BACKUP SLIDES: COMPREHENSIVE LITERATURE REVIEW

Slide L1: Three Streams of Cryptocurrency Valuation Literature

1. Network Effects & Adoption Models

Study	Key Finding	Limitation
Peterson (2018)	Bitcoin follows Metcalfe's Law: Value $\propto$ Users^2	Can't explain crashes with growing users
Wheatley et al. (2019)	Generalized Metcalfe's Law fits bubbles	Purely descriptive, no prediction
Cong et al. (2021)	Token value from platform adoption	Assumes rational expectations

2. Monetary & Store of Value Models

Study	Key Finding	Limitation
Yermack (2015)	Bitcoin fails as currency (too volatile)	Doesn't explain why it has value
Dyhrberg (2016)	Bitcoin = "Digital gold" hedge	Unstable correlations
Schilling & Uhlig (2019)	Theoretical valuation model	Requires fundamental value assumption

3. Production Cost Models (Our Domain)

Study	Key Finding	Our Advance
Hayes (2017)	Daily mining cost creates price floor	We use CUMULATIVE costs
Fantazzini et al. (2016)	Cost models outperform others	We identify regime dependence
Prat & Walter (2021)	Mining equilibrium model	We test structural breaks

Our Contribution: First to show production cost anchoring is regime-dependent

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Slide L2: Variable Selection - Comprehensive Evidence

Ahmed (2022) - Extreme Bounds Analysis

- Tested 300+ potential Bitcoin predictors
- Method: Leamer's extreme bounds test across 2+ million regressions
- **Robust predictors**: Google Trends, VIX, Trading Volume
- **Fragile predictors**: S&P500, Gold, Oil, Exchange rates
- **Our takeaway**: Use only robust variables + our novel CEIR

Sovbetov (2018) - Cross-Country Analysis

- Studied Bitcoin returns across multiple exchanges
- **Significant**: Google Trends, SP500 (mixed evidence)
- **Insignificant**: Gold, currency pairs
- **Our takeaway**: Confirms Google Trends importance

Borri, Shakhnov & Veronesi (2023) - Liquidity Drivers

- Comprehensive study of Bitcoin liquidity determinants
- Used Lasso/Ridge to identify robust factors
- Found parsimonious models outperform kitchen sink
- **Our takeaway**: Justifies our focused approach

Slide L3: The Regulation Non-Effect

Feinstein & Werbach (2021) - Definitive Study

"The Impact of Cryptocurrency Regulation on Trading"

Events Tested (17 total):

1. China bans (2013, 2017) - No lasting effect
2. Japan regulation (2017) - No effect
3. South Korea restrictions (2018) - No effect
4. India banking ban (2018) - No effect
5. US SEC actions (multiple) - No effect

Quote: *"We find almost entirely null results across all specifications... no systemic evidence that regulatory measures cause traders to flee"*

Our Regulation Tests

- Created RegIndex: Count of "regulation" mentions in crypto news
- Added to all specifications as robustness
- Results: $\beta \approx 0.003$, $p > 0.80$ in all models
- No improvement in R^2 or predictive power

Conclusion: Regulation affects headlines, not prices

Slide L4: Natural Experiments in Cryptocurrency

Why Natural Experiments Matter

- **Identification challenge**: Crypto markets have no randomization
- **Endogeneity concerns**: Everything affects everything
- **Solution**: Exploit exogenous policy/technical shocks

Previous Crypto Natural Experiments

Study	Experiