NOVUS

Hit Rate & Win-Loss Ratio

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Introduction

We have been advocating the importance of hit-rate (*HR*) and win-loss ratios *(WLR)* as portfolio metrics for a while now. *HR* measures how often one is right. *WLR* is the ratio between how right is someone when they're right versus how wrong is someone when they're wrong. In this study, we add further evidence as of why such portfolio metrics matter. We introduce a risk-adjusted performance metric that all investors inherently try to maximize, which we call relative net gain *(RNG)*. We then recast *RNG* in terms of *HR* and *WLR*. We demonstrate that while it's true that returns can be generated through different *HR* and *WLR* combinations, not all combinations make sense. Also, we show that the *WLR* that is necessary to achieve positive *RNG* increases non-linearly with *HR*. Since *WLR* is tied more to portfolio considerations (such as portfolio construction and management of existing positions) while *HR* is more a function of research efforts, one concludes that portfolio considerations matter more for investment processes that have inherently low *HR*. We conclude by exploring how *RNG* changes for variations around *HR* and *WLR* and derive insights on what investors should do to improve returns depending on where they sit in the *HR* vs. *WLR* spectrum.

Hit-rates (*HR*) and Win-loss ratios *(WLR)* are key aggregate metrics which investors should monitor across their portfolios. Broadly speaking, *HR* measures the ratio between the number of ideas which have generated positive P&L over a given period versus the total number of ideas. *WLR* on the other hand is defined as the ratio between the average P&L of winning positions versus the average P&L of losing positions. These definitions are appropriate for absolute return portfolios but can be easily adapted to a benchmark-oriented investment strategy by substituting P&L with relative performance versus the benchmark. To neutralize the effect of inflows and outflows, it is advisable to measure average P&L in bps terms as opposed to ``hard currency'' terms.

Why are HR and WLR Important?

There are three practical reasons as of why the importance of *HR* and *WLR* surged over the last few years.

1) They are general. *HR* and *WLR* are generic enough that they can be used across different strategies, investment processes and even investment roles. An allocator building a multi-manager portfolio can think of *HR* and *WLR* in terms of the managers that she allocated capital to. Measuring *HR* and *WLR* boils down to assessing how many managers ended up delivering a positive performance versus the total number of managers in the portfolio (*HR*) and what is the average contribution of a winning manager versus the contribution of a losing manager *(WLR)*. For more complex strategies where a position consists of several instruments, the concept applies at the position (and not instrument) level.

2) They go deeper. Unlike returns (the only other generic performance metric that allows for comparison across different strategies and investment processes), *HR* and *WLR* are closer to the fundamental degrees of freedom such as idea selection and portfolio construction. As such, they provide greater insights into the fundamental characteristics of an investment process. In very loose terms, one can think of *HR* as more closely related to idea selection and the research process behind ideas. In fact, there is no portfolio construction, initial sizing or scaling-in rule that can help a losing position become a profitable one[1]. Conversely, *WLR* is more closely related to portfolio construction and the management of existing positions.

3) Third, they are persistent (more so than returns). Because of the considerations above, *HR* and *WLR* tend to persist over time (much more than returns do). This is because their combination is more closely associated with the nature of the investment process. Based on analyses around hundreds of portfolios, we know for example that the top decile performers in the fundamentally-driven equity long / short arena tend to score *HR* around 60% and *WLR* around 1.2 or higher. A profitable, long volatility book on the other hand would display *HR* around 10\% and *WLR* in excess of 20.

Relative Net Gains

All investors aim at maximizing returns over risk in some shape or form. While several concrete definitions for risk-adjusted return exist, we introduce one here - which we call ``Relative Net Gains'', *RNG* - that we find particularly useful in that it ties very simply to *HR* and *WLR*. Through *RNG*, we will explore how *HR* and *WLR* relate to risk-adjusted returns.

