Dispersion Trading in Practice: The "Dirty" Version

From Textbook Correlation Trades to Execution-Driven Reality

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Abstract

Everyone loves the textbook dispersion trade: short index vol, long single-stock vol, vega-neutral. Practitioners who actually make money run a "dirty" version that accounts for execution, funding, liquidity, and flow asymmetries.

1 Introduction

Textbook dispersion isolates the correlation embedded in index options by shorting index volatility and buying the component stock volatilities, sized so that first-order vega cancels. In practice, the trade is *dirty*: your realized outcome is driven by **execution friction**, **funding & margin**, **liquidity asymmetry**, and **flow-distorted surfaces**. The edge isn't found in a tidy identity; it emerges when your infrastructure extracts correlation premia faster than costs erode it. *This is a flow business, not a backtest fantasy.*

2 Textbook ("Pure") Dispersion

Consider an approximately equal-weighted index of N stocks with (log) returns $\{r_i\}_{i=1}^N$:

$$r_{\text{idx}} \equiv \frac{1}{N}\sum_{i=1}^{N} r_i, \qquad \sigma_i^2 \equiv \mathrm{Var}(r_i), \qquad \bar{\sigma}^2 \equiv \frac{1}{N}\sum_{i=1}^{N}\sigma_i^2.$$

Assume homogeneous average pairwise correlation ρ. Then

$$\mathrm{Var}(r_{\text{idx}}) = \frac{1}{N^2}\sum_{i=1}^{N}\sum_{j=1}^{N}\mathrm{Cov}(r_i,r_j) = \frac{1}{N^2}\Big(\sum_i \sigma_i^2 + \sum_{i\neq j}\rho\,\sigma_i\sigma_j\Big). \tag{1}$$

If we further approximate $\sigma_i \approx \bar{\sigma}$, we obtain

$$\sigma_{\text{idx}}^2 \approx \frac{1}{N^2}\Big(N\bar{\sigma}^2 + \rho\,\bar{\sigma}^2\,N(N-1)\Big) = \bar{\sigma}^2\left(\rho + \frac{1-\rho}{N}\right). \tag{2}$$

For large N, $\sigma_{\text{idx}}^2 \approx \rho\,\bar{\sigma}^2 \;\Rightarrow\; \rho \approx \dfrac{\sigma_{\text{idx}}^2}{\bar{\sigma}^2}$. A "pure" dispersion book is effectively *short* ρ: short index options, long a basket of single-stock options, *vega-weighted* so a parallel shift in implied vol minimally impacts P&L. If realized correlation falls below implied, the position earns carry and mark-to-market.

3 Dirty Dispersion in Practice

The equal-vol, equal-weight, frictionless world behind (2) never exists on a desk. Empirically observed frictions include:

(a) **Execution friction.** You trade *hundreds* of single names with heterogeneous smiles and term structures; crossing bid–asks and rebalancing churn consume theoretical edge.

(b) **Vega vs. Gamma.** Books are sized on vega notionals, but correlation shocks transmit via *gamma* in stress; a vega-neutral book is not corr-neutral in large moves.

(c) **Funding & margin.** Long single-name options consume margin/cash; index shorts free less margin than expected. Carry, financing, and borrow add drag.

(d) **Liquidity asymmetry.** Index options are deep; long-basket liquidity is patchy. "Parallel" strikes/tenors across 100–500 names is a myth; curvature mis-matches accumulate.

(e) **Flows distort surfaces.** Systematic long-dated put demand lifts index skew and long-end vol; single names underreact. The correlation surface is thus a *flow artifact*, not a model constant.

4 Practical Example: Clean Math vs. Dirty Reality

We reconstruct a realistic S&P-style example from the thread and compute both the *theoretical* edge and the *frictions* that erode it.

Setup (equal-weighted intuition)

- Index implied volatility: $\sigma_{\text{idx,imp}} = 12\%$.
- Average single-stock implied volatility: $\bar{\sigma}_{\text{stk}} = 28\%$.

