Value at Risk Analysis of a Leveraged Swap*

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Abstract

In March 1994, Procter and Gamble Inc. charged $157m against pre-tax earnings, representing the losses on 2 interest rate swaps. This was only one of the major interest rate based losses experienced by various firms during the 1994-1995 period. Since then, considerable effort has been devoted to the development of risk measures to warn against the potential of large losses. One such measure is Value at Risk (VaR). In this paper, I conduct a Value at Risk analysis of one of the swap contracts. I am specifically interested in understanding whether VaR would have provided a warning that losses of the magnitude experienced were possible.

The contract was initiated in November 1993 and terminated in March 1994 with a loss of approximately $100m. It was a 5 year semi-annual swap in which the company received a fixed rate and paid a floating rate. The floating rate was based on 30-day commercial paper, a discount of 75 basis points, and a spread. The spread would be set in May 1994, and its magnitude depended on the yield on the 5-year constant maturity Treasury and the price of a particular Treasury bond. Once set, the spread would apply to the remaining term of the contract, and so represented a one-time bet on interest rates.

The VaR analysis is based on a one-factor Heath-Jarrow-Morton model of the term structure, using publicly available data on the Friday before the initiation date. The estimation is based on historical volatilities of forward rates, calibrated ("shifted") so that the premium paid equals the calculated value of the contract. This generates the distribution of contract values six months ahead, permitting the calculation of the VaR.

The calculated VaR is approximately seven times the value of the contract. A complementary measure of risk (the "conditional expected loss") is about ten times the value of the contract. In summary, the analysis indicates that VaR would have provided us with an accurate warning about the risk embedded in the contract. An interesting by-product that emerges is that the one-factor model captured the yield curve evolution during that time rather well.

One aspect of this study is that it examines the VaR of a specific contract at a point in time. By contrast, most studies of VaR have focused on how well the measure tracks losses on portfolios across time. The latter give us information on whether the assumptions on asset price distributions that underlie the computation of VaR are supported by historical data. Such information is clearly important for a variety of reasons. The emphasis here is not so much on historical accuracy as on the use of the measure to evaluate the risk of a specific contract.

1. Introduction

In this paper, I study the riskiness of a leveraged interest rate swap contract. The contract, initially worth about \$6.65m, experienced an extreme change in value over a short period of time in 1993-1994, leading to a loss of over \$100m. While large losses in financial markets have a long and significant history, there has rarely been a period of time like the mid 1990's when a string of occurred in a variety of financial markets. Since then, considerable effort has been devoted to the development of risk measures to warn against the potential of such losses. One such measure is Value at Risk (VaR). In this paper, I conduct a Value at Risk analysis of the contract. I am specifically interested in understanding whether VaR would have provided a warning that losses of the magnitude experienced were possible.

The specific contract[1] is the swap agreement executed between Proctor and Gamble (P&G) and Banker's Trust (BT) in November 1993. The contract was terminated in March 1994 with a loss of approximately \$100m. Briefly[2], P&G paid the floating rate on the five-year, semi-annual swap. This floating rate was based on 30-day commercial paper and a spread. The spread was to be set on May 4, 1994. The magnitude of the spread depended on the yield on the 5-year constant maturity Treasury and the price of a particular Treasury bond. Once set, the spread would apply to the remaining term of the contract, and so represented a one-time bet on interest rates. Thus, P&G had sold an interest rate option to BT. As it turned out, interest rates moved so as to make the spread very large, resulting in the loss.

In light of this and other losses, attention has been focused on quantifying the losses that are possible on leveraged contracts such as this one as well as on portfolios of assets. One such measure is Value at Risk, which has rapidly gained acceptance as both a risk measure and as a regulatory tool.[3]

VaR attempts to answer the following question: what is the most I expect to lose with a certain probability over a given horizon? Typically, the probability is set to 1% or 5%. In case of 5%, VaR attempts to explain what is the dollar amount that could potentially be lost over the time horizon. Formally, it is related to the tail of the distribution of portfolio value changes at the horizon. If we look at the 5% VaR, then if $F_T()$ is the distribution of changes in the portfolio values at horizon T, then VaR satisfies $F_T(VaR) = 5\%$. This tells you that the probability of a loss greater than the VaR is 5%, so you do not expect to lose more than the VaR with 95% probability.

Clearly, the calculation of VaR, and its usefulness as a risk measure, depends critically on how well we can estimate the distribution of future portfolio values. There are typically three ways in which this is done. The first is "parametric VaR," where an assumption is made about the return distribution of assets[4]; a common assumption is that of normally distributed returns. This is usually applied only to portfolios where the assets do not exhibit non-linear payoffs such as portfolios with significant option positions. This is complemented by the second or "simulation" method, which assumes that the return distribution on certain assets is known and uses a parametric model to simulate the return distribution of other assets (e.g. the Black-Scholes model

[1]This was only one of the major interest rate based losses experienced by various firms and municipalities during the 1994-1995 period. See Jorion (1996) for a survey.
[2] Details of the agreement are presented in the next section.
[3]See Jorion(1996).
[4] This underlies the Riskmetrics methodology of JP Morgan.

for options). The third method is “historical VaR” where it is assumed that the future return distribution is the historical return distribution.

For the interest rate option in the contract, I use a variation of the parametric method. I calculate the future value distribution using an interest rate model. This requires an assumption about the stochastic process governing term structure movements over time. I use a one-factor Heath-Jarrow-Morton type model, using publicly available data on the Friday before the start date of the contract. The estimation is based on historical volatilities of forward rates, calibrated (“shifted”) so that the premium paid equals the calculated value of the contract. The model is implemented as a “tree.”

