Liquidity and Asset Prices

An asset is liquid if it can be traded at the prevailing market price *quickly* and *at low cost*. This paper shows that in addition to risk, liquidity affects asset prices and returns. Traditional theories of asset pricing suggest that asset returns are increasing in risk because investors are risk-averse. We demonstrate that, in addition, asset returns increase in illiquidity, because investors want to be compensated for the costs of illiquidity. That is, asset pricing depends on two asset characteristics: risk and liquidity.

This paper surveys our research on the effects of liquidity on asset prices and returns. We find that liquidity is an important factor in capital asset pricing and suggest that portfolio managers should explicitly consider the liquidity effect in their investment decisions.

1. What Is Illiquidity?

Illiquidity reflects the costs of executing a transaction in the capital markets. These costs (AMIHUD/MENDELSON, 1991b) include the following components:

(1) *Bid-ask spread*, which is the difference between the buying and selling prices (respectively), quoted by dealers, market-makers and investors. Market-makers supply liquidity by standing ready to buy and sell at the quoted prices, thus providing for a continuous and liquid market. The bid-ask spread represents a cost to investors because a pair of simultaneous "round trip" buy and sell transactions incurs the full bid-ask spread.

(2) *Market-impact costs* reflect the price discount of a large sell order or the price premium paid for a large buy order, both beyond the quoted bid-ask spread (which can be considered the market impact of standard size orders). The market impact thus represents an additional cost to investors.

(3) *Search and delay costs* are incurred when a trader looks for better prices than those quoted on the exchange, or searches for, say, buyers when selling a large block in order to reduce the market impact costs. While saving on cost components (1) and (2), the trader bears instead additional search and delay costs. These costs include direct costs as well as the risk borne while the orders wait to be executed.

(4) *Direct trading costs* including exchange fees, taxes and brokerage commissions.

These four components of transaction costs are highly correlated: assets with high bid-ask spreads often suffer from large brokerage commissions, large market impact and high search and delay costs. Further, the four attributes of illiquidity can often be substituted for one another. For example, investors turn to "upstairs" dealers (thereby incurring

larger fees as well as search and delay costs) to reduce the market impact of a large order; or traders send orders to the opening of trade to reduce the bid-ask spread [1] while increasing their delay cost, because their order has to wait for the opening of trade.

2. How Does Liquidity Affect Asset Prices?

We have developed [2] a model that shows how liquidity affects asset prices. In our model, assets are characterized by their transaction costs, and investors - by their investment horizons. Investors maximize the expected present value of the cash flows generated by the assets they invest in, including the costs of transacting.

In equilibrium, the return on an asset is an increasing function of its transaction cost. This is because, as one might expect, investors require a compensation for bearing these costs. In equilibrium, the return-illiquidity relation reflects investment clientele based on investors' holding periods: The more liquid assets are allocated in equilibrium to short-therm investors, whereas the long-term investors hold the less-liquid assets. Consequently, the illiquidity effect is more prominent for more liquid assets, because they trade more frequently and hence are more sensitive to transaction costs.

We present below empirical evidence on the liquidity effect. First, we demonstrate that the cross-sectional variation of stock returns is explained by liquidity and systematic (β) risk differentials. Then, we examine the effects of liquidity on bond yields. Then, we examine evidence on the impact of trading restrictions on stock prices, and we conclude with evidence on the impact of liquidity over time during the stock market crash of 1987.

2.1 Liquidity and stock returns

For stocks, our liquidity effect suggests a positive relation between the bid-ask spread and risk-adjusted average returns. We tested this relation using 20 years of data on NYSE stocks (AMIHUD/MENDELSON, 1986, 1989). We formed 49 stock portfolios grouped by their bid-ask spread and by their β (systematic risk) coefficient, seven groups for each ($7 \cdot 7 = 49$). Then, we estimated the relation between the bid-ask spread and the portfolios' average returns (in excess of the 90-day T-bill rate), controlling for β. The empirical results were consistent with the theoretical predictions: average returns were increasing in the bid-ask spread, and the rate of increase was lower for portfolios with higher spreads.

Table 1 (based on AMIHUD/MENDELSON, 1986b) summarizes empirical results for our seven spread groups (with group 1 having the lowest bid-ask spread and group 7 having the highest bid-ask spread). The table shows that required returns increase with the illiquidity of the stock group. For example, the average monthly return on stocks in group 1 (that had an average spread of 0.486%) was

Table 1: The Relation between the Bid-Ask Spread (in %) and Required Monthly Risk-adjusted Returns (in %) for Seven Spread Groups (AMIHUD/MENDELSON, 1986a).

Spread Group	Average Spread (%)	Excess Required Return *	Relative Value**
1	0.486	0.000	100.00
2	0.745	0.164	85.91
3	0.939	0.082	92.42
4	1.145	0.242	80.52
5	1.396	0.322	75.64
6	1.774	0.509	66.27
7	3.208	0.681	59.49

Note:

* The excess required returns in this column are relative to the required return on spread group 1 (normalized to 0). For example, the average required monthly risk-adjusted return on stocks in spread-group 2 is 0.164 percentage points higher than for stocks on spread-group 1.

