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Fixed Income Arbitrage in a Financial Crisis (A): US Treasuries in November 2008

On November 4, 2008, James Franey[1] studied the prices of two U.S. Treasury bonds, both maturing in August of 2015. Their prices did not seem consistent with each other, and Franey sensed that their inconsistency presented an unusual opportunity for his fledgling hedge fund.

After accumulating thirteen years of experience as a fixed-income trader at Morgan Stanley, Franey had set out to form his own investment management company in June of 2006. Using contacts that he had developed at his previous job and a convincing pitch, Franey had raised an initial $300 million for his new hedge fund, Kentish Town Capital (KTC). Building on Franey's background and experience, KTC's focus was on fixed income relative value strategies, which exploited pricing differences between otherwise similar bonds or related securities.

Looking back on the two years since founding the firm, Franey realized that starting a new fund on the cusp of a great financial crisis and significant market volatility could have been highly problematic. However, Franey's experience at Morgan Stanley had been gained predominantly in Treasury and interest-rate derivatives trading, and he had not developed a full understanding of the technicalities of mortgage securities. As a consequence KTC had stayed away from those products and had taken no risk in mortgage markets.

Instead, Franey had invested in traditional fixed income and Treasury relative value trades, which in the ensuing turmoil had performed well. By November 2008 the firm was significantly ahead of many competitors that had encountered serious trouble in mortgage markets. Whether it was luck or smarts or a bit of both, Franey felt that if he could continue to make appropriate decisions, he was well positioned to take advantage of one of the most unusual market environments in history.

[1] The protagonist in this case, the investment management company for which he works, and the actions he takes on behalf that company are fictional. However, the protagonist, his actions, and his fund are based on the experiences in 2008 and 2009 of real people making real trades at an actual fund. *Moreover, all securities and prices in this case are real and historical. Keystrokes that may be used to call related information to the screen of any Bloomberg terminal are included as footnotes.*

Professor Ryan Taliaferro and Stephen Blyth, Managing Director, Harvard Management Company prepared this case. HBS cases are developed solely as the basis for class discussion. Cases are not intended to serve as endorsements, sources of primary data, or illustrations of effective or ineffective management.

The environment

Like many market participants, Franey had first became aware of serious troubles in the financial markets in August of 2007, when LIBOR, the rate at which large financial institutions lent to each other on an uncollateralized basis, had begun to drift up after having been flat for a full year. This uptick in interbank lending rates had surprised many, and Franey had believed it reflected deteriorating confidence in banks' solvency, especially since it had occurred at about the time that the Bank of England had begun taking steps to support Northern Rock, a large U.K. commercial bank.

By December 2007, U.S. financial institutions were struggling, and the U.S. Federal Reserve was offering temporary funding and accepting as collateral an unusually diverse set of securities. Into 2008 conditions had deteriorated further, and by February, Northern Rock had collapsed. In late March, the Fed had facilitated the purchase of Bear Stearns by J. P. Morgan Chase to avoid an imminent bankruptcy filing by the fifth largest U.S. investment bank.

In early September, Fannie Mae and Freddie Mac, two large U.S. government agencies that owned or guaranteed many mortgages in the United States, had been placed into conservatorship by the government. Then on September 15, 2008, in a shock to financial markets around the world, Lehman Brothers had filed for protection in the largest bankruptcy ever recorded. The next day, as a consequence of its exposure to Lehman commercial paper, the Reserve Primary Money Fund "broke the buck," with shares in its money market fund valued at less than a dollar.

After Lehman's collapse, volatility had intensified as Lehman's former counterparties had struggled to replace positions that had existed with Lehman. While these counterparties—including all the major investment and commercial banks—had not necessarily suffered any instantaneous losses on these positions when Lehman collapsed, since most had held collateral from Lehman against the aggregate value of their trades, on the night of September 14, 2008 they had suddenly become exposed to the market risks that the Lehman contracts had offset. As these financial institutions had struggled to replace their Lehman positions in vast waves of "risk replacement," trades had hit the market in large chunks and prices had fluctuated wildly.

