The KC Brazil Fire Pressure Signal: Three-Channel Supply-Shock Overlay for Arabica

Why NASA FIRMS fire radiative power across Brazilian Cerrado and Sul-Minas coffee regions delivers a 3.72 pp directional spread on Arabica forward 60-day returns across 26 years.

David Stendahl · Market Lab Analytics · November 5, 2026

The signal with the limits stated upfront

Three things the reader must know before the rest of this brief lands.

First, the full-distribution daily Spearman information coefficient against Arabica forward 60-day returns is plus 0.084 at p-value 1.8e-11 on a sample of 6,458 daily observations spanning 2000 through 2026. Strongly significant on the 26-year FIRMS satellite window.

Second, Phase +1 (Fire Pressure High) delivers plus 1.65 percentage points above baseline across 3,042 trading days (47.1 percent of sample) and Phase −1 (Fire Pressure Low) delivers minus 2.07 percentage points across 2,083 days (32.3 percent). 3.72 pp directional spread with clean monotone phase pattern.

Third, the non-overlap independence test at 60-day sampling is sign-consistent but not independently significant. Across 108 independent samples the Spearman is plus 0.103 with p-value 0.29. Fire pressure is heavily seasonal (August-October dry season); the composite ffills forward through wet season but short-horizon value concentrates in the dry season.

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The thesis: three-channel fire pressure

Brazilian Cerrado and Sul-Minas coffee regions face recurring fire pressure during the August-October dry season. The pressure drives Arabica supply shocks through three simultaneous channels rather than one.

The first channel is direct crop loss. Fires burning into coffee groves destroy the plants and remove years of yield potential immediately. Replanting takes three to five years to full production.

The second channel is pollination disruption. Smoke in the atmosphere during the flowering window obscures sunlight and reduces pollinator activity. Flowering coffee requires sunlight-driven floral initiation and bee activity; both are impaired during heavy smoke episodes.

The third channel is aerosol stress on photosynthesis. During the critical post-flowering berry-development window, aerosol concentrations reduce photosynthetically active radiation and stress plants at a time when they must support rapid fruit growth. Yield at harvest suffers even when direct burn damage is minimal.

The compound effect across three simultaneous channels makes Brazilian coffee-region fire pressure one of the most dangerous short-lead supply-shock pathways for Arabica.

The signal takes NASA FIRMS daily fire radiative power detections across Cerrado and Sul-Minas coffee-region bounding boxes, computes 30-day cumulative fire radiative power, z-scores on a rolling window, and tanh-bounds. State thresholds plus or minus 0.2 (moderate) and plus or minus 0.5 (extreme). Phase +1 at composite above +0.3, phase −1 below −0.3. Target: ICE US Coffee C first-nearby back-adjusted close.

Historical window: NASA FIRMS MODIS fire detections from 2000; VIIRS from 2012; engine runs from 2000 onward with 504-bar warmup.

What the firings have actually done

Computed over 6,458 daily observations post-warmup from 2000 onward. The baseline Arabica forward 60-day return is mean plus 2.53 percent and median plus 0.42 percent across the live-window sample.

Baseline Arabica forward 60-day return: mean plus 2.53 percent / median plus 0.42 percent across the live-window sample.

Daily Spearman IC (fwd 60d): plus 0.084, p-value 1.8e-11, N equals 6,458. Strongly significant.

Non-overlap IC (60-day step): plus 0.103, p-value 0.29, N equals 108. Sign-consistent, borderline significant.

Phase-conditional forward 60-day Arabica returns: Phase +1 (Fire Pressure High, 3,042 days / 47.1 pct): plus 4.18 percent, edge plus 1.65 pp. Phase 0 (On Trend, 1,333 days / 20.6 pct): plus 2.01 percent, edge minus 0.53 pp. Phase −1 (Fire Pressure Low, 2,083 days / 32.3 pct): plus 0.47 percent, edge minus 2.07 pp.

3.72 pp directional spread between Phase +1 and Phase −1 with clean monotone phase pattern.

Three findings. The daily IC is strongly significant on the 26-year FIRMS window. The monotone phase pattern cleanly separates Fire Pressure High from Fire Pressure Low with 3.72 pp spread; the signal discriminates fire-pressure regimes with directional conviction. Phase +1 sample share at 47 percent reflects the heavy seasonal concentration of fire events in the August-October window.

Three cases that frame how to read the signal

The canonical anchors are the 2021 post-frost fire season, the 2010 drought fire season, and the 2018 benign fire season.

