Method 1: Trend $\times Volatility Market Regime Detection$

large Economic, Mathematical, and Practical Interpretation

1 Introduction

Financial markets do not operate in a single continuous state. Instead, they evolve through *regimes* characterized by different combinations of direction, stress, and investor behavior. Method 1 is a structural market regime detection framework designed to classify the prevailing *risk environment* rather than predict returns.

The objective of this method is simple but fundamental:

> *To determine whether the current market environment structurally rewards risk-taking, punishes it, or is transitioning between the two.*

This method deliberately avoids short-term forecasting, machine learning, or performance optimization. Its role is to provide *context*, which serves as the foundation for higher-level models and decision-making processes.

2 Why Trend and Volatility?

Market behavior can be decomposed into two orthogonal dimensions:

- **Trend**: the direction of long-term capital flows.

- **Volatility**: the level of stress, uncertainty, and instability in those flows.

Trend answers the question:

> *Is capital structurally moving into or out of risky assets?*

Volatility answers the question:

> *How violently and disorderly is this movement occurring?*

Neither variable alone is sufficient. An uptrend can coexist with rising fragility, and a downtrend can unfold quietly before panic emerges. The interaction between trend and volatility defines the true market regime.

3 Feature Construction

Method 1 relies on four core features derived directly from market prices.

3.1 Price

The price series represents the final aggregation of all available market information. All other features are transformations of price and exist to extract structural properties from it.

3.2 Log Returns

Daily log returns are computed as:

$$r_t = \log\left(\frac{P_t}{P_{t-1}}\right) \tag{1}$$

Log returns are additive over time, scale-invariant, and standard in financial modeling. In this framework, returns are not used as predictive signals but as inputs for risk measurement.

3.3 Realized Volatility (20-Day)

Realized volatility is estimated as:

$$\sigma_{20}(t) = \sqrt{252} \cdot \text{std}(r_{t-19:t}) \tag{2}$$

Volatility captures market stress, uncertainty, leverage effects, and information shocks. High volatility alters investor behavior, tightens risk constraints, and increases correlations. It is therefore treated as a *regime variable*, not a directional signal.

3.4 200-Day Moving Average

The 200-day moving average is defined as:

$$MA_{200}(t) = \frac{1}{200}\sum_{i=0}^{199} P_{t-i} \tag{3}$$

This indicator approximates the market's long-term equilibrium and reflects the horizon at which large institutional capital reallocates. Two hundred trading days correspond roughly to one business year, encompassing earnings cycles, policy shifts, and macroeconomic adjustments.

3.5 Trend Distance

Trend strength is measured by the normalized distance between price and its long-term equilibrium:

$$\text{TrendDist} * t = \frac{P_t - MA * 200(t)}{MA_{200}(t)} \tag{4}$$

This quantity captures the conviction and maturity of the prevailing trend and later contributes to regime confidence.

4 State Variables

From the continuous features, two discrete state variables are derived.

4.1 Trend State

- **UP**: price is above the 200-day moving average.

- **DOWN**: price is below the 200-day moving average.

- **NEUTRAL**: price fluctuates near the moving average.

The trend state captures the dominant long-term direction of capital flows.

4.2 Volatility State

Volatility is discretized into three levels using historical calibration:

- **LOW**: calm, orderly markets.

- **MEDIUM**: rising stress and uncertainty.

- **HIGH**: disorderly markets and systemic pressure.

To avoid noise-induced regime switching, the volatility state is smoothed using rolling majority voting, reflecting the persistence of market stress.

5 Regime Definition

The combination of trend and volatility states yields five economically interpretable regimes.

5.1 RISK$_O N$

Definition: Uptrend with low volatility.
Characteristics:

- Capital flows favor risk assets.

- Drawdowns are shallow and short-lived.

- Risk premia compress.

Interpretation:

Risk-taking is structurally rewarded.

5.2 RISK$_O N_F RAGILE$

Definition: Uptrend with medium volatility.
Characteristics:

- Trend remains positive.

- Stress is increasing.

- Downside risks become asymmetric.

Interpretation:

Risk-taking remains valid but requires caution.

5.3 TRANSITION

Definition: No dominant trend-volatility alignment.
Characteristics:

- Choppy price action.

- Conflicting signals.

- High probability of false breakouts.

Interpretation:

The market is reassessing its structure.

5.4 $\text{RISK}_O FF_T RANSITION$

Definition: Downtrend without extreme volatility.
    Characteristics:

- Capital quietly de-risks.

- Volatility has not yet spiked.

- Often underestimated by investors.

    Interpretation:

      Risk appetite is deteriorating beneath the surface.

5.5 $\text{RISK}_O FF$

Definition: Downtrend with high volatility.
    Characteristics:

- Forced selling and deleveraging.

- Correlations rise sharply.

- Liquidity conditions worsen.

    Interpretation:

      Capital preservation dominates investment decisions.

6 Regime Confidence

Regime confidence measures the internal consistency and stability of the detected state. It is not a probability of correctness but an assessment of regime strength based on:

- Trend strength (distance from equilibrium).

- Volatility positioning relative to historical norms.

- Persistence of the regime over time.

    Higher confidence indicates a stable and well-established regime, while lower confidence signals fragility or transition.

7 Interpretation and Usage

Method 1 should be interpreted as a *situational awareness tool*. It provides context rather than forecasts. Example interpretations include:

- $\text{RISK}_O N, high confidence : Favor risk exposure.$

- $\text{RISK}_O N_F RAGILE, moderate confidence : Maintain exposure with tighter risk control.$

- $\text{RISK}_O FF_T RANSITION : Begin defensive positioning early.$

- $\text{RISK}_O FF, high confidence : Prioritize capital preservation.$

    This framework is intentionally simple, interpretable, and extensible, forming a robust foundation for more advanced regime models.

8 Conclusion

Method 1 establishes a disciplined and economically grounded approach to market regime classification. By separating direction from stress and embedding persistence and confidence, it provides a reliable structural view of the market environment. This makes it suitable as a standalone analytical tool and as the base layer for more sophisticated models.