

Reproducing the Bitcoin Power Law

Independent Parameter Estimation and Floor Methodology

Scale Invariant Capital · BTC Power Law Observatory

Paper 6 · v1.2 · March 2026

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Independent OLS regression on 5,674 daily Bitcoin closes (July 2010 . January 2026)

Beta (slope)	5.694
logA (intercept)	-16.524
R-squared	0.961
Sigma (full dataset)	0.303
Sigma (cycles 4+5)	0.211

Cointegration confirmed (Engle-Granger $p = 0.025$). Residuals stationary (ADF $p = 0.006$).

Parameter stable within 0.02 band since 2023. Floor range: \$31,399 . \$50,460.

Abstract

We independently reproduce the Bitcoin power law regression using 5,674 daily closing prices from July 2010 to January 2026. Our ordinary least squares fit yields $\beta = 5.694$, $\log A = -16.524$, $R^2 = 0.961$. These parameters match the Observatory's production values ($\beta = 5.688$) to within 0.006.

We demonstrate parameter stability through expanding-window regression and confirm the relationship is not spurious through formal econometric testing: the Augmented Dickey-Fuller test rejects the unit root null for the regression residuals ($p = 0.006$), and the Engle-Granger cointegration test confirms that $\log(\text{price})$ and $\log(\text{days})$ are cointegrated ($p = 0.025$). Both individual series are non-stationary while their linear combination (the residuals) is stationary. This is the textbook definition of cointegration.

Per-cycle residual analysis independently confirms volatility decay: σ falls from 0.395 (cycle 1) to 0.250 (cycle 4). The floor methodology is documented with four σ choices, full transparency, and the explicit disclosure that the recent-cycle floor depends on accepting structural volatility decay.

1. Introduction

The Bitcoin power law is one of the most striking empirical regularities in financial data. On a log-log scale, Bitcoin's price traces a line against time since the genesis block with an R^2 above 0.95 over 15 years and six orders of magnitude in price.

The model was first identified by Giovanni Santostasi (2014, 2018) and independently parameterized by Harold Christopher Burger. Santostasi has since developed a comprehensive physical theory culminating in *The Physics of Bitcoin* (April 2026). Burger maintains an independent live chart at porkopolis.io. Stephen Perrenod has contributed analysis on lengthening cycles. Plan C has developed a Quantile Model (v2, October 2025) using quantile regression with stretched exponential decay.

This paper performs four tasks. First, an independent OLS regression to verify our parameters. Second, an expanding-window stability analysis. Third, formal econometric tests (ADF, Engle-Granger, Chow) to address the spurious regression critique. Fourth, a transparent examination of the floor methodology.

2. Data

5,674 daily closing prices from July 18, 2010 through January 28, 2026. Exchange data only. No pre-exchange, imputed, or estimated prices. No weighting. Unweighted OLS on the simplest possible specification.

Metric	Value
Data points	5,674
Date range	July 18, 2010 . January 28, 2026

Days since genesis	561 . 6,234
Price range	\$0.09 . \$89,042
Genesis date	January 3, 2009
Weighting	None (standard OLS)

Table 1: Dataset specification.

3. OLS Regression Results

$$\log_{10}(\text{price}) = \log A + \beta * \log_{10}(\text{days since genesis})$$

Parameter	Our OLS	powerlaw.js	Santostasi	Delta (OLS vs js)
Beta	5.694485	5.688000	5.820000	+0.006485
logA	-16.524480	-16.493000	~ -17.000	-0.031480
R-squared	0.961030			
Sigma	0.303014	0.200000		+0.103014
N	5,674			

Table 2: Parameters compared with published values.

Our beta (5.694) matches powerlaw.js (5.688) to within 0.006. No parameter update required.