The horizon chosen is six months, corresponding to the time period after which the spread was to be set. The term structure model provides the distribution of yield curves in six months. This generates the distribution of contract values six months ahead, permitting the calculation of the VaR.

The calculated VaR is approximately seven times the value of the contract. One criticism of VaR is that it does not provide information about the expected loss if a large loss was to occur. For example, suppose losses that occur with probability less than 5% occur. What is the expected loss? A complementary measure of risk, the “conditional expected loss,” provides this information. For the contract at hand, this figure is about ten times the value of the contract.

In summary, the analysis indicates that VaR would have provided us with an accurate warning about the risk embedded in the contract. An interesting by-product that emerges is that the one-factor model captured the yield curve evolution during that time rather well.

One aspect of this study is that it examines the VaR of a specific contract at a point in time. By contrast, most studies of VaR have focused on how well the measure can track losses on portfolios across time. The latter give us information on whether the assumptions on asset price distributions that underlie the computation of VaR are supported by historical data. Such information is clearly important for a variety of reasons. The emphasis here is not so much on historical accuracy as on the use of the measure to evaluate the risk of a specific contract.

The details of the contract are described in the next Section. In Section 3, I summarize the movements in interest rates that occurred, and how the contract lost money. Section 4 contains the VaR analysis.

The Details of the Contract

The Original Contract

Procter and Gamble (P&G) was one party to the contract, while Bankers Trust (BT) was the counter-party. The original swap contract had the following features[5].

- The contract commenced on November 2, 1993
- The notional principal was US $200 million
- The contract would reset semi-annually and last for 5 years
- The spread would be set on May 4, 1994 and would then remain fixed for the remainder of the contract
- Every six months, BT would pay P&G the fixed rate of 5.3%
- On May 4, 1994, P&G would pay BT the average of the 30-day commercial paper rates minus 75bp
- Every six months thereafter, P&G would pay BT the average of the 30-day commercial paper rates plus the spread minus 75bp
- The spread would be determined on May 4, 1994 by the following formula:

$$\text{spread} = \max\left\{0, \frac{\frac{98.5}{5.78\%}C_5 - T_{30}}{100}\right\}$$

where

C_5 = the yield on the 5-year constant maturity Treasury, and
T_{30} = average of the bid/ask clean price of the 6.25% 8/15/2023 Treasury bond, which at the time was the benchmark Treasury bond.

Note that the spread was to be determined once and would then apply for the remainder of the contract, as shown in Figure 1.

Modifications of the contract

The terms of the contract were not carried out. While not relevant for the analysis in this paper, it is interesting to note that the contract was modified in January of 1994. This was prior to the first increase in interest rates by the Federal Reserve Board (Fed) in February of 1994. In January, the date on which the spread would be determined was moved to May 19, 1994, two days after the scheduled meeting of the Fed, and the discount of 75 basis points was increased to 88 basis points. Presumably, the additional discount was compensation for the risk of an additional rise in interest rates at the May 17 Fed meeting. In March of that year, the contract was terminated, with a loss of about $100m.

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[5] See Smith (1997) for a summary of the contract features, and for an insightful analysis of how the contract could have been replicated or hedged using Treasury options. Details of the contract are contained in Case No. C-1-94-735 filed at the US District Court, Southern District of Ohio, Western Division

The Swap and the Embedded Option

One way to think about the leveraged swap is to separate it into two parts. One part is the more standard swap while the second part is the option.

The "standard" part of the swap is the 5.3% fixed versus the 30-day commercial paper rate. This is not quite a standard swap because the floating rate is the average of the 30-day commercial paper rate between reset dates rather than the commercial paper rate on the reset date. Based on Treasury yields on October 29, 1993 (the Friday before the start date of the contract), the 5-year semi-annual Treasury swap rate can be calculated to be 4.82%, which implies a 48 basis point difference from the fixed rate charged. It seems reasonable to argue that a 48bp spread over the Treasury swap rate is an appropriate spread over the Treasury rate for an AA corporation and given that the commercial paper rates were 10-20 basis points higher than the Treasury yields.

If we take this view, then the 75 basis point discount is the premium paid to P&G in return for selling the option to BT. The analysis conducted in this paper will proceed on this assumption. In fact, from now on, I will ignore the "standard" part of the contract and focus solely on the option component.

The Analysis Date and Data

Unless otherwise specified, the analysis in paper is conducted using data for October 29, 1993, which is the Friday of the week before the contract commenced. It seems reasonable to assume that an analysis of this type would have taken place the week prior to the start date of the contract.

All interest rate data used in this paper is the weekly H15 data provided by the Federal Reserve Board. In particular, term structures are computed by "bootstrapping" the yields reported on constant maturity Treasuries. The price data on the August 15, 2023 Treasury bond was obtained from Reuters.

The Value of the Contract

To value the option, note that P&G is paid 75 basis points on a $200m notional principal over 10 semi-annual periods. This means that every six months for five years, P&G is paid 0.0075*200m/2 = $750,000.
The (continuously compounded) zero-coupon yield curve on October 29, 1993 was:

Maturity	Rate
0.25	3.19488
0.5	3.36274
1	3.57107
2	3.94032
3	4.25543
5	4.82093
7	5.22319
10	5.49831
30	6.31597

Using linear interpolation for rates in between the indicated dates, we find that the premium paid to P&G for selling the option was $6.65m.

