Is Timing Money? The Return Shaping Effect of Technical Trading Systems

Extended Abstract

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The success of trading systems based on technical analysis still seems puzzling and is controversial discussed among experts. In practice, technical trading is widely accepted, whereas academics are traditionally rather skeptical. But in the late 1980s, the picture started to change: the prominent study written by Brock et al. (1992) analyzed the profitability of technical trading rules and found strong support for the predictability of stock returns from past returns. They concluded that the damnation of technical analysis might have been premature. Since then, the subject of technical analysis became somehow acceptable in the academic circle and more and more empirical studies were conducted, which provided an extensive analysis (for a literature review see Park & Irwin 2007). However, the previous research is predominantly based on historical backtests and bootstraps of different markets. This work investigates the hypothesis that trend following systems should profit from autocorrelated returns and contributes to recent literature by trying to answer the questions why, i.e. under which circumstances trading systems may work. Therefore, I consider the interdependency of the implementation of a trading system and the parameterization of different underlying stochastic processes, which simulate the asset return. The different parameters, which are put into the simulation, are estimated from real market data to obtain a realistic bandwidth. As stochastic processes, different AR and GARCH models are used. Since trading systems are presumed to alter or "reshape" the underlying's return distribution, evaluation of the performance is not only done by using standard performance measures, but also by applying the concepts of stochastic dominance as well as expected utility, including a loss averse utility function (if necessary). Therefore, the entire return distributions of the trading system and its corresponding buy-and-hold strategy as a reference have to be generated. More precisely, the concept of risk profiles as described by Eisenfahr & Weber (2003) is used for visualization.

A risk profile is derived from a distribution function $F(x)$ by the simple transformation $R(x) = 1 - F(x)$ so that it contains the exact same information. Nevertheless, risk profiles facilitate the interpretation of graphs, because any point $(x, R(x))$ can be read as: with a probability of $R(x)$ the investor makes at least a return of $x$. In general, the attractiveness of a return distribution from an investor's point of view depends on the individual preferences. However, a comparison of alternatives only requires weak assumptions on the preferences if one strategy stochastically dominates the other one. If the risk profiles of two alternatives A and B are denoted as $R_A(x)$ and $R_B(x)$, then first-order stochastic dominance of A over B holds if

$$R_A(x) \geq R_B(x) \text{ for all } x$$

(1)
Graphically this means that the risk profile $R_A(x)$ lies completely above the profile of $R_B(x)$, no intersection occurs. In such a case, any investor with a monotonically increasing utility function will prefer alternative A (Levy 2006). However, for alternatives with intersecting risk profiles, the weaker concept of second-order stochastic dominance may still hold. Alternative A dominates B at second order if
\[ \int_{-\infty}^{y} R_A(x)dx - \int_{-\infty}^{y} R_B(x)dx > 0 \] for all $y$. \hfill (2)

In this case, any investor with a monotonically increasing and concave utility function will prefer A (Eisenfuhr & Weber 2003). Graphically, the condition can be interpreted as a statement on the areas between the risk profiles: if areas where $R_A(x)$ is above $R_B(x)$ are denoted as positive and areas where $R_A(x)$ is below $R_B(x)$ as negative, then alternative A second-order stochastically dominates B if the sum of the areas from $-\infty$ up to any point $y$ is positive. In cases where no stochastic dominance holds, a preference-free comparison of investment alternatives is not possible anymore. However, assuming risk neutrality in a first step, the area under a risk profile is the expected return (Shreve 2008):
\[ \mathbb{E}_x = \int_{x}^{\infty} (1 - F(z))dx. \] \hfill (3)

Therefore, the aggregated size of the areas between two risk profiles measures the difference in expected return. For a risk neutral investor, this coincides with the gain or loss in expected utility. This measure is denoted as the relative advantage between two investment alternatives and reflects the annualized expected excess return of the trading system. It serves as the central measure. To additionally incorporate individual risk preferences, a value function is introduced as proposed by Tversky & Kahneman (1992), which reflects loss aversion with respect to a given reference value. This approach is based on the prospect theory (Kahneman & Tversky 1979) and assumes that investors try to maximize a S-shaped value function, given as:
\[ V(x) = \begin{cases} 
-A \cdot (\theta - x)^{\gamma_L} & \text{for } x \leq \theta \\
+B \cdot (x - \theta)^{\gamma_G} & \text{for } x > \theta 
\end{cases} \] \hfill (4)

The parameters $A$ and $B$ control the loss aversion, the exponents $\gamma_L$ and $\gamma_G$ describe the sensitivity of the value function. The parameter $\theta$ determines the reference point, while the restrictions $A > 0$ and $B > 0$ ensure that $V(x)$ is an increasing function. The condition $A > B$ reflects loss aversion by a steeper slope for losses than for gains. Since $0 < \gamma_L \leq 1$ and $0 < \gamma_G < 1$, the curve is concave for gains and convex for losses. Empirically, Tversky & Kahneman (1992) found the following values for the parameters: $A = 2.25$, $B = 1.0$ and $\gamma_L = \gamma_G = 0.88$ which is used in the simulations. Applying the value function on the returns, i.e. $R(V(x)) = 1 - F(V(x))$, I obtain "weighted" risk profiles and analyze the areas between these curves as described above.
Relationship (3) now reads as

$$E(V(x)) = \int_{0}^{\infty} (1 - F(V(x)))dx. \quad (5)$$

The area under the risk profile can therefore be interpreted as the expected utility according to the utility function applied, the area between two profiles as the difference in expected utilities. When applying a utility function, I again refer to this measure as the relative advantage. However, in this case, the relative advantage gauges the annualized expected excess utility of the trading system. Results indicate that the success of a trading system depends both on the degree of autocorrelation of the asset return driving process as well as on the implementation of the trading system itself.

References

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