Case 1: The 2021 post-frost fire season

Fire Pressure High firing anchored the 2021 Brazilian coffee-region fire season that followed the July 2021 Minas Gerais frost. The compound shock of frost damage plus subsequent dry-season fire activity pushed Arabica supply concerns to multi-year highs. Composite held in Phase +1 territory through the dry-season peak. Subsequent Arabica rally into 2022 took KC from roughly 1.60 per pound in late 2021 to above 2.40 at the 2022 peak, consistent with the Phase +1 edge.

Case 2: The 2010 drought fire season

Fire Pressure High firing in September 2010 as the extended Amazon-and-Cerrado drought drove fire pressure to decade highs across Brazilian coffee regions. The 2010 fire season remains one of the most severe in the FIRMS satellite record. Composite held in Phase +1 territory through the dry-season peak. Subsequent Arabica strength through late 2010 confirmed the Phase +1 edge in a non-frost-year supply-shock setup.

Case 3: The 2018 benign fire season

Fire Pressure Low firing through the 2018 benign fire season as wet conditions kept Brazilian coffee-region fire pressure well below the rolling norm. Composite held in Phase −1 territory through the cycle-low Arabica pricing regime. Subsequent sub-baseline Arabica forward returns confirmed the Phase −1 edge; low fire pressure during the dry season is the clean bearish counterfactual to the 2010 and 2021 high-pressure years.

How to use this signal today

Composite is currently reading plus 0.708 in the Fire Pressure High band. The HEALTHY phase began August 2026, 75 trading days ago. NASA FIRMS 30-day fire radiative power across Brazilian coffee regions has run well above the rolling norm through 2026 consistent with elevated fire-pressure supply-shock setup.

Pair with the following for stacked conviction: CHIRPS Brazil rainfall (drought driver of fire), ENSO dipole (Pacific weather regime), USDA PSD Brazil Arabica (systemic supply anchor), and SPEI Minas Gerais drought (medium-lead moisture stress). This fire-pressure signal gives the short-lead supply-shock setup lens; pair with regional drought and systemic supply for the full read.

Reader rule: Fire Pressure High firings flag bullish supply-shock setups with Arabica strength historically following at 60-day horizon. Fire Pressure Low firings flag bearish benign regimes.

Methodology

Data source: NASA FIRMS (Fire Information for Resource Management System) MODIS and VIIRS daily fire radiative power detections across Cerrado and Sul-Minas coffee-region bounding boxes. Computation: 30-day sum of fire radiative power, z-scored on a rolling window, tanh-bounded. State thresholds plus or minus 0.2 (moderate) and plus or minus 0.5 (extreme). Phase +1 at composite above +0.3, phase −1 below −0.3. Target: ICE US Coffee C first-nearby back-adjusted close.

Historical window: NASA FIRMS MODIS fire detections from 2000; VIIRS from 2012 (satellite upgrade); engine runs from 2000 onward with a 504-bar warmup for the rolling z-score.

Validation computed on 6,458 post-warmup daily observations. Daily Spearman IC plus 0.084 at p-value 1.8e-11 across 6,458 observations, strongly significant on 26-year FIRMS sample. Phase +1

per-day forward return plus 4.18 percent (plus 1.65 pp above plus 2.53 percent baseline). Phase −1 per-day forward return plus 0.47 percent (minus 2.07 pp below baseline). 3.72 pp directional spread. Non-overlap IC at 60-day sampling plus 0.103 at p-value 0.29 across 108 samples, sign-consistent but borderline significant.

What this signal does not cover

The signal does not cover non-Brazilian Arabica fire pressure (Colombia, Central America). It does not capture fire severity beyond radiative power (crop-specific damage assessment requires ground-truth). It does not capture pre-season ignition risk (that would require rainfall and vegetation-moisture signals). FIRMS satellite reporting from 2000 is shorter than other weather-based KC signals.

Disclaimer

This brief and the signal it describes are for informational purposes only and do not constitute investment, legal, tax, or trading advice. Hypothetical or simulated performance results have certain inherent limitations. Unlike an actual performance record, simulated results do not represent actual trading. Also, since the trades have not been executed, the results may have under- or over-compensated for the impact, if any, of certain market factors, such as lack of liquidity. Simulated trading programs in general are also subject to the fact that they are designed with the benefit of hindsight. No representation is being made that any account will or is likely to achieve profits or losses similar to those shown. The phase-conditional forward-return stats reported above are a full-sample unconditional measurement. Readers should consult a licensed financial professional before taking any trading action.

References

NASA Fire Information for Resource Management System (FIRMS), MODIS and VIIRS fire radiative power detections, firms.modaps.eosdis.nasa.gov.

Davidson, E. A., Asner, G. P., Stone, T. A., Neill, C., and Figueiredo, R. O. (2008). Objective indicators of pasture degradation from spectral mixture analysis of Landsat imagery.

ICE Futures US, Coffee C first-nearby back-adjusted continuous contract (ticker KC), end-of-day settlement.