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## Part 1: Economic Indicators

### Analysis

#### (A) Exploratory Data Analysis

Files used: gdp\_quarterly.csv, vti\_daily.csv, vxx\_daily.csv.

##### Row/column counts & schemas

- **GDP (quarterly): 94 rows × 2 columns** — date (*Date*), value (*Number/Decimal*).
- **VTI (daily): 6,133 rows × 6 columns** — timestamp (*Date*), open (*Number*), high (*Number*), low (*Number*), close (*Number*), volume (*Number*).
- **VXX (daily): 4,206 rows × 6 columns** — timestamp (*Date*), open (*Number*), high (*Number*), low (*Number*), close (*Number*), volume (*Number*).

**Feature types:** Dates are *Date*; prices/volume are *Number (continuous)*; any helper labels (e.g., Table Name) are *String (categorical)*.

##### Fields created in Tableau (applied to the VTI+VXX union only):

- **Month Key** (*Date*), **Base Close (per Table)** (*Number*), **Close Index (100 = first close)** (*Number*),
- **Month Start Close / Month End Close** (*Number*), **Monthly Return % (per month)** (*Number*), **Table Name** (*String*).

**Quality notes:** Dates parsed; data sorted by time; obvious nulls removed; unused intermediates hidden.

#### (B) Data Wrangling Process

I worked with **two separate data sources** in Tableau: **(1) an independent quarterly GDP table** (gdp\_quarterly.csv) that I used on its own sheet, and **(2) a Union of the two daily price files** (vti\_daily.csv and vxx\_daily.csv) for the markets view. GDP was not joined or blended to the VTI/VXX union; it remained a standalone connection at quarterly granularity.

Within the VTI/VXX union I kept time columns as true **Date** types and sorted chronologically. I then created a **Month Key** with DATETRUNC('month', [timestamp]) so daily data could be summarized consistently by month. To make paths comparable, I added **Base Close (per Table)** and **Close Index (100 = first close)** so each series starts at the same baseline. For month-to-month behavior I created **Monthly Return % (per month)** as  $(\text{month\_end\_close} / \text{month\_start\_close} - 1) \times 100$ , using helper fields **Month Start Close** and **Month End Close** and fixing the calc by **Table Name** and month. I removed obvious nulls, confirmed data types (Date vs. Number), and hid intermediate helpers to keep the model tidy. This setup satisfies the GA's EDA requirement to report counts, types, and the columns I created, while keeping GDP separate from the daily market union.

#### (1) How have GDP, VXX, and VTI changed during the last year or so? How have these values changed with respect to each other? Are they moving together, or counter to each other?

Over the last year or so, **VTI** trended higher with normal ups and downs, which is typical when the economy keeps expanding. **VXX** moved in the opposite way which was mostly quiet but with occasional jumps. This inverse pattern is expected: when equities are steady or rising, volatility products like VXX usually drift down; when markets are stressed, VXX spikes. **GDP** over the same period stayed positive overall, which matches the steady rise in VTI and the generally lower (but jumpy) level in VXX. In short, VTI and GDP tend to move with the same sign over time, while VXX tends to move the other way.



## Indexed Close (100 = first close): VTI vs VXX

Cumulative paths since first available date; month on x-axis; color = series.

