

## Sanders & Associates

Fred Cramer was sitting at his desk collecting his thoughts. He had assembled a great deal of information about risk measurement and needed to assess what the implications would be for Sanders & Associates. This was the result of a meeting last week. At the meeting the main topic of conversation was the recent concern of clients about Sanders use of derivatives in their portfolios. Recent newspaper reports about the Common Fund's loss of \$125 million because of derivatives and other reports about losses due to derivatives, had caused some of their clients to express concern about Sanders exposure to derivative losses. The concern was not only on the clients' part but there was also internal concern about the level of risk exposure that the firm had. Fred had been charged with exploring alternatives to deal with this issue. It seemed that a new approach called Value at Risk might address most of the concerns. Ultimately, Sanders might purchase Value at Risk from an outside vendor but for the present, Fred needed to understand how it worked and how the results might be interpreted.

### **Sanders & Associates**

Jack Sanders founded the firm in 1978. After a very successful career as a portfolio manager at one of the largest mutual fund companies, Jack decided to establish his own firm and began Sanders & Associates by offering the Master Fund. At present, the firm has over a billion dollars under management with five portfolio managers and fifteen analysts. From the beginning, the style of the firm reflected Jack Sanders basic investment philosophy. The strategy involved forming portfolios that would track an index and then use research to overweight selected stocks and bonds that would outperform. Ideally, this approach would always closely track the index, but would also consistently outperform the index. In fact, the firm had been very successful over the last fifteen years. For the last five years, Sanders had been using derivatives to adjust the exposure of some of the portfolios in order to take advantage of opportunities.

Fred Cramer joined Sanders & Associates about three years ago. Before this, he was a portfolio manager at a large Trust Bank. During his time at the bank, he developed considerable experience using derivatives in portfolio management. At Sanders he was responsible for managing a large, \$50 million, balanced portfolio called the Serus Fund. This fund was marketed as a relatively low risk portfolio consisting of positions of 60% equity and 40% bonds. His approach has been to use basic index portfolios and to adjust his holdings of broad asset classes through derivatives. For example, he might hold US Treasury 20 year bonds and then use interest rate swaps to swap from fixed to floating if he thought that rates would be rising in the near future. For equities, he might sell call options on an index portfolio if he thought the

market would be flat or down during the next year. While he has always been conservative, the Serus Fund has done quite well over the last two years.

### **The Current Situation**

In July 1995, the Common Fund announced losses in its portfolio of over \$125 million due to derivative trades. The Common Fund was a conservative firm that managed almost \$20 billion in assets for 1,421 educational institutions. The fact that this type of fund could suffer losses of this magnitude stunned investors. This event plus the long list of other derivative driven disasters such as, Barings Bank, Proctor & Gamble, etc. had focused new attention on any fund manager who used derivatives. Since Sanders was quite open about its use of derivatives, the Common Fund losses triggered a deluge of inquires from clients about the risks that Sanders was taking through the use of derivatives.

While to date, Sanders had not experienced any loss of clients, there was considerable concern within the firm that they had to be more effective in conveying the level of risks that the firm was taking. This was true of the existing clients as well as any new clients. As part of this, Fred had been assigned the job of reviewing the traditional measures of portfolio risk and also exploring the newer concept of Value at Risk as a way of measuring risk. In order to do this, Fred decided to focus on the Serus Fund.

Fred had managed the Serus fund for about 3 years. By design, it was a balanced fund with about 60% equity and 40% debt. Its benchmark portfolio was a 60/40 weighted portfolio of the S&P 500 and the Lehman Brothers Government/Corporate Bond index. Fred's basic strategy was to buy the index and then use derivatives to overweight or underweight certain sectors. The last two years had been quite good. Serus had beaten the benchmark in each of the last two years. The result had been a net inflow of over \$20 million in new money. Basically, Sanders marketed the fund as an index fund with some upside potential, but the recent press reports on derivatives had raised serious questions both from clients and from inside the firm.

As a first step, Fred decided to examine a subset of assets of his own fund. These are listed in Exhibit 1. The actual holdings in the Serus Fund were much more extensive, but he felt that a limited number of assets would make it easier to interpret and explain the results. Essentially, the core holdings are index portfolios. The derivative positions were created to take advantage of opportunities to enhance return. The swap position was originated 6 months ago in anticipation of an increase in 6 month LIBOR rates. In terms of the equities, Fred had sold the OTC call option on the Wilshire 5000 and used the proceeds to buy OTC calls on the S&P 500. This position was taken in response to Fred's belief that in the next 3 years the large cap stocks would outperform the small cap stocks. Finally, the currency overlay was designed to remove the currency risk from his position in the Japanese market.

