**Crypto Arbitrage Analysis Report**

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**Introduction**

This report is an analysis of statistical crypto arbitrage opportunities across selected *Cointegrated Pairs/Baskets*of cryptocurrencies *— Bitcoin (BTC), Ethereum (ETH), Tether (USDT), Dogecoin (DOGE), Shiba Inu (SHIB), and Litecoin (LTC)* — over the past 12 months with a hypothetical 7 basis points (bps) commission on all limit orders, and 20 basis points (bps) on all market orders. This analysis aims to determine if short-term price inefficiencies can consistently profit from using momentum and reversal strategies, factoring in execution costs.

**Approach**

Get Historical Data

* Source: CoinGecko

Daily OHLCV (Open, High, Low, Close, Volume) data retrieved from major crypto exchanges.

* Interval: 1 year (daily frequency).
* Crypto Asset Pairs analyzed:
  + BTC/ETH
  + USDT/DOGE
  + SHIB/LTC

Perform Strategies 2 Specific Arbitrage Strategies

Two complementary strategies were examined:

1. Momentum Arbitrage
   * Signal based on Rate-of-Change (ROC) over 20, 50, and 100-day windows.
   * Long when ROC > threshold; flat or short when ROC < threshold.
   * Focus: capturing continuation of price trends.
2. Reversal Arbitrage
   * Signal based on z-score (standard deviation) of rolling returns.
   * Long when z-score < –2, short when z-score > +2.
   * Focus: capturing mean reversion around short-term price inefficiencies.

Perform Execution & Slippage with assigned basis points

* Market Orders: 20 bps average slippage.
* Limit Orders: 7 bps execution cost.
* Transaction costs applied at every position change.

Perform Backtesting of Arbitrage Strategies

* Equal-weighted across tested assets.
* Rebalanced daily based on signal changes.
* Performance evaluated both at single-asset level and portfolio level.

**Performance Evaluation**

Performance Metrics

For each asset and strategy, we report:

* Annualized Return (%)
* Annualized Volatility (%)
* Sharpe Ratio
* Hit Rate (%) (proportion of profitable trades)
* Max Drawdown (%)
* Average Holding Period
* Execution Costs (aggregate slippage/commissions)
* Momentum strategies tended to outperform reversal strategies in BTC and ETH, reflecting persistent trends based on supply /demand behavior contraints.
* Reversal strategies were more effective in DOGE and SHIB, where mean-reverting “noise” dominated.
* Limit order execution significantly improved net profitability by reducing costs, especially in high-turnover strategies.

Visuals

* Line Charts for each asset (1-year).
* Equity curve comparisons: Momentum vs Reversal, Market vs Limit orders.
* Bar charts of total returns across strategies
* Heat Maps of pricing where yellow indicates moderate volatility, **blue** indicates low volatility, and **green** indicates high volatility.
* Drawdown plots highlighting periods of extreme volatility.

Findings

The analysis confirms that crypto markets exhibit both momentum and mean-reversion dynamics depending on the coin and time horizon:

* Asset Coin Pairs (BTC, ETH) favor momentum.
* Asset Coin Pairs (DOGE, SHIB) exhibit stronger reversals.
* Slippage assumptions materially impact net profits — execution strategy (limit vs market) can determine profitability.
* Arbitrage across Coin Pairs (e.g., BTC/ETH) illustrate expectations of future returns, though opportunities are less frequent compared to single-asset coins.

**Conclusion**

While hypothetical arbitrage in cryptocurrency markets can be constrained by transaction costs and latency (actual executed vs forecasted price), systematic strategies that utilize momentum and reversal patterns alongside weighting methods have the potential to generate risk-adjusted returns when carefully executed. [See Charts] Sharpe Ratio of 1 for the momentum strategy for Bitcoin(BTC)/Ethereum (ETC) pairs/baskets and a Sharpe Ratio of 2 for the reversal strategy of pairs/baskets Dogecoin(DOGE), Tether (USDT), Shib-Inu (SHIB), and Litecoin (LTC). The reversal strategy is the most profitable and least volatile option for these short-termed price inefficiencies analyzed cryptocurrencies. However, robustness more than likely will occur. To manage apparent robustness the following must be done on a consistent basis in the future for the selected pairs/basket analyzed.

* Adaptive time periods for signal generation.
* Cost-sensitive portfolio weighting.
* Ongoing rebalancing and monitoring of liquidity conditions for each coin analyzed in this analysis.

*This analysis was performed using Python (version 3.13; Python Software Foundation, 2024), with data manipulation handled by Pandas (McKinney, 2010), numerical computing via NumPy (Harris et al., 2020), and visualizations produced using Matplotlib (Hunter, 2007). Data Source: CoinGecko. (2025). Cryptocurrency market data API. CoinGecko. Retrieved August 11, 2025, from* [*https://www.coingecko.com/en/api*](https://www.coingecko.com/en/api)*. All quantitative results are based on independent analysis and verified historical crypto data.*

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