3. The Nature of the Bet

On November 2, 1993, the 5-year CMT yield was 5.02% while the clean price of the August 2023 Treasury bond was 102 31/64, corresponding to a yield to maturity of 6.0679%. This means that the second term in the spread formula was

$$\frac{\frac{98.5}{5.78} * 5.02 - 102.578125}{100} = -0.170297$$

implying that the spread was zero.

On our analysis date (October 29, 1994), the 5-year CMT yield was 4.82% while the Treasury (clean) price was 103.94, implying that the second term was –0.2180.

If yields had remained unchanged between November 1993 and May 1994, the contract would have implied that for 10 semi-annual periods, P&G would be receiving 5.3% and paying the average of the 30-day commercial paper rates less 75 basis points.

Figure 2 shows the difference between the 3-month commercial paper rate and the 3-month constant maturity Treasury yield. Numerical values are provided below for the last four months before the start of the contract. It is evident that the basis was much below 75 basis points. Consequently, if the spread had remained at zero on May 4, 1994, P&G would have guaranteed itself below Treasury financing for five years.

To understand the nature of the bet, it is instructive to look at what would have to happen to rates for the contract to have lost money. The question being posed is: by how much must the term structure shift for the contract to lose money?

This is complicated a little by the fact that the spread depends on both an interest rate and a price:

$$\text{spread} = \max\left\{0, \frac{\frac{98.5}{5.78\%} C_5 - T_{30}}{100}\right\}$$

A simple way to convert yield changes to price changes is to use a bonds modified duration,

dP = -MD * P* dy.

On October 29, 1993, the August 2023 Treasury had a modified duration of 13.18719, which leads to the following conclusion: it would take an increase in yields of greater than 70.9 basis points over the next six months for the spread to become positive.

Note that an increase in yields of 70.9 basis is still profitable, since it implies receiving 75 basis points and not paying out anything on the option. To get a clearer idea of what would be required for the contract to break even, we need to find the value of the spread so that the present value of the 75 basis point discount equals the payout on the option given the spread. For the term structure prevailing on October 29, 1993, it turns out that An increase in yields of 84.3 basis points results in the contract breaking even.

One could ask how frequently the yield curve had shifted by more than 84 basis points over a six month period. Since 1982, it turns out that there has been a shift both the 5-year and 30-year of more than 84 basis points over 6 months in 63 out of 595 weeks from June 1992 to October 1993, which is a frequency of 10.59%. However, the last time this occurred was in May 1990. Figure 2 shows the 6-month yield differences for the two yields of interest.

Another way to think about the interest rate bet is to note that typically, the Fed raises interest rates by 25 basis points. This means that P&G could be betting that rates would not be increased more than three times in the period six months to May 4, 1994. Of course, the effect of monetary policy on the short end of the term structure does not mean that medium and long term rates cannot rise significantly. In fact, a significant steepening of the term structure could easily cause the spread to become significant.

Next, consider the sensitivity of the spread to changes in the level of the curve versus changes in the shape of the curve[6]. The spread depends positively on the 5-year CMT yield. Re-writing the constants that multiply the spread, we find that

$$\text{spread} = \max\{ 0, 17.0412C_5 - 0.01T_{30}\}$$

Using the modified duration formula, we find that

$$\Delta\text{spread} = \max\{0, 17.0412\ \Delta C_5 + 13.68279\ \Delta Y_{30}\}$$

where Y_{30} is the yield on the 30-year bond. It is evident that fundamentally, the bet is on the level of interest rates. A flattening of the curve (i.e., a fall in Y_{30} relative to C_5) and a steepening of the curve (i.e., i.e., a rise in Y_{30} relative to C_5) basically cancel each other. The fact that the option payoff depends primarily on the level of the curve provides some justification for using a one-factor model.

Finally, note that if the spread changes by 1%, the implied payment is $1m a period for 9 periods, so a 1% rise in yields leads to (undiscounted) future payments of $9m.

<u>The Ex-Post Behavior of Interest Rates and the Spread</u>

Unfortunately for P&G, interest rates rose quite sharply between November 1993 and May 1994. Figure 4 shows the movement in the 5-year and 30-year constant maturity yields.

Weekly numerical values are given in the following table. In summary, the 5-year CMT yield rose from 4.82% to 6.65% while the 30-year yield rose from 5.99% to 7.31%. The contract was renegotiated in January 1994, and the table shows that at that time, yields had risen by roughly 25 basis points. In March, when the contract was terminated, yields had risen by about 100 basis points from the beginning.

Table 3 shows the weekly behavior of the spread. In January, the current value of the spread is still zero, but it rises to over 11% by the end of March, 1994. You can see that if P&G had not terminated the contract, the spread at the beginning of May would have been over 30%. This means that over the term of the contract, P&G would be receiving 5.3%, paying the (average)

[6] This is similar to Smith (1997), but conducted on a different date.

commercial paper rate less 75 basis points plus 30%. The 1-month commercial[7] paper rate changed from 3.14% to 4.05% on May 6. In broad terms, if the contract had been carried out to its conclusion, P&G would have ended up paying approximately 30% plus CP minus 5.3% minus 0.75%. If we assume that commercial paper rates stayed fixed at 4.05%, then this implies a net payment of 28%; on the $200m notional principal, this amounts to paying $28m every six months for 9 periods[8], an undiscounted total payment of $252m, $217m if discounted at 5%, $211m at 6%, and $205m if discounted[9] at 7%.

[7] Note that the contract was based on the average commercial paper rate over the reset period, not the CP rate on a particular day.
[8] I have ignored the 75bp payment P&G would have received on May 4, 1994 in this calculation.
[9] P&G's debt at during this period was yielding about 7%.

2. Value at Risk

In this section, I use a one-factor term structure model to calculate the Value at Risk (VaR) of the contract. The model is the proportional volatility version of the Heath-Jarrow-Morton (1922) framework.

The Value at Risk of a contract is intended to measure the potential losses that can occur over a given time horizon. It is calculated as follows.

Let V be the current value of the contract (or a portfolio of assets). At a time horizon T, let $F_T(v)$ denote the distribution of values of the contract at the horizon, so

$$F_T(v) = \text{prob}(\tilde{V}_T \leq v)$$

For a confidence level α, let V_α be defined by

$$1 - \alpha = F_T(V_\alpha)$$

Therefore, with probability α, the portfolio value at the horizon will exceed V_α. This means that losses in excess of V_α only occur with probability $1-\alpha$. The Value at Risk is then defined as:

$$VaR = V - V_\alpha$$

Typically, α is chosen to be 95% (e.g., the JP Morgan Riskmetrics methodology) or 99% (by most regulatory agencies). In this paper, I use $\alpha = 95\%$. The interpretation of this number is that with 95% probability, the portfolio will not lose more than the VaR.

Clearly, what is critical here is the calculation of the future value distribution. There are two basic ways in which this is done. The first is based on a historical simulation, the second on an assumption about the distribution of future values. In the latter case, sometimes the distribution can be calculated analytically (for example, if we assume that all returns are normally distributed); otherwise, the value distribution is obtained by simulation.

In the case of the P&G swap, I will assume that that the stochastic evolution of interest rates is given by the following equation:

$$d(\log f(t,T)) = \mu(t,T)dt + \sigma(t,T)dz$$

where f(t,T) is the instantaneous forward rate prevailing at time t for time T in the future, and μ and σ are known functions of t and T. I use the discrete time parameterization[10] described in Jarrow (1996, Chapter 12). The function μ is restricted by conditions of no arbitrage, and only the volatility function needs to be estimated.

[10] This specification, like other "log-normal" specifications, has the property that if the time steps are made very small, then forward rates explode. This was not a problem with the coarse time steps in our implementation.

The Horizon

Looking at the contract on October 29, 1993, a natural horizon date is 6 months. This when the spread will be determined, and the time period over which the bet has been placed.

The Model Implementation

The model was implemented as a (non-recombining) tree, using monthly time steps. This means that after 6 months, there are $2^6 = 64$ nodes, and so 64 term structures. In the implementation, every node is equally likely. The implementation calculates the full forward curve at every node. At each node, I calculated the 5-year CMT yield and the clean price[11] of the August 15, 2023 bond, and then the spread. Given the spread at a node, the payment made by P&G for the next 4 ½ years is known. I then computed the term structure at each node, using this to discount the values of the payments. This yields the value of the contract at each node. Since each node is equally likely, we now have $F_T(v)$.

Notes on the Implementation and Choice of Model

Note that the size of the problem grows very quickly with the number of steps. A weekly estimation would involve 2^{26} nodes in six months, which is very large. An alternative is to use a short rate model, like the Black-Derman-Toy (1990) model, which has a recombining tree. A weekly estimation for such a model would produce 27 (26+1) yield curves after 6 months, but would require an enormous lattice. This is because after 6 months, we need the value of the 30-year Treasury bond, and this requires the lattice to extend out for the full 30 years. The total number of nodes in such a lattice would be about 300,000. In all this, the nodes do not need to be stored; however, not storing the information requires a lot of computing. By contrast, the HJM tree implemented here stores the entire forward curve at every node, so it is only necessary to go out 6 months, though at the cost of a non-recombining tree.

The Volatility Estimation

To implement the model, I need estimates of forward rate volatilities, the $\sigma(t,T)$. These we calculated as follows.

- Step 1: bootstrap the CMT yields to produce continuously compounded term structures using linear interpolation, using data from January 8, 1982 to October 29, 1993.
- Step 2**:** calculate forward curves *monthly*
- Step 3: Interpolate the monthly forward curves so that all forward rates are at monthly time steps. Step 2 ensures that no overlapping data is used. This means that there are 360 forward rates (30 years times 12 months).
- Step 4: Calculate the volatilities of the forward rates using the procedure described, e.g., in Jarrow (1996, Chapter 13) for the one-factor case

[11] Assuming equally spaced coupon dates

The estimation produced the volatility function shown in Figure 5, where you can see the hump usually seen about 1-year out. I am not sure why there is an initial dip, though I believe this results from the interpolation.[12]

This forward curve produce an option value somewhat below the present value of the premium. I multiplied all calculated volatilities by 1.03535 to equate the option value to the premium paid.

The Initial Term Structure and Forward Curve

The term structure and forward curve on October 29, 1993 are shown in Figure 6.

Sample Term Structures after 6 Months

These, as well as the term structure on October 29, 1993, are shown in Figure 7. Recall that the implemented tree has 64 terminal nodes, labeled 63 to 126.   The higher the node number, the higher the curve. It can be seen that the curves retain their basic shape, which is an artifact of the one-factor model.

The Spread and Future Contract Values

Out of the 64 nodes, the spread was positive on 7 nodes, or 10.93%. The relevant information is shown in the following table:

Spread	Value	Probability	CMT5	T30 price
0.062232	49.07267	0.09375	0.059289	94.81414
0.062527	49.30414	0.07813	0.059298	94.79932
0.062829	49.54152	0.06250	0.059306	94.78411
0.06312	49.77079	0.04688	0.059315	94.76911
0.063425	50.01055	0.03125	0.059323	94.75354
0.063731	50.25117	0.01563	0.059332	94.73767
0.17427	136.0099	0.00000	0.063672	91.07946

The table shows that with 5% probability, the payment on the option would exceed $49.5m, so the Value at Risk is $42.85m. Recall that the value of the premium paid is $6.65m. so the VaR is about 7 times the value of the contract. The table also shows that in the worst case in the model, the 5-CMT yield is 6.37% while the clean price of the August 2023 Treasury is 91.08. On May 1, 1998, the actual CMT yield was 6.78% while T30 price was $87.3. Given the coarseness of the estimation, this indicates to me that the model actually captured the possible paths of the term structure quite well.

Another risk measure, which complements VaR, is the conditional expected loss. This is defined as the expected loss conditional on being in the region that occurs with less than 5% probability. In our model, this turns out to be $64.8m, about ten times the value of the contract.

[12] Since the analysis is done monthly, the first forward rate is the 1-month spot rate. However, the shortest CMT has a three month maturity, and so the initial rates were obtained using linear interpolation.

In summary, it is clear that the Value at Risk of the contract clearly points out the potential loss from the contract. While the actual events in the months after October 29, 1993 were worse than the worst case in the model, and while it is unfortunate that this worst case was realized, it is evident that a VaR analysis of the type conducted here would have clearly indicated the risk inherent in the contract.