As these events had unfolded, particularly in the days after the Lehman collapse, Franey had sensed an increasing mood of panic. Volatility had spiked dramatically in all asset classes, and the stress on market participants, who were trying desperately to react to wildly changing prices, had been overwhelming. Simultaneously, as the money market had disintegrated, the risk aversion of market participants had risen to extraordinary levels.

Early in the crisis, as conditions had begun to deteriorate, Franey had anticipated that the yield curve would steepen as the Fed cut short-term rates. Franey had been right, and the "steepener" trades, in which he owned short-dated treasuries and sold short longer-dated treasuries in duration-matched amounts, had performed well. However, after the Lehman bankruptcy, many investors, Franey included, had closed positions as quickly as possible and had been content to hold Treasury bills and little else. Prime brokers, KTC's included, had increased collateral requirements to such an extent that it had become nearly impossible to hold positions in anything but Treasuries anyway. For a few weeks, Franey had had no ability to exploit even the most lucrative opportunity, and in fact had been thankful that he had actually been able to reduce his portfolio and simply hold Treasury bills.

At the same time, government intervention had accelerated, and by the first week in October, the U.S. Congress had passed the Troubled Asset Relief Program, which had granted broad powers to the U.S. Treasury. Treasury had used its new powers quickly to purchase equity stakes in financial

intermediaries. By mid-October Treasury had announced that it would be purchasing $125 billion of preferred shares from nine large institutions. That purchase had been finalized on October 24, exactly one week ago.

Because of his bet on a steepening yield curve, Franey had done well in spite of the crisis. With his ability to execute trades returning, he now felt ready to take advantage of what he thought was an even more attractive opportunity in the market for U.S. Treasury bonds.

The Treasury securities

Franey was studying two bonds with identical maturities. One was a U.S. Treasury bond that paid a semi-annual coupon at a 4.25% annual rate and that matured in August of 2015.[2] The other was a U.S. Treasury bond that paid a semi-annual coupon at a 10.625% annual rate and that also matured in August of 2015.[3] (**Exhibit 1** summarizes terms for the two bonds.) Remarkably, the yields on these similar bonds were quite different: the higher coupon bond was priced to yield 3.61%,[4] while the lower coupon bond was priced to yield 3.26%.[5] Franey thought that he could exploit the yield spread of 35 basis points (0.35%) to earn a return for his investors.

Franey was aware that government bonds of the same maturity occasionally could have different yields when one bond had more liquidity, that is, when one bond was more heavily traded and therefore more quickly and easily saleable for cash, than another bond. It was not unusual to see such liquidity differences between U.S. Treasury bonds when one had been sold by the Treasury recently, and so was "on the run," and the other had been trading for many years, and so was "off the run." On his screen, reproduced in **Exhibit 2**, Franey had a chart that plotted the yield difference (spread) between the two bonds, starting in 2005 when the newer 4.25% bond had been issued as a ten-year bond.[6] (The 10.625% bond was an old thirty-year bond that had been issued in 1985.) Looking at the chart, Franey could see evidence that the older, less liquid 10.625% bond had earned a modest yield premium of 3 to 5 basis points in 2005 while the 4.25% bond was on the run. However, shortly thereafter the yields had converged and had remained close to zero for some time.

The spread had reappeared in March of 2008, roughly at the time of J. P. Morgan's purchase of Bear Stearns, at a level higher than could be explained by a liquidity difference between the two bonds. The spread soon had disappeared, but it then had reappeared in June; since June the spread had been growing. In September 2008, almost coincident with the Lehman bankruptcy, the widening had begun to accelerate and had reached a peak of 35 basis points on October 7, four days after passage of the Troubled Asset Relief Program. The following day, October 8, the yield spread had fallen back nearly to zero. That day also was the day that the Fed had authorized a $37.8 billion loan to AIG. Franey did not know if there was a relationship between the Fed's action on that day and the sudden disappearance of the yield spread.

By October 15 the yield spread had reappeared yet again, and by November 4th it had grown back to its previous peak of 35 basis points. Franey had not acted to profit from the yield spread in early October, but it seemed that the market had just given him a second chance.

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[2] Bloomberg: T 4.25 08/15/15<Govt>DES<GO>.

[3] Bloomberg: T 10.625 08/15/15<Govt>DES<GO>.

[4] Bloomberg: T 10.625 08/15/15<Govt>GY<GO>.

[5] Bloomberg: T 4.25 08/15/15<Govt>GY<GO>.

[6] Bloomberg: T 4.25 08/15/15<Govt>T 10.625 08/15/15<Govt>HS<GO>.

Franey thought that he could place a bet that the yield spread would return to zero. In effect, he would "sell" a certain amount of the yield spread at 35, and assuming the spread moved instantaneously to zero, he would realize a profit roughly equal to 35 times that amount's dollar sensitivity to a one-basis-point change in yield spread. (That is, he would realize a profit equal to 35 times his trade's DV01 measure.)

To implement this strategy, Franey would buy the bond with the higher yield and sell the bond with the lower yield. When the yields converged, which they must by the common August 2015 maturity date, he would realize his profit. During the period over which he held the bonds, he believed he would be insulated from interest rate risk, since he expected any change in interest rates to affect both bonds similarly.

The 10.625% bond was priced at 141.8281[7] (per $100 face amount) and had a Val01 of 0.0741.[8] Val01 measured the amount by which the bond's price would fall if its yield changed by one basis point. The 4.25% bond was priced at 105.9688[9] and had a Val01 of 0.0625.[10] To create a long-short portfolio that had no exposure to changes in interest rates, for each $1,000 face amount of the 10.625% bond that Franey bought for $1,418.28 + $23.68 accrual,[11] he would sell $1,185.60 (= $1,000 x 0.0741/0.0625) face amount of the 4.25% bond for $1,256.37 + $11.23 accrual (= $1,185.60 x (105.9688 + 0.9470 accrual[12])/100). The difference between the $1,441.96 (= $1,418.28 + $23.68) and the $1,267.60 (= $1,256.37 + $11.23) would be borrowed at a short-term overnight rate which would add no duration (Val01) exposure. The present value of holding the position until the yields converged completely would be about $26,[13] not including any interest that Franey paid on the loan that supported his long position in the 10.625% bonds or any interest that Franey received from the proceeds of the 4.25% bonds that he sold to create his short position. In this zero-investment example, Franey would have completely financed his purchase of the 10.625% bonds with the proceeds from the sale of the 4.25% bonds plus some borrowing, allowing him to realize a profit with no net investment of KTC's capital.

Financing

In practice, Franey's prime broker would not permit him to create a zero-investment portfolio. Still, the amount of leverage that would be permitted in a position of this kind would be high. Financing the trade would require a few additional steps, though the basic intuition would be the same as in the zero-investment example.

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[7] Bloomberg: T 10.625 08/15/15<Govt>HP<GO>. A Bloomberg quote of 141-26+ implies a decimal price of 141.828125 (= 141 + 26/32 + 1/64).

[8] Bloomberg: T 10.625 08/15/15<Govt>PDH1<GO>.

[9] Bloomberg: T 4.25 08/15/15<Govt>HP<GO>. A Bloomberg quote of 105-31 implies a decimal price of 105.96875 (= 105 + 31/32).

[10] Bloomberg: T 4.25 08/15/15<Govt>PDH1<GO>.

[11] The quoted ("clean") price of the bond did not include the value of the portion of the imminent coupon payment that already had accrued to the current owner. A buyer would have to pay the seller the ("dirty" price) total of the clean price and the accrual. By November 5, 2008, the date on which Mills's trade would settle, the 10.625% Treasury would have accrued 82 days of interest, or $23.68 per $1,000 face amount. Bloomberg: T 10.625 08/15/15<Govt>YA<GO>.

