquidation

of a multi-strategy fund, illustrating the need to recognize and control for liquidity risk.

Market microstructure also matters for investment managers through transaction costs. Improvements in transaction costs modeling are a "low hanging fruit" for investment managers because, for one, it is easier to model costs than returns, but also because these models offer the opportunities to have more realistic back-tests, build better portfolios and improve execution.

Transaction cost models serve three purposes. First, they can be used in the execution and evaluation of trades where a transactions cost model is important in the decision of where and when to trade and is necessary as a benchmark to evaluate the execution of those trades. Second, transaction costs can be used in portfolio management to generate a trade list that delivers the highest possible alpha. Third, they can be used in back-testing to assess the performance of strategies with realistic trading costs. As an example, one stock might have a high alpha but high transaction costs which vary with the amount between traded as a proportion of average daily volume. If too much of the stock is being traded alpha might be wiped out completely, thus modeling these costs are important for portfolio choices.

Modeling trading costs is also important in improving trade execution. In particular, there are two questions of interest in this area. How do traders select among the choices of tactics they have available and can performance of trading desks be evaluated given the choice of tactics employed. This is particularly important since there is a principle agent problem when someone hands over his or her trades to a trading desk. These questions are answered empirically by examining over 100,000 order-level execution data from an anonymous buy-side firm. Trading costs can then be modeled as a function of stock characteristics such as market capitalization, price, market, etc. and trade tactics being selected. Trade tactics are assumed simply to be active or passive and are endogenously determined by other factors such as liquidity, information leakage, risk, and urgency. Thus, the trade tactics are estimated in a first pass regression, which determines the tactic that should be employed, and in a second pass estimation the costs are determined given the tactic. The findings of the first pass regression are that more active strategies are preferred in smaller capitalization, more volatile stocks that are not exchange-listed. Also, active tactics are preferred for higher liquidity demands and smaller trade values. The estimation of the cost model then yields the following findings. Costs increase with trade size, and volatility and decrease with market capitalization. Also, correcting for the selection of the tactic aggression increases costs. Thus, this model can be used to evaluate the performance of brokers controlling for the difficulty of the trades they were handed.

Finally, the advent of algorithm trading has potentially important ramifications for portfolio management. Instead of generating a trade list and handing in over to a trading desk, a portfolio optimizer can be made to directly execute trades. The mean–variance optimization can then be modified to account for trade tactics by modeling alpha and price impact as a function of aggressiveness. Thus, as technology evolves a closer alignment between investment decisions and execution will be made possible.

Dynamic Portfolio Analysis
Richard Grinold, Barclays Global Investors
Speaker

In his presentation, Richard Grinold develops a dynamic portfolio analysis model in which the portfolio is viewed as a moving object to capture the

essentials of a long–short investment management strategy.

The active long–short investment strategy modeled is the simplest system based on three principles: (1) Old information becomes stale, (2) new information arrives, and (3) trading occurs to close the gap between what the securities held and the securities that should be held.

The model has two parameters. The first, measures the rate of change of the information driving the strategy, and the second controls the speed of trading in the portfolio. Furthermore, the model can be used in both a descriptive and a normative manner. For instance, in the descriptive application, an investment strategy is observed and the values of the parameters are estimated for the purpose of understanding the portfolio properties. The model can also be used in normative manner in two different ways. At the strategic level, portfolio choices that differ in the speed and perceived strength of the information flow can be evaluated. At the tactical level, the rate of trading can be chosen in an optimal manner, given the speed and perceived strength of information flow and the level of costs. Also, since the overall purpose of the model is not to capture the detailed nature of the investment strategy but rather its most salient characteristics, the model works best at the aggregate level. Thus, the model makes use of many simplifying assumptions.

First, two portfolios and the laws of motion (difference equations) that govern their evolution are introduced. The first portfolio is simply called the model (M) and is a function of time. The second portfolio is called the portfolio (P), which is made up of the positions actually held when transaction costs are accounted for.

The first difference equation describes the information flow via changes in M. The second difference equation shows how P is adjusted to make it more like M.

The first difference equation describes changes in M. There are N assets and time is discrete. The portfolio is rebalanced at intervals Δ which can be a day, a week, or a month. Changes in M are then equal to: $\Delta m(t) = -g \times m(t - \Delta t) \times \Delta t + u(t)$. Thus, the change in M arises from the arrival of new information $[u(t)]$ and the fading of old information $[-g \times m(t - \Delta t) \times \Delta t]$.

The parameter g plays a leading role and constitutes the annual rate of information loss. It can be shown that the inverse of g is the average age of information in the model.

The second difference equation describes changes in P. Changes in P are equal to $\Delta p(t) = p(t) - p(t - \Delta t)$, which is the amount traded. The trade is linked to M by a second-difference equation: $\Delta p(t) = d \times \{m(t) - p(t - \Delta t)\} \times \Delta t$. The gap between M and P is called the backlog and it is closed at an annual rate equal to d. If there is no backlog no trade occurs.