Figure 1: Time Line of the Contract

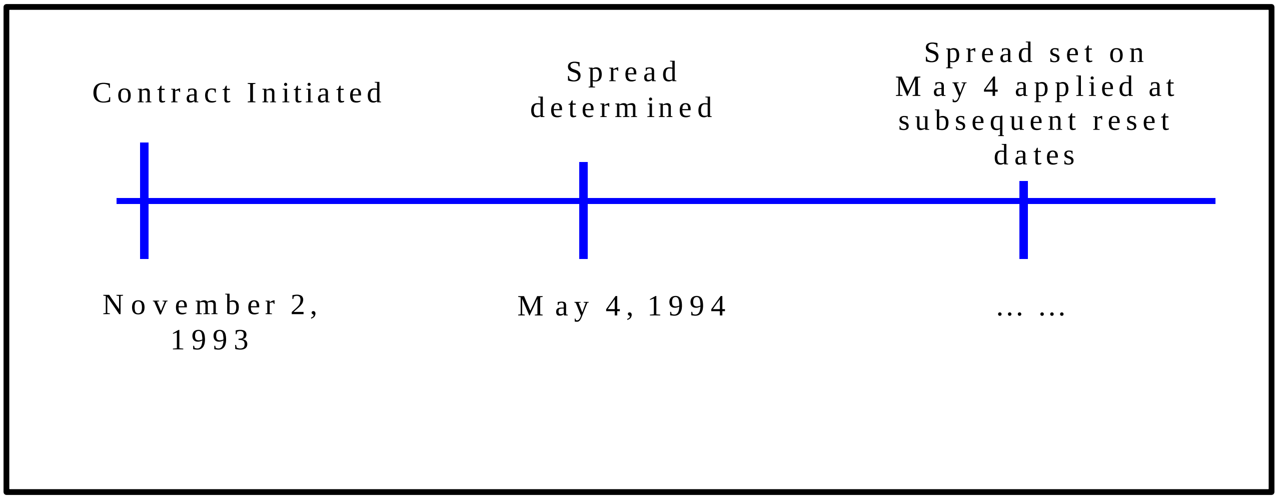

Figure 2: Commercial Paper Spread Over Treasury

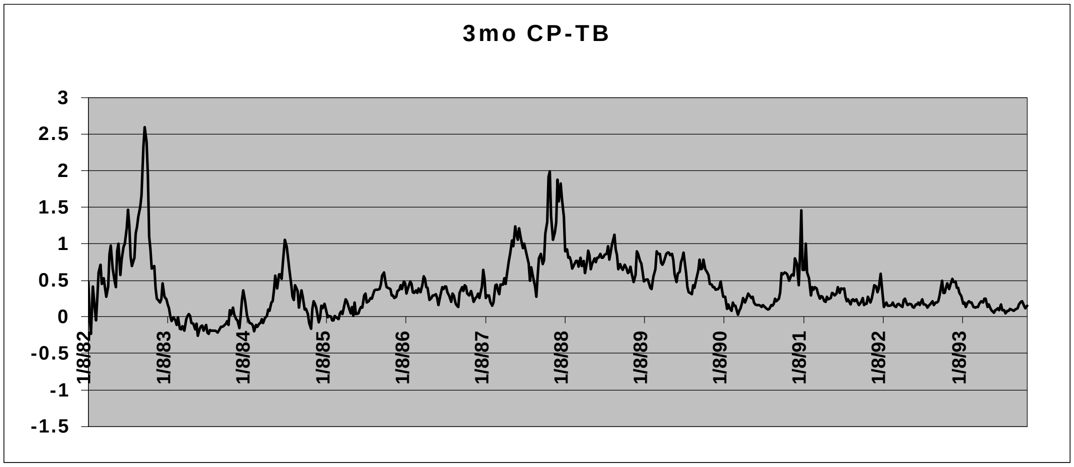

Figure 3: 6-Month Yield Differences

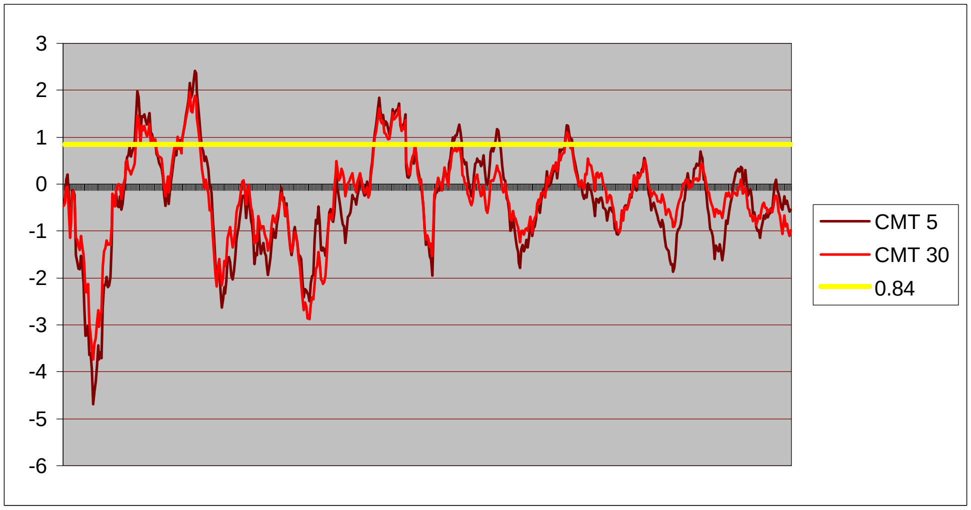

Figure 4: Treasury Yields

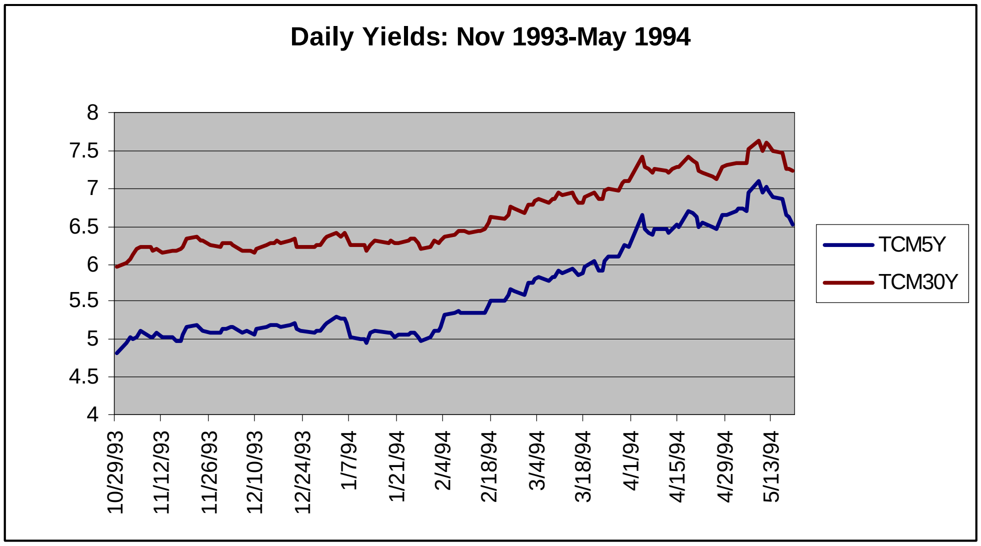

Figure 5: The Volatility Function

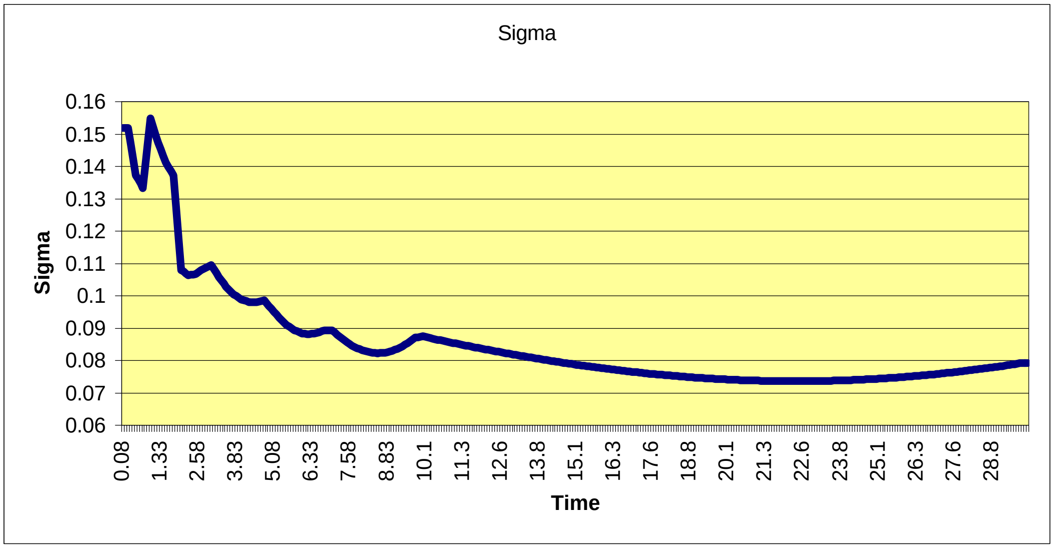

Figure 6: The Initial Curves

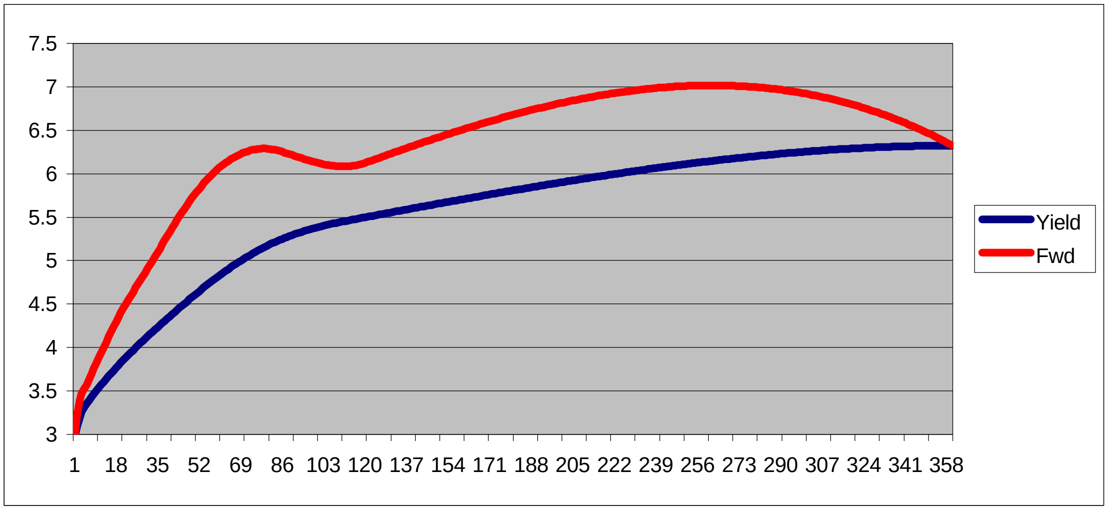

Figure 7: Sample Term Structures in 6 Months

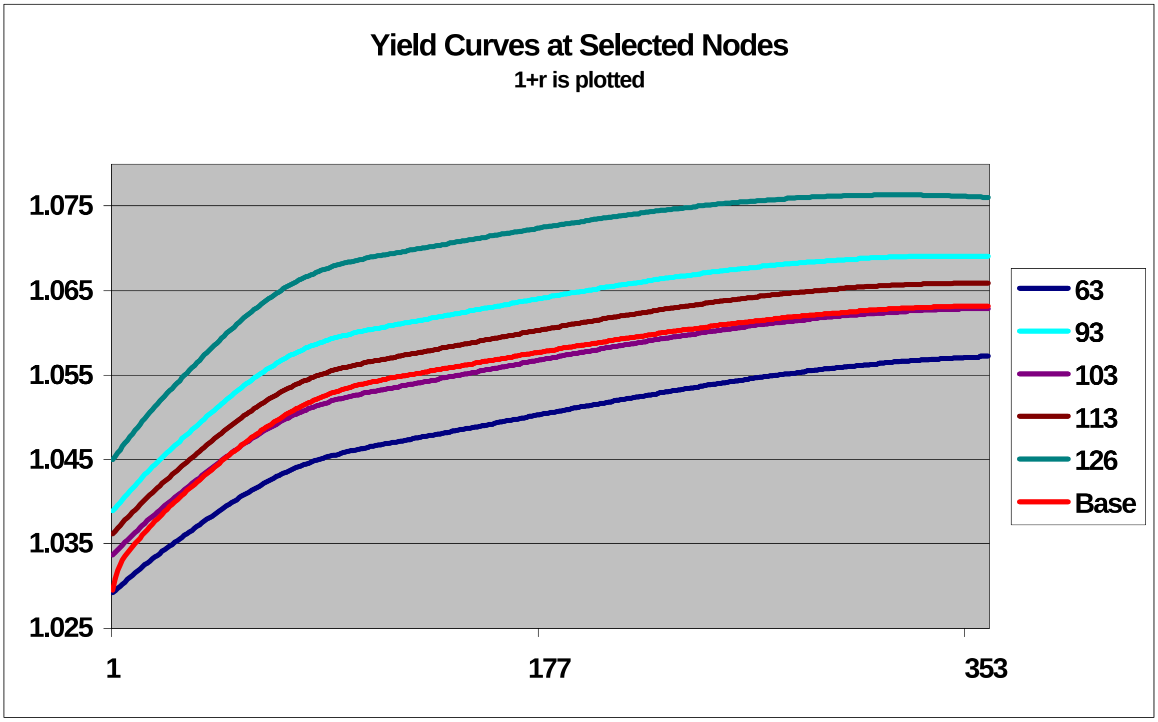

Figure 5: Behavior of the Spread

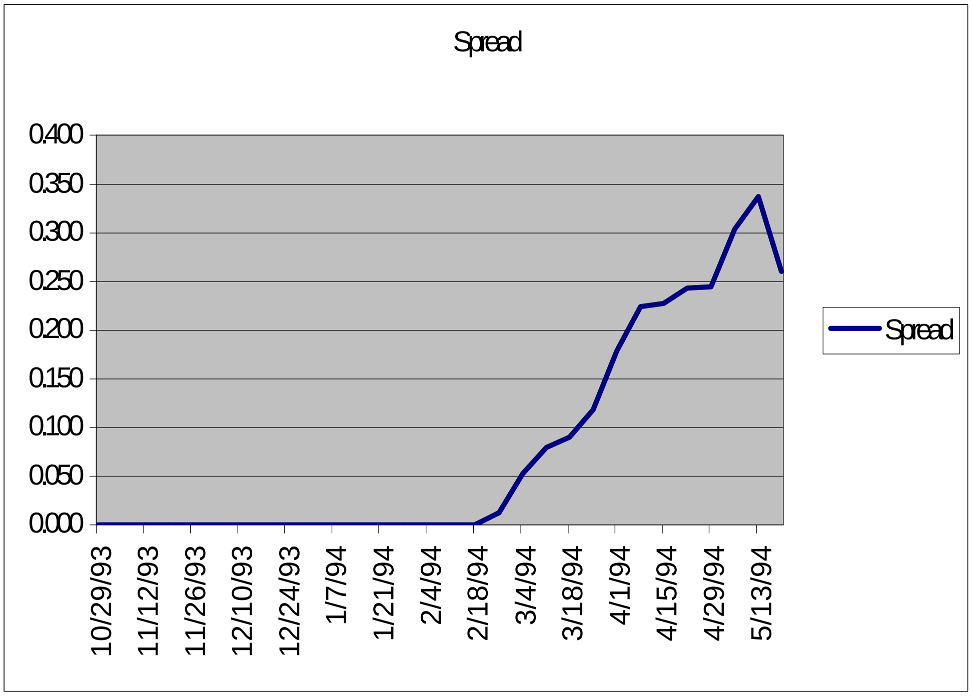

Table 1

Date	3-mo TB	3-mo CP	Difference (bp)
7/2/93	3.08	3.25	0.17
7/9/93	3.1	3.19	0.09
7/16/93	3.09	3.18	0.09
7/23/93	3.14	3.19	0.05
7/30/93	3.14	3.22	0.08
8/6/93	3.14	3.22	0.08
8/13/93	3.09	3.2	0.11
8/20/93	3.07	3.17	0.1
8/27/93	3.06	3.14	0.08
9/3/93	3.06	3.16	0.1
9/10/93	3.02	3.13	0.11
9/17/93	3.03	3.15	0.12
