Quantifying Exhaustion: A Regime-Dependent Analysis of TD Sequential and RSI Filters

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Abstract

This paper investigates the statistical efficacy of Tom DeMark's TD Sequential indicator when filtered by the Relative Strength Index (RSI). By backtesting the "TD 13" exhaustion signal across multiple assets, we analyze whether momentum confirmation via RSI improves the predictive ability compared to a standalone TD Sequential strategy.

1 Introduction

The pursuit of identifying market inflection points remains one of the most lucrative yet perilous endeavors in quantitative finance. Strategies designed to capture these reversals, often termed "contrarian" or "mean-reversion" systems, face a fundamental asymmetry: the profit potential of entering at a global extremum is often outweighed by the ruinous risk of "catching a falling knife" during high-velocity crashes or parabolic runaways.

Among the myriad of technical tools designed to quantify trend exhaustion, Tom DeMark's **TD Sequential** indicator stands out for its algorithmic rigor. By requiring specific price-action sequences rather than lagging averages, the TD Sequential attempts to impose a structured countdown to market turns. However, empirical observation suggests that in regimes of exceptional volatility or liquidity cascades, the standard "TD Countdown 13" signal can fire prematurely, trapping traders in positions against a dominant trend that has not yet normalized.

This paper posits that the efficacy of the TD Sequential 13 signal is not absolute but is instead highly regime-dependent. We hypothesize that by conditioning the price-based exhaustion of the TD Sequential with the momentum-based constraints of the **Relative Strength Index (RSI)**, we can filter out low-probability signals generated during "neutral" market states.

Specifically, this study investigates whether a "confluence" approach—requiring a TD 13 Countdown to coincide with an RSI deviation (below 40 for buys, above 60 for sells)—improves win rates compared to a naive, unconditional implementation of the indicator. By backtesting this hypothesis across a diverse basket of currency pairs over a fixed 50-period holding horizon, we aim to provide a statistical framework for distinguishing between a "cheap" asset and a "dying" one.

2 Methodology

2.1 Data Acquisition and Preprocessing

The dataset comprises hourly ($H1$) Close price series for a basket of a number of major and emerging markets foreign exchange pairs EUR/USD, USD/CHF, GBP/USD, USD/JPY, AUD/USD, USD/CAD, USD/MXN, EUR/HUF, EUR/PLN. For a given currency pair, let the time series of closing prices be denoted as $P = \{p_1, p_2, \ldots, p_T\}$, where T represents the total number of observations.

2.2 The Relative Strength Index (RSI)

The Relative Strength Index (RSI) was developed by J. Welles Wilder Jr. and first published in his 1978 book, *New Concepts in Technical Trading Systems*. Designed during an era of manual calculation, Wilder sought to create a momentum oscillator that was computationally efficient yet capable of normalizing price changes across different assets and timeframes. It has since become a staple in quantitative finance for identifying mean-reversion opportunities and market extremes.

The RSI is a bounded oscillator ranging from 0 to 100. It measures the internal strength of an asset by comparing the magnitude of recent gains to recent losses. The calculation involves a specialized smoothing technique known as "Wilder's Smoothing."

Let P_t be the closing price at time t. We define the period-over-period price change as $\Delta P_t = P_t - P_{t-1}$. We separate these changes into positive (U_t) and negative (D_t) components:

$$U_t = \max(\Delta P_t, 0) \quad \text{and} \quad D_t = |\min(\Delta P_t, 0)| \tag{1}$$

For a standard look-back period N (typically 14), the calculation proceeds in two steps. First, the initial average gain ($\bar{U}_{init}$) and average loss ($\bar{D}_{init}$) are simple arithmetic means:

$$\bar{U}_{init} = \frac{1}{N} \sum_{i=0}^{N-1} U_{t-i}, \quad \bar{D}_{init} = \frac{1}{N} \sum_{i=0}^{N-1} D_{t-i} \tag{2}$$

For all subsequent periods, Wilder employed a smoothing function equivalent to an Exponential Moving Average (EMA) with a decay factor of $\alpha = 1/N$. This ensures data persistence and reduces the volatility of the indicator:

$$\bar{U}_t = \frac{\bar{U}_{t-1} \cdot (N-1) + U_t}{N} \tag{3}$$

$$\bar{D}_t = \frac{\bar{D}_{t-1} \cdot (N-1) + D_t}{N} \tag{4}$$

The Relative Strength (RS) is the ratio of these smoothed averages:

$$RS_t = \frac{\bar{U}_t}{\bar{D}_t} \tag{5}$$

The final RSI value is derived by normalizing the RS ratio:

$$RSI_t = 100 - \frac{100}{1 + RS_t} \tag{6}$$

The primary application of the RSI in this study is the identification of extremum points where the probability of a reversal increases.

- **Overbought ($RSI \geq 70$):** Indicates that the asset has experienced significant upward momentum relative to its recent history. This condition suggests buyer exhaustion and is often utilized as a signal to exit long positions or initiate short positions.
- **Oversold ($RSI \leq 30$):** Indicates that the asset has experienced excessive selling pressure. This condition suggests seller exhaustion, presenting a potential entry point for long positions.

2.3 The TD Sequential Indicator

The TD Sequential is a market timing indicator created by Tom DeMark and designed to anticipate price exhaustion and potential trend reversals. Unlike standard technical indicators that rely on smoothed averages, the TD Sequential is strictly price-action based, comparing current prices to specific historical lags. The indicator is composed of two distinct phases: the **Setup** (identifying momentum saturation) and the **Countdown** (identifying trend exhaustion).

2.3.1 Phase 1: The TD Setup (The "9")

The first phase attempts to identify a short-term momentum extension. A *TD Setup* consists of a series of nine consecutive closes compared to the close four bars prior.

Let C_t be the closing price at time t. The conditions for the Setup are defined as follows:

- **TD Buy Setup (Bullish):** Requires nine consecutive closes, each **lower** than the close four bars prior.
$$C_t < C_{t-4} \tag{7}$$
- **TD Sell Setup (Bearish):** Requires nine consecutive closes, each **higher** than the close four bars prior.
$$C_t > C_{t-4} \tag{8}$$

Rules of Construction For either Setup to be finalized, the respective condition must hold true for nine **consecutive** periods.

- **Interruption (Cancellation):** If at any point during the count (e.g., at bar 7) the condition fails (i.e., $C_t \geq C_{t-4}$ for a Buy Setup or $C_t \leq C_{t-4}$ for a Sell Setup), the Setup is immediately cancelled, and the count resets to zero.
- **Completion:** A completed "Setup 9" typically indicates a momentary pause or a minor reaction in the trend (a price bounce/correction of 1–4 bars), but it does not necessarily signal a major trend termination.

2.3.2 Phase 2: The TD Countdown (The "13")

Once a TD Setup (Buy or Sell) is successfully completed, the indicator transitions to the *Countdown* phase. This phase seeks to identify the exact moment of trend exhaustion to target a theoretically low-risk entry for a reversal. The objective is to accumulate a count of 13.

The mathematical conditions for the Countdown differ from the Setup and are typically more rigorous:

- **TD Buy Countdown:** Compares the current Close to the **Low** two bars earlier.

$$C_t \leq L_{t-2} \tag{9}$$

- **TD Sell Countdown:** Compares the current Close to the **High** two bars earlier.

$$C_t \geq H_{t-2} \tag{10}$$

Initiation and Transition Rules The transition from Phase 1 (Setup) to Phase 2 (Countdown) follows specific logic regarding "Bar 9". This logic applies symmetrically to both Buy and Sell sequences:

1. **Immediate Initiation:** If the 9th bar of the TD Setup also satisfies the respective Countdown condition (e.g., $C_{setup\_9} \leq L_{setup\_9-2}$ for a Buy sequence), then that 9th bar is simultaneously counted as **Bar 1** of the Countdown.
2. **Postponement:** If the 9th bar does not meet this condition, the Countdown initiation is postponed. The algorithm waits for the first subsequent bar that satisfies the Countdown requirement to mark Countdown Bar 1.

Counting Logic Unlike the Setup, the Countdown does **not** require consecutive bars.

- The count accumulates only on bars where the specific condition is met ($C_t \leq L_{t-2}$ for Buy; $C_t \geq H_{t-2}$ for Sell).
- If the condition is not met on a given bar, the count simply pauses (it does **not** reset to zero).
- The signal is fully generated upon the close of the 13th qualifying bar.

2.3.3 Strategic Usage and Interpretation

The completion of a "Countdown 13" represents a zone of trend exhaustion.

- **Buy Signal:** A completed TD Buy Countdown 13 suggests seller exhaustion and potential for a bullish reversal.
- **Sell Signal:** A completed TD Sell Countdown 13 suggests buyer exhaustion and potential for a bearish correction.

In the context of this research, we hypothesize that a standalone TD 13 signal may be insufficient to suggest a reversal. Therefore, we utilize the RSI filter defined in the previous section to enhance the probability of the expected reversal.

3 Experimental Design and Strategy Specifications

To evaluate the efficacy of the RSI as a regime filter, we employ a comparative backtesting framework. We define two distinct strategy models: a baseline model relying solely on the TD Sequential indicator, and a filtered model incorporating momentum thresholds.

3.1 Strategy 1: The Baseline Model (Unfiltered TD 13)

The baseline model serves as the control group. It operates on the hypothesis that the completion of a TD Countdown 13 represents a definitive market exhaustion point, irrespective of the prevailing momentum oscillator values.

3.1.1 Entry Logic

The strategy initiates a position immediately upon the confirmed close of the 13th Countdown bar.

- **Long Entry (E_{long}):** Triggered when a TD Buy Countdown 13 is completed.
- **Short Entry (E_{short}):** Triggered when a TD Sell Countdown 13 is completed.

3.1.2 Exit Logic (Time-Based)

To isolate the predictive power of the entry signal without the interference of complex trailing stops or profit targets, we utilize a fixed time-based exit.

- **Holding Period:** All positions are held for a fixed duration of $\Delta t = 50$ periods.
- **Rationale:** This extended holding period is selected to capture "global" reversals—significant structural shifts in the market trend—rather than minor scalping reactions.

Mathematically, if a trade is opened at time t_{entry}, it is closed at $t_{exit} = t_{entry} + 50$.

3.2 Strategy 2: The Filtered Model (TD 13 + RSI Confluence)

The second strategy introduces a momentum constraint. The hypothesis is that a TD 13 signal is more reliable when confirmed by a supporting RSI regime. Specifically, we aim to filter out signals that occur during "neutral" momentum states, targeting only those at the upper and lower statistical bounds of the market (ideal for ranging environments).

3.2.1 Entry Logic with Filters

We apply a strict logical conjunction (AND condition) between the TD signal and the RSI value at the moment of the signal generation.

Bullish Signal (Long) A long position is initiated if and only if:

$$\text{Signal}_{long} = (\text{TD Buy Countdown} = 13) \quad \wedge \quad (RSI_t < 40) \tag{11}$$

Note: The threshold of 40 is selected (rather than the standard 30) to allow for slightly earlier entries while still ensuring the market is in the lower quantile of its range.

Bearish Signal (Short) A short position is initiated if and only if:

$$\text{Signal}_{short} = (\text{TD Sell Countdown} = 13) \quad \wedge \quad (RSI_t > 60) \tag{12}$$

Note: The threshold of 60 acts as the upper bound filter, ensuring we only short when momentum is relatively high but showing exhaustion signs via the TD count.