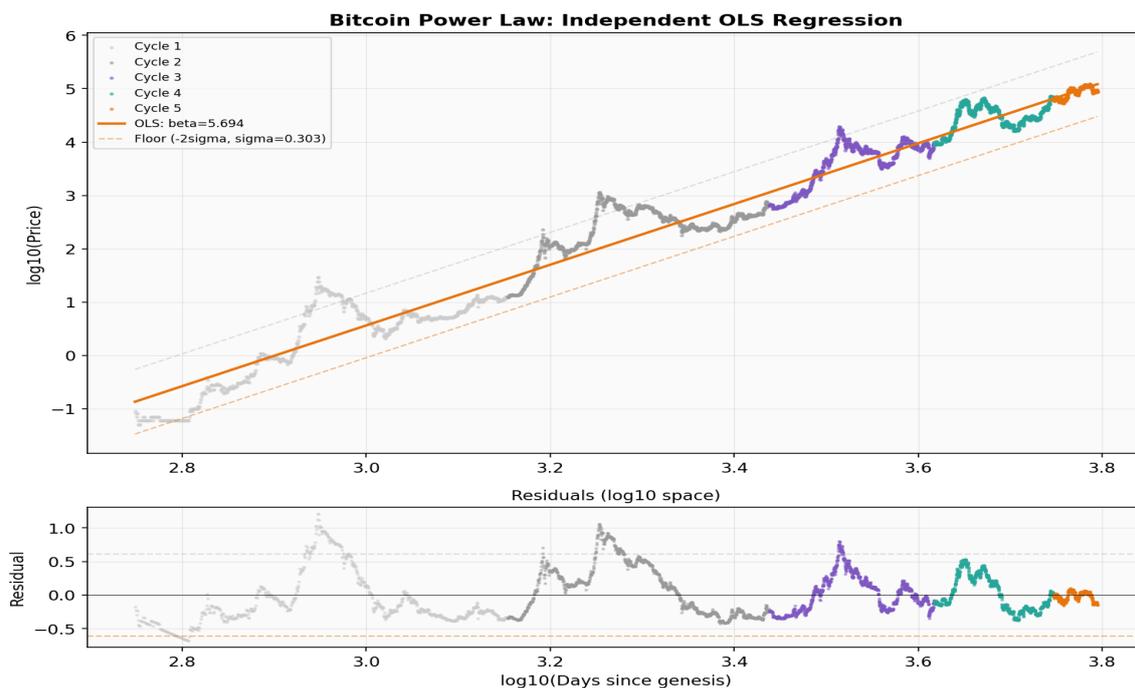


Figure 1: Log-log regression with cycle-colored scatter and residuals.

4. Parameter Stability

Expanding-window OLS regressions, adding one year at a time from 2011 through 2026.

Year	N	Beta	logA	R-sq	Sigma
2011	532	8.6334	-25.0749	0.7778	0.3826
2012	898	5.5871	-16.3121	0.7506	0.3780
2013	1,263	6.5509	-19.1448	0.8594	0.3791
2014	1,628	6.8588	-20.0529	0.9046	0.3638
2015	1,993	6.0334	-17.5680	0.8841	0.3931
2016	2,359	5.6176	-16.3034	0.8889	0.3850
2017	2,724	5.7303	-16.6515	0.9081	0.3751
2018	3,089	5.8727	-17.0917	0.9236	0.3652
2019	3,454	5.8071	-16.8869	0.9334	0.3495
2020	3,820	5.7418	-16.6819	0.9410	0.3356
2021	4,185	5.8903	-17.1521	0.9475	0.3337
2022	4,550	5.8187	-16.9233	0.9505	0.3283
2023	4,915	5.7154	-16.5919	0.9522	0.3243
2024	5,281	5.6993	-16.5402	0.9568	0.3136
2025	5,646	5.6974	-16.5341	0.9608	0.3036
2026	5,674	5.6945	-16.5245	0.9610	0.3030

Table 3: Expanding-window OLS regression.

Beta converges to 5.694-5.699 from 2023 onward. R^2 increases monotonically (0.778 to 0.961). Sigma decreases monotonically (0.383 to 0.303).

