CME Group

CAPM & Select Sector Futures

Introduction – The Capital Asset Pricing Model (CAPM) determines the theoretical rate of return an investor expects to obtain from investing in a financial asset. The model postulates the return of an asset must be equivalent to the risk free rate plus a risk premium attributable to the asset's sensitivity to the broad market's return.

$$E(R_i) = R_f + \beta_i(E(R_m) - R_f)$$

Where:

$E[R_i]$ – expected return on the asset

R_f – risk free rate

B_i – beta (the sensitivity of the asset's return to Market returns)

$E[R_m]$ – return of the broad market (approximated by the return of a broad market index such as the S&P 500)

If a financial asset's expected return is above the CAPM predicted theoretical return, the asset is underpriced and one could potentially make profits with a long position in the asset. If a financial asset's expected return is below the model predicted return, the asset is overpriced and one may then potentially make profits with a short position in the asset

Of interest to us is the comparison of historical realized returns of the S&P 500 Select Sector Indices ("Select Sector Indices") and returns indicated by the CAPM model over the same historical period. Moreover, we will examine the performance of trades conducted using CME E-Mini S&P 500 Select Sector Futures ("Select Sector Futures") based on the perceived historical mispricing of these indices relative to theoretical CAPM returns.

Methodology - Our data consists of monthly, quarterly, bi-annual & 8 month returns for 9 S&P 500 Select Sector Total Return Indices starting from the 1st of January 2011. We calculate the realized returns over these time horizons and subtract the theoretical returns predicted by the CAPM model. Return differentials which are significantly different from zero are indicative of mispricing between the market and the CAPM model.

The following parameters will be used to obtain returns from the CAPM Model:

- R_f – Average one month BBA USD Libor rate measured year to date (referred to as YTD hereafter).
- B_i – Measured YTD for each S&P 500 Select Sector index against the S&P 500 Total Return Index (SPTR).
- R_m – Returns obtained from the S&P 500 Total Return Index.

Exhibit 1 – Excess Returns

Deviation = Actual Return - Theoretical Return					
	Total Return Ticker	**1 month**	**3 month**	**6 month**	**8 month**
Consumer Discr.	**IXYTR**	0.33%	2.39%	3.57%	6.03%
Consumer Staples	**IXRTR**	3.39%	1.46%	9.71%	10.81%
Energy	**IXETR**	-3.55%	0.25%	-2.94%	-0.37%
Financials	**IXMTR**	-2.42%	-3.60%	-10.62%	-12.49%
Health Care	**IXVTR**	2.33%	0.33%	9.33%	9.93%
Industrials	**IXITR**	-0.34%	-3.36%	-3.38%	-5.00%
Materials	**IXBTR**	-0.66%	-0.17%	-1.10%	-2.45%
Technology	**IXTTR**	0.00%	1.41%	-0.14%	-1.26%
Utilities	**IXUTR**	5.70%	6.87%	12.41%	11.78%

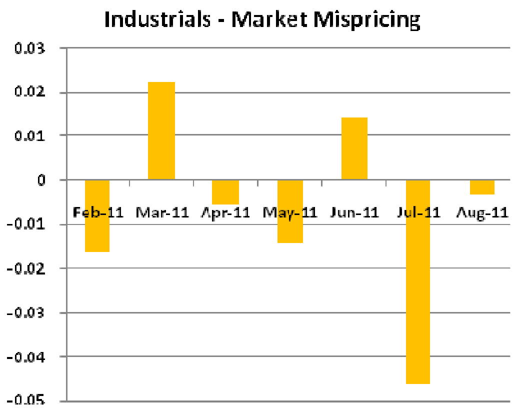
Data range : 1/1/11 – 8/31/11

Exhibit 1 indicates the differences between historical realized returns and theoretical returns based on the CAPM model at various time horizons. The Consumer Staples & Utilities Sector Indices realized returns have been greater than the CAPM theoretical predicted returns over the time horizons sampled. Financials, Materials & Industrials Sector Indices realized are lower than the CAPM predicted returns.

If an investor feels that the sector indices will continue to outperform & underperform CAPM returns, a strategy in which one takes a long futures position in the outperforming sector index and a short futures position in the underperforming sector index could be profitable.

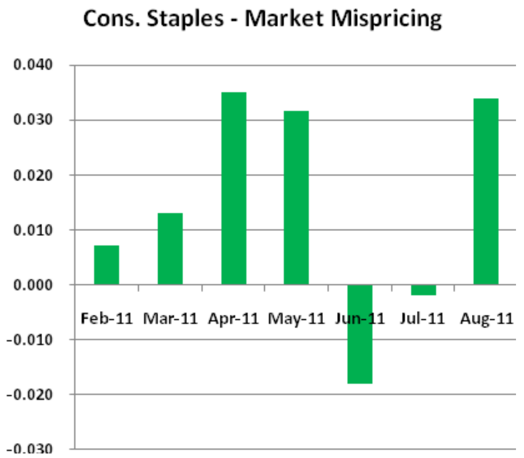
However, if one feels that realized returns will revert back to CAPM theoretical returns, one could take a short position in the outperforming sector index and a long position in the underperforming index. These long/short strategies are referred to as inter-market spreads. These spreads are speculative strategies which may profit from a change in the relative value of the indexes traded.

Exhibit 2



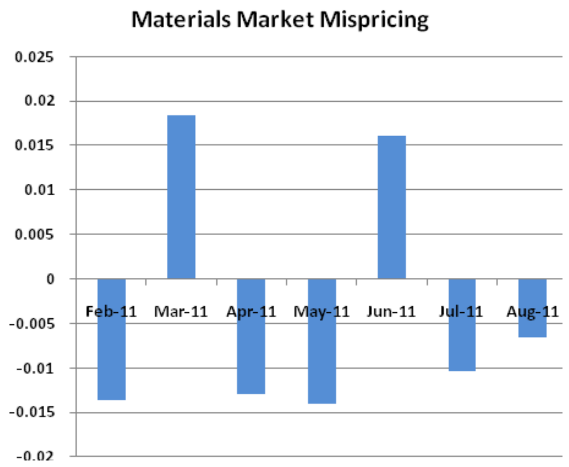
Deviation = Actual Return – (CAPM)Theoretical Return

Exhibit 3



Deviation = Actual Return – (CAPM) Theoretical Return

Exhibit 4



Deviation = Actual – (CAPM) Theoretical

When engineering an inter-market spread trade using futures contracts, one can adjust for the difference in notional values of the contracts. One can also adjust for the betas of the underlying indices. In adjusting for differences in an equity index beta, we seek to balance the economic risks on both sides of the transaction and thus neutralize the anticipated effects of market volatility on our net position.

Exhibit 5

Select Sectors (Total Return)	Beta	Futures Contract Multiplier	Index Level (8/31/11)	Futures Contract Notional
Consumer Discretionary	1.028	$100	373.6	$37,360
Consumer Staples	0.597	$100	305.1	$30,510
Energy	1.221	$100	683.4	$68,340
Financials	1.303	$250	132.6	$33,150
Health Care	0.829	$100	332.2	$33,220
Industrials	1.128	$100	321.3	$32,130
Materials	1.159	$100	369.4	$36,940
Technology	0.968	$100	243.5	$24,350
Utilities	0.641	$100	336.4	$33,640

For example, if sector 1's corresponding futures contract has a notional value of 59,000 and a beta equal to 1.4 while sector 2's corresponding futures contract has a notional value of 42,000 and a beta equal to 1.1, an investor can calculate the beta weighted spread ratio in the following way:

$$(\text{Notional1} \times \text{Beta1}) \div (\text{Notional2} \times \text{Beta2}) = (59{,}000 \times 1.4) \div (42{,}000 \times 1.1) = 82{,}600 \div 46{,}200 \approx 1.79$$

Sector 1's risk adjusted value is 1.79 times larger than Sector 2's. Hence 1.79 futures contracts based on sector 2 may be traded for every futures contracts traded on sector 1 to balance the expected risk of the two positions. The notional value of the futures contract can be calculated by multiplying the futures contract price by the futures contract's multiplier. The multiplier indicates the monetary value of a one point (1.00) change in the price of a futures contract.

Futures Contract Notional Value

= (Futures Contract Price x Multiplier)

All Select Sector Futures contracts have multipliers equal to \$100, except for the Financials sector futures contract which has a multiplier equal to \$250.