3.2.2 Exit Logic

To ensure strict comparability between the Baseline and Filtered models, the exit logic remains identical:

$$t_{exit} = t_{entry} + 50 \tag{13}$$

3.3 Research Hypothesis

We postulate that the **Filtered Model** will exhibit a higher Sharpe Ratio and Hit Ratio (Win Rate) compared to the Baseline Model, specifically by reducing false positives in strong trending markets where the RSI remains neutral (40–60) or "pegged" at extremes. The filter is designed to optimize performance in mean-reverting (ranging) market structures, effectively identifying the "global top" or "global bottom" by confirming that price exhaustion (TD 13) coincides with momentum extremes (RSI).

Figure 1: **Generated Signals (USD/CAD H1).** The plot shows contrarian signals generated from the Countdown Pattern. Green annotations denote Buy signals, and Red annotations denote Sell signals.

4 Results and Discussion

4.1 Performance Attribution

The primary objective of this backtest was to isolate the marginal contribution of the RSI momentum filter when applied to the TD Sequential 13 exhaustion signal. Table 1 summarizes the comparative performance across major and exotic currency pairs (11,000 data points per currency pair).

The metrics presented are:

- **Expectancy:** The average dollar return per trade taking into account the historical Hit Ratio.

Figure 2: **Generated Signals With RSI Filter (EUR/USD H1).** The plot shows contrarian signals generated from the Countdown Pattern. Green annotations denote Buy signals, and Red annotations denote Sell signals.

- **Hit Ratio:** The percentage of trades resulting in a profit.
- **Filter:** The percentage of original TD 13 trades retained after applying the RSI condition.

Table 1: Comparative Analysis: TD Sequential vs. RSI-Filtered Strategy

Asset	**TD 13 Only (Raw)**		**Filter**	**With RSI Filter**	
	Expectancy	*Hit Ratio*	*(% Retained)*	*Expectancy*	*Hit Ratio*
EURUSD	-69.85	50.00%	70.00%	-86.49	53.57%
USDCHF	-139.28	44.73%	84.21%	-153.11	46.87%
GBPUSD	41.40	55.81%	67.44%	**94.65**	**65.51%**
USDJPY	29.41	47.05%	78.43%	36.25	47.50%
AUDUSD	-151.27	37.20%	65.12%	-118.30	39.28%
USDCAD	8.91	43.90%	82.93%	**62.80**	47.05%
USDMXN	88.19	57.14%	54.29%	7.30	52.63%
EURHUF	121.17	62.16%	62.16%	**133.12**	**65.21%**
EURPLN	174.68	65.51%	65.52%	140.21	63.15%

4.2 Analysis of Findings

The introduction of the RSI filter generated mixed results across the asset universe, highlighting the regime-dependency of contrarian strategies.

4.2.1 Significant Improvements

The filter demonstrated the highest efficacy in **GBPUSD** and **USDCAD**.

- For **GBPUSD**, the RSI filter removed approximately 32.5% of the raw trades (Filter Density: 67.44%). This selectivity drastically improved the expectancy from 41.40 to 94.65, while boosting the hit ratio by nearly 10 percentage points (55.81% to 65.51%).
- Similarly, **USDCAD** saw a massive increase in expectancy (8.91 to 62.80). The filter successfully eliminated low-probability signals, transforming a marginally profitable strategy into a robust one.

4.2.2 Deterioration in Performance

Conversely, the filter acted as a hindrance in certain pairs, most notably **USDMXN** and **EURUSD**.

- In **USDMXN**, the expectancy collapsed from 88.19 to 7.30. The low filter retention rate (54.29%) suggests that the RSI condition was too restrictive, filtering out many profitable high-momentum reversal trades that occur in volatile emerging market currencies.
- **EURUSD** and **USDCHF** remained negative expectancy strategies regardless of the filter, suggesting that the underlying TD 13 signal may not be an effective standalone predictor for these highly liquid, efficient pairs during the tested period.

4.2.3 Conclusion on Filtering Efficiency

The data suggests that the RSI filter has the potentiel to add value. The variance in "Filter Density" (ranging from 54% to 84%) indicates that a "one-size-fits-all" RSI threshold may be suboptimal; parameter optimization per asset class could yield more consistent results.