### **Valuation**

As a first step, Fred wanted to estimate the current market value of the assets in his portfolio. Exhibit 2 shows some current market parameters that he needed to value the assets and Exhibit 3 shows the current estimates of the value of each asset and derivative position. The bonds were valued based on current yield to maturities for comparable treasury securities, while the value of the swap is the mark to market value<sup>1</sup> at the current swap rate. The value of the US equities is based on current market prices for the stocks. Equity derivatives are valued based on the Black-Scholes model<sup>2</sup> for pricing European Call options. Fred assumed a dividend yield of 3% for the S&P 500 call option and a 1% dividend yield on the Wilshire 5000 call option. Volatilities were based on historic return data (See Exhibit 5.) The Japanese equity is based on the current stock prices in yen converted into US \$ at the spot rate. Finally, the value of the currency hedge is valued at the difference between the contract rate and the current market 90 day forward rate for yen.

### Risk Measurement

The issue with risk measurement is how much the value of the assets can change over time. A traditional approach is to describe asset risk in terms a single dimension. For bonds this is interest rate risk. Here the traditional measure of bond portfolio risk is the modified duration. Technically, duration is a measure of price elasticity of a bond with respect to a change in its yield<sup>3</sup>. The higher the duration the larger the price change is for any change in

<sup>1</sup> For swaps the mark to market value (MTM) for the receive-fixed swap is the difference between the value of the existing swap at the current swap rate less the value of a replacement having the same remaining time to maturity, and credit risk as the original. For a fuller discussion see, Keith Brown and Donald Smith, *Interest Rate and Currency Swaps: A Tutorial*, The Research Foundation of The Institute of Chartered Financial Analysts, 1995, pages, 21-23.

<sup>2</sup> Black- Scholes Option Pricing Model:

$$\text{Call Value} = S e^{-q(T-t)} N(d_1) - X e^{-r_f(T-t)} N(d_2)$$

where S = current index value  
q = annual dividend yield  
X = exercise price  
 $r_f$  = risk-free rate  
 $\sigma$  = annual volatility  
N(.) = cumulative Normal Distribution  
T-t = time to maturity (in years)

$$d_1 = \frac{\ln(S e^{-q(T-t)} / X) + (r_f + \frac{1}{2} \sigma^2)(T-t)}{\sigma \sqrt{T-t}}$$

$$d_2 = d_1 - \sigma \sqrt{T-t}$$

<sup>3</sup> See, Fabozzi, F., *Bond Markets, Analysis and Strategies*, Second Edition, Prentice Hall, Englewood Cliffs, NJ, 1993, Chapter 4 for a discussion of bond volatility.

yield. For equities, risk is defined as beta risk<sup>4</sup>, which captures the risk relative to some broad index. In this case, where the benchmark for equities is the S&P 500 index, Fred believed that this was the appropriate index for both the US equities and the dollar returns of the Japanese equity.

The risk measures for the derivatives in the portfolio were a little more difficult to express. For swaps, duration is also the standard risk measure. The duration of a pay-fixed swap is estimated as the duration of the floating rate (received) - the duration of fixed-rate bond with the same coupon<sup>5</sup>. This measure only adequately expresses the risk for parallel shifts in the yield curve and as such, does not fully capture the risks. Risk for options can be expressed as the delta<sup>6</sup>, which is the sensitivity of the price of the option to a change in the price of the underlying asset. However, since option prices are also sensitive to changes in interest rates and volatilities, delta can not fully reflect the risks. The same is true for the forward exchange rate agreement. It depends on the spot rate and interest rates so a single measure really does not capture the full risks of the forward agreement. These examples capture one of the major problems of using the traditional risk measures for derivatives. Generally, derivatives have exposure to more than one risk factor and a single dimensional risk measure does not fully capture the risks.

Finally, Fred was unsure how to combine all of these diverse risk measures into a single risk measure for the portfolio. One approach was to estimate the historic volatility of the whole portfolio. However, he was unsure how to incorporate the derivatives and moreover, because of the derivatives, he was unsure how he could capture the impact on the value of the portfolio of an unusual event. In addition, since there were multiple risk factors for both the derivatives and the assets, he also wanted to incorporate the correlations between the risk factors.

The fact that these problems could not be adequately addressed using single dimensional risk measures, led to the development of the Value at Risk concept. The basic idea was to picture the multi-dimensional aspect of risk by simulating the value changes in a portfolio and assessing the probabilities of change of a particular size. While this was originally developed for derivative portfolios, Fred believed that this same approach could be applied to portfolios more broadly.

## Value at Risk

<sup>4</sup> See Bodie, Z., A. Kane, and A. Marcus, *Investments*, Third Edition, Irwin, Boston Ma., 1996, Chapter 8 for a discussion of Beta risk.

<sup>5</sup> For a fuller discussion see, Keith Brown and Donald Smith, *Interest Rate and Currency Swaps: A Tutorial*, The Research Foundation of The Institute of Chartered Financial Analysts, 1995, page, 23.

<sup>6</sup> Delta is defined as follows: (See footnote 2 for definitions of variables.)

$$\text{Call Value} = C = S e^{-q(T-t)} N(d_1) - X e^{-r_f(T-t)} N(d_2)$$

$$\text{Delta} = \frac{dC}{dS} = N(d_1)$$

Value at Risk takes a somewhat different approach to measuring risk of the portfolio. In this context, the approach is to develop a risk profile of the change in portfolio value over some period of time. Since Value at Risk was developed for traders' derivative portfolios, risk was measured as the risk exposure of a portfolio of derivatives to overnight changes in underlying risk factors. In this context, Fred believed that for his purposes one month is a more appropriate interval over which to consider the risk.

The process necessary to calculate a value at risk was as follows:

1. Estimate current market value.
2. Estimate the risk factors for the portfolio.
3. Assign sources of risk to each asset.
4. Estimate the distribution of each of the risk factors.
5. Estimate the cross-correlation between the risk factors.
6. Run simulations and estimate the values of the assets given a realization of the risk factors.
7. Plot the probability of a particular value of the portfolio based on the simulation.

Steps 1 and 2. Estimate current market values and risk factors.

Exhibit 3 has the current estimates of market value of the portfolio. Given the portfolio, Fred considered the basic risk factors as equity risk, interest rate risk and exchange rate risk. These could be broken down further into S&P500 risk and Tokyo Stock Exchange Risk. Interest rate risk consists of changes in the short-term rate, the mid-term rate, the long-term rate and the swap spread<sup>7</sup>. Finally, the exchange rate risk for this portfolio is the yen/US \$ rate.

Step 3. Assign factors.

Exhibit 4 shows the assignment of assets to risk factors. Note that some assets only depend on one risk factor. Bonds and the equities are cases of this. Other assets such as swaps depend on two risk factors. The swap depends on the level of the 3 year US treasury rate and also on the swap spread. Note that the equity call options depend not only on the value of the underlying index but also on the 3 year US Treasury rate. In addition, there a large number of assets that are sensitive to changes in the same risk factor.

Step. 4. Estimate the distribution of risk factors.

Exhibit 5 shows some of the summary statistics for monthly percentage changes<sup>8</sup> in the risk factors. These were based on six years of historical data. Month-end numbers were used to

<sup>7</sup> Swap spread is the spread between the swap rate and the US Treasury rate for comparable maturities.

<sup>8</sup> Monthly percentage changes are reported in Exhibit 5 and were calculated as:

$$\% \Delta = \frac{\text{Ending} - \text{Beginning}}{\text{Beginning}}$$

calculate the month-to-month percentage changes. Thus, for spot yen exchange rates the mean monthly percentage change in the rate was  $-.36\%$  and the monthly standard deviation was  $.034$ . The S&P 500 index had a mean percentage change of  $1.18\%$  and a standard deviation of  $.0287$  or  $.10$  annualized<sup>9</sup>.

As a first cut, Fred decided to assume that most percentage changes were normally distributed<sup>10</sup>. He assumed a 0 mean and standard deviations were the same as those reported in Exhibit 5. The exception was the swap spread where he used the current value of the spread as the mean and used the historic standard deviation.

#### Step 5. Estimate cross correlations

He also decided to use historic correlations that were reported in Exhibit 5. In those cases where the correlation is less than  $.10$  he assumed a 0 correlation.

#### Step 6. Simulation

Exhibit 6 shows a summary of the risk factors, the assumed distributions and correlation matrix. With these assumptions on the distributions of the underlying risk factors, a value at risk profile could be generated. The basic idea was to run a simulation and estimate the probabilities of changes in the value of the underlying portfolio.

### Results

Fred looked over his assumptions and decided to generate two Value at Risk profiles. The first would be the portfolio without the derivatives and the second one would be with the derivatives included. This would help him understand what the impact of the derivative positions were. Did they increase or decrease the risk of the portfolio?

Exhibit 7 shows the basic inputs for the simulation of the change in portfolio value without derivatives. The left-hand column displays current values of the risk factors while the right-hand column shows the values of the risk factors at the end of the month. In this exhibit the risk factors are set equal to the current values and the resulting change in portfolio value is from the return on the cash position. The simulation uses the assumed distributions for the risk factors and runs 1000 scenarios with different values of the risk factors. Exhibit 8 shows the risk profile for the changes in value of the portfolio given the assumed distributions and correlations (See Exhibit 6) for the risk factors.

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The only exception is the swap spread which is the difference between the swap rate and the 3 year treasury rate. The statistics reported are for the swap spread itself and not the percentage change.

<sup>9</sup> Monthly standard deviations are annualized by multiplying the monthly number by  $\sqrt{12}$ .