** The relative values were calculated assuming that the required monthly return on stocks in spread-group 1 is 1% (leading to a benchmark value of 100).

0.322% lower than the average monthly returns on stocks in group 5 (whose average bid-ask spread was 1.4%). On average, each 1% increase in the spread was associated with a 0.2% higher monthly required return.

The increase demanded in required return for more illiquid assets *decreases* as we move towards the more illiquid assets. For example, comparing groups 1 and 2, we see that an increase of approximately 0.26 percentage points in the spread was associated with an increase of 0.16 percentage points in the required return. However, comparing groups 4 and 5, we see that an increase of approximately 0.25 percentage points in the spread was associated with an increase of only 0.08 percentage points in the required return. These results are consistent with the clientele effect discussed above.

The last column of table 1 shows the effects of liquidity on asset *values*. Assume that the required monthly return on the lowest-spread group (group 1) is 1%. Then, the value of $1 invested in group 1 is $100. Using this number as a benchmark, the last column of table 1 shows the corresponding value for each of our seven spread groups. Clearly, liquidity has a paramount effect on asset values. For example, if the cash flows generated by an asset give rise to a market value of $100 in group 1, changing its liquidity to that of group 7 will cut its value down to $59! This difference is large, showing that illiquidity costs play a significant role in de-termining asset values.

Table 1 shows that the effect of illiquidity on asset values is large. Intuitively, this happens because illiquidity costs are incurred *repeatedly*, whenever the stock is traded. To see this, consider for example a stock that has illiquidity costs of 3% of its value and has a turnover rate of 50%, i.e., the stock trades once every two years on average [3]. If the discount rate is 8% over the investment horizon and the 3% illiquidity costs are associated with every trade, the present value of the illiquidity cost stream is

$$0.03 \cdot \sum_{t=0}^{\infty} \frac{1}{1.08^t} = 0.03 + \frac{0.03}{1.08} + \frac{0.03}{1.08^2} + \ldots = 0.21$$

Thus, over a long horizon we find that 21%, or about *one-fifth* of the value of the stock is represented by the illiquidity costs. In other words, the price of the stock must reflect the full present value of the costs associated with trading it over its lifetime. This total illiquidity cost is significantly higher than the one-time cost of 3%.

2.2 Liquidity and bond yields

We tested our liquidity effect theory on bonds (AMIHUD/MENDELSON, 1991a) by examining the differences in liquidity and in yields of U.S. treasury bills and notes with less than 6 months to maturity. For these maturities, both are discount instruments and if they have the same maturity, they both have identical underlying cash flows. However, Treasury bills are much more liquid than notes. For example, the average bid-ask spread on bills in our sample was 0.00775%, whereas the average bid-ask spread on bills was 0.0303%. The brokerage fees are $12.5 to $25 per $1,000,000 value for bills and $78.125 per $1,000,000 for notes.

Because notes are less liquid than bills, our theory predicts that their yields should be higher than those of bills with the same maturity. We tested the liquidity effect using data from the quote-sheets of First Boston Securities over 37 randomly-selected days between April and November of 1987. We matched each note with two bills whose maturities straddled it, giving rise to 489 triplets of matched notes and bills with essentially the same maturity. Then, we calculated the (annualized) yield to maturity on the notes and the bills.

The results are presented in table 2. The average yield differential between notes and bills was 0.43 percentage points per annum with a standard error of 0.021 percentage points, highly significant. This strongly supports the liquidity effect: the notes, which had lower liquidity, compensated for their higher transaction costs by higher yields.

Thus, we found that liquidity differences strongly affect the pricing of bonds: the lower the liquidity, the higher the yield to maturity. We expect to find

Table 2: Estimated Means and Standard Deviations for the Relative Bid-Ask Spread and Annualized Yield to Maturity for 489 Triplets of Notes and Bills.

	Spread (%)	Yield (%)
Notes (N)		
Mean	0.0303	6.523
S.D.	0.0004	0.606
Bill 1 (B1)		
Mean	0.00761	6.039
S.D.	0.00547	0.756
Bill 2 (B2)		
Mean	0.00801	6.137
S.D.	0.00664	0.677

Note:
Each note is matched with two bills whose maturity dates straddle the note's: Bill 1 just precedes it (i.e., has less days to maturity) and Bill 2 just follows. The data consist of 37 days during April-November 1987. (AMIHUD/MENELSON, 1991a).

this relation in other segments of the bond market. For example, government bonds which are just issued -"on the run" bonds - are most liquid and have a slightly lower yield than seasoned bonds that were issued earlier and are less liquid.

