Fundamental Value and Limits to Arbitrage

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Many academics and policymakers think that asset prices have deviated significantly from "fundamental values" and that this deviation is part of the problem affecting financial institutions. For example, if mortgage and credit assets, which banks hold in plenty, are currently priced below "fundamental values," then banks will be assessed larger losses than they otherwise would. This in turn can lead to binding bank capital requirements, concerns over banks defaulting, etc.

But, what is fundamental value, and how can one make these sorts of statement? The notion that one can accurately assess fundamental value on the most toxic mortgage-backed securities should be rightly treated with some suspicion. However, there is considerable evidence that arbitrage forces, which we normally take to be the key enforcer of fundamental value relationships, are not present in today's environment. This is circumstantial evidence for fundamental value deviations.

Below I discuss two pricing relationships which reflect these distortions. The examples are somewhat involved; but bear with me because they are not as complicated as they sound, and they are illuminating.

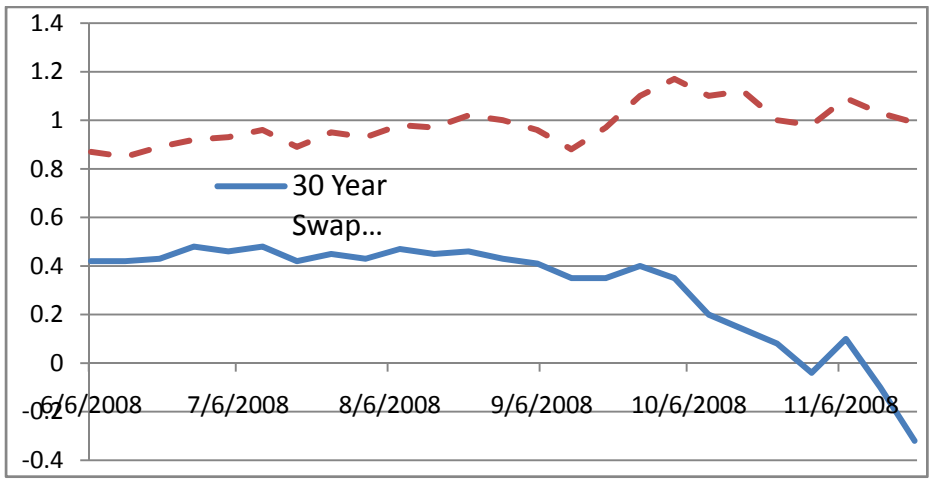

Figure 1: Swap Spreads in % (source: Federal Reserve)

Figure 1 graphs the interest rate swap spread for maturities of 5 years and 30 years. The 30 year swap spread measures the difference between 30 year Treasury rates and 30 year fixed-for-floating (LIBOR) interest rate swap rates. Since the swap rate reflects LIBOR which in turn reflects bank credit risk, swap rates are almost always higher than Treasury rates. However, since September there are a number of dates on which the 30 year swap rates have been below Treasury rates (while the usual pricing pattern prevailed for all other maturities – see the 5 year spread on the graph). For example, on November 20 the 30 year swap rate was 20 basis points below the 30 year Treasury. Market participants ascribe this reversal of the usual pattern to an unwinding of long-term swap trades by a number of players. However, the fact the spread was negative suggests that the other side of the market must have been lacking. Arbitrageurs' capital that would otherwise enter to take advantage of the negative 20 bp spread was absent.

