Liquidity Black Holes: what are they and how are they generated

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This article was published in the Singapore Foreign Exchange Market Committee Biennial Report, 2001-2002. Thanks go to Natalia Alvarez-Grijalba of State Street and Stephen Spratt of Sussex University for statistical assistance.

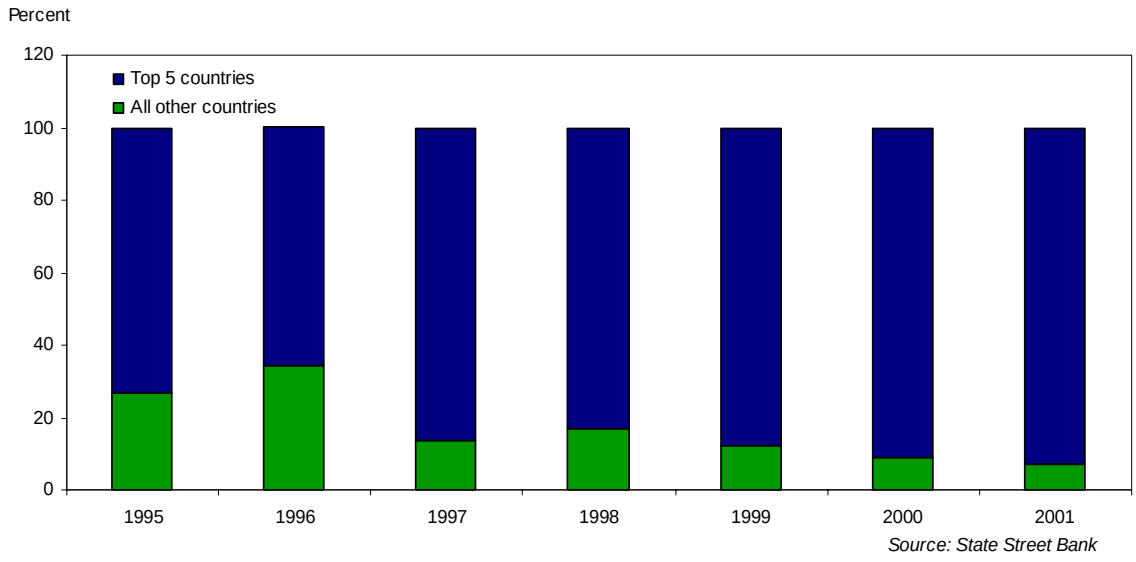
Why does liquidity matter?

Financial liquidity matters. In general market participants have a strong preference for trading in the most liquid markets, which partly explains the recent pressure for mergers and cross-listing agreements between stock markets and the consolidation of electronic bond and currency exchanges. In a series of partnerships and cross-listings, European exchanges have coalesced around two groups and the London Stock Exchange is expected to enter into a partnership or merger shortly. The Singapore and Australian stock exchanges have entered into a partnership designed to support liquidity.

As important as the level of liquidity, is its *uncertainty*. In an age where there is an intolerance for risks that cannot be quantified, investors avoid markets altogether where liquidity is uncertain. This is one of the reasons why portfolio flows to emerging markets are concentrated in a very small number of large markets, see chart 1. There is some evidence that investor preference for liquidity increased following the collapse of LTCM in September 1998, a hedge fund whose arbitrage strategies fatally depended on the maintenance of liquidity.

It is of particular concern, therefore, that traders frequently talk of episodes in which the liquidity faced by a buyer or seller of a financial instrument virtually vanishes, reappearing again a few days or weeks later. Moreover, these liquidity black holes, as I have coined them, are not confined to the usual suspects such as the Indonesian rupiah market in August 1997 or the South African rand in April 1998, but are said to occur in the largest markets. Traders regularly swap war stories about liquidity black holes in the dollar/yen or sterling/dollar exchange rate or the US Treasury market. Liquidity black holes were certainly present in the collapse of major equity markets outside Asia in 2002.

Chart 1: The proportion of gross cross-border equity flows to 17 emerging markets accounted for by just five markets.