Next, the model and portfolio characteristics are examined by linking them to the difference equations. Three characteristics are examined (1) the ability of P to capture M, (2) the exposure of both M and P to information age, and (3) the trade flow and trade risk of P. First, in regards to the ability of P to capture M, we have that P is less efficient if the information moves faster (g increases) and the speed of trading is held fixed. Correspondingly, P becomes more efficient as the speed of trading (d) increases while the speed of information flow is fixed. Second, M's ability to add value declines in lockstep with information age. P, however, is underexposed to the more powerful recent information. P is also overexposed to the older information. It is slow in shedding the positions that it built up, although they are now largely depleted of any ability

to add value. Third, if $\Delta p(t)$ is the change in P in the period from t to $t + \Delta t$, then the ratio $\Delta p(t)/\Delta t$ is the annual rate of change, which will be called the trade flow. The unconditional expected value of the trade flow is zero, as at any time the likelihood to be buying or selling any asset is equal. The variance of the trade flow is the trade risk. If Ω is the N by N asset covariance matrix, trade risk is $E(\Delta p'/\Delta t \times \Omega \times \Delta p/\Delta t)$. The trade risk measures both the speed of trading and the risk of the assets that are being traded.

Applying data to the model yields a surprisingly abundant set of results. The framework is useful to characterize the efficiency of the implementation, analyze and explain many aspects of a given strategy, and optimize the rate of trading.

How to Define Price Manipulation
Albert S. (Pete) Kyle, University of Maryland
Speaker

Price manipulation is a familiar concept in legal, financial, and economic circles. However, despite being widely used the term "illegal price manipulation" is not currently defined under United States law and it is often used in an imprecise manner in the finance and economics literature. For Albert S. (Pete) Kyle, the litmus test of illegal price manipulation is when a trading strategy simultaneously undermines economic efficiency and makes markets less liquid for risk transfer. Since price effects are market-wide the terms "price manipulation" and "market manipulation" can be viewed as interchangeable. This definition applies equally to the financial and commodities markets.

Financial markets improve welfare in two ways. First, the prices that arise from trading in the financial markets offer a valuable signal to producers which is used to allocate resources efficiently. Thus, more accurate prices allow resources to be allocated more efficiently. For example, when a corn farmer increases his plantings as a response to high prices, he relies on the price for his production decision. Second, markets allow risks to be transferred to those most willing to bear it. Thus when market liquidity or market depth increases it becomes less costly to transfer risk. For instance, when a grain merchant chooses to hedge a greater fraction of his inventory because market liquidity improves, he relies on the liquidity of the market to determine the manner in which risks are allocated. However, some traders enhance price accuracy at the expense of market liquidity and vice-versa. On one hand, informed traders make prices more accurate but because of adverse selection increased informed trading comes at the expense of market liquidity. On the other hand, noise traders make prices less accurate but their participation increases market liquidity and reduces the adverse selection problem.

Therefore, illegal price manipulation should be defined as a trading scheme which undermines both price accuracy and market liquidity and thus unambiguously reduces welfare.

According to this definition, "corners" or "squeezes," and "pump-and-dump" schemes, as well as fake transactions and failure to make truthful disclosures, all constitute illegal price manipulation. A "corner" or "squeeze" scheme consists in obtaining a sufficiently dominant position in an asset thereby making it costly for traders with short positions to acquire the asset for the purpose of making delivery. This scheme creates an artificially high price in the cornered asset which compromises price accuracy. Furthermore, if market participants anticipate the market the asset to be cornered they will withdraw liquidity as adverse selection increases. For an asset to be successfully cornered the manipulator must finance his long position in such a way that the asset is not loaned to traders who may have short positions. Thus, a corner can be

diagnosed from intentional use of off-the-street financing.

A "pump-and-dump" scheme consists in acquiring a large long position in an asset, then divulging false positive information regarding the asset before selling it at a profit. This scheme clearly jeopardizes price accuracy but also reduces market liquidity by undermining the credibility of truthful releases of information.

False disclosures also constitute illegal price manipulation because they simultaneously make prices less accurate and reduce market liquidity. Furthermore, reverse "corners" and "squeezes," reverse "pump-and-dumb" strategies also qualify as illegal price manipulation.

The strategies which would not qualify as illegal price manipulation include routine hedging even with market power, routine market making even with market power, routine speculation where there is an attempt to make a profit based on legitimately acquired private information or based on providing a risk-bearing service, market bluffing and mixed-strategies, and "punching the close."

Speculation makes markets more informative and more liquid. Whereas hedging makes markets more liquid for others as well as market-making. Bluffing and mixed-strategies consist in an informed trader with bullish information to mix some sell trades (bluffing) into his overall buying strategy. By implementing this strategy the trader extracts more liquidity, increases the liquidity for others, and encourages the production of private information. In a cash-settled derivatives contract, an outcome financially and economically equivalent to making or taking delivery can be achieved by replacing expiring long or short positions with purchases or sales in the cash market at the moment of expiration which is sometimes referred to as "punching the close." This is not illegal price manipulation because the buyer is supplying some liquidity in the same way a market maker would.