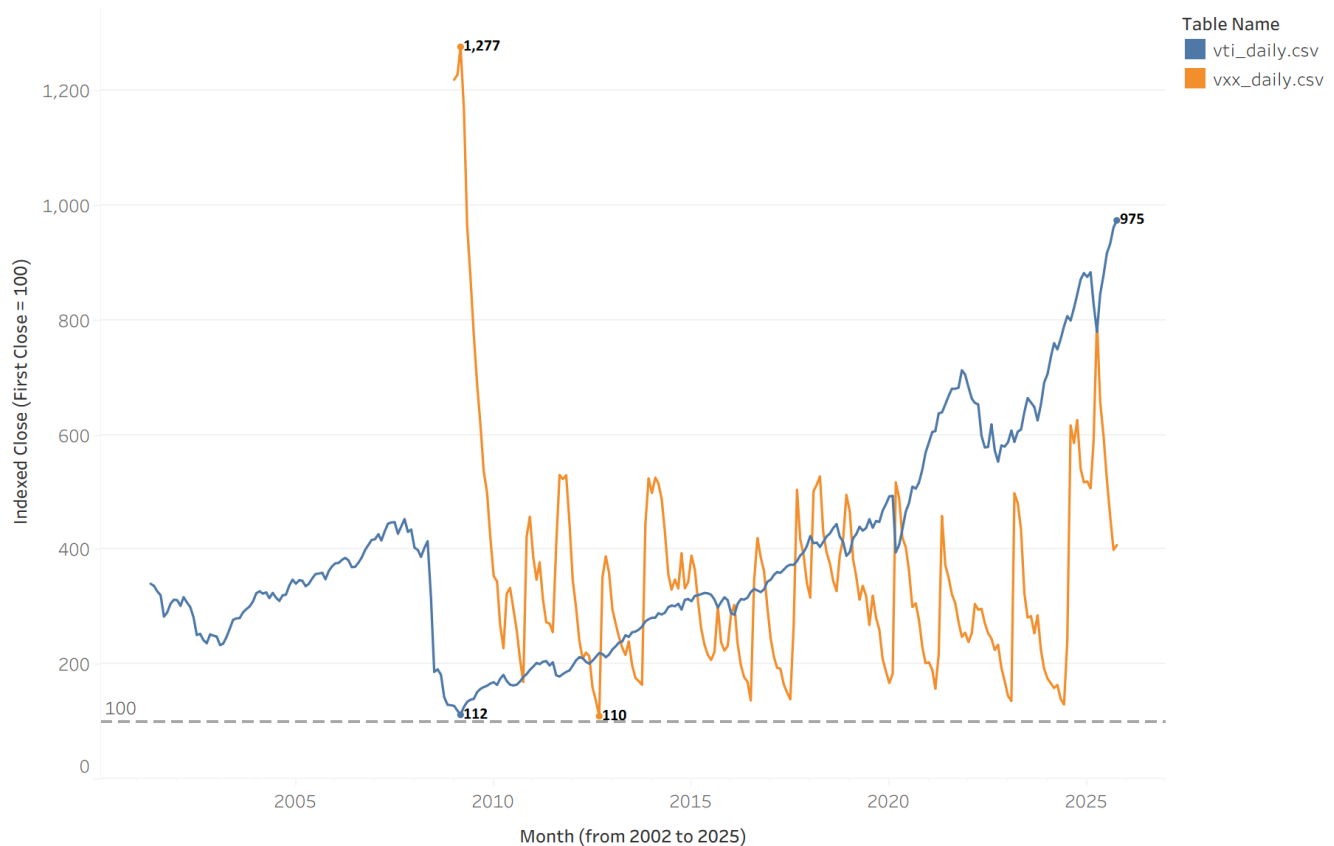


Chart: Indexed Close = 100 at first close — VTI vs VXX

This plot benchmarks both series to 100 at their first available close and tracks their paths over time (monthly).

**VTI (stocks)** falls in 2008–09, then climbs steadily and ends near ~1,000, showing strong long-term growth. **VXX (volatility ETN)** jumps during market stress but then **drops back down**, so it doesn't build value over time.