Source: State Street Bank

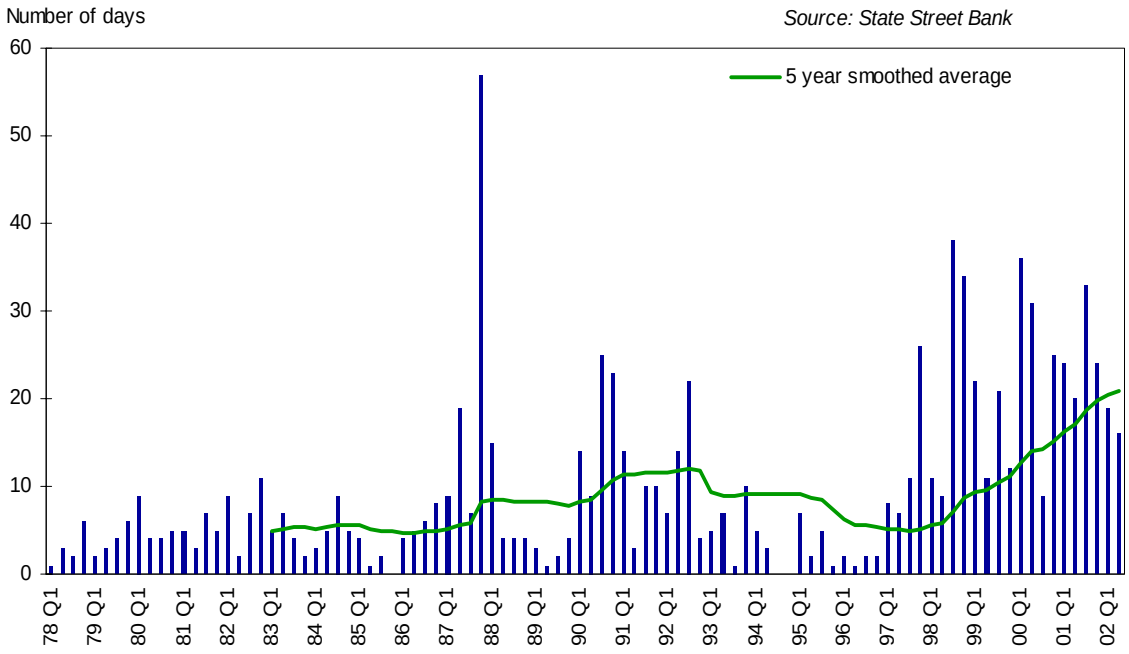
Issues of concept and definition

Liquidity and volatility are related, but separate concepts. A lack of liquidity will in most cases lead to volatility and so the rise in volatility in major financial markets is supportive of the traders' anecdotes, see chart 2. But it is not proof. Liquidity black holes will lead to higher volatility, but not all instances of higher volatility stem from a liquidity black hole. The public announcement of new and surprising information which leads traders to move their bids significantly to a new level will appear as price volatility, but reflects a well functioning market moving to a new equilibrium, not an illiquid one.

An ill-functioning market would be one where that public announcement causes the price of an instrument to fall and that fall then causes some market participants to sell, pushing the price lower still, causing more to sell. Price falls triggering further sales. This is what is said to have occurred in dollar/yen trading in September 1998, or in the 30 year US Treasury market in February 2001 or in the UK equity market this year as UK insurers responded to price declines by selling equities. The kind of price move observed in a feedback loop like this is of a very different character to the original public announcement effect. In this unstable environment liquidity to sell (or buy) virtually vanishes only to reappear when the market stabilises. By a stable market we mean a market where buyers are brought out by lower prices and sellers by higher prices.

This definition opens up a dimension of horizons. A market may have many micro-black holes when looked at over periods of a few minutes, but is stable when looked at over periods of a few days. The longer these periods last the more concerning they are. We are concerned with time periods long enough - say a few days and perhaps as long as a week - for liquidity black holes to yield significant costs to those who are dependent on trading on a particular day, say month or quarter end, or long enough to change an investment decision or at least potentially to do so. An increasingly large number of financial contracts use a market price of an instrument on a specific date or time on the assumption that the market price will reflect underlying valuation and not liquidity.

Chart 2: The number of days in a quarter that the average price of the three largest equity markets has moved by 2 standard deviations more than the average daily price move



A hypothesis about liquidity black holes and diversity

The presence of liquidity problems in the largest of markets suggests that liquidity is not about size, but diversity.

In an illiquid market the same size of sell order will push the market down further than in a liquid market. Imagine a market where there is a large number of market participants, using the exact same information set, in the exact same way, to trade the exact same financial instruments. When one buys they all do and vice versa. Market participants would face volatility and illiquidity when they came to buy or sell. This would not be reduced by having more players, only by increasing the amount of diversity in their actions. (Indeed, on these assumptions it is possible to show that the bigger the market was, the less liquid it would be). Now imagine a market with just two players but with opposite objectives or opposite ways of defining value. When one wants to buy the other wants to sell. This market is small, but the price impact of trading would be low and liquidity would be high.