To see why the negative spread is anomalous, consider the following trade. An arbitrageur could purchase $100 worth of a 30 year Treasury, say at 4%. Using the Treasury as collateral, he can do a repurchase agreement where he pays the repo rate to finance this purchase, and then roll over this financing every 3 months in the repo market, paying the then prevailing repo rate. He can then do a fixed rate swap paying 3.80% and receiving 3-month LIBOR, where the LIBOR rate is reset every 3 months. The cash-flows from these trades are as follows:

Treasury Purchase:	*Receive 4% per annum for next 30 years*
	Pay 3-month repo rate, rolled every 3 months, to finance the purchase
Swap Trade:	*Pay 3.80% per annum for next 30 years*
	Receive 3-month LIBOR rate, reset every 3 months, for next 30 years

First note that the trade eliminates all interest rate risk. If, for example, interest rates rise, both the 3-month repo rate as well as the 3-month LIBOR rate will rise. If they rise one-for-one, the change in interest rates is offset. The only source of interest rate risk is if they don't rise one-for-one – but as I argue, such risk works in the arbitrageur's favor in this case.

LIBOR rates have been between 100 and 300 basis points (i.e. 1% to 3%) above the Treasury repo rate recently; historically this spread is always positive and averages closer to 40 basis points. Thus, based on current values, the difference between the LIBOR receipt and the repo payment earns the arbitrageur 100 to 300 basis points currently. While this profit may revert to 40 basis points eventually, it will always remain positive. The latter is because LIBOR reflects unsecured bank financing, and repo rates reflect financing secured by Treasuries as collateral. When the financial world goes into a panic, the spread rises (as has been the case recently), so that the "risk" goes in the arbitrageur's favor. The trade also earns a fixed rate differential of 20

basis points. Moreover, if the swap spread turns positive, the arbitrageur can unwind the trade at a profit. The trade has "positive carry" and substantial upside.

Why is this trade not being done in sufficient size to eliminate the negative swap spread? There are three "limits to arbitrage" that may be at work here. First, the trade requires capital: haircuts and collateral for the repo and swap. There is little risk capital in the marketplace now, given the losses suffered by financial institutions. Second, many practitioners have noted that the repo market is currently not functioning well; volume of trade has fallen and many money funds have withdrawn from the triparty repo market. Last, the swap is a bilateral contract with another party, and given the counterparty risk concerns present currently an arbitrageur may be reluctant enter a swap. These three frictions are all possible, and the fact that they have significantly affected pricing relationships indicates how *distorted asset markets are currently*.

The latter is the key take-away from the swap spread example. If prices on such a simple trade are distorted because normal arbitrage forces do not operate, what is the state of the pricing on more complicated assets?

Let us consider an asset that is one step more complicated to value but closer to the heart of the current crisis. Figure 2 graphs the option-adjusted spread on the 30-year Ginnie Mae 6% TBA mortgage-backed security (MBS). Since a mortgage offers a homeowner a put option (i.e. prepayment), to compare the MBS yield to other bond market interest rates, one has to strip out the value of the option. The option-adjusted spread presented in the figure is computed based on Bloomberg's built-in prepayment model. If the computation is precise, the spread reflects the excess return one can earn from buying the MBS. Although Bloomberg's computation is probably not precise in this sense, my observations below focus on how the spreads move up at the "right" times, rather than on the absolute level of these spreads.

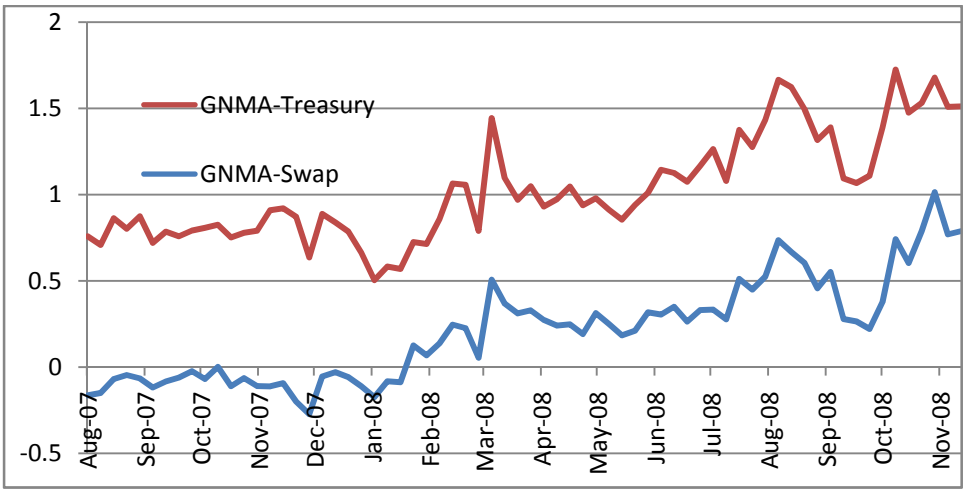

Figure 2: OAS in % on GNMA 6s (source: Bloomberg)