2.3 Restricted stocks

That illiquidity exacts a toll in terms of price discounts is clearly seen from the evidence on restricted stock. Some U.S. companies whose stock is publicly traded issue stock which is identical in all rights to the publicly traded one except that it cannot be traded in public markets, and its sale is subject to restrictions [4]. Thus, we observe two securities - the publicly traded stock and the restricted stock issued by the same company - with the only difference between them being in their liquidity.
Naturally, the restricted stock, whose liquidity is lower, has a lower price. In a recent study, SILBER (1991) found that the price of restricted stocks is on average 33.75% lower than the price of the publicly traded stock of the same companies. The median difference was 35%. This price discount is about the same as that found twenty years earlier in the SEC's Institutional Investors Study (1971), and is also often observed in court cases which determine the values of restricted stock. There are large differences in discounts between the restricted stocks of various companies. Silber found that the discount is decreasing in the revenues and earnings of the company which indicate good creditworthiness. Also, the discount depends on the existence of a special relation between the restricted stockholders and the company, implying better monitoring.
The conclusion is that lower asset liquidity, even if temporary, leads to considerable lower asset prices.

2.4 Liquidity and the stock market crash

We have shown that differences in liquidity between assets affect their prices. It is also expected that *changes* in liquidity of assets should change their prices. We have shown this in the context of the October 1987 stock market crash. In general, market liquidity deteriorated during the Crash to levels not hitherto experienced in the U.S. securities markets. Orders could not be promptly executed, which means lack of liquidity, and information on execution and other market data were available with a considerable time lag. There were expectations of the closing of the markets, which is the ultimate illiquidity. Thus, the Crash taught investors that the markets are not as liquid as they originally thought. By our theory, this should be reflected in lower asset values.
In our study of the Crash on a sample of NYSE stocks included in the S&P 500 list (AMIHUD/MENDELSON/WOOD, 1990), we found that on October 19th the dollar bid-ask spread increased by more than 63% compared to its pre-Crash level, and the quote size (the amount which dealers are willing to execute at the quoted prices) also showed a dramatic decline. A similar decline in liquidity was

also found in London, where the bid-ask spread of the most liquid stocks increased from 1.2% prior to the Crash to 3.4% on the Crash day and remained at about 3% through November. The sharp decline in market liquidity came after a period when investors had believed that the market had the capacity to process sufficiently large order flows with a very small effect on prices. This was reflected, for example, in the belief that portfolio insurance transactions and program trading will not adversely affect market liquidity. This belief was, however, dented in the sharp price declines on the week before the Crash, which made investors realize that the market is not as liquid as had been previously thought. This downward revision in investors' expectations regarding the liquidity of the market was reflected in the price declines that followed.

By our liquidity-effect theory, stocks that suffered a relatively greater decline in liquidity should have experienced greater price declines. We tested this on our sample by relating the price declines of each stock (relative to the market) to the increase in its bid-ask spread. The results support our theory: The stocks whose bid-ask spread increased relatively more on the day of the Crash suffered greater price declines. Adding the quote size as a measure of liquidity we also found that the price declines were greater for stocks whose quote size shrunk more than the average.

We also examined how the recovery in stock prices by the end of October 1987 was related to the recovery in liquidity. Indeed, the average market bid-ask spread somewhat narrowed, but it was still almost 40% higher than its pre-Crash level. We found that the price recovery was greater for stocks whose bid-ask spreads became narrower. This provides further support to our liquidity-effect theory. We also found that in the wake of the Crash, the market grew to appreciate liquidity more so than before, leading to a "flight to liquidity:" stocks with a higher level of liquidity were in demand after the Crash and enjoyed a relatively greater price recovery. The conclusion from our evidence on the 1987 Crash is that changes in asset liquidity over time results in value changes. This means that security analysis should incorporate liquidity considerations. Just as expected increases in profitability or a decline in risk should lead to an increase in the price of a stock, so should an increase in its liquidity.

3. Conclusion

We have shown that the expected returns on capital assets depend on their liquidity (or marketability) in addition to risk. For both bonds and stocks, *the greater the illiquidity of an asset, the greater its return*, after controlling for risk. Further, the effects of liquidity or asset values and returns are larger than one would naively expect, because the costs of illiquidity are incurred repeatedly, whenever the asset is traded.

These results have important implications for investments, corporate financial decisions and public policy. Securities analysis should incorporate, in addition to cash-flow and risk considerations, the liquidity of the security and possible changes in it. In selling new securities, attention should be given to their liquidity in order to increase their price. And companies should employ strategies [5] to make their publicly-traded securities more liquid. Finally, our results suggest that there is a public policy interest in increasing market liquidity, because this would reduce required returns and the associated corporate cost of capital [6].

Footnotes

[1] There is no bid-ask spread at the opening.
[2] AMIHUD/MENDELSON (1986b).
[3] This is the average turnover rate on New York Stock Exchange stocks.
[4] It should be noted that the inferior liquidity of restricted stocks is temporary, because they can usually become publicly traded within a period of two to four years.
[5] Such strategies are detailed in AMIHUD/MENDELSON (1988).
[6] See AMIHUD/MENDELSON (1991b).

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