At first sight, our imaginary market where there is no diversity is far from reality. However, only a few changes are required to bring us to a reality filled with black holes. There are markets which are large in terms of daily turnover but are dominated by a few instruments. As information costs have collapsed we increasingly share the same information, by and large, and regulatory forces are encouraging more timely and democratic disclosure of company information. We do not start off using this information in the same way, as in our extreme example, however, we may end up doing so as a result of a combination of uncertainty and the use of common, market sensitive risk management systems.

In an uncertain world, market participants collect in herds. If I feel I don't know where I should be going but I think others may know, my best strategy is to follow what others are doing. Moreover, if governments bail out financial firms only when their combined failure will impact the financial system, but not when an individual failure will leave the system unscathed, there are far more risks to being wrong and alone than being wrong and in a crowd. This is why banks have an uncanny habit of making spectacular investment mistakes together such as during the Latin American debt crisis of the early 1980s, the property crash in the UK and Scandinavia in the late 1980s, the Asian financial crisis in the mid-to-late 1990s and the dot.com debacle at the turn of the decade.

Market-sensitive risk management systems require market participants to reduce their exposure to risk when volatility rises and/or prices decline. In response to a negative shock, a herd, using market sensitive risk management systems will sell the same instruments at the same time and the further price decline will trigger further sales raising volatility which will also trigger further sales. Market-sensitive risk management systems are prevalent and are becoming more so. They take many forms. They include sophisticated value-at-risk systems used by banks and risk limits imposed on their traders or margin calls. There are also solvency tests for insurers or limits on pay-out rates. Regulators are overly fond of market-sensitive risk systems especially when they focus on the micro institutional aspect of risks to the neglect of the macro-prudential aspects.

Markets prone to black holes

The foreign exchange market is one of the largest markets in terms of daily turnover with an estimated $1.5trn of foreign exchange spot and forwards traded every day. It is dominated by just three major instruments. Dollars, yen and euros are on one side of over 80% of foreign exchange transactions. Just 12 banks account for 75% of all foreign exchange trading. These large international banks have been encouraged by regulators to use market sensitive risk management systems. In short, FX is a large market dominated by few instruments and few players, using similar information sets and decision rules. It should be rife with liquidity black holes despite its enormous size.

The bond market is not quite the exact opposite, but nearly so. In recent years the largest bond market, the US Treasury market, has shrunk and turnover has fallen off. Because US government bond yields are global benchmarks they are traded and held by a diverse set of players from banks and insurance companies to pension funds, mutual funds and central banks. Being benchmarks they are used for many different things - investments, pricing for issuance, hedges, safe-havens etc. The large role played by the public sector and quasi-public sector who are not regulated as private financial institutions adds considerably to diversity of players, strategies and decision rules. Bond investors also have a large number of alternatives to choose beyond US Treasuries with diverse maturities, size of issue and credits. There are more bond instruments than equity instruments.

If diversity is key, the 10 year US Treasury market - a global bond benchmark - should have less liquidity black holes than the dollar/yen market. If size was key, however, equity markets would have more liquidity black holes, bonds next and major currency markets last.

Table 1: Ranks of diversity and turnover

Ranks – 1 = most, 3 = least

	Players	Instruments	Risk Management	Turnover
Bonds	1	1	1	2
Equities	2	2	2	3
Currencies	3	3	3	1

A test:

To test for liquidity black holes and the ill or well functioning of markets we want to investigate the direction of causality between price changes and positions. The key casual relationship is how past returns influence current trades. In a well functioning market we should find a negative casual relationship – when prices go up, market participants sell and when prices go down, market participants buy see figure 1. If LBHs are present we would expect the opposite casual relationship, a positive feedback trading effect where price rises causes more purchases and price falls cause more sales – see figure 2. To separate these relationships we use a direct Granger-causality analysis using a two variable autoregression of market positions and returns (see figure 3). This is a well-established procedure made popular by J. Hasbrouck (Journal of Finance, 1991).