Finally, the proposed definition of illegal price manipulation is consistent with United States case-law which implements a four-part test involving ability, intent, causation, and artificiality.

Lawrence Leibowitz, NYSE Euronext,
Keynote Speaker

Lawrence Leibowitz, the Group Executive Vice President, Head of US Markets and Global Technology at NYSE Euronext, discussed the transition of the New York Stock Exchange from a member owned exchanged to a for-profit public company.

The principle improvement has been the increasing focus of the NYSE on client satisfaction and technological innovation. For instance, with the introduction of the Hybrid Market, NYSE customers can now send orders for immediate electronic execution, or route orders to the stock exchange floor. The fully electronic method has the advantage of speed, completing orders in fractions of a second while manual transactions may take up to a few seconds.

Furthermore, the avenues of trading have greatly increased over the last few years and Lawrence Leibowitz discussed the technological improvements at the NYSE geared to compete against these other trading platforms.

Panel Discussion
Peter Jenkins, NYSE Euronext,
Ian Domowitz, Investment Technology Group,
and **Robert Ferstenberg,** Morgan Stanley
Chaired a Panel

Ian Domowitz, discussed the performance of algorithmic trading engines versus manual trading in

Dark Pools. Dark Pools are crossing networks that provide liquidity not displayed on order books. Dark pools are useful for investors who wish their orders to remain anonymous. Thus, Dark pools allow investors to hide the information they possess. Dark pools represent 15%–20% of the overall market.

Robert Ferstenberg, uses proprietary data on block trades to model in a multivariate setting transaction costs as a function of stock characteristics, market conditions and order aggressiveness. More aggressive strategies are more costly in terms of transaction costs and more aggressive strategies have higher price reversals. The overall conclusion is that institutional shareholders appear to be too much in a hurry when trading large blocks because there is a substantial amount of money left on the table when more aggressive block trades are conducted.

Valuable Information and Costly Liquidity: Evidence from Individual Mutual Fund Trades
Donald B. Keim, University of Pennsylvania
Speaker

Mutual funds are an important investment vehicle for consumers throughout the world and mutual fund performance largely depends on the cost and performance of the fund's trades. Yet, because mutual fund regulators have generally not required funds to report their trades many questions on how mutual fund performance relates to the funds trading activities have remained unanswered. In particular, cash flows into and out of funds and the accompanying trading transactions they require has been an issue of long-standing interest. The trading costs associated with cash flows have been recognized as potentially impeding fund performance and a drawback of open-end funds in general. However, cash flows might affect mutual funds differently depending on whether they are actively managed or are index funds. Active fund managers have some latitude to avoid demanding liquidity where it is in short supply whereas index funds do not. In principle, however, the lack of information contained in index fund trading should give these funds lower spreads. Thus, how cash flow into and out of open-end funds affect firm performance is still and open question. Another open question is the relationship between fund size and trading cost and performance.

The presentation answers many of these questions by analyzing a unique dataset of Canadian mutual fund trades. Until June 2005, Canadian mutual funds were required to report all their trades with a maximum 60-day delay on an annual and semi-annual basis to the Ontario Securities Commission. The rule however did not precise reporting guidelines therefore the data vary across fund family. Only funds reporting transaction dates are kept in the sample. The final sample consists of 210 unique mutual funds, with transaction data ranging from January 2001 to December 2003, which represents about 15% of the total net assets in the Canadian mutual fund industry. The sample contains transactions on 99,988 buys ($29.4 bill) and 67,061 sells ($24.56 bill). The data contains the security traded by the mutual fund, the trade date, and the dollar amount. Other data are obtained from Morningstar, CRSP (for US equities), Datastream (for Canadian equities), TAQ (US intraday data) and TSX Trade and Quote (Canadian intraday data). Trade costs are calculated using the Value-Weighted Average Volume (VWAP) benchmark.

The first question asked is what are the determinants of fund's trade costs. The explanatory variables examined are (1) an indicator variable as to whether the stock traded is Canadian or from the United States, (2) an indicator variable for whether the fund is actively managed or an index fund, (3) an indicator variable for whether the fund traded the stock at any time during the week prior to the trade,

(4) the log of the market capitalization of the traded stock, (5) the average daily trade volume for the traded stock, measured over the 20 trading days prior to the trade and divided by the stock's total shares outstanding, (6) the ratio of dollar value of shares traded to market capitalization, (7) the log of the total net assets of the fund, (8) the log of the total net assets of the fund sponsor, (9) the proportional bid-ask spread at the close of the day of the trade, and (10) the indicator variable for whether the cash flow in the fund is positive or not. The OLS regression of results with VWAP as the dependent variable show that, as in previous research, trade size and liquidity-related are important determinants of trade costs. The pertinent results are that trade breakup reduces trading costs, that indexers have higher costs than active managers, that fund flows lead to higher trade costs when they necessitate sales rather than buys, and that larger funds enjoy lower trading costs but larger fund families do not.