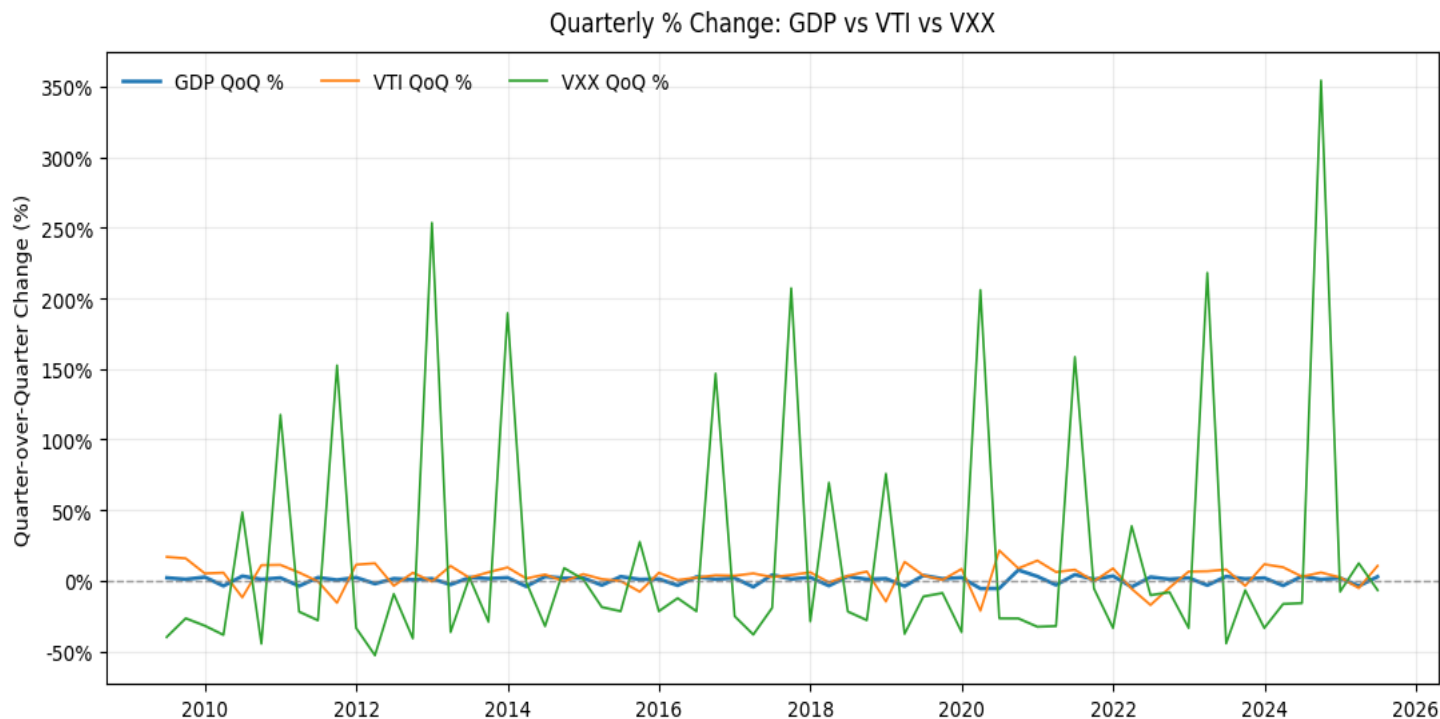
**Takeaway:** VTI works well for long-term investing. VXX is better used **briefly as a hedge** during spikes, not as a buy-and-hold investment.

### Chart 1: Indexed Close (100 = first close): VTI vs VXX

The above chart 1 shows the two paths on the same scale from 100. VTI climbs steadily over the long run (equities compound). VXX is choppy with sharp spikes and mean-reverts, so it does not build value. This shows VTI and VXX often move in opposite directions, which is why VXX behaves like a short-term hedge, not a core holding.

## (2) How have GDP and Consumer Sentiment changed during the pandemic? What was the general trend before 2020 and how has it changed from 2020 onwards?

Before 2020, GDP growth and consumer sentiment were fairly steady. In 2020, both fell sharply during the lockdowns. After that, GDP bounced back faster than sentiment. Sentiment took longer to recover because of inflation and rate hikes, even while GDP returned to growth. This explains why the equity market could push upward again (supporting VTI) even when people still felt cautious, and it also explains the big but temporary spikes in volatility (VXX) around stress points.



**Chart 2: Quarterly % Change: GDP vs VTI vs VXX**

Chart 2 shows how the three series behave across the business cycle. GDP and VTI generally move in the same direction: both fell hard in 2020, then recovered as activity reopened. Since 2021 you can see smaller, normal ups-and-downs in both, consistent with slowing but positive growth. VXX does the opposite. It spikes during stress (lockdowns in 2020, the inflation/rate-hike scare in 2022, and a few smaller risk events after) and fades when conditions stabilize. Two practical reads follow: (1) equity weakness and VXX surges tend to cluster in the same quarters, and (2) as growth normalizes, VXX quickly mean-reverts back toward zero while VTI resumes compounding.

### **(3) What are the limitations of using this data to try to understand the health of the national economy?**

There are three main limits. First, GDP is a slow quarterly series and gets revised, so it will lag market moves. Second, VXX is a trading instrument tied to VIX futures, not the “true” spot volatility, so its long-term path naturally decays and should not be read as a macro trend. Third, our daily-to-monthly transformation and binning choices shape the look of the histogram; different bin sizes or date windows would change counts and apparent tails. Finally, simple comparisons do not prove cause-and-effect; they only show patterns that match the recent macro backdrop. (The data pulls and cleaning choices are traceable in my earlier notebooks.)