<sup>10</sup> If a variable is normally distributed the mean and standard deviation fully describe the distribution. Note that the skewness of a normal distribution is 0 and the Kurtosis is 3.

Exhibit 9 shows the full portfolio including the derivatives. Once again the column of ending values is shown with the current values of the risk factors. The change in value at the end is attributed to the both the return on the cash position and the decrease in time to maturity on the options. The simulation results (1000 trials) for the portfolio with derivatives are shown in Exhibit 10.

Fred wondered how he should interpret these results and how he might explain them to his colleagues and clients? Also, he was concerned about all the assumptions he had made. He knew that clients and colleagues would ask if changing some of the assumptions dramatically change the results? One way or the other he needed to be able to address these issues before he presented his results at the next meeting which was in two days.

**Exhibit 1**  
**Sanders & Associates**  
**Portfolio Assets**

<u>Assets</u>	<u>Description</u>
Cash	Invested in 30 day Treasury Bills.
Bond A	US Treasury Bond, 8 year maturity, 8% coupon, Face Value \$4.5 million.
Bond B	US Treasury Bond, 20 year maturity, 6.5% coupon, Face Value \$3.8 million.
US Portfolio	Portfolio of 200 NYSE listed stocks designed to track the S&P 500 index.
J Portfolio	Portfolio of 300 Tokyo Stock Exchange Listed Stocks designed to track the TOPIX index.
Swap	3 year Interest Rate Swap, pays fixed of 7% and receives 6 month LIBOR on Notional Principal of \$3 million.
S&P Calls	Bought 100 Over-The-Counter (OTC) 3 year maturity European Call options on the S&P 500 with a strike price of 600. At maturity the options pay the maximum of 500 times the difference between the index value and 600 or 0.
Wilshire Calls	Sold 80 Over-The-Counter (OTC) 3 year maturity European Call options on the Wilshire 5000 with a strike price of 6000. At maturity the options pay the maximum of 50 times the difference between the index value and 6000 or 0.
Yen Forward	Taken the Sell side of a forward contract with 90 days to maturity to exchange ¥400 million into US\$ at ¥97.3/US\$.

**Exhibit 2**  
**Sanders & Associates**  
**Current Market Rates**

**Interest Rates****Values as of December 23, 1995**

30 day T-Bill Rate	5.42%
3 year US Treasury Rate	5.35%
7 Year US Treasury Rate	5.59%
30 year US Treasury Rate	6.05%
3 year Swap Rate-Middle Rate	5.58%
3 year Swap Spread (Swap Rate - 3 yr. Treas.)	0.23%

**Equities**

S&P 500 Composite Index	612.00
TOPIX Composite Index	536.84
Wilshire 5000	6002.99