The second question asked is whether the post-trade performance of the stock related to information captured by trade-, stock-, and fund-specific variables. This question is answered by examining the subsequent excess returns of the stock's traded at the 1 week, 1 month, and 3 month horizons. The findings are that larger trades predict poor subsequent performance, that trades precipitated by fund flows have flat or poor post-trade performance, active fund trades outperform index fund trades primarily in the near term, that larger funds and fund families exhibit better trade performance, and finally that trade breakup leads to better trade performance. These results suggest that active managers add-value through information as well as through lower trade costs, and that the greater resources available to large funds and fund families improve performance. In addition, the fact that trades related to fund flows have flat or poor performance is indicative of the lack of information in these trades and the fact that trade breakup leads to better performance suggests that information concealment by mutual funds is a valuable strategy.

The third question asked is whether trading costs are related to subsequent performance. This question is answered in two steps. In a first stage, a measure of expected trading costs is estimated based on fund and stock characteristics. In a second stage, excess returns are regressed on the expected measure of trading costs, expected trading costs interacted with a proxy on the information content of the trade and controls. The results are that more costly trades are related to higher performance. Furthermore, if informed trades include a cost related to the price impact of the information the coefficient on the interaction term will be positive and significant for buys and negative and significant for sells. This is found to be the case.

Overall, the results show the cost of the open-end structure since fund flows result in trades with higher trade costs and no or poor post-trade performance. The findings are also that trade breakup and larger funds have lower costs and better post-trade performance. Finally, active funds add value through lower trade costs as well as better post-trade returns.

What Happened to the Quants in August 2007?
Andrew W. Lo, Massachusetts Institute Technology
Speaker

During the week of August 6, 2007, many prominent hedge-funds experienced unprecedented losses. Strangely, these hedge-funds were confined almost exclusively to funds using quantitative strategies, with the hardest-hit funds employing long/short equity market-neutral strategies that, by construction were supposed to be immune to most market gyrations. Furthermore, these hedge-funds had little exposure to the troubled credit markets

and equity and credit markets movements during that time were fairly uneventful. Then on August 9, 2007, as the S&P 500 dropped 3% for the day, most of the market-neutral funds continued their losses calling into question their market-neutral status.

Andrew Lo, in his presentation gets to the bottom of this riddle by examining some indirect evidence about the profitability of long–short equity strategies over the past decade and during the week of August 6, 2007. The performance of a specific long–short equity strategy is simulated to see if the losses during August 2007 can be recreated. The long–short equity strategy performance of August 2007 is then contrasted to that of August 1998 when the Long-Term Capital Management (LTCM) debacle occurred.

The specific long–short equity strategy chosen consists in buying (long position) the previous day losers (underperforming relative to the equally weighted market portfolio) and selling (short position) the previous day winners (outperforming the market benchmark). The strategy invests an equal dollar amount in the long and short positions. This strategy is often called contrarian because it benefits from market over-reaction. Moreover, this strategy benefits from supplying liquidity to the marketplace by buying the losers, which are stocks with excess supply, and shorting the winners, which have excess demand. Thus a contrarian strategy plays a market-making role, which has stabilizing effects on the marketplace. Looking at the performance of this particular long–short equity strategy over the period 1995–2007 and in different market capitalization deciles reveals four things. First, the performance of such a strategy is fairly impressive. In 1995, for instance, its daily return was 1.38%, which translates to 345% per year assuming 250 trading days. Second, the enormous turnover of such a strategy reveals the importance of automated trading platforms, electronic communications networks, and mathematical optimization algorithms, without which the implementation of such trades would not be possible. Third, the contrarian strategy is more profitable in smaller market capitalization firms, although the transaction costs to implement such a strategy for those firms is likely to be much higher. Fourth, there is a secular trend of declining average returns in the strategy. For instance, the profitability of the strategy drops to an average 0.44% daily return in 2000 and to 0.13% by 2007. In order to maintain the same returns as in 1998, an 8.96 leverage ratio is needed.

The simulated contrarian strategy is able to recreate the losses that occurred on August 7 through August 9, 2007. Using a leverage ratio of 8:1, the daily returns of the strategy were $-4.64\%, -11.33\%, -11.43\%$ on the 7th, 8th, and 9th of August 2007, respectively. On the 10th of August 2007, the return of strategy strongly rebounded with a 23.67% return. Thus, the simulated strategy is able to explain what happened to many long–short equity hedge funds around that time. By the close of business on August 9, 2007, the leverage contrarian strategy lost a little over a quarter of the assets it started off with 3 days before. Furthermore, the rebound on August 10 was likely to be of small comfort to portfolio managers who cut their risks as a result of the previous day losses.

