ARROWSTREET CAPITAL, L.P.

Beta Arbitrage

John Capeci, Ph.D.
Partner, Arrowstreet Capital, LP

September 2007

ARROWSTREET CAPITAL, L.P.

Beta Arbitrage

This note is designed to provide more background on how the beta arbitrage component of our long/short equity strategy has worked over time[1].

Review of the concept:

The intent of beta arbitrage is to exploit the average underperformance of high beta stocks relative to the return predictions of standard asset pricing models. Exploiting this insight must be done carefully because the return advantage of holding long portfolios of low beta stocks comes with significant risk. We exploit beta arbitrage in our long/short strategy by restricting the beta of the portfolio to be zero, but not restricting the net investment to equal a zero. In normal times, we maintain a slight long bias in the portfolio. A long bias, combined with a zero beta for the whole portfolio, allows the long side of the portfolio has a lower beta than the short side of the portfolio.

The second important feature of our beta arbitrage approach is that we dynamically vary the degree to which we exploit beta arbitrage based on our return forecasts of high beta versus low beta stocks. Specifically, the portfolio construction process sets ranges for long and short exposure which, absent any forecast differentials among stocks, gravitate toward a small long bias. The extent to which we are net long is a function of the specific return forecasts in our model for high beta stocks versus low beta stocks. In some environments, high beta stocks may show attractive characteristics relative to low beta stocks, such as attractive value or momentum. In these environments, we may have a very small long bias, or even a short bias. In other situations, low beta stocks may have much higher forecasts than high beta stocks, in which case we will exploit beta arbitrage more aggressively, and establish a larger net long exposure. The extent to which we engage in beta arbitrage is reflected in the size of our net long bias.

Beta Arbitrage in Arrowstreet's Offshore Opportunities Long/Short Strategy

Figure 1 below illustrates the relationship between our stock level excess return forecasts (alpha) and stock level estimates of beta during a period when the incentive for beta arbitrage is great. This is taken from the end of September 2005. At this time, there was a pronounced negative association between the return forecast and the beta estimate, as can be seen from the scatter diagram. As a result, our process established a net exposure of almost 15% in Arrowstreet's representative long/short account. By contrast, Figure 2 shows the association between beta and alpha at the end of April, 2007. At this time, our forecast model actually preferred high beta stocks, and accordingly, our fund established a small net short position.

[1] This document is provided for informational purposes only and is not intended as investment advice.