Under the toy identity (equal-weight/equal-vol assumption),

$$\rho_{\text{imp}} \approx \frac{\sigma^2_{\text{idx,imp}}}{\bar{\sigma}^2_{\text{stk}}} = \frac{0.12^2}{0.28^2} \approx 0.184.$$

Ex-post reality

Assume realized correlation falls to $\rho_{\text{real}} = 0.12$ (earnings dispersion, idiosyncratic tape), and the average stock vol realizes near 28%:

$$\sigma^2_{\text{idx,imp}} = 0.12^2 = 0.01444, \qquad \sigma^2_{\text{idx,real}} \approx \bar{\sigma}^2_{\text{stk}} \cdot \rho_{\text{real}} = 0.28^2 \cdot 0.12 = 0.00941.$$

Variance edge:

$$\Delta\text{Var} \approx 0.01444 - 0.00941 = 0.00503 \quad (\text{vol}^2 \text{ points}).$$

Sanity: $\sigma_{\text{idx,imp}} \approx 12.0\%$ vs. $\sigma_{\text{idx,real}} \approx 9.7\%$. **Textbook takeaway:** short index vol / long single-stock vol profits as correlation drops $0.184 \to 0.12$.

Where the edge dies if you're sloppy

1) Execution drag (basket crossing). Trade the top 200 names; average all-in spread cost ~ 1.5 bps (vega-weighted, relative to index-notional P&L):

$$\text{Round-trip slippage} \;\approx\; 200 \times 1.5 \text{ bps} \;=\; 300 \text{ bps}.$$

That is *3% of index-notional P&L*. If your variance edge translates to only a few percent-of-vega across the life, 300 bps can nuke it.

2) Funding / carry. Long single-name options consume margin; index shorts free less than you think. Add $\sim$ 50–100 bps/year (repo, margin, borrow). Over 3–6 months, subtract another 15–50 bps.

3) Surface mismatch (residual vega/gamma). Vega-neutral sizing does not immunize gamma in stress or skew curvature when names gap differently. MTM noise can rival the corr edge unless you rebalance ruthlessly (which costs more spread).

Clean math edge vs. dirty realized outcome

- **Model edge:** correlation drop $0.184 \to 0.12 \Rightarrow$ variance advantage ≈ 0.00503 ($12.0\% \to 9.7\%$ on the index leg, holding stock vols steady).
- **Dirty drag:** $\sim$ 300 bps basket crossing + 15–50 bps funding + mismatch/gamma noise can *fully offset* the advantage unless:
  - you restrict to liquid names (tighter quotes),
  - time entries around known flow,
  - size on vega-notional but monitor gamma,
  - and automate rebalance logic to minimize churn.

5 P&L Attribution: Pure vs. Dirty

Table 1: P&L Components: Clean Model vs. Dirty Realization

Component	**Clean (Pure Dispersion)**	**Dirty (Realized on Desk)**
Correlation P&L	Short corr earns carry when realized < implied	Still present, but sized/timed; partially offset by frictions
Execution P&L	Frictionless trades, zero slippage	Bid–ask crossing, rebalancing churn, market impact
Carry / Funding	Ignored	Theta − repo/margin/borrow drag
Residual Vega / Curvature	Negligible	Skew convexity, surface misalignment, name-specific smiles
Gamma / Delta Hedging	Perfect	Imperfect under stress; vol-of-vol and tail corr shocks