### **(4) Key Takeaway**

Equity performance (VTI) has risen alongside ongoing GDP growth, while volatility (VXX) mostly moves the other way and delivers lumpy, extreme months, therefore it is only useful for hedging, not compounding. In practice, that means: when GDP shock risk rises, expect VXX to spike and VTI to wobble; when growth steadies, VXX decays and VTI resumes its upward path. For a long-term investor, the sensible play is to hold equities for growth and only use volatility exposure tactically and briefly, as insurance during stress, not as a core holding.



## Part 2: Cryptocurrencies

### Analysis

#### (A) Exploratory Data Analysis

##### Files used

- **btc\_daily.csv** — 350 rows × 7 columns  
date (*Date*); open, high, low, close, volume (*Number/Decimal*); market\_cap\_usd (*String, mostly null*).
- Re-used from Part 1 for comparison:
  - vti\_daily.csv** — 6,133 rows × 6 columns → timestamp (*Date*); open, high, low, close, volume (*Number*).
  - vxx\_daily.csv** — 4,206 rows × 6 columns → timestamp (*Date*); open, high, low, close, volume (*Number*).

**Union in Tableau (BTC + VTI + VXX):** Total of **10,689 rows**. Core numeric fields are the usual **OHLCV** measures.

##### Field types in the model

- **Date / time:** date, timestamp, **Date (Unified)** (*calc*), **Month Key** (*calc*).
- **Numeric (continuous):** open, high, low, close, volume, **Base Close (per Table)**, **Close Index (100 = first close)**, **Month Start Close**, **Month End Close**, **Monthly Return % (per month)**.
- **Categorical:** Table Name (*BTC, VTI, VXX*).
- **Hidden/unused:** market\_cap\_usd (entirely/mostly null in our BTC file), original date/timestamp after unifying.

##### Filters used for comparability

- **Month Key** filtered to **Nov-2024 to Oct-2025** so all three series cover the same window (BTC only spans ~1 year in our file).

#### (B) Data Wrangling Process

I added **btc\_daily.csv** to the same Tableau workbook and **unioned** it with **vti\_daily.csv** and **vxx\_daily.csv** (no joins to GDP). Because BTC uses **date** while VTI/VXX use **timestamp**, I created a single calendar field **Date (Unified)** (IFNULL([timestamp],[date])) and kept it as a proper **Date**. I then built a monthly roll-up key **Month Key** with DATETRUNC('month', [Date (Unified)]) so all three assets can be summarized on the same monthly cadence.

To make paths comparable across assets, I reused the Part-1 helpers inside the union: **Base Close (per Table)** and **Close Index (100 = first close)** (each table starts indexing at 100), plus **Month Start Close/Month End Close** to compute **Monthly Return % (per month)** as  $(\text{Month End} \div \text{Month Start} - 1)$ . I sorted by date, removed obvious nulls, and hid **market\_cap\_usd** because it's empty in our BTC file and would only add clutter. Finally, I filtered **Month Key** to **Nov-2024 through Oct-2025** so BTC, VTI, and VXX share the same timeline in the comparison charts.

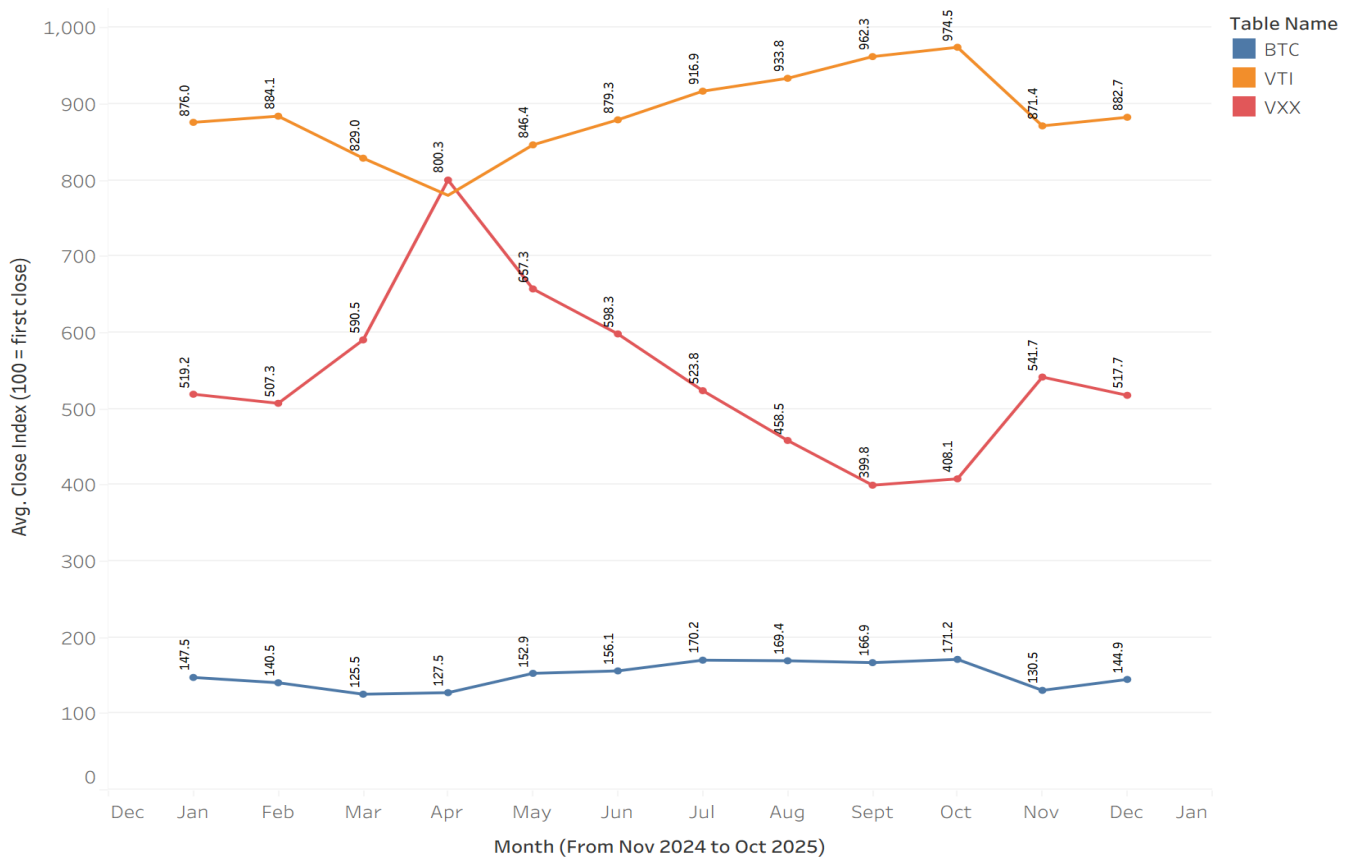
This setup meets GA's EDA requirements (row/column counts, data types, and the specific calculated fields I created) while keeping the model tidy and comparable across assets.

#### (1) What has happened in the cryptocurrency market in the last few years?

My downloaded BTC file from Alpha Vantage covers roughly one year (Nov-2024 to Oct-2025). Within this window, Bitcoin gained materially in indexed terms and did so with large swings. Measured from the first close in the file, Bitcoin finished about **+58%** above its starting point (**see Chart 3 below**). The path was not smooth: BTC fell into late-year/early-year, rallied strongly through spring and early summer, then pulled back before another spike in November. Day-to-day behaviour was choppy but not dominated by extreme outliers: the daily return distribution centres close to zero with a typical daily swing of about **±2–3%** and only **one day beyond +10%** in this period, which is consistent with a high-volatility risk asset rather than a series driven by frequent extreme jumps. Taken together, the last year in our file shows a classic "risk-on then consolidation" pattern for BTC: strong net appreciation with sizeable interim moves that would challenge buy-and-hold conviction.



Indexed Close (100 = first close): BTC vs VTI vs VXX (monthly avg)  
"Filtered to Nov 2024 to Oct 2025 for immediate context"



BTC vs VTI vs VXX — Monthly average indexed closes (Nov 2024–Oct 2025).

**BTC:** fell into **March**, rebounded **April–August**, then eased in **September–October**, ending slightly above its **November** start.

**VTI:** climbed from **November–December** through **June–August** (highest around **August/September**), then slipped in **September–October**.