Figure 1: No liquidity black holes

		Endogenous variables	
		Return	Signed trade
Explanatory variables	Past returns	–	–
	Past signed trades	+	+

Figure 2: A market with positive-feedback trading and liquidity black holes

		Endogenous variables	
		Return	Signed trade
Explanatory variables	Past returns	? / –	+
	Past signed trades	+	+

Figure 3:

$$r_t = \sum_{i=1}^{r} \alpha_i r_{t-i} + \sum_{i=0}^{r} \beta_i x_{t-i} + \varepsilon_{1t}$$

$$x_t = \sum_{i=1}^{r} \gamma_i r_{t-i} + \sum_{i=1}^{r} \delta_i x_{t-i} + \varepsilon_{2t}$$

rt = return from t-1 to t

xt = 1 if buyer initiated trade at t, 0 if no trade at t, -1 if seller initiated trade at t

Data

To carry out our empirical tests we use publicly available, weekly data for five years of purchases and sales of futures contracts on the Chicago Board of Trade, for 10 major market instruments – 5 currencies versus the dollar, 3 slices of the US bond market and 2 major equity markets. This data is more extensive in the breadth of instruments covered and length of data series than used in some related studies on market liquidity, but it poses a few hurdles.

Ideally we would examine daily position data on the spot market. That said, given the strong coincident and lagged correlation from daily orders to daily prices, we would be more likely to find spurious correlation from prices to orders using daily data. At a weekly level it is highly unlikely that the relationship between orders to data spills over into the relationship between prices to orders. In this regard, using weekly data is more robust than using daily data. In a similar vein using futures prices instead of spot prices should also work against a spurious positive correlation. Futures prices might be expected to exhibit less positive feedback than spot prices because using futures is a lower

risk and less capital intensive way of expressing the stabilising view that the current market move is related to non-fundamental factors and will eventually be unwound. A positive coefficient on a weekly basis would be, therefore, all the more surprising and more significant to see.

Results

There is a statistically significant positive co-efficient between past returns and current positions in the case of all of the foreign exchange instruments and a statistically significant negative coefficient for the bond instruments. The equity instruments show signs of becoming less negative over time. See table 2.

Table 2: The statistical significance of the Granger causality vector auto-regression of last week's price to this week's orders

T - Statistic	1992/93 - Jan 97	Jan 97 - Jun 99	Jun 99 - Jun 02
CAD	6.08	3.53	4.50
CHF	5.51	5.27	4.01
JPY	4.31	3.98	3.47
AUD	4.62	2.44	3.04
MXN	-0.78	2.34	3.02
NASDAQ	-2.69	-0.29	1.03
2yr Treasury note	0.42	-0.18	-0.26
10yr Treasury note	0.60	-5.04	-0.75
SP500		1.32	-1.10
5yr Treasury note	-0.45	-1.61	-2.09
Average FX	3.95	3.51	3.61
Average Equity	-2.69	0.52	-0.04
Average Fixed Income	0.19	-2.28	-1.03

Implications and conclusions

The results in table 2 show surprisingly strong evidence that liquidity black holes are prevalent in currency markets, not so much, but increasingly so in equities and not in bond markets. Within the currency markets the dollar/yen exchange rate, one of the "largest" exchange rates in terms of turnover appears rife with liquidity black holes. The "smaller" Australian dollar also exhibits liquidity black holes, but less so than the yen. The result are broken up into three periods in order to isolate the impact of the last major currency crisis, the Asian financial crisis.

These results imply that diversity is key to liquidity and yet it continues to receive little direct attention by those trying to support financial market liquidity. Indeed the actions of financial market regulators - charged with ensuring we have smooth functioning markets - are often, indirectly and inadvertently, to reduce diversity. It is interesting that the currency markets exhibit more black holes than bond markets. Not least because many of the forces which have reduced diversity in the currency markets are emerging in bond markets. There is increasing consolidation in industry players and exchanges. There is a worrying trend by regulators to insist that the market sensitive risk management systems used by the banks – big players in foreign exchange markets – are also used by insurance companies – big players in the bond markets.

Diversity matters and probably more so than size in the development of liquid financial markets. Markets can be large, but prone to troublesome liquidity black holes if they are not diverse. This can be seen in the foreign exchange markets today and there are worrying signs that diversity is falling in other major financial markets. Diversity relates to numbers of players and instruments, but in markets prone to herding, a critical role is played by the diversity of decision rules. Market-sensitive risk management systems reduce diversity of decision rules and the encouragement by regulators for these systems to be used across industry players will increase the number of liquidity black holes.

This is avoidable. Good risk management does not mean the use of the same decision rules. Indeed, investors with different investment objectives are ill served by risk-management systems which lead them to behave in the same way as other investors. The mantra of regulators should not be high and common standards, but high and diverse standards. In this way regulators may take advantage of the observation that if poor diversity can make large markets illiquid, then good diversity can make small markets more liquid than their size would suggest.