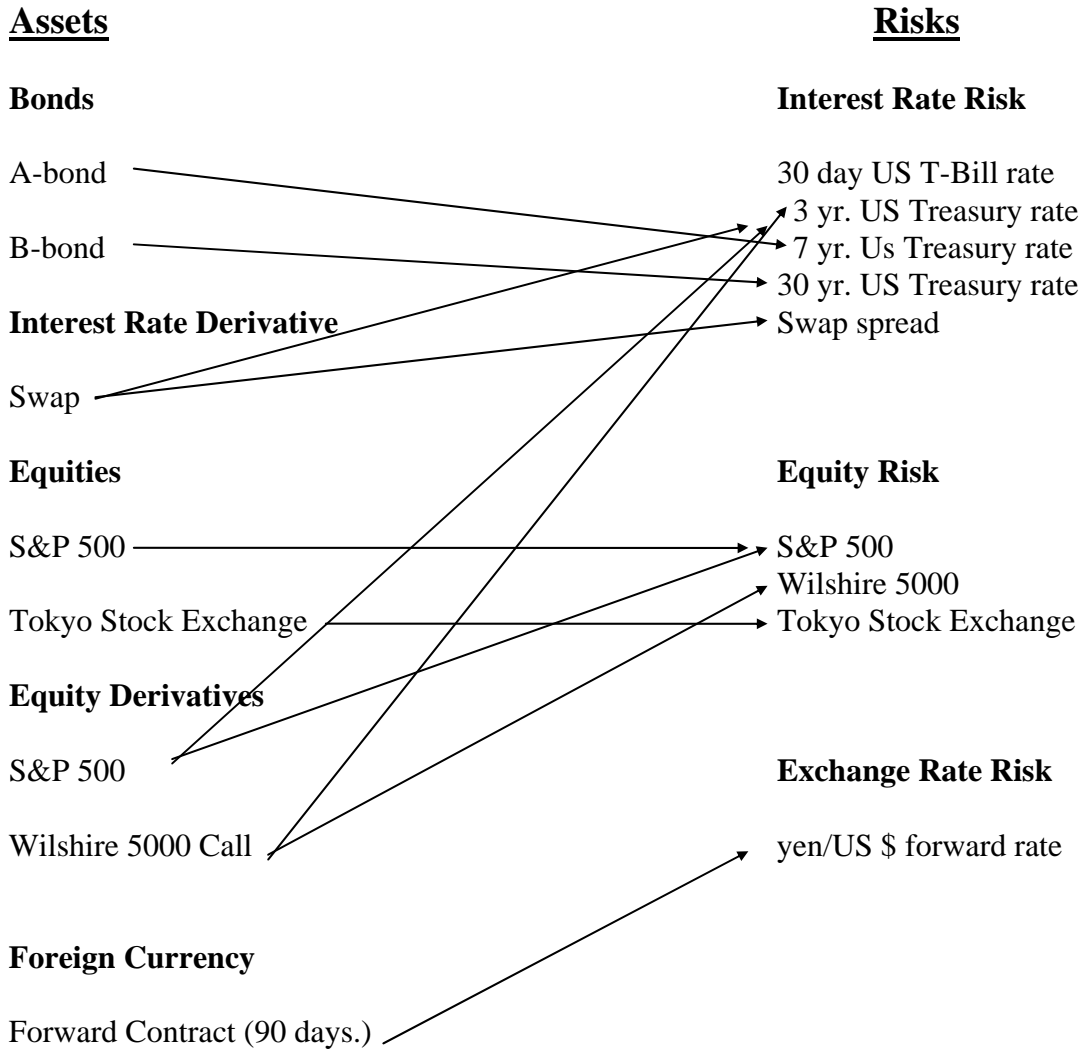
**Exchange Rates**

Yen/US \$ Spot	¥102.30
Yen/US \$ 90 Forward	¥100.98

**Exhibit 3**  
**Sanders & Associates**  
**Asset Valuations**

<u>Asset</u>	<u>Valuation</u>	<u>Value</u>
Cash	Current Cash Value	\$ 800,000
<b>Bonds</b>		
Bond A 7 yr. mat ytm=5.59%	$P_0 = \frac{4.5 \cdot (8\% / 2)}{(1 + ytm/2)^1} + \frac{4.5 \cdot (8\% / 2)}{(1 + ytm/2)^2} + \dots + \frac{4.5 \cdot (8\% / 2) + 4.5}{(1 + ytm/2)^6}$	\$ 5,096,787
Bond B 30 yr. mat ytm=6.05%	$P_0 = \frac{3.8 \cdot (6.5\% / 2)}{(1 + ytm/2)^1} + \frac{3.8 \cdot (6.5\% / 2)}{(1 + ytm/2)^2} + \dots + \frac{3.8 \cdot (6.5\% / 2) + 3.8}{(1 + ytm/2)^6}$	\$ 3,931,223
<b>Equities</b>		
US Port	Market Value per Share x # of Shares (in US \$)	\$ 14,575,200
J Port (¥)	Market Value per Share x # of Shares (in ¥)	¥ 421,008,720
J Port (\$)	$\frac{(\text{Market Value per Share} \times \# \text{ of Shares in yen})}{\text{Yen / US \$ Spot Rate}}$	\$ 4,115,433
<b>Derivatives</b>		
Swap-3 yr. Swap rate (sr)=5.59%	$S_0 = \left\{ \left( \frac{3 \cdot 7\%}{(1 + sr/2)^1} + \dots + \frac{3 \cdot 7\%}{(1 + sr/2)^6} \right) - \left( \frac{3 \cdot sr}{(1 + sr/2)^1} + \dots + \frac{3 \cdot sr}{(1 + sr/2)^6} \right) \right\}$	\$ -76,904
S&P 500 Call (Long)	Call Value = $S e^{-q(T-t)} N(d_1) - X e^{-r_f(T-t)} N(d_2)$ x number of calls q=3%, $r_f=3$ yr. Treas., T-t=3 years, X=600, S=612, $\sigma = .10$	\$ 3,298,713
Wilshire 5000 Calls (Short)	Call Value = $S e^{-q(T-t)} N(d_1) - X e^{-r_f(T-t)} N(d_2)$ x number of calls q=1%, $r_f=3$ yr. Treas., T-t=3 years, X=6000, S=6003, $\sigma = .105$	\$ -3,407,684
Yen Forward $f_0 = 97.3$ $f_1 = 100.98$	$F_0 = \left( \frac{400,000,000 \text{yen}}{f_0} - \frac{400,000,000 \text{yen}}{f_1} \right)$	\$ 149,816
<b>Total Portfolio Value as of December 23, 1995</b>		<b>\$ 28,481,584</b>