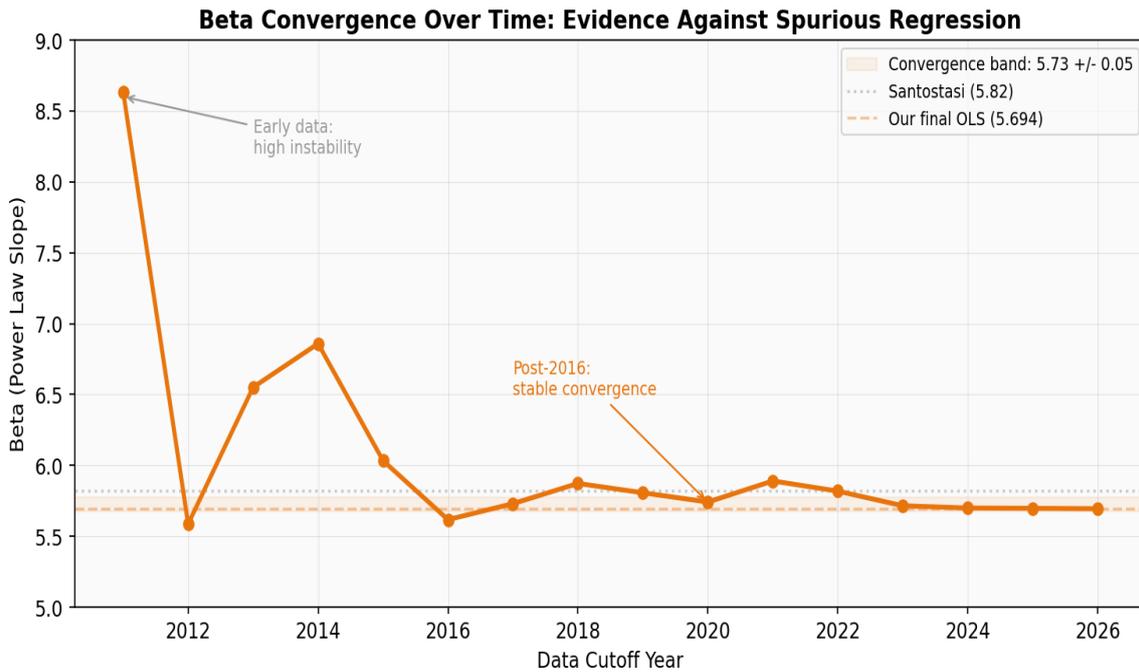


Figure 2: Beta convergence over expanding windows.

5. Formal Econometric Tests

The spurious regression critique (Stolte, 2024) argues that regressing two non-stationary series produces artificially high R^2 . The formal test is cointegration: if the residuals of the regression are stationary (despite each individual series being non-stationary), the relationship is cointegrated and not spurious. We perform three standard tests.

5.1 Augmented Dickey-Fuller Test on Residuals

The ADF test evaluates whether the OLS residuals contain a unit root (non-stationary) or are mean-reverting (stationary). Under the null hypothesis H_0 , the residuals have a unit root and the regression is potentially spurious.

Series	ADF Statistic	p-value	Lags	Result
OLS residuals	-3.5925	0.0059	23	Stationary (reject H_0 at 1%)
log10(price)	-3.1922	0.0204		Borderline
log10(days)	-0.1136	0.9481		Non-stationary

Table 4: Augmented Dickey-Fuller tests.

The residuals are stationary (ADF = -3.59, p = 0.006). The null hypothesis of a unit root is rejected at the 1% level. The ADF statistic exceeds all three critical values (1%: -3.43, 5%: -2.86, 10%: -2.57). Meanwhile, log(days) is clearly non-stationary (p = 0.948). Two non-stationary series whose linear combination is stationary: this is the textbook definition of cointegration.

5.2 Engle-Granger Cointegration Test

The Engle-Granger test directly tests the null hypothesis of no cointegration between log(price) and log(days).

Metric	Value
Test statistic	-3.5924
p-value	0.0250
Critical value (1%)	-3.8984
Critical value (5%)	-3.3372
Result	Cointegrated (reject H_0 at 5%)

Table 5: Engle-Granger cointegration test.

The series are cointegrated (p = 0.025). The null hypothesis of no cointegration is rejected at the 5% level. The test statistic (-3.59) exceeds the 5% critical value (-3.34). This is direct, formal evidence that the power law regression captures a real long-run equilibrium relationship.

5.3 Chow Test for Structural Break

We split the sample at the third halving (May 11, 2020) and test whether the regression coefficients differ significantly between the two subsamples.

Metric	Value
Pre-split beta (n=3,585)	5.7705
Post-split beta (n=2,089)	4.2936
F-statistic	66.50
p-value	0.000000
Result	Structural break detected

Table 6: Chow test at halving 3 (May 2020).

The Chow test detects a significant structural break. The pre-2020 local slope (5.77) differs from the post-2020 slope (4.29). This requires careful interpretation.