In comparison to the August 1998 the August 2007 losses are even more amazing. On August 17, 1998 Russia defaulted on its government bonds, causing a global fight to quality that widened credit spreads which, in turn, generated extreme losses for LTCM and other fixed-income arbitrage hedge funds. In contrast to August 2007 where an apparent demand for liquidity caused a firesale liquidation that is easily observed in the contrarian strategy's daily returns, the demand for liquidity in the fixed-income arbitrage space of August 1998 had little or no impact on this strategy. This difference suggests a greater financial integration in 2007 than in 1998. While this development can be viewed

positively, the greater integration creates increased risks of financial contagion.

The large losses, on August 2007 were very likely caused by the liquidation of one or several large market-neutral hedge-funds during those days. Only a sudden liquidation would cause the strategy to face such large loses in the absence of any other significant market development, and market-neutral funds were the likely culprits since the S&P 500 and the MSCI-ex-US indices actually showed gains making it unlikely that long-biased funds were unwinding their positions.

The sudden unwind of a large equity market-neutral portfolio likely had a spill over effect on other funds, including quantitative long-only funds. This is because any factors used to create market-neutral portfolios would have also generated losses for other portfolios which use those factors. Looking at the cumulative returns of S&P 1500 factor portfolios using the CS AlphaScoreCard factors from July 2 to September 30, 2007 shows that the small-size, price-reversal, traditional-value, and relative-value factors all faced substantial declines starting in July 2007, whereas the other CS factors had positive cumulative returns, suggesting possibly that the unwind started in July 2007 and affected other quant funds.

Thus, the large quant fund losses of August 2007 are likely to have been caused by the rapid and large unwind of a market-neutral hedge fund, possibly due to the credit market woes, which in turn forced other quant funds to reduce risk and de-leverage their positions, causing further losses in a broad set of equity funds.

Looking at the price impact of trades over the August 2007 period shows a sudden rise in illiquidity peaking during the week of August 6th before dropping again. This is further evidence that the losses on August 7th, 8th, and 9th were due to a liquidity shortfall and that the rebound was spurred by investors realizing they could profit from supplying liquidity. The rebound in itself is evidence that the previous losses were generated by illiquidity as opposed to a fundamental change, which would have had a permanent effect on prices.

The events of August 2007 provide several lessons to the financial markets. First, the financial markets are much more integrated than in 1998 and the returns of different hedge-fund strategies are also much more inter-connected. Second, hedge-funds can add and withdraw liquidity rapidly with important consequences to the financial markets. Third, the low return environment for hedge-funds has spurred increases in leverage which exacerbates fund fluctuations. Overall, these observations lead to the realization that systemic risks in the hedge-fund industry are increasing. These lessons can be important for the possibility and direction of regulation in the hedge-fund industry.

Liquidity of Corporate Bonds
Jiang Wang, Massachusetts Institute of Technology
Speaker

There is some evidence that the lack of liquidity appears to be an important feature of the corporate bond market. For instance, daily volume in the corporate bond market as compared with the total stock available for trading is low compared with the treasury and equity markets. Additionally, yield spreads on corporate bonds are hard to justify with fundamentals such as default risk, which may be attributed to a liquidity premium. Finally, there is excess short-term volatility in bond returns, which may be due to a high price impact of trade.

This presentation examines the liquidity of corporate bonds by constructing a measure of illiquidity estimated using the magnitude of bond price

reversals. In the absence of theory, a precise definition and quantification of illiquidity remain elusive. However, at least two properties of illiquidity are clear: first, it arises from market frictions, and second, its impact on the market is transitory. These two properties motivate the construction of an illiquidity measure based on price reversals. If a bond price is assumed to be based on two components: a fundamental value component which follows a random walk and a transient component which is a gauge of illiquidity. Then the transient component, and thus illiquidity can be extracted by estimating the negative auto-covariance of bond returns, which is denoted by gamma.

The illiquidity measure or gamma is estimated using transaction level data from the TRACE (Transaction Reporting and Compliance Engine) database. On July 1, 2002, TRACE began Phase I of bond transaction reporting, requiring that transaction information be disseminated for investment grade securities with an initial issue size of $1 billion or greater. Phase II, implemented on April 14, 2003, expanded reporting requirements, bringing the number of bonds to approximately 4,650. Phase III, implemented on February 7, 2005, required reporting on approximately 99% of all public transactions. To maintain a balanced data the Phase I only period and the Phase III period are eliminated to create a sample of Phase I and Phase II bonds from April 14, 2003 to December 2007. To be included in the sample bonds must have prices available for at least a full year and must trade on at least 75% of all business days. The final sample consists of 1,249 bonds with an average maturity of 6.84 years, an average issued amount of $867 million, and an average age of 4.15 years.