We could omit the beta adjustment and focus on the notional values alone. Using the above example, we would then calculate a spread ratio of approximately 1.4:

$$(\text{Notional1}) \div (\text{Notional2})$$
$$= (59{,}000) \div (42{,}000) \approx 1.40$$

Consider the Consumer Staples & Industrials sector indices; based on Exhibit 1 we can see that Consumer Staples has consistently outperformed the CAPM model (or generated excess returns relative to the CAPM model predicted return) for the 8 months preceding September 2011. Meanwhile the Industrials sector has consistently underperformed CAPM during the same time period. Moreover, on the 1st of September, the Consumer Staples futures contract was priced at 305.1 which corresponds to a notional value of \$30,510 (\$100 x \$305.1) and the Industrials futures contract was priced at 321.3 which corresponds to a notional value of \$32,130 (\$100 x 321.3). With this data, and the betas for these two sector indices indicated in Exhibit 5, we could have constructed a beta weighted inter-market spread ratio on the 1st of September in the following way:

$$\text{Notional}_{IND} \times \text{Beta}_{IND}) \div (\text{Notional}_{CS} \times \text{Beta}_{CS})$$
$$(\$32{,}130 \times 1.128) \div (\$30{,}510 \times 0.597)$$
$$= (\$36{,}243) \div (\$18{,}214)$$
$$\approx 1.99$$

Exhibit 6

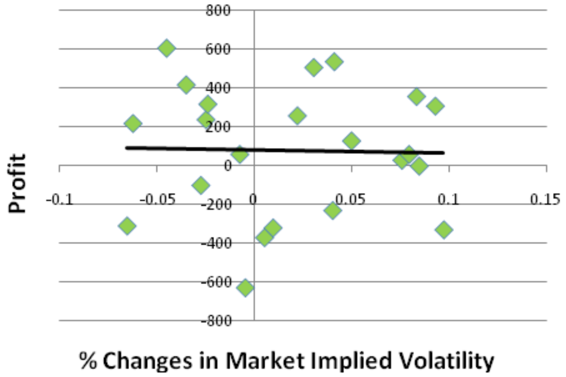
	S&P E-mini Select Sector Consumer Staples	S&P E-mini Select Sector Industrials
9/1/2011	**Long 2 @ 305.1 = Notional \$61,020**	**Short 1 @ 321.3 = Notional \$32,130**
10/3/2011	**Short 2 @ 295.2 = Notional \$59,040**	**Long 1 @290.7 = Notional \$29,070**
	Loss of \$1,980	**Profit of \$3,060**
	Net Profit of \$1,080	

Thus, a spread ratio of approximately 2 suggests that for every Select Sector Industrials contract we trade, we will trade 2 Select Sector Consumer Staples contracts to balance the volatility exposure on each side of this inter-market spread.

As indicated by Exhibit 6, during the four plus week period beginning on September 1st we make a profit of \$3,060 on our short position and a loss of \$1,980 on our long position. The net profit from this trade is \$1,080.

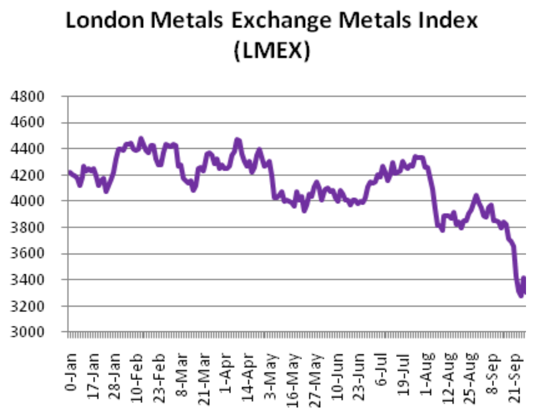
Exhibit 7 illustrates that daily percentage changes in market implied volatility, estimated by implied volatility based on near-the-money options on E-Mini S&P 500 Futures, did not have a significant effect on the P&L realized on our beta weighted spread trade during this time period. In this case, an investor does not need to adjust the inter-market spread based on the expected directional movement of the broad equity overall market.

Exhibit 7



However despite our neutral position relative to market implied volatility, a strategy of taking a long position in Consumer Staples and a short position in Industrials was substantially profitable. From a fundamental standpoint, the profit obtained in this strategy may be explained by the significant drop in the price of industrial metals during September 2011, as seen in exhibit 8.