[12] Bloomberg: T 4.25 08/15/15<Govt>YA<GO>.

[13] The modified duration of the 10.625% bond was 5.14, and the modified duration of the 4.25% bond was 5.84. (To retrieve modified durations from Bloomberg, use the PDH1 key sequences in the preceding footnotes.) Assuming the yields converged to the midpoint of 3.61% and 3.26%, a change in yield of 0.35%/2 for each bond, the capital gain to KTC for each $1,441.96 long position in the 10.625% bonds with corresponding $1,267.60 short position in the 4.25% bonds would be $25.93 = ($1,441.96 x 0.35%/2 x 5.14) + ($1,267.60 x 0.35%/2 x 5.84).

Franey would use some of KTC's capital together with borrowed funds to enter into the long position in the 10.625% bond. As collateral for the loan from his prime broker, he would give to his prime broker the bonds that he had purchased. Typically the term of the loan would be for one day, but in general Franey would be able to renew (roll over) the loan for another twenty-four hour period at the end of each day in a pattern typical for a repurchase agreement ("repo"). The prime broker would determine the interest rate that it would charge on the loan and the fraction of the total investment (the "haircut") that would be required to come from Franey's own capital. The prime broker determined the interest rate and the haircut by assessing the risk of the collateral and the risk of the borrower, in this case KTC.

With a U.S. Treasury bond as the collateral, haircuts were generally low. For this trade, KTC's prime broker required a 2% haircut and a 0.15%[14] annual interest rate on the loan.

KTC's short position in the 4.25% bond would be financed similarly. To create the short position, KTC would ask its prime broker to find another investor who owned the 4.25% bonds and who was willing to lend them temporarily to KTC. KTC would then sell the borrowed bonds for cash, which it would deposit as collateral with the prime broker. Generally the prime broker would require an additional amount of cash collateral from KTC's own resources. At the time, this amount was 2%, and the rate that KTC would receive on the cash posted against its short bond position was 0.10%[15].

With these financing arrangements, for each $1 million KTC allocated toward purchasing 10.625% bonds, it could borrow $49 million toward additional purchases; similarly, for each $880 thousand allocated toward the short sale of 4.25% bonds, KTC could borrow and sell $44 million of those bonds.[16] Therefore, for each $1.88 million of KTC's capital allocated to the long-short investment, the firm stood to gain $902 thousand (= $50 million x ($26/$1,441.96)) for a return of about 48% on its capital. Interest charges on the prime broker's loans would reduce KTC's return, but the faster the bonds' yields converged, the less interest KTC would have to pay. To close the position, KTC would sell the 10.625% bonds, purchase the 4.25% bonds, repay the prime broker's loans, and receive back its collateral.

Financing risks

If Franey could hold his position in the bonds until they matured in 2015, his trade would be a riskless arbitrage. However, several factors could make the trade risky, if there was a chance that Franey would have to close the trade before 2015.

First, if the yield difference widened, Franey's prime broker would require him to post more collateral or close a portion of the trade. For example, if the yield on the 4.25% bonds stayed unchanged at 3.26% while the yield on the 10.625% bonds increased ten basis points to 3.71%, widening the yield spread from 35 basis points to 45 basis points, the value of a $50 million position in the 10.625% bonds would fall by $257 thousand.[17] KTC would be required to replace from its own resources this loss in the value of the prime broker's collateral, increasing KTC's original $1 million capital investment in the long side of the trade by over 25%. If KTC could not post this additional cash collateral, it would be required to sell some of its 10.625% bonds (at the new, lower price) and

[14] Bloomberg: RVGT01D<Index>GP<GO>.

[15] Bloomberg: RPGT01D<Index>GP<GO>.

[16] Recall that to keep the long-short portfolio neutral with respect to changes in interest rates, Mills would sell $1,267.60 worth of the 4.25% bonds for each $1,441.96 purchase of 10.625% bonds.