Figure 1

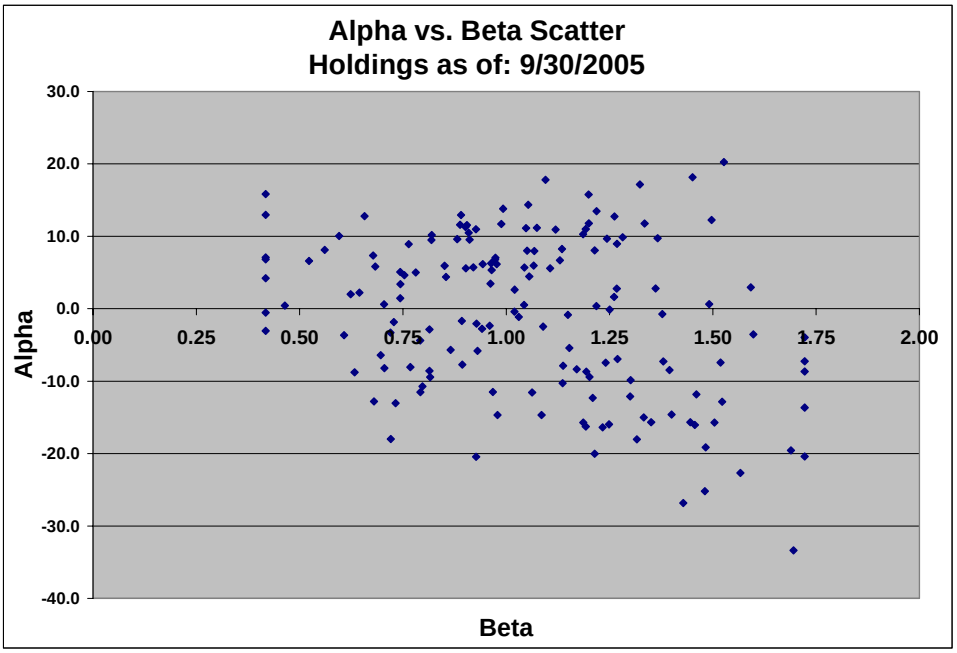

Figure 2

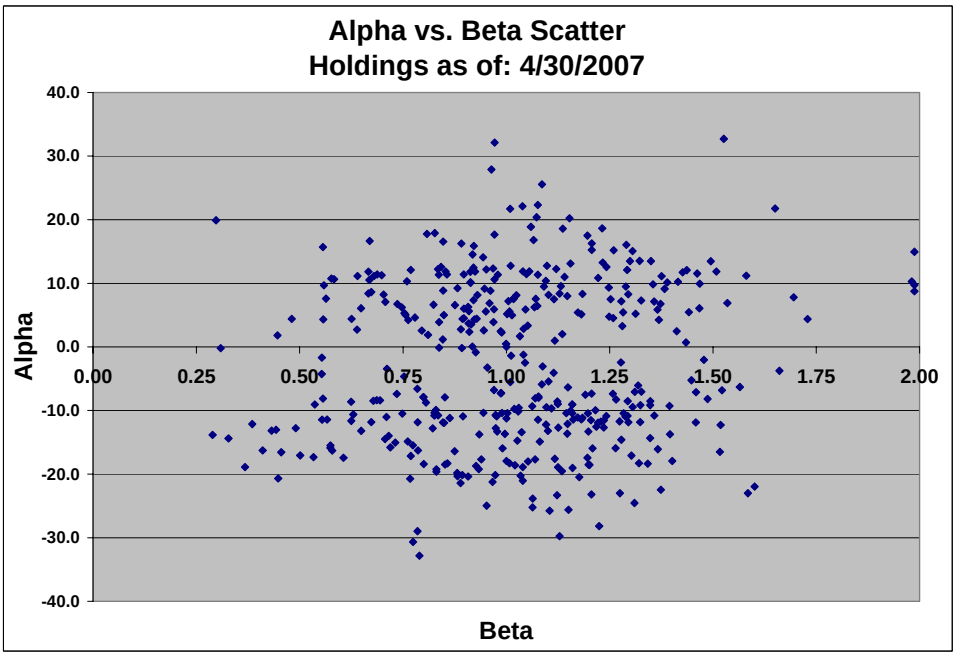

Figure 3 shows how the net long exposure of the strategy has varied over time. We first implemented the beta arbitrage component of our model in September 2005. The net long exposure in any month is indicated by the height of the blue line. As you can see, the net long exposure in the strategy has

varied substantially, from a maximum of 17.50% net long at the end of September 2006, to a period beginning in April 2006 when we actually established a small net short position. On average, the net long exposure over this period has been about 9%.

Figure 3

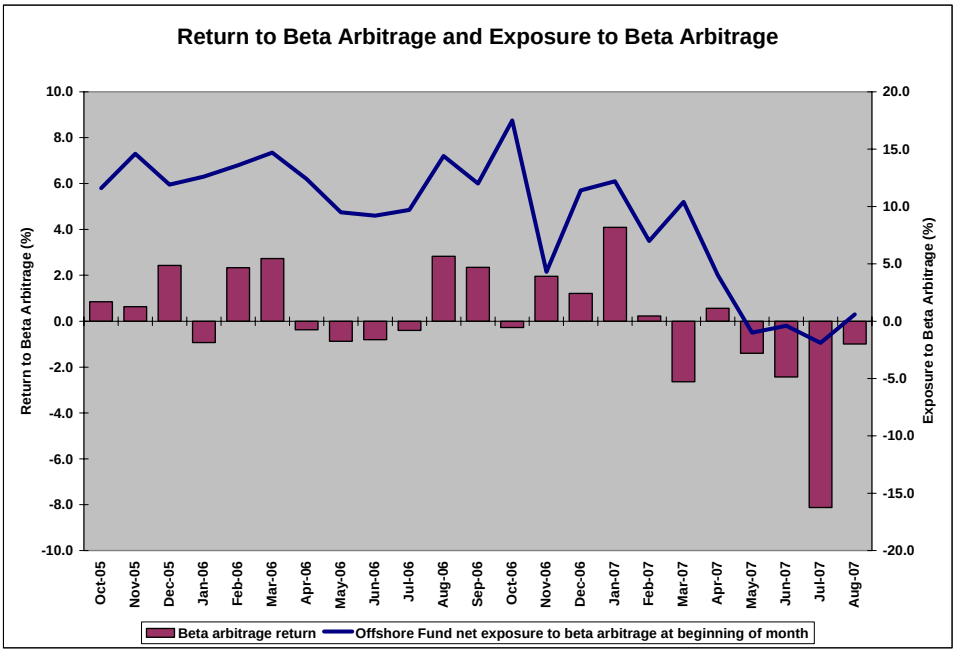

Figure 3 also displays the return to engaging in beta arbitrage, which is illustrated by the height of the purple bars. At each month, the height of the blue line shows the net long exposure to beta arbitrage in our strategy at start of the indicated month; the height of the purple bar shows the return to beta arbitrage during the month.

This return to beta arbitrage represents the payoff to a strategy of maintaining a constant net long/zero beta portfolio. Specifically, the return represents the return on a "characteristic portfolio" which maintains a net long exposure of 100% but also maintains a beta of 0. This portfolio is constructed by minimizing the portfolio weighted sum of squared return variances, subject to the portfolio constraints of 100% investment and zero beta. One can think of this characteristic portfolio as representing a naïve beta arbitrage strategy, since it always maintains the same characteristics of zero beta and full dollar investment. The weights in this portfolio can vary over time, since the estimates of volatility and beta can change over time; however, the portfolio has a fairly stable property of being roughly $1.80 long and $.80 short for every $1 invested.

As you can see, the return on the naïve beta arbitrage strategy can vary from month to month. In most months over this period, naïve beta arbitrage had a positive return. In some months, however, most notably May through August of this year, the naïve beta arbitrage experienced negative returns, as high-beta stocks performed quite well relative to low beta stocks.

On net, our tactical approach to beta arbitrage has served the strategy well, since it has typically been associated with net long exposure in those months when beta arbitrage was profitable and turned toward a net short position when beta arbitrage was acting most perversely.