Exhibit 8



Another inter-market spread example is provided below comparing the performance of the Utilities and Financials Sector futures. From Exhibit 1, we see that the Financials sector index has consistently underperformed CAPM while the Utilities sector index has consistently outperformed CAPM. Thus we could take a long futures position in the Utilities sector and a short futures position in Financials sector. However, for this spread, we only account for the difference in the notional values as opposed to beta adjusting the two indices, i.e. we do not adjust the inter-market spread for the differences in the respective betas. On the 1st of September, the Utilities Sector futures contract was priced at 336.4 and the Financials Sector futures contract was priced at 132.6. We can calculate a notional value adjusted inter-market spread ratio as follows:

$$\frac{(\text{Multiplier}_{\text{Util}} \text{ x Futurest Price}_{\text{Util}})}{(\text{Multiplier}_{\text{Fin}} \text{ x Contract Price}_{\text{Fin}})}$$

$$= (\$100 \text{ x } 336.4) \div (\$250 \text{ x } 132.6)$$

$$= (\$33{,}640) \div (\$33{,}150)$$

$$\approx 1.01$$

Thus a spread ratio of approximately 1.00 indicates that for every Utilities sector futures contract we trade 1 Financials sector futures contract to balance the monetary value of each side of the inter-market spread.

Exhibit 9

	S&P E-mini Select Sector Utilities	S&P E-mini Select Sector Financials
9/1/2011	Long 1 @ 336.4 = Notional $33,640	Short 1 @ 132.6 = Notional $33,150
10/3/2011	Short 1 @ 335.4 = Notional $33,540	Long 1 @116.45 = Notional $29,112
	Loss of $100	Profit of $4,038
	Net Profit of $3,938	

From Exhibit 9 we see that during the September 1st through October 3rd period the short Financial Sector leg of our spread position generated a $4,038 profit while the long Utilities Sector leg suffered a $100 loss. The net profit of the inter-market spread was $3,938.

Of note is that this notional value spread strategy was not immunized against changes in market implied volatility. The volatility relationship is illustrated in Exhibit 10 suggesting a strong positive correlation between the profitability of our position and changes in market implied volatility during September 2011.

Exhibit 10

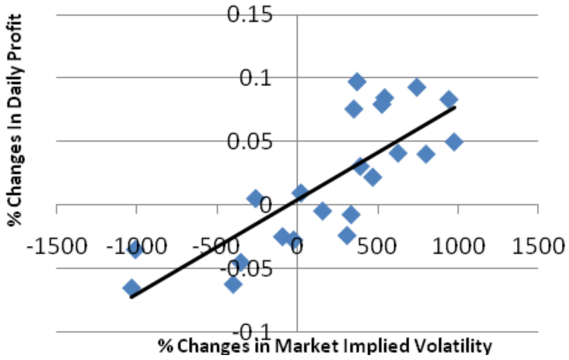


Exhibit 11

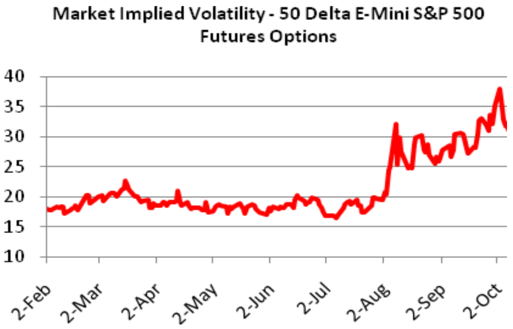


Exhibit 11 illustrates the upward trend in equity market implied volatility during August/September 2011. Equity market volatility tends to increase rapidly when equity prices are dropping. Stable to bullish market trends generally are accompanied by stable to declining implied volatility. Thus in an environment of falling equity market prices, we would expect our defensive Utilities sector to outperform the much less defensive Financials Sector.

In comparison to outright equity index futures positions, inter-market spread trades often possess significantly less risk. As a result, investors who construct spread trades based upon the appropriate spread ratios using CME group contracts will generally be subject to lower initial margin requirements.

We next present an example of an inter-market spread in which we make no adjustment to balance the beta risk and monetary values of the two select sector futures contracts. We trade the same number of contracts on each side of the inter market spread regardless of the notional values of the futures contracts and/or the beta risk of the two index futures utilized.

In this example, we select our contracts and positions based on a mean reversion strategy. Mean reversion is a principle whereby prices, price ratios or returns in the short term, tend to oscillate about a longer term average. Significant deviations from the long term average leads to expectations that prices will revert or return to the average or mean relationship.

In the context of spread trading, one could look at the ratio of index prices between two sector indices, determine a long term mean ratio and then analyze how the ratio in the short term has been behaving relative to this mean.

Exhibit 12 illustrates the relative behavior of the price ratio and mean price ratio between the Financials and Materials Select Sector Indices. If we were to adopt a mean reversion trading strategy as of the 31st of August, we might expect that this ratio would increase in order to revert back to the mean. In order for this to happen the Financials Select Sector Index price would need to outperform the Materials Select Sector Index. We could take advantage of our expectation by taking a long position in the Financials Select Sector futures contract while simultaneously taking a short position in the Materials Select Sector futures contract.