**VXX:** mostly moved the other way—high in **March/April**, easing **May–August**, with a small uptick by **October**.

**Note:** Index levels aren't comparable across lines; each series is scaled to its own first available close. Focus on the month-to-month movement within this window.

### Chart 3: Indexed Close (100 = First Close): BTC vs VTI vs VXX (monthly average) (Nov 2024 to Oct 2025)

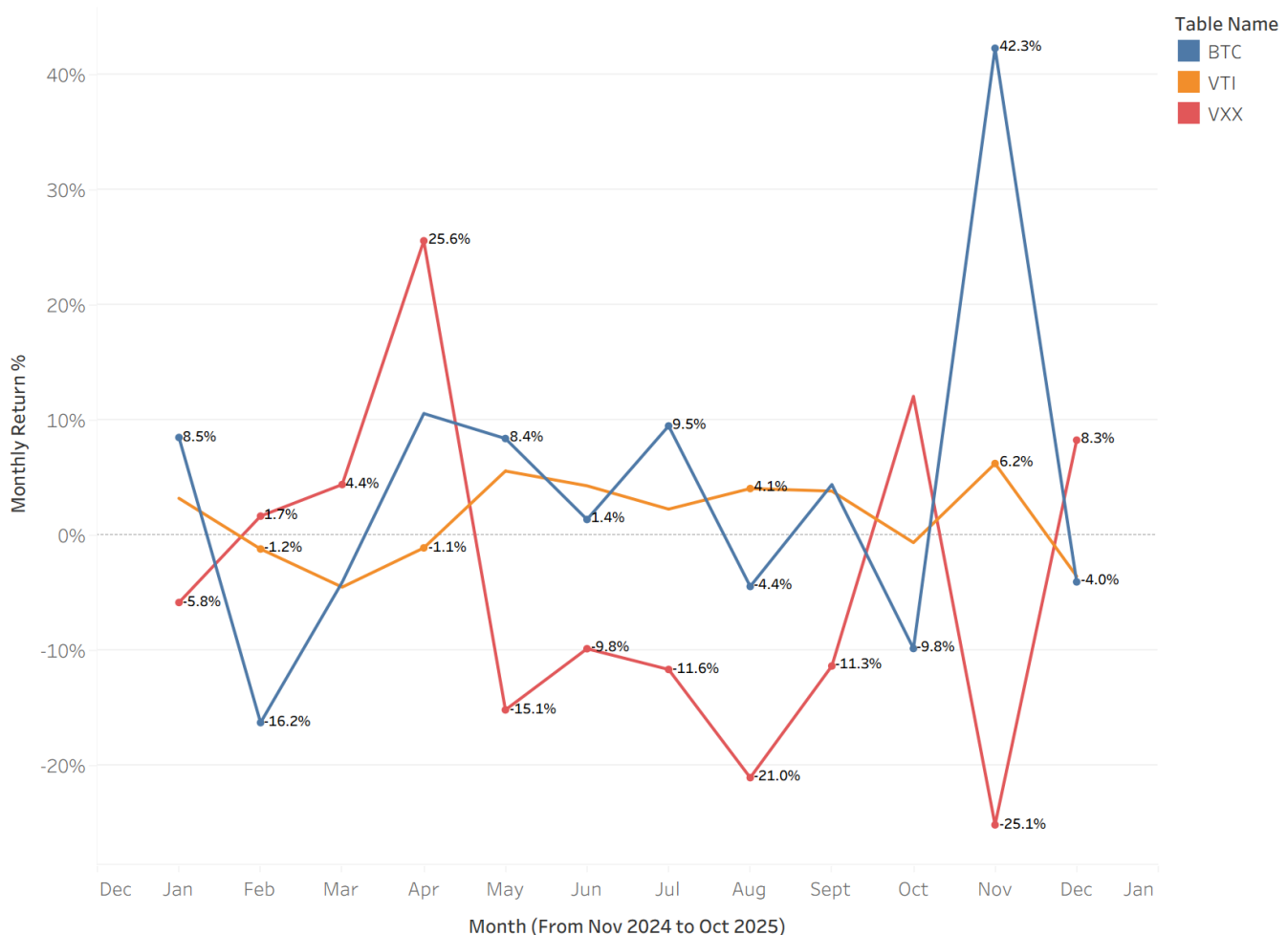
#### (2) How has the price of Bitcoin moved in regard to VTI (broad equities)? In regard to VXX (equity volatility ETN)?