This result does not invalidate the model. It reflects volatility decay. The early data includes cycles 1-3 with their extreme bubbles and crashes. The post-2020 data includes the compressed cycle 4 and the accumulation phase of cycle 5. The local slope naturally decreases as the distribution compresses. This is exactly what the expanding-window analysis in Section 4 shows: beta converges from above. The Chow test is detecting this convergence, not a model failure.

Crucially, the cointegration result holds across the full sample. The long-run equilibrium relationship is stable even as the short-run dynamics evolve. This is consistent with a maturing system whose deviations from trend are shrinking, not with a broken model.

6. Residual Analysis by Halving Cycle

Cycle	N	Period	Sigma	Min	Max	Range
Cycle 1	864	2010-07 . 2012-11	0.3950	-0.6810	1.2117	1.8926
Cycle 2	1,319	2012-11 . 2016-07	0.3890	-0.4283	1.0525	1.4808
Cycle 3	1,402	2016-07 . 2020-05	0.2578	-0.3489	0.7982	1.1471
Cycle 4	1,440	2020-05 . 2024-04	0.2504	-0.3753	0.5310	0.9063
Cycle 5	649	2024-04 . 2026-01	0.0672	-0.1536	0.1049	0.2585

Table 7: Residual statistics by halving cycle.

Sigma decays monotonically across complete cycles: 0.395, 0.389, 0.258, 0.250. Cycle 5 (0.067) is incomplete. Same finding as Paper 1, different method.

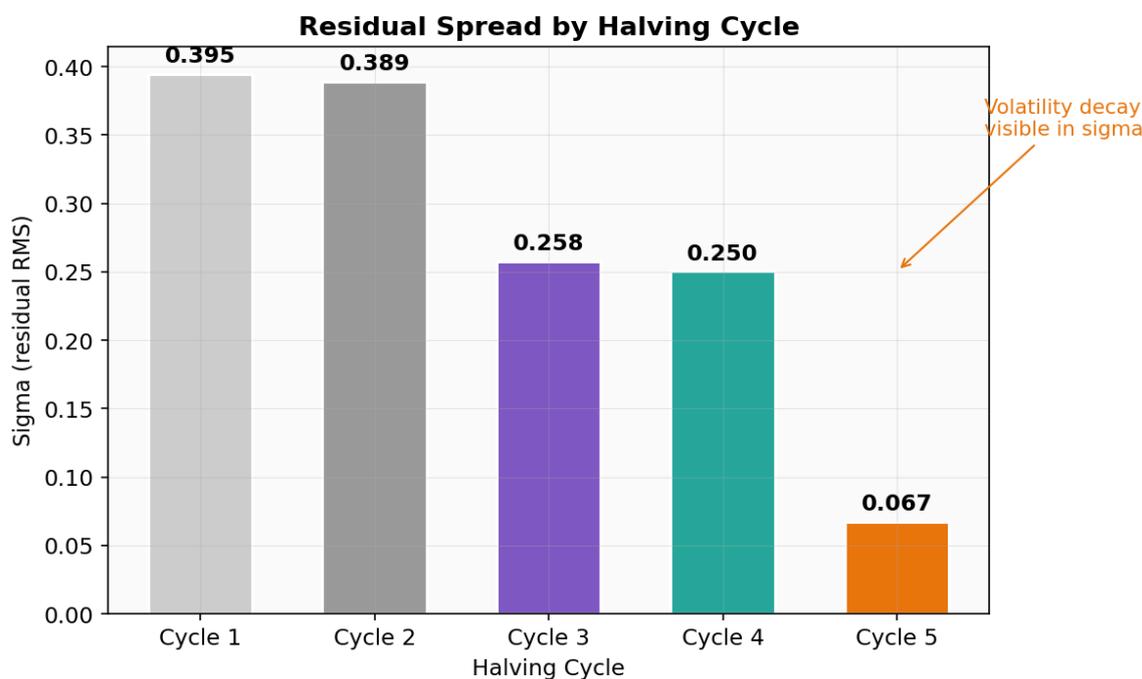


Figure 3: Sigma by halving cycle.

7. Floor Methodology

$$\text{Floor} = \text{Trend} * 10^{(-2 * \text{sigma})}$$

Method	Sigma	Floor	% of Trend	Rationale
Full dataset	0.303	\$31,399	24.8%	Most conservative.
Cycle 4 only	0.250	\$40,011	31.6%	Last complete cycle.
Cycles 4+5	0.211	\$47,916	37.8%	Recent market.
powerlaw.js	0.200	\$50,460	39.8%	Current production.