6 Visualizations

6.1 Correlation Term Structure: Theoretical vs Observed

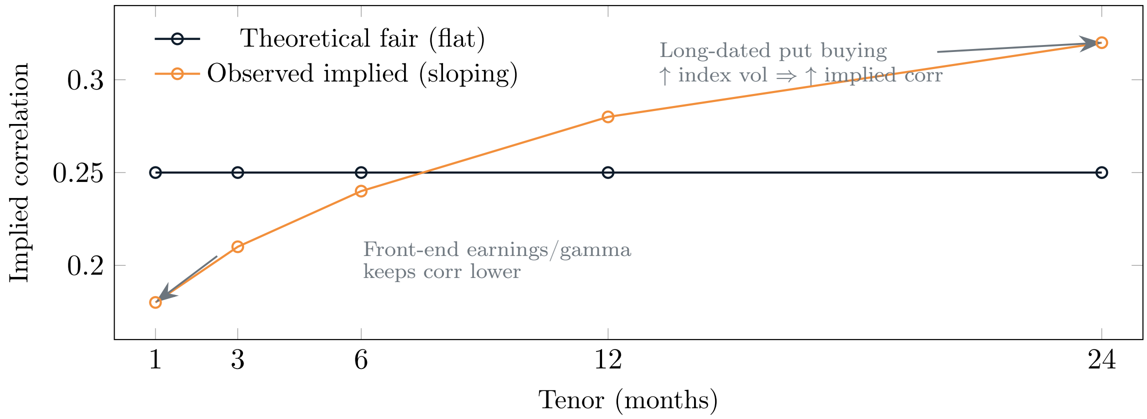

Figure 1: Flows bend the correlation curve. Long-end hedging demand lifts index vol relative to single stocks, raising long-tenor implied correlation.

6.2 "Pure" vs "Dirty" Dispersion: P&L Anatomy

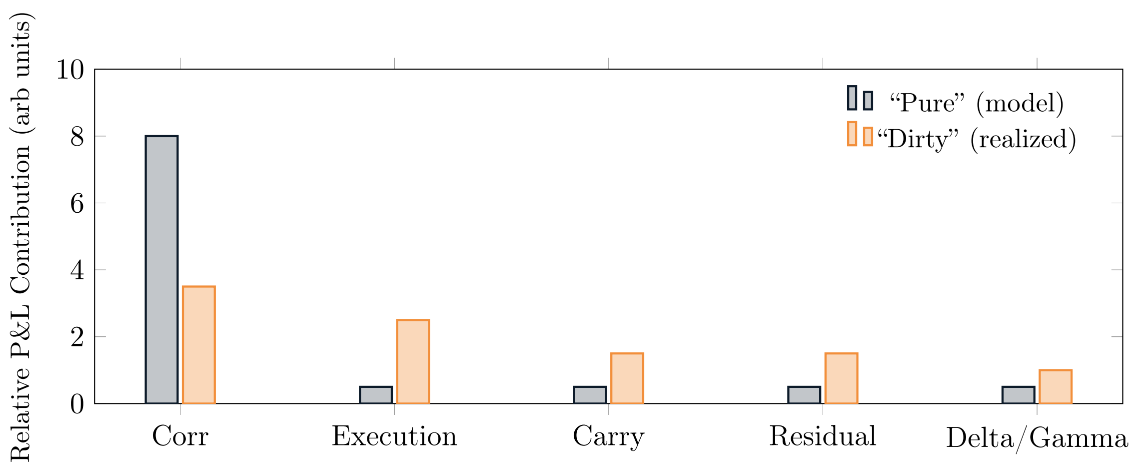

Figure 2: The model says "short correlation earns carry"; the desk says "only if it survives execution, funding, and curvature mis-matches."

6.3 Execution Friction Schematic (Optional)

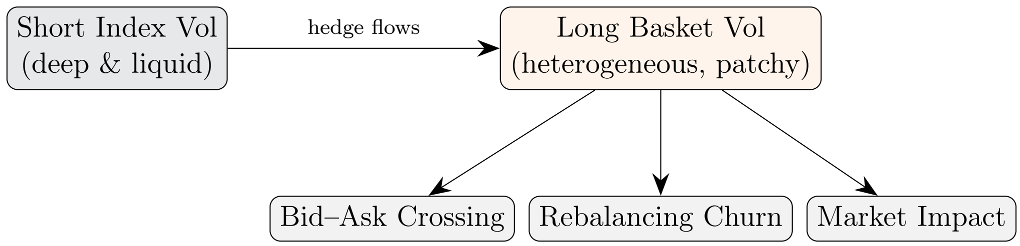

Figure 3: Execution frictions multiply across a large basket: you do not cross one spread, you cross *hundreds*.

7 Conclusion

- "Pure" dispersion is didactic: vega-neutral, correlation-isolated, frictionless.
- Real P&L comes from *dirty* dispersion: flow-aware, execution-aware, funding-aware.
- You do not arbitrage correlation cleanly; you harvest correlation premia when index vol is flow-distorted, single-stock vol is slow, and your infrastructure recycles risk faster than costs erode it.