The blue line graphs the spread on the Ginnies versus the interest rate swap (i.e. LIBOR) curve. The Ginnies carry the explicit "full faith and credit of the U.S. government" and are therefore as safe as Treasuries. Moreover, if a homeowner defaults on a mortgage, the U.S. government absorbs any losses, paying par to the holder of the mortgage-backed security. Thus there is no default issue with these securities, and the risks as with all MBS, are prepayment risk and interest rate risk. Ginnies also have much higher underwriting standards than subprime mortgages, so that the typical equity buffer is on the order of 20%.

Prior to February of 2008 the spread is negative reflecting the low credit risk that comes with the explicit government guarantee. The first blip upwards in the spread is in March with the Bear Stearns event. Bear Stearns was an important player in the mortgage market, and thus one read of this graph is that the capital devoted to pricing and bearing MBS risk shrank in the Bear Stearns event. The next blip upwards in the spread is at the end of July, corresponding to the problems with Fannie Mae and Freddie Mac. Although Ginnie Mae was not directly affected in this event, the problems in Fannie and Freddie further shrank the risk-capital in the mortgage market. The spread increases again the week of September 26 (data is weekly in the graph). Note that since the spread is measured relative to swaps, and LIBOR was also affected during this event, the spread rise is not initially dramatic.

While I am pointing to only a few data points to identify these limited arbitrage effects, so that other explanations may also be consistent with the data, I have collaborated on other work studying longer time-series and cross-sections of MBS to show that the MBS market does exhibit significant limits of arbitrage effects. See Gabaix, Krishnamurthy, and Vigneron (2007).

The upper (red) line in the graph reflects the MBS spread relative to Treasuries. The high spreads reflect a phenomenon that is common in crises: investors especially value the liquidity of Treasuries, pushing the spreads relative to Treasuries up on all securities. The spread patterns are broadly similar to that of the lower (blue) line. The low point in the spread occurs the week of September 12 (again, data is weekly).

These high spreads on a security which has no credit risk points to the scarcity of arbitrage capital in the marketplace and the large effects that this shortage can have on asset prices. For financial institutions, this observation is important because it suggests that the value of financial claims reflecting future mortgage risk is especially low. Hence the losses on financial institutions balance sheets are larger than they would otherwise be if prices were at fundamental value. For households and the mortgage market more generally, the high Ginnie Mae spread implies that homeowner mortgage rates remain at high spreads relative to Treasuries. Thus, it helps explain why mortgage rates have remained high despite the general drop in interest rates as reflected by the Federal Funds rate or the rates on Treasuries.

If the prices on these two low-risk assets – swap spread and Ginnie Mae MBS – can be as affected by market disruptions, we can surmise that more risk-sensitive assets such as the senior tranches on subprime CDOs must be more affected. Thus, it is very likely that asset prices are far from fundamental values.

References and Further Reading:

1. Gabaix, Xavier, Arvind Krishnamurthy and Olivier Vigneron, 2007, "Limits of Arbitrage: Theory and Evidence from the MBS market," *Journal of Finance*, 62(2), 557-596.
2. Krishnamurthy, Arvind, 2002, "The Bond/Old-Bond Spread," *Journal of Financial Economics*, 66(2), 463-506.
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4. Shleifer, Andrei and Robert Vishny, 1997, "The Limits of Arbitrage," *Journal of Finance*, 52(1), pp. 35-55.