Let us denote as π the P&L generated over a certain period, as N_w and N_l the number of winning and losing positions, respectively, and as φ_w and φ_l the average P&L of a winning versus a losing position, respectively. As discussed earlier, `position' must be understood in the broadest sense of the word. A position can be an individual

[1] We are making a small approximation here because a stop-loss rule - if applied too early for example - may have prevented an unprofitable idea from becoming a profitable one.

stock for example, or a bundle of instruments that is necessary to implement a specific idea. A winning position is defined as a position that has generated a positive P&L over the period, but can also be defined as a position that has generated an outperformance versus a specific benchmark (see previous considerations about adapting the framework to long only, benchmark-sensitive portfolios). By definition, we have:

$$\pi = N_w \cdot \phi_w + N_l \cdot \phi_l. \quad (1)$$

By factoring out $N_l \cdot \varphi_l$ one obtains:

$$\pi = N_l \cdot \phi_l \cdot \left(1 + \frac{N_w}{N_l} \cdot \frac{\phi_w}{\phi_l}\right). \quad (2)$$

Next, we define RNG as the ratio between the P&L generated over the period (π) and the gross loss accrued during the same. That is, we have:

$$RNG = \frac{\pi}{N_l \cdot |\phi_l|}. \quad (3)$$

Since in the worst case (i.e., all positions resulting in a loss), the P&L equals gross losses, we have $RNG >= -1$. By definition we have:

$$\begin{aligned} &\phi_l < 0 \\ &WLR = \frac{\phi_w}{\phi_l} \\ &HR = \frac{N_w}{N_w + N_l} \end{aligned} \quad (4)$$

we can re-write:

$$\begin{aligned} RNG &= \left(\frac{\pi}{N_l \cdot |\phi_l|}\right) = \\ &= \left(\frac{HR}{1 - HR} \cdot WLR - 1\right) \end{aligned} \quad (5)$$

where RNG denotes the net relative gains over the period. RNG can be thought of as an ex-post way of measuring rewards generated over risk incurred. *Eq. (5)* relates ex-post risk-adjusted returns as a function of HR and WLR.

The Null Boundary

By definition, RNG can be either positive or negative depending on whether a positive versus negative P&L was generated during the period. Let us define the null boundary as the relationship between HR and WLR when $RNG = 0$. This allows us to explore how HR and WLR relate to each other right at the cusp between a profitable portfolio and an unprofitable one. By setting $RNG = 0$ in *Eq. (5)* and expressing WLR in terms of HR we have:

$$WLR = \frac{1 - HR}{HR}. \quad (6)$$

Figure (1) depicts the null boundary as well as the non-applicable areas (shaded in grey), which result from the fact that by definition we have $0 < HR < 1$ and $WLR > 0$.

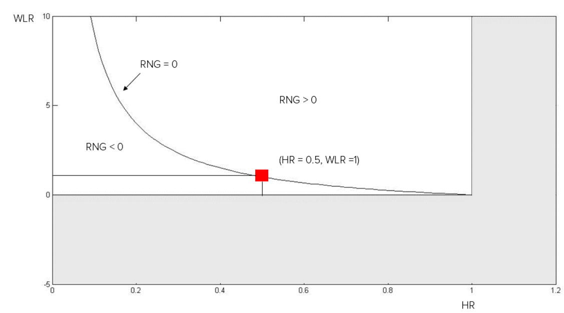

Figure 1: The Null Boundary

An interesting point on the curve is represented by the equilibrium point (denoted as a red square), which depicts a portfolio where there are as many ideas generating a profit as there are generating a loss $(HR=0.5)$ and where the same amount of profit is generated on average for winning positions as it was for losing positions $(WLR=1)$. For a given HR, the set of WLR that results into a profitable portfolio are infinite. These combinations are represented by all WLR values above the null boundary for a given HR. The opposite is not true when considering a given WLR. The range of HR that results into a profitable portfolio is finite. This also means that - for a given HR - the P&L that can be generated is unbound (although it's clear that higher WLR are unlikely), while is opposite is not true for a given WLR.