**Exhibit 4  
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Risk Sensitivities by Asset**



**Exhibit 5**  
**Sanders & Associates**  
**Historical Descriptive Statistics 7/90-7/95**

**A. Statistics**

	<u>Spot Yen</u>	<u>S&amp;P 500</u>	<u>Wilshire</u>	<u>Topix</u>	<u>Swap rate</u>	<u>Swap Spread</u>	<u>3 yr treas</u>	<u>7 yr treas</u>	<u>30 yr treas</u>	<u>30 day treas</u>	<u>yen 90 d forw</u>
Mean	-0.0036	0.0118	0.0095	-0.0048	-0.0055	0.0041	-0.0048	-0.0048	-0.0040	0.0001	-0.0037
Standard Error	0.0040	0.0034	0.0036	0.0073	0.0065	0.0002	0.0069	0.0050	0.0036	0.0113	0.0040
Median	-0.0013	0.0101	0.0113	-0.0017	-0.0120	0.0037	-0.0138	-0.0089	-0.0071	-0.0049	-0.0009
Standard Deviation	0.0340	0.0287	0.0307	0.0622	0.0555	0.0016	0.0589	0.0427	0.0304	0.0957	0.0340
Sample Variance	0.0012	0.0008	0.0009	0.0039	0.0031	0.0000	0.0035	0.0018	0.0009	0.0092	0.0012
Kurtosis	0.7783	6.8700	7.9941	0.4403	-0.2119	-1.1118	0.2790	-0.1659	0.0716	0.8744	0.8410
Skew ness	0.1485	-1.0153	-1.2332	-0.2313	0.3478	0.4934	0.4288	0.2656	0.2663	0.1439	0.1300
Range	0.1857	0.2211	0.2426	0.3388	0.2660	0.0054	0.2800	0.1970	0.1554	0.5324	0.1876
Minimum	-0.0825	-0.1251	-0.1418	-0.1996	-0.1239	0.0019	-0.1273	-0.0882	-0.0815	-0.2332	-0.0839
Maximum	0.1033	0.0960	0.1008	0.1392	0.1421	0.0073	0.1526	0.1088	0.0740	0.2993	0.1037
Sum	-0.2572	0.8517	0.6844	-0.3487	-0.3960	0.2963	-0.3469	-0.3453	-0.2916	0.0091	-0.2665
Count	72	72	72	72	72	72	72	72	72	72	72

**B. Correlations**

	<u>Spot Yen</u>	<u>S&amp;P 500</u>	<u>Wilshire</u>	<u>Topix</u>	<u>Swap rate</u>	<u>Swap Spread</u>	<u>3 yr treas</u>	<u>7 yr treas</u>	<u>30 yr treas</u>	<u>30 day treas</u>	<u>yen 90 d forw</u>
<u>Spot Yen</u>	1.000										
<u>S&amp;P 500</u>	0.113	1.000									
<u>Wilshire</u>	0.140	0.981	1.000								
<u>Topix</u>	-0.074	0.335	0.353	1.000							
<u>Swap rate</u>	0.154	-0.239	-0.195	-0.010	1.000						
<u>Swap Spread</u>	0.039	0.067	0.068	-0.197	-0.006	1.000					
<u>3 yr treas</u>	0.153	-0.237	-0.202	-0.016	0.971	-0.065	1.000				
<u>7 yr treas</u>	0.145	-0.314	-0.278	-0.066	0.935	0.025	0.936	1.000			
<u>30 yr treas</u>	0.086	-0.489	-0.463	-0.151	0.738	0.064	0.743	0.895	1.000		
<u>30 day treas</u>	-0.017	-0.032	-0.029	0.026	0.319	-0.039	0.233	0.218	0.141	1.000	
<u>yen 90 d forw</u>	0.999	0.111	0.138	-0.082	0.142	0.046	0.139	0.135	0.082	-0.017	1.000

## Exhibit 6

### Sanders & Associates

### Distributions for Simulation

#### A. Distributions

Risk Factors	Predicted Values of Risk Factors- normal=normal distribution(mean, standard deviation)
<u>Spot Yen</u>	current Value * (1+normal(0, .034))
<u>S&amp;P 500</u>	current Value * (1+normal(0, .029))
<u>Wilshire</u>	current Value * (1+normal(0, .031))
<u>Topix</u>	current Value * (1+normal(0, .062))
<u>Swap Spread</u>	current Value * (1+normal(current value, .0016))
<u>3 yr treas</u>	current Value * (1+normal(0, .059)4))
<u>7 yr treas</u>	current Value * (1+normal(0, .043))
<u>30 yr treas</u>	current Value * (1+normal(0, .030))
<u>30 day treas</u>	current Value * (1+normal(0, .096))
<u>yen 90 d forw</u>	current Value * (1+normal(0, .034))

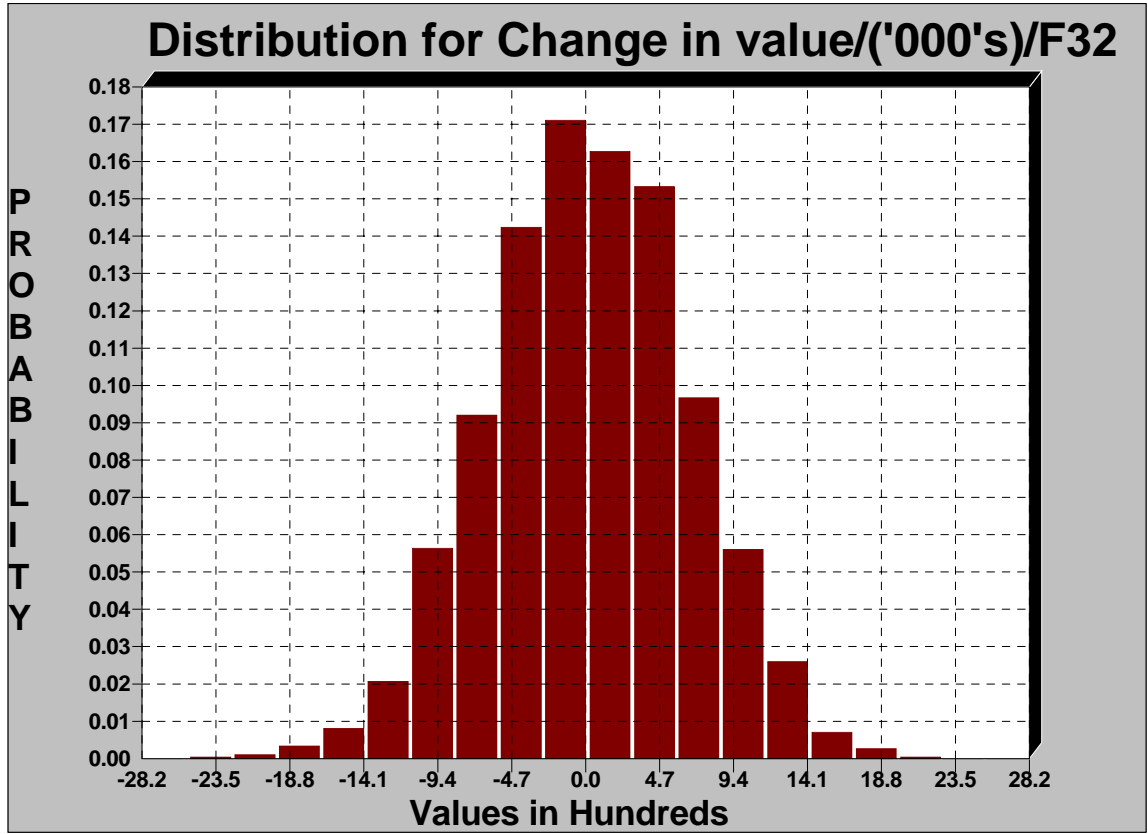
#### B. Assumed Correlations

	<u>Spot Yen</u>	<u>S&amp;P 500</u>	<u>Wilshire</u>	<u>Topix</u>	<u>Swap rate</u>	<u>Swap Spread</u>	<u>3 yr treas</u>	<u>7 yr treas</u>	<u>30 yr treas</u>	<u>30 day treas</u>	<u>yen 90 d forw</u>
<u>Spot Yen</u>	1.000										
<u>S&amp;P 500</u>	0.113	1.000									
<u>Wilshire</u>	0.140	0.981	1.000								
<u>Topix</u>	0.000	0.335	0.353	1.000							
<u>Swap rate</u>	0.154	-0.239	-0.195	0.000	1.000						
<u>Swap Spread</u>	0.000	0.000	0.000	-0.197	0.000	1.000					
<u>3 yr treas</u>	0.153	-0.237	-0.202	0.000	0.971	0.000	1.000				
<u>7 yr treas</u>	0.145	-0.314	-0.278	0.000	0.935	0.000	0.936	1.000			
<u>30 yr treas</u>	0.000	-0.489	-0.463	-0.151	0.738	0.000	0.743	0.895	1.000		
<u>30 day treas</u>	0.000	0.000	0.000	0.000	0.319	0.000	0.233	0.218	0.141	1.000	
<u>yen 90 d forw</u>	0.999	0.111	0.138	0.000	0.142	0.000	0.139	0.135	0.000	0.000	1.000

**Exhibit 7**  
**Sanders & Associates**  
**Portfolio without Derivatives**

<u>Asset</u>	<u>Current Value</u>	<u>Current Market Value</u> ( <sup>'000</sup> 's)	<u>Ending Variables</u>	<u>Ending Market Value</u> ( <sup>'000</sup> 's)
<b>Cash</b>				
Cash		\$ 800		\$ 804
30 day T-bill			5.42%	
<b>Bonds</b>				
<i>US Treasuries</i>				
	<u>Y-T-M</u>		<u>Y-T-M</u>	
A-8.00%, 8 yr. mat., \$4.5 mill.	5.90%	\$ 5,096	5.90%	\$ 5,096
B-6.35%, 20 yr. mat., \$3.8 mill.	6.05%	<u>3,931</u>	6.05%	<u>3,931</u>
Total US \$ Value		\$ 9,027		\$ 9,027
<b>U.S. Equities</b>				
<b>Return</b>				
<u>S&amp;P 500</u>		<u>\$ 14,575</u>	0	<u>\$ 14,575</u>
Total US \$ Value		\$ 14,575		\$ 14,575
<b>Foreign Equities</b>				
<b>Return</b>				
Tokyo Stk. Exchange (yen)		421,009	0	\$ 421,009
<u>Yen/US\$ Exchange Rate (yen)</u>	<u>102.3</u>		<u>102.3</u>	
Total US \$ Value		\$ 4,115		\$ 4,115
<b>Portfolio Value</b>		<b>\$ 28,518</b>		<b>\$ 28,521</b>
<b>Change in value</b>				<b>\$ 4</b>

**Exhibit 8**  
**Sanders & Associates**  
**Portfolio without Derivatives-Simulation Results**



**Exhibit 9**  
**Sanders & Associates**  
**Portfolio with Derivatives**

<u>Asset</u>	<u>Current Value</u>	<u>Current Market Value</u> ( <u>'000's</u> )	<u>Ending Variables</u>	<u>Ending Market Value</u> ( <u>'000's</u> )
<b>Cash</b>				
Cash		\$ 800		\$ 804
30 day T-bill			5.42%	
<b>Bonds</b>				
<i>US Treasuries</i>	<i>Y-T-M</i>		<i>Y-T-M</i>	
A-8.00%,8 yr. mat., \$4.5 mill.	5.90%	\$ 5,096	5.90%	\$ 5,096
<u>B-6.35%,20 yr. mat., \$3.8 mill.</u>	<u>6.05%</u>	<u>3,931</u>	<u>6.05%</u>	<u>3,931</u>
Total US \$ Value		\$ 9,027		\$ 9,027
<b>Interest Rate Derivatives</b>				
	Swap rate		Swap rate	
\$2 mill. Notional Principal				
3 yr. Fixed for Floating @ 7.0%				
3 yr Treasury	5.90%		5.90%	
<u>+ Swap spread</u>	<u>0.23%</u>		<u>0.23%</u>	
Swap Rate	5.59%	-77	5.59%	-77
Total US \$ Value		\$ (77)		\$ (77)
<b>U.S. Equities</b>				
			Return	
<u>S&amp;P 500</u>		<u>\$ 14,575</u>	<u>0</u>	<u>\$ 14,575</u>
Total US \$ Value		\$ 14,575		\$ 14,575
<b>Equity Derivatives</b>				
<b>S&amp;P 500 Calls</b>				
Rf=	5.35%	\$ 3,299	5.35%	\$ 3,251
Dividend yield =	3.0%		3.0%	
Vol.=	0.1		0.1	
current Index Value	612		612	
Div. Adj. Price	559.3		560.7	
Mat=	1080		1050	
Strike Price=	600		600	
D1 =	0.608		0.603	
D2 =	0.435		0.432	
<b>Wilshire 5000 Calls</b>				
Rf=	5.35%	\$ 3,408	5.35%	\$ 3,336
Dividend yield =	1.0%		1.0%	
Vol.=	0.105		0.105	
current Index Value	6003		6003	
Div. Adj. Price	5825.6		5830.4	
Mat (days)=	1080		1050	
Strike Price=	6000		6001	
D1 =	0.811		0.799	
D2 =	0.629		0.620	
<b>Foreign Equities</b>				
			Return	
Tokyo Stk. Exchange (yen)		421,009	0	\$ 421,009
<u>Yen/US\$ Exchange Rate (yen)</u>	<u>102.3</u>		<u>102.3</u>	
Total US \$ Value		\$ 4,115		\$ 4,115
<b>Forward Rate Agreements</b>				
Contract Rate (yen/\$1.00)	97.3	\$ 150	97.3	\$ 150
90 day forward rate	<u>100.98</u>		<u>100.98</u>	
<b>Portfolio Value</b>		<b>\$ 28,482</b>		<b>\$ 28,509</b>
<b>Change in value</b>				<b>\$ 27</b>

**Exhibit 10**  
**Sanders & Associates**  
**Portfolio with Derivatives-Simulation Results**