The first finding is that illiquidity in corporate bonds is highly significant in all years studied with an average gamma coefficient varying between 0.50 and 0.66. Furthermore, the significance of the gamma coefficient cannot simply be explained by the bid-ask bounce. Interestingly, the magnitude of mean-reversion is not symmetric in the sign of the initial price change. In a simple theory of liquidity based on costly market participation the bounce-back elect should be more severe conditioning on an initial price movement that is negative, predicting a positive difference between a gamma conditioned on a negative price change with one conditioned on a positive price change. This difference is indeed positive and significant.

The second finding is that it is possible to devise a trading strategy that profits from supplying liquidity. To address this question, a simple contrarian strategy is created that takes a long position in a bond when its price moves downward by more than a threshold, and takes a short position when the price moves upward by more than the threshold. For the full sample and a trading strategy with a zero threshold in price changes, the average daily profit per bond is a significant $2.88 for a $100 notional position.

Next, the cross-sectional determinants of illiquidity are examined. The main finding, here, is that older bonds and smaller bonds have higher illiquidity. There is also higher illiquidity for bonds with smaller average trade sizes and higher idiosyncratic return volatility.

The monthly fluctuations in the illiquidity measure are then examined by aggregating the illiquidity for all bonds. After decreasing markedly and relatively smoothly during 2003 and the first half of 2004, aggregate illiquidity reversed its trend and climbed up in late 2004 before spiking in April/May 2005. The rise in illiquidity during that period coincides with the downgrade of Ford and GM to junk status in early May 2005. The illiquidity measure then resumed its downward trend until August 2007. At that point it rose sharply to an unprecedented level since the beginning of the sample period. The sharp rise corresponds to the sub-prime mortgage

crisis hitting the market and credit conditions in the United States precipitously worsening. A principal component analysis of the illiquidity measure is conducted and it is found that there is strong commonality in the illiquidity measure of bonds. Moreover, monthly changes in aggregate illiquidity are strongly related to changes in the CBOE VIX Index.

Finally, in a cross-sectional regression of yield spreads against the illiquidity measure and controls, it is found that the illiquidity measure is positive and significant.

The Subprime Crisis: Lessons for Risk Management
Robert J. Shiller, Yale University
Speaker

In his presentation, Robert Shiller discussed his upcoming book titled "Subprime Solution: How today's global financial crisis happened and what to do about it."

Robert Shiller starts by observing that there is a disconnect between the scientific culture on one hand and the humane culture on the other. He laments that because of this disconnect Economist are not sufficiently consulted in finding solutions to the current global financial crisis. This is reflected in the many proposals currently circulating to assist subprime borrowers. These proposals involve, in one way or another, a bailout, the consequences of which have not been well thought out. For instance, the Dodd–Frank proposal of expanding the Federal Housing Administration (FHA) role to insure troubled mortgages is a bailout because it could result in the FHA having liabilities that will come at the expense of taxpayers. This bailout sends a potentially bad message to the homeowners who took responsible actions by not getting a loan they could not afford. Furthermore, for Robert Shiller, the Term Auction Facility where the Federal Reserve will auction term funds to depository institutions is also a bailout. All advances must be collateralized but there is a lemon's problem in that the depository institutions know more about the quality of the assets put up for collateral and are therefore going to give their worst assets. Also, since the Term Auction Facility is not an expansion of credit and is thus monetary policy neutral, it is not likely to solve the current crisis. Thus, financial theory appears to be absent from the current solutions to the subprime crisis. Furthermore, the prevailing rational for a bailout stems from a domino theory of the financial system where if one financial institution collapses its repercussions will be felt across the entire sector. Hence, a bailout responds to the need to mend the institutions with the poorest health. Instead, Robert Shiller proposes that we view the financial sector crisis as a disease epidemic where the focus is on preventing the healthy from becoming sick.

The current focus on solving the subprime crisis should thus be to rely on financial theory, to understand previous real estate crises, and to focus on innovating the financial system. In terms of financial theory it is important to understand how risks are spread and the moral hazard implications of a bailout. Also, there should be a focus on behavioral finance. Furthermore, it is important to look back in the past and examine previous crises. For instance, the great depression created a large decline in real estate prices. Between 1925 and 1933 real estate prices declined roughly 30%. In comparison, real estate prices have declined around 15% so far. It is interesting that the previous real estate crisis was centered on Florida with the advent of the automobile making that area a valuable vacation destination. Finally, the current solutions to the subprime crisis should involve far reaching innovations in the financial sector. For instance, the great depression saw a major overhaul of the financial sector and many institutions were created such as

the Federal Home Loan Bank Board, the Federal Deposit Insurance Corporation, the Federal Housing Administration, the Securities and Exchange Commission, Fannie Mae, the Appraisal Institute, and the Investment Company Institute, among others.

Robert Shiller's proposals fit into three broad categories. First, we should improve the current information infrastructure. Second, we need to create new markets. And third, we need to create new retail institutions.