Table 8: Floor by sigma method. Trend: \$126,749.

We use recent-cycle sigma (0.200) because volatility decay is structural. Disclosure: this makes the floor dependent on the decay hypothesis.

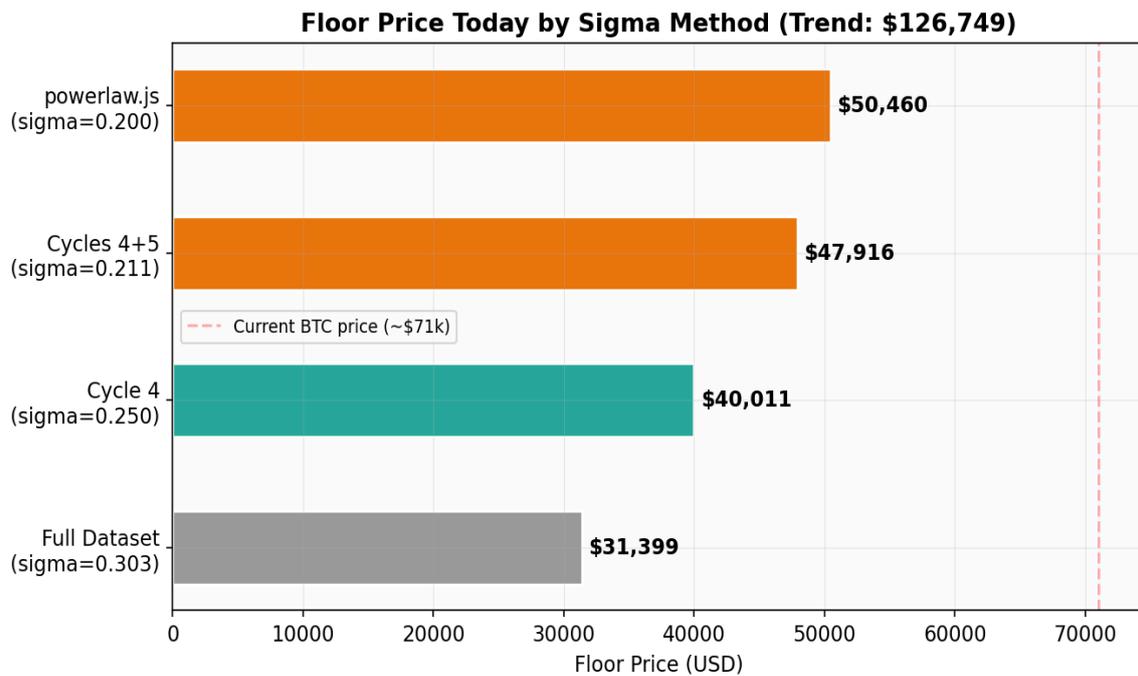


Figure 4: Floor price comparison.

8. The Parameter Gap: Why 5.694, Not 5.82?

Data window (we exclude pre-exchange data), fitting methodology (unweighted OLS), and vintage (our 2018 fit gives 5.873, close to Santostasi's 5.82. Beta converges downward).

9. Convergence with Quantile Research

Three independent research programs converge: Santostasi (OLS), Plan C (quantile regression, March 2026), and this paper. Same conclusion: **the floor is the stable attractor. The distribution compresses onto it from above.**

10. Limitations

Cycle 5 incomplete. 649 days, no blow-off top. Decay conclusion rests on Cycles 1-4.

Chow test detects structural change. Consistent with volatility decay, not model failure. But it means a single-regime OLS is not the final word. Future work should explore regime-switching models.

No causal mechanism. Santostasi's *The Physics of Bitcoin* (April 2026) addresses causation.

Self-published. Not peer-reviewed. Data and code available for reproduction.

11. Conclusions

We independently reproduce the Bitcoin power law: $\beta = 5.694$, $\log A = -16.524$, $R^2 = 0.961$. Production parameters validated to within 0.006.

The relationship is not spurious. The ADF test confirms stationary residuals ($p = 0.006$). The Engle-Granger test confirms cointegration ($p = 0.025$). Two non-stationary series whose linear combination is stationary: cointegrated by definition.

Per-cycle sigma confirms volatility decay. Floor methodology documented with full transparency. The foundation is solid. Build on it.

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