9/24/93	2.99	3.16	0.17
10/1/93	2.97	3.18	0.21
10/8/93	3.04	3.26	0.22
10/15/93	3.1	3.25	0.15
10/22/93	3.12	3.24	0.12
10/29/93	3.13	3.28	0.15

Table 2

	tcm5y	tcm30y
10/29/93	4.82	5.99
11/5/93	5.03	6.12
11/12/93	5.04	6.19
11/19/93	5.04	6.22
11/26/93	5.13	6.31
12/3/93	5.14	6.26
12/10/93	5.10	6.17
12/17/93	5.18	6.28
12/24/93	5.16	6.27
12/31/93	5.14	6.28
1/7/94	5.21	6.36
1/14/94	5.03	6.24
1/21/94	5.06	6.29
1/28/94	5.05	6.29
2/4/94	5.14	6.3
2/11/94	5.36	6.42
2/18/94	5.40	6.51
2/25/94	5.60	6.68
3/4/94	5.74	6.79
3/11/94	5.85	6.87
3/18/94	5.91	6.87
3/25/94	6.00	6.92
4/1/94	6.19	7.06
4/8/94	6.47	7.29
4/15/94	6.47	7.26
4/22/94	6.60	7.31
4/29/94	6.56	7.22
5/6/94	6.76	7.38
5/13/94	6.98	7.56
5/20/94	6.65	7.31

Table 3

	CMT5	Clean Price	Term	Spread	1MOCP
10/29/93	4.82	103.94	-0.218	0.000	3.14
11/5/93	5.03	100.56	-0.148	0.000	3.15
11/12/93	5.04	101.44	-0.156	0.000	3.15
11/19/93	5.04	98.81	-0.129	0.000	3.14
11/26/93	5.13	100.09	-0.127	0.000	3.15