The first proposal to improve the information infrastructure includes six elements. The first element is to subsidize financial advice so that it is affordable to lower income people. Also, it is important that this advice be disinterested. The second element is the creation of a business conduct authority which informs consumers against dangerous financial products. The third element, is to create a default option for consumers. Many consumers for instance do not sign on to company sponsored 401K plans because of the hassle of enrolling. A default option would automatically enroll them unless they opt otherwise. The fourth element is to create trained notaries who would read carefully the terms of the loan and relay this information to the consumers. The fourth element is to improve disclosure. The fifth element is improving and centralizing data on occupational income and home prices to better credit scores. And finally the sixth element is create new words in our language to reduce the confusion over financial terms such as inflation indexed unit.

The second broad proposal is to create new markets where real estate and real estate derivatives are traded internationally in a liquid market. This same concept can also apply to personal income flows.

Finally, the third big proposal is to create new retail institutions. In particular a new mortgage instrument needs to be created which offers mortgage lenders and borrowers to renegotiate the terms of the loan on a continuous basis before financial difficulty occurs. Another instrument needed is home equity insurance and occupational insurance which allow households to protect themselves against the loss of home equity and occupational income, respectively.

Deciphering the 2007/2008 Liquidity and Credit Crunch

Markus K. Brunnermeier, Princeton University
Speaker

In his presentation, Markus Brunnermeier discusses the run-up to the 2007/2008 liquidity and credit crunch, how the crisis unfolded, the financial mechanisms at work, and compares the current crisis with previous ones.

The run-up to the current crisis can find its roots in the dramatic transformation of the banking structure over the previous two decades. The traditional banking model consisted of banks originating mortgages and loans, which were kept on the banks' balance sheets. Recently, however, a new model has emerged in which banks originate loans and subsequently repackage them in a portfolio to create so-called structured products. Some examples include, Collateralized Debt Obligations (CDOs), which are backed by a portfolio of debt, Collateralized Loan Obligations (CLOs) backed by a portfolio of loans, and Collateralized Mortgage Obligations (CMOs) backed by a portfolio of mortgages. These portfolios are then sliced into tranches of differing risks before being sold-off to investors. Forming a portfolio exploits the power of diversification, while tranching allows different parts of the portfolio to be marketed to investors with different risk appetites. The safest tranche (often referred to as super senior) offers investors a relatively low interest rate but is the first to be paid from the pool. The most junior

tranche (often referred as to "toxic waste") receive payment only after all other tranches have been made whole. Tranches in between the two are called mezzanine tranches. Furthermore, the tranching is conducted in such a way as to insure a specific rating for each tranche.

Contemporaneously, banks have created off-balance sheet vehicles (conduits and Structured Investment Vehicles, or SIVs) that shorten the maturity of long-term structured products by buying long-term assets and financing their purchase with mostly asset-backed commercial paper (ABCP) with an average maturity of 90 days. ABCP's are backed by the assets of the vehicle. The strategy of buying long-term assets with higher interest rates and borrowing short-term paper exposes these SIVs to funding liquidity risk which is alleviated by the credit lines which are granted by the sponsoring banks.

There are several reasons why structured products are beneficial. First, they complete the markets. Second, they transfer risk to the investors best able to bear it. For instance, pension funds which are limited by their charter to only buy AAA rated assets can now participate in the mortgage market by buying the safest tranches of CMOs, whereas hedge funds can focus on the risker tranches. However, there were also dubious reasons for the popularity of structured products. Regulatory and ratings arbitrage was one them. Moving loans off the balance sheet allowed banks to replace the 8% capital charge required by the Basel I accords with the much lower rate required on the credit lines necessary to sponsor SIVs. Furthermore, SIV securitization allowed banks to engage in ratings arbitrage by allowing them to raise AAA rated capital as opposed to capital raised with their own lower rating. This rating arbitrage was optimal since the rating agencies did not fully adjust the banks' own ratings for extending credit lines. Another suspect reason is that managers of large funds sought to enhance their portfolio returns and allowed them to take on highly leveraged positions without having to explicitly state them. Furthermore, the fund managers might have viewed the illiquidity of such investments positively, since they carry a liquidity premium and, in the absence of prices, managers can mark-to-model allowing them to smooth their monthly returns thereby making these investments look less risky. One last questionable reason, was that structured products seemed relatively attractive to investors who took credit ratings at face value and ignored the fact that they received a more favorable rating compared to corporate bonds. "Rating at the edge" might have contributed to the diference in standards because the safest tranches were always sliced in such a way that they would barely make the cutoff for the AAA rating.

The "originate and distribute" banking model creates several perverse consequences. First, since banks only hold risky loans for a short time before selling them off their incentives to carefully approve loan applications and to monitor them once approved is drastically reduced. Instead the banks' primary focus is on the pipeline or warehouse risk created by the loans, which are waiting to be passed on. Second, the banking model creates a distance between the borrower and the lender, which is a source of complexity and opaqueness. Thus, the consequences of securitization have been a deterioration of lending standards, which resulted in a housing frenzy and a private-equity bonanza.