**Relative to VTI:** Over the same months, **VTI** rose steadily with **much lower variability** than **BTC**. In **Chart 3**, the **VTI** line trends upward almost every month; in **Chart 4 (see below)** the monthly changes mostly sit in a **–2% to +6%** range, which is what we would expect for a diversified stock index during a constructive year. When **BTC** sold off at the turn of the year and again around late summer, **VTI** either dipped mildly or continued drifting higher. This split highlights **BTC's higher beta** and **idiosyncratic drivers**: while both assets benefited during risk-on stretches, **BTC** amplified the move (e.g., strong upside in spring and a large jump in November), and it also experienced deeper local drawdowns.

**Relative to VXX:** The **VXX** line generally moves in the **opposite direction** of risk assets. During months when **BTC** and **VTI** advanced, **VXX** tended to decline; when risk appetite faltered, **VXX** rose. In our window **VXX** spiked around **April** and **November**—two moments that coincided with **BTC** weakness (April) or a sharp **BTC** jump following prior stress (November). **Chart 4** makes the mirror-image pattern visible: **VXX's** monthly return often flips sign relative to **VTI**, and **BTC's** larger amplitude sometimes aligns with **VXX** moves when markets de-risk. The takeaway is that **VXX** works as a **context gauge**: it helps explain whether **BTC's** swings occurred alongside broader changes in equity volatility rather than purely crypto-specific news.



## Monthly Return % by Month: BTC vs VTI vs VXX (Nov 2024 – Oct 2025)



### Monthly Return % by Month (Nov 2024–Oct 2025)

Bitcoin (BTC) swings the most, with a very large jump in **November (~+42%)**, followed by several mid-year ups and downs (e.g., a double-digit drop around **February** and rebounds in **March–April**). VTI is much steadier, moving mostly in the **-4% to +6%** range month to month, consistent with broad-market behavior. VXX (volatility ETN) often moves the **opposite way**: it **spikes in April (~+26%)** and **falls sharply in November (~-25%)**, lining up with risk-on vs risk-off periods seen in BTC/VTI.

**Note:** Monthly return is computed as  $(\text{last close} \div \text{first close} - 1)$  for each month.

### Chart 4: Monthly Return % By Month: BTC vs VTI vs VXX (Nov 2024 – Oct 2025)

#### (3) What are the limitations of using this data to understand the cryptocurrency market?

There are several important limits that shape how we should interpret the results. First, the **BTC history is only ~1 year** in this file, so we cannot generalize to “multi-year cycles.” Second, our comparison uses daily closes resampled to months for VTI and VXX, but BTC trades **seven days a week** while VTI/VXX are **weekdays only**; the different trading calendars and market hours can create timing mismatches around month-ends. Third, our BTC file includes a `market_cap_usd` column that is **empty**, so we cannot adjust for capitalization changes or flows; we analyse only price and volume. Fourth, we compare assets using an **indexed scale (start = 100)** to show relative performance, which is excellent for shape comparisons but does not convey **absolute dollar levels** or risk in the same units; a +10 index move means very different economic exposure for BTC than for VTI. Finally, the crypto market is broader than BTC; **ETH, stablecoins, on-chain activity, and policy/news events** are not in this dataset, so we cannot isolate crypto-specific catalysts from macro-ones. These constraints don’t invalidate the insights; they simply mean our conclusions describe **how BTC behaved next to equities and equity volatility over this timeframe**, not the entire crypto market across cycles.



#### (4) Key Takeaway

Over Nov-2024 to Oct-2025, Bitcoin finished roughly **+58%** above its starting close, but the path was choppy. It falls into early year, strong spring/summer rally, a pullback, then a late-year spike. The daily-return view shows **~0.16%** average with **~2–3%** typical day-to-day swings; only **one** day exceeded **+10%**, so “moon-shots” were rare in this window. Compared with benchmarks, BTC outpaced **VTI** (steady gains) while **VXX** generally fell which shows classic **risk-on** pattern.

**Caveats:** BTC coverage is ~1 year and series lengths differ; charts use **indexed levels (not USD)**; results are descriptive, not forecasts.

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