[17] The modified duration of the 10.625% bond was 5.14, so a rise of 0.10% in the yield of the bond would result in a loss of $50 million x 0.10% x 5.14.

repay some of its loan in order to restore the loan-to-collateral ratio to 98%. In this example, KTC would have to sell bonds worth about $12.7 million at the new price, or over 25% of its long position. To keep the trade balanced, KTC probably also would close a similar fraction of its short position in the 4.25% bonds.

Second, the prime broker could decide that either KTC's credit had deteriorated or that the riskiness of the government bonds had increased such that the 2% haircut was no longer sufficient. If the prime broker changed the haircut to 3%, KTC would have to post additional capital or close an appropriate fraction of its position in order to bring the loan-to-collateral ratio to 97%. In this example, KTC would have to post about $500 thousand of additional capital or sell bonds worth about $16.5 million.

Consequently, Franey knew that his trade was not riskless: in the case of a widening yield spread between the bonds and in the case of an increase in the haircut, he could be asked to post additional collateral or be required to close part or all of his position before 2015, possibly at a loss.

Decision

Franey thought he had found a clear opportunity to make money for his investors. However, he was unsure why the yield spread existed in the first place, and he was unsure how to assess the risks of trying to profit from it. His intuition was that investors who had put the trade on at a low spread had been surprised when the spread had widened further, perhaps as a consequence of a distressed sale. These investors then had been forced to sell, widening the spread still further.

This intuition made sense to Franey, but it also added to his concerns. What if other funds moved aggressively into this trade, and then for some reason the yield difference increased? Would they have to unwind their positions? What amplifying effect on prices would their simultaneous reduction in their positions have?

Finally, before he did anything, Franey thought he should check if the difference in yields between the two bonds could be rationalized using the slope of the yield curve (**Exhibit 3**). After all, one of the bonds had a higher coupon and therefore a shorter duration than the other. Perhaps the yield difference did not create an investing opportunity after all.

Franey made a list of what he thought he knew about this investment opportunity and what the risks of exploiting it might be. He needed to decide if he should try to exploit it, and, if he did, how much of his own capital he should allocate and how much of his prime broker's capital he should borrow.

Exhibit 1 Terms for United States Treasury bonds 10.625%[a] and 4.25%[b] due August 2015.

Coupon	10.625%	4.25%
Coupon frequency	Semi-annual	Semi-annual
Coupon type	Fixed	Fixed
Day count	Act/Act	Act/Act
Issue date	August 15, 1985	August 15, 2005
Maturity date	August 15, 2015	August 15, 2015
Amount issued	$7.15 billion	$32.47 billion
Amount outstanding (Nov '08)[c]	$4.02 billion	$32.47 billion

Source: Bloomberg, accessed December 2010.

[a] Bloomberg: T 10.625 08/15/15<Govt>DES<GO>.

[b] Bloomberg: T 4.25 08/15/15<Govt>DES<GO>.

[c] Treasury repurchased $3.13 billion of the 10.625% bonds through debt buy-backs in 2000 and 2001.

Exhibit 2 Yield spread[a] between U.S. Treasury bonds 10.625% and 4.25% due August 15, 2015, for the period August 15, 2005 through November 3, 2008. Spread is the yield-to-maturity of the 10.625% bond less the yield-to-maturity of the 4.25% bond.

Source: Bloomberg, accessed December 2010.

[a] Bloomberg: T 4.25 08/15/15<Govt>T 10.625 08/15/15<Govt>HS<GO>.

Exhibit 3 U.S. dollar yield curve on November 3, 2008.

Maturity	Annual yield[a]
1 month	0.20
3 month	0.49
6 month	1.07
1 year	1.31
2 year	1.45
3 year	1.69
5 year	2.71
7 year	3.21
10 year	3.96
30 year	4.33

Source: Federal Reserve Statistical Release: Selected Interest Rates, http://www.federalreserve.gov/releases/h15/data.htm, accessed December 2010.

[a] Annual yields are for actively traded non-inflation-adjusted issues adjusted to constant maturities.