Exhibit 12

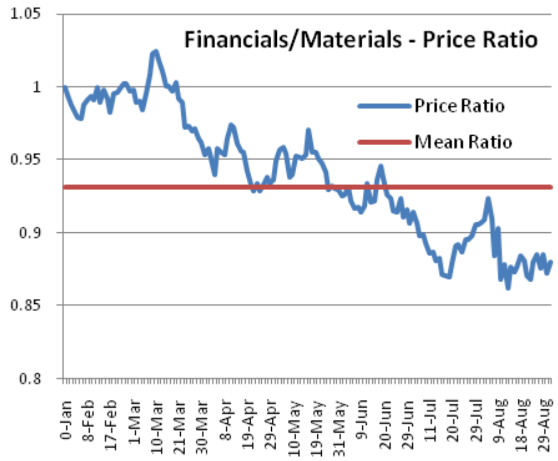


Exhibit 13 illustrates the profit an investor might have realized in the month of September by adopting such a strategy.

Exhibit 13

	S&P E-mini Select Sector Financials	S&P E-mini Select Sector Materials
9/1/2011	Long 1 @ 132.6= Notional $33,150	Short 1 @ 369.4 Notional $36,940
10/3/2011	Short 1 @ 116.45 = Notional $29,112	Long 1 @309 Notional $20,900
	Loss of $4,038	Profit of $6,040
	Net Profit of $2,002	

As indicated in Exhibit 13, the short Materials sector leg accrued a profit of $6,040 while the long Financial sector leg incurred a loss of -$4,080. The net profit for this spread trade was $2,002. While this strategy proved to be successful on this occasion, such a strategy is inherent with risk. Many fundamental and technical factors may impact the outcome of this type of inter-market spread.

Exhibit 14: Inter-market Spread Style

	Beta & Notional Adjusted	Notional Adjusted	No Adjustments
Cons. Staples/Industrials	*$1,080* *(2 x 1)*	*$2,070* *(1 x 1)*	*$2,070* *(1 x 1)*
Financials/Utilities	*$3,838* *(1 x 2)*	*$3,938* *(1 x 1)*	*$3,938* *(1 x 1)*
Financials/Materials	*$2,002* *(1 x 1)*	*$1,599* *(1 x 1.1)*	*$2,002* *(1 x 1)*

***** *The terms below the profit/loss figures indicate the spread ratios used. A spread ratio of 1 x 1.1 was used to calculate the profit for the notional adjusted Financials/Materials trade to keep the monetary scales in the table comparable.*

Exhibit 14 summarizes the profits made in the aforementioned strategies using different adjustment criteria. The results suggest that the notional values of these contracts are approximately equal, thus in general, there is no significant difference between adjusting the inter market spread trades for the notional value and not making any adjustments. However the Beta adjusted inter-market spreads differ significantly in terms of profit as the betas of these various sectors, as indicated in 2nd column of Exhibit 5, are quite different.

In our last example we present an inter-market spread trade based on investor expectations regarding future directional equity market movement (Approximated by the S&P 500). Assume as of the 31st of August 2011 an investor expected the market to decline during the following month. As such a strategy that takes a long position in a 'low beta' select sector futures contract and a short position in the market index (a higher beta contract) might prove to be profitable.

Of note is the fact that we only balance the notional values of the two sides of the trade as opposed to calculating a beta weighted spread ratio. We would like to take advantage of the lower beta of the Consumer Staples Index. Our net exposure in this trade can be calculated in the following way:

(Notional1 × Beta1) - (Notional2 × Beta2)

Since we have balanced the Notional values of the two sides of the trade where:

Notional1 = Notional2

we can restate the previous relationship as:

Market Exposure
= (Notional1) × (Beta1 – Beta2)

As of September 1, we are long one E-mini Consumer Staples Select Sector futures contract. This long futures position has a notional value = $61.020 and a beta = 0.597. We are also short one E-mini S&P 500 futures contract. This short futures contract has a $60,600 notional value with beta =1. Our net exposure is approximately:

$61,000 × (1 – 0.597) = $24,583

Via this inter-market spread we have created a short position of approximately $61,000 with a negative beta of 0.403. This position is anticipated to generate a $245.83 gain for every 1% decline in the market. This position is illustrated in Exhibit 15.