The unfolding of the crisis started in early 2007 with an increase in sub-prime mortgage defaults. This led to the downgrading of several structured products. A back of the envelope calculation puts the total losses stemming from the sub-prime market to around $500 billion. This loss alone is not able to explain the full extent of the 2007/2008 crisis as it amounts to a roughly 2% change in the stock

market. Thus, an amplifying mechanism is needed to explain the problems facing the credit markets.

What really hurt the banking sector was the resulting drying-up of the ABCP market, which was used to finance SIVs. The drying up of short-term funds made SIVs draw on the credit lines of sponsoring banks. As a result several European banks needed to be bailed-out, including Northern Rock, which experienced a bank run before being nationalized by the UK government. Meanwhile, the sub-prime problems spilled-over to the corporate bond market, possibly because of a concerned on how to value structured products in general and doubts on the reliability of credit ratings. Furthermore, the credit crisis was most likely the root cause of the large losses incurred by quant hedge-funds as they needed to unwind their positions to draw liquidity for their beleaguered credit related funds.

Thus, there were mechanisms at work amplifying relatively small shocks and triggering liquidity spirals which ultimately resulted in a full-blown financial crisis. The first mechanism at work was a collateral crisis, caused by increased volatility and initial losses, which created a liquidity spiral. Initial losses cause funding problems for speculators requiring them to reduce their positions. This in turn makes prices move away from fundamentals, thereby exacerbating losses on existing positions and creating the need for higher margins, furthering funding problems for speculators. The second mechanism at work is a collateral crisis caused by information asymmetry. Financiers become especially careful about accepting assets as collateral if they fear receiving a particularly bad selection of existing assets. They might, for example, be worried that the SIV that issues ABCP sold the good, "sellable" assets and left as collateral the bad, less valuable "lemons." The third mechanism was a traditional run on financial institutions. The fourth mechanism is gridlock risk where one institution cannot repay its obligations until it receives payment from another. The opaqueness of structured products makes gridlock worse by inhibiting multilateral netting of accounts. The fifth mechanism is precautionary hoarding where financial institutions increase their funding cushion. Finally, the sixth mechanism, is Knightian uncertainty, where investors focus on the worse case scenarios because they are unable to assign probabilities to different outcomes.

Overall, the 2007/2008 crisis resembles many previous ones in which the common theme is the interaction between funding and market liquidity. However, the traditional elements of the crisis are exacerbated by liquidity spirals and a new level of opaqueness engendered by structured products and off-balance sheet vehicles.

Are Hedge Fund Managers OverPaid?
Peter Muller, Morgan Stanley
Speaker

In his presentation Peter Muller examines two questions. First, what is the right price to pay someone who creates excess returns? And second, is there a structure which aligns incentives between the investors and the managers?

Currently, most hedge-funds have a 1/20 structure where there is a 1% management fee and hedge-funds get to keep 20% of profits. Under this structure if LIBOR is assumed to be 6% simple calculations show that the hedge-fund's gross returns need to be around 8% before investors receive any money. Under a 3/30 structure that gross return grows to 11% and under the highest compensation structure of 5/44 (Medallion Fund) the gross return is 15%. To answer the question of whether these fees are too high is difficult and depends obviously on what the performance of these funds have been. In the case of the Medallion Fund returns have been

between 35% and 40% and there is no anecdotal evidence that investors were unhappy with their compensation structure. However, in the case of Amaranth Advisors investors were greatly unhappy with that structure considering the large losses they faced.

Peter Muller argues that hedge-fund managers are not so much overpaid or underpaid as they are incorrectly compensated. He proposes a different form of hedge-fund compensation structure. The goals of a compensation structure are threefold. First, investors should pay for value-added. Second, investors ought to have the right to remain invested with the hedge-fund if they choose so. Third, there should be disincentives to grow the funds' assets if no excess returns are generated.

The compensation structure that Peter Muller proposes meets these goals and consists of five elements. The first element is that investing in hedge-funds should be viewed as a long-term contract between the investors and the fund managers where long-term is considered to be roughly 5-years. Second, investors should not have to pay a management fee but simply fund expenses. Management fees to not give incentives for managers to generate abnormal returns and therefore should be eliminated. Third, when alpha is created it should be divided equally among managers and investors since they both participated equally in the process. Managers provided the human capital necessary to generate that alpha and investors contributed the funds. The fourth element is that this incentive fee needs to remain at risk for a period of time (possibly 5 years) so that there is no free ride. Thus, if in 1 year the fund losses money managers ought to repay a portion of the previously acquired incentive fees. Finally, if hedge-funds create an asset management vehicle which is then sold off, the investors should receive some of the proceeds since they were equal partners.

Overall, this compensation structure is possible to implement. The practical considerations of such a plan are that it might be necessary for investors to have equity infusions in order to pay for initial expenses and allow for a smoothing of cash flows. It is also a fair compensation plan since it treats managers and investors as equal partners.