Another interesting set of observations results from inspecting the sensitivity of the null boundary for small variations in the HR. To that extent, let us take the derivative of WLR vs. HR along the null boundary. From *Eq. (6)* we have:

$$\frac{dHR}{dWLR} = -\frac{1}{HR^2}. \tag{7}$$

We note that the derivative is always negative. This is an immediate consequence of the fact that - when HR declines - the WLR that is needed to keep the portfolio at the margin of profitability must increase. This makes intuitive sense. What is less intuitive - and perhaps more powerful as an insight - is that the rate at which the WLR must increase (to keep the portfolio marginally profitable) sharply increases for decreasing HR. This is clearly visible for $HR < 0.5$ - the equilibrium point. This means that investment processes with an inherently low HR (such as those with a very light research process) must aim at a very high WLR if they want to return a profit. For example, consider a purely algorithmic trend-following strategy whose entry signals are determined by a classical price break-out. As any manager following such strategies will tell you, whether the instrument exhibiting such pattern is a commodity or a FX pair matters less than the price action itself. As a consequence, HR can be low. Conversely though, scaling into the position becomes very important as a way to maximize WLR and not miss a very significant trend. Similarly, stop losses are very important too to keep the damage inflicted by losing positions under control.

Let us now consider a situation where $HR > 0.5$. In that range, the sensitivity of WLR to HR diminishes (compared to the range where $HR < 0.5$). This means that - for $HR > 0.5$ - there is limited benefit in trying to further improve HR.

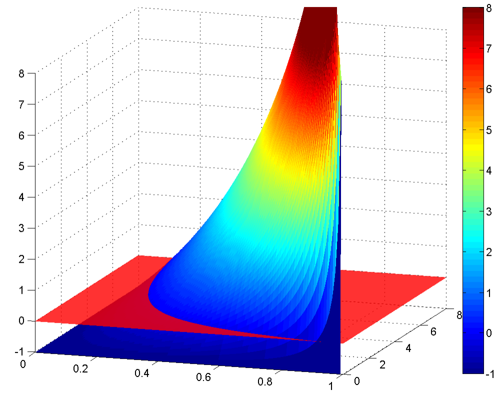

Figure 2: RNG as a function of HR and WLR.

Profit Sensitives

Let us now explore how RNG changes for small changes in either HR or WLR. By taking partial derivatives w.r.t. HR and WLR from *Eq. (5)* we have:

$$\frac{\partial RNG}{\partial HR} = \frac{WLR}{HR^2} \tag{8}$$

and

$$\frac{\partial RNG}{\partial WLR} = \frac{HR}{1 - HR} \tag{9}$$

Figure (2) depicts RNG as a function of HR and WLR. The red horizontal plane represents $RNG = 0$. The intersection of such plane with the RNG surface represents the null boundary curve. From *Eq. (9)* we note that the sensitivity of RNG vs. WLR tends to zero for $HR \rightarrow 0$. That is, RNG won't move much for changes in the WLR when HR is low. In other words, it does not matter if your WLR is high if your HR is abnormally low. Also, note that the sensitivity tends to infinity for $HR \rightarrow 1$. That is, a small improvement in the WLR is much more powerful for investment processes characterized by high HR levels. This remark is aligned to what observed earlier. For $HR > 0.5$, WLR is the only thing that matters if one seeks to improve RNG. Also, note that such sensitivity is independent of WLR.

From *Eq. (8)* we note that the sensitivity of RNG w.r.t. HR declines with the square of HR. That is, the RNG does not improve much upon changes in the HR for high levels of HR. This is kind of obvious, in the sense that there is no point in working on the HR for high levels of HR. What is less obvious is that the decline goes with the square of HR. Also, we note that the sensitivity of RNG w.r.t. HR increases proportionally with WLR. The higher the WLR already, the more RNG will be positively influenced by increases in the HR.

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