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INTRODUCTION

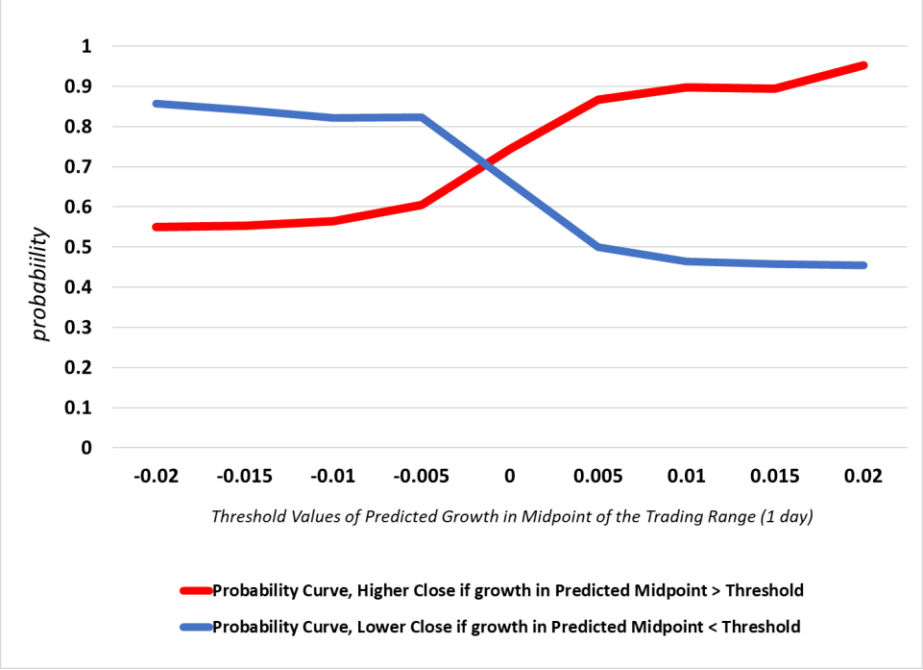
Drawing on predictions of high and low (H/L) prices, we present evidence that the direction of daily and multi-day rates of return can be predicted in a probabilistic framework. The research is based on backtesting over the period 3/20/2007 to 11/29/2019 with daily prices from SPY, the SPDR exchange traded fund which tracks the S&P 500.

In general, we establish probabilities that k-trading day closing prices will be above or below the previous trading day closing price. Thus, we might inspect metrics based on predictions of H/L prices and project an 85 percent probability that the 20-trading-day forward closing price will be above yesterday's closing price. This probability compares with an average of 54 percent positive movements of the 20 trading day closing price over the study period, and so is significantly greater. Similarly, HL prediction metrics might suggest there is a more than 50 percent chance the 20 day forward closing price will be below the previous trading day closing price – when the overall average for the study period is 33 percennt. In addition, these forward predictions can be augmented with other explanatory variables, such as discussed in the literature on predictions of the rate of return. [1]

The basic concepts behind these findings are illustrated here with the simplest case - predictions of the direction of change of the daily closing price, given predictions of the daily high and low prices.

Predicting Current Day Closing Price

The basic finding is illustrated with the following chart, developed with daily price data and one-day high low forecasts for the SPDR exchange traded fund SPY, over 3/20/2007 to 11/29/2019.



[1] See the classic paper - Campbell, John Y. and Samuel B. Thompson. 2008. Predicting excess stock returns out of sample: Can anything beat the historical average? The Review of Financial Studies 21(4): 1509-1531.

Predicted growth rates for the criterion variable – **predicted growth in the midpoint of the trading range** – are shown on the horizontal axis.

Consider the red line which - as the legend indicates - maps out probabilities when the criterion variable exceeds values on the horizontal axis.

When the criterion is greater than -.02, the chances that the daily closing price will be higher than that of the preceding trading day is about 0.55. This rises to about a 95 percent chance when the criterion exceeds .02.

Similarly, the blue line is a probability curve for a lower daily closing price, when the criterion is less than the threshold value on the horizontal axis.

Application of this information is straight-forward. After the opening of the market on a trading day, predictions of the daily high and low are available, as is the prediction of the midpoint of the daily trading range. Compare this predicted midpoint with the previous trading day midpoint for the current value of the criterion variable – the predicted growth in the daily midpoint. If this growth rate is fairly high, say greater than 1 percent growth, there is, based on extensive backtests, an approximately 90 percent chance the current day closing price will be higher than the previous trading day's closing price.

One might seek to close out a position entered at a lower price with this information, or confidently purchase a call option.

Note that opportunities for high probability outcomes are less often, as it were. In other words, the criterion is greater than the necessary threshold for a 90 percent or higher probability approximately 3.4 percent of the time.

This approach is based on the correlation between the midpoint of the trading range and the closing price. The simple correlation between the daily rate of return and the growth in the daily midpoint 0.911. Thus, the midpoint of the trading range for a period is a proxy for the closing price. What we have done, therefore, is substitute predictions of the midpoint of the trading range for the actual midpoint. The average of predictions of the daily high and low prices, of course, is the forecast of the midpoint of the trading range for that trading day.

Further Details

The following two Tables provide the underlying data used to develop the probability curves in the Figure above.

There are 3189 trading days in the simulation. Calculating predictions for the daily high and low prices for each of these trading days (on an out-of-sample basis), we consider the relationship between the directional change of the daily return and the predicted growth in the midpoint of the daily trading range.

Probability Curve for Higher Closing Prices

Threshold Value of Predicted Growth in midpoint >>	Proportion of Cases where current day closing price > previous day closing price	Cases where current day close > previous trading day close	Cases where predicted growth in midpoint > first column value
-0.02	0.549	1737	3163
-0.015	0.553	1731	3129
-0.01	0.564	1713	3035
-0.005	0.605	1664	2751
0	0.743	1225	1648
0.005	0.867	358	413
0.01	0.897	96	107
0.015	0.894	42	47
0.02	0.952	20	21

Consider the first row in the Table. The information in this row indicates that there are 3163 trading days for which the predicted growth in the daily trading range exceeds -.02. A total of 1737, or 54.9 percent of these, are linked with positive directional change in the daily rate of return, calculated with today's closing price and the closing price of the preceding trading day.

As we increase the threshold value, the casers where predicted growth in the daily midpoint of the trading range is above the threshold value decrease. At the same time, the number of these cases where today's closing price is above yesterday's closing price increase.

A similar logic governs the Probability Curve for Lower Closing Prices.

Probability Curve for Lower Closing Prices

Threshold Value of Predicted Growth in midpoint <<	Proportion of Cases where current day closing price > previous day closing price	Cases where current day close > previous trading day close	Cases where predicted growth in midpoint < first column value
-0.02	0.857	5	35
-0.015	0.841	11	69
-0.01	0.822	29	163
-0.005	0.826	78	447
0	0.666	517	1550
0.005	0.503	1384	2785
0.01	0.467	1646	3091
0.015	0.460	1700	3151
0.02	0.458	1722	3177

For the entire study period of 3163 trading days, 54.5 percent of the daily returns are positive while 45.5 percent of the daily returns are negative. These ratios set starting or ending points for the probability curves.