12/3/93	5.14	100.06	-0.125	0.000	3.27
12/10/93	5.1	100.66	-0.137	0.000	3.41
12/17/93	5.18	99.59	-0.113	0.000	3.34
12/24/93	5.16	100.5	-0.126	0.000	3.31
12/31/93	5.14	98.75	-0.112	0.000	3.35
1/7/94	5.21	100.28	-0.115	0.000	3.21
1/14/94	5.03	99.41	-0.137	0.000	3.12
1/21/94	5.06	99.56	-0.133	0.000	3.13
1/28/94	5.05	100.44	-0.144	0.000	3.11
2/4/94	5.14	98.69	-0.111	0.000	3.14
2/11/94	5.36	97.97	-0.066	0.000	3.41
2/18/94	5.4	95.19	-0.032	0.000	3.46
2/25/94	5.6	94.13	0.013	0.013	3.47
3/4/94	5.74	92.59	0.052	0.052	3.57
3/11/94	5.85	91.81	0.079	0.079	3.61
3/18/94	5.91	91.72	0.090	0.090	3.61
3/25/94	6	90.44	0.118	0.118	3.67
4/1/94	6.19	87.66	0.178	0.178	3.68
4/8/94	6.47	87.84	0.224	0.224	3.77
4/15/94	6.47	87.53	0.227	0.227	3.71
4/22/94	6.6	88.16	0.243	0.243	3.88
4/29/94	6.56	87.34	0.245	0.245	3.89
5/6/94	6.76	84.81	0.304	0.304	4.05
5/13/94	6.98	85.28	0.337	0.337	4.37
5/20/94	6.65	87.31	0.260	0.260	4.35

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