Exhibit 15

	E-mini S&P Consumer Staples Select Sector	E-mini S&P 500
9/1/2011	Long 2 @ 305.1 = Notional $61,020	Short 1 @ 1212 Notional $60,600
10/3/2011	Short 2 @ 295.2 = Notional $59,040	Long 1 @1086.25 Notional $54,312
	Loss of $1,980	Profit of $6,288
	Net Profit of $4,308	

The profitability of this strategy relies on the lower beta of the Consumer Staples sector relative to that of the S&P 500 index. In a declining market environment the defensive Consumer Staples sector is expected to decline at a slower pace than the S&P 500 index. We anticipate moderate losses on a long Consumer Staples sector futures position, with profits on a short E-mini S&P 500 futures position expected to more than offset these losses. Note that this strategy is reliant on an investor correctly predicting market price direction.

As seen in Exhibit 15, E-mini S&P 500 futures declined more than 10% during the September 1 to October 3 period. The short leg of this inter-market spread generated a $6,288 profit. The long Consumer Staples Sector futures leg suffered a loss of $1,980 during this timeframe. The net profit of this one to one inter-market spread was $4,308.

Conclusion – Equity index market participants can utilize CME E-Mini S&P 500 Select Sector futures contracts to take advantage of numerous styles of inter-market spread trading opportunities. These opportunities include spread trades among the E-mini S&P 500 Select Sectors futures contracts as well as creating spread pairs between the CME E-Mini S&P 500 Select Sector futures contracts and the CME E-Mini S&P 500 futures contract, the industry's most liquid equity index futures contract.

We have demonstrated that certain S&P 500 Select Sector Indices have experienced a degree of mispricing relative to the CAPM model during the first eight months of 2011. We also observed an example of mean reversion in the context of the price ratio between two Select Sector Indices.

Observations like these may provoke inter-market spread trading opportunities while maintaining a market price neutral and volatility neutral position.

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Appendix

The following tables were created to construct Exhibit 1 in the body of the paper. Table 1c indicates the data used to define our risk free parameter in the CAPM model. The data used to create tables 1a, 1b and 1c is sourced from Bloomberg.

Exhibit 1a

Actual Returns					
	Ticker	**1 month**	**3 month**	**6 month**	**8 month**
Consumer Discr.	IXYTR	-5.26%	-6.76%	-3.86%	1.86%
Consumer Staples	IXRTR	0.24%	-3.76%	5.49%	8.48%
Energy	IXETR	-10.23%	-10.67%	-11.81%	-5.36%
Financials	IXMTR	-9.56%	-15.27%	-20.10%	-17.83%
Health Care	IXVTR	-2.14%	-7.01%	3.38%	6.61%
Industrials	IXITR	-6.49%	-13.42%	-11.56%	-9.60%
Materials	IXBTR	-6.99%	-10.52%	-9.51%	-7.18%
Technology	IXTTR	-5.26%	-7.20%	-7.12%	-5.17%
Utilities	IXUTR	2.30%	1.25%	7.86%	9.27%

Exhibit 1b

Theoretical Return - CAPM YTD Beta						
	Ticker	**Beta**	**1 month**	**3 month**	**6 month**	**8 month**
Consumer Discr.	IXYTR	1.028	-5.59%	-9.15%	-7.43%	-4.17%
Consumer Staples	IXRTR	0.597	-3.15%	-5.22%	-4.23%	-2.33%
Energy	IXETR	1.221	-6.68%	-10.92%	-8.87%	-4.99%
Financials	IXMTR	1.303	-7.14%	-11.66%	-9.48%	-5.34%
Health Care	IXVTR	0.829	-4.47%	-7.34%	-5.95%	-3.32%
Industrials	IXITR	1.128	-6.16%	-10.07%	-8.18%	-4.59%
Materials	IXBTR	1.159	-6.33%	-10.35%	-8.41%	-4.73%
Technology	IXTTR	0.968	-5.25%	-8.61%	-6.99%	-3.91%
Utilities	IXUTR	0.641	-3.40%	-5.63%	-4.55%	-2.52%

Exhibit 1c

1-month Libor	
Date	**Rate (%)**
30-Jan-11	0.26
28-Feb-11	0.261
31-Mar-11	0.24345
29-Apr-11	0.21025
31-May-11	0.19043
30-Jun-11	0.18555
29-Jul-11	0.1911
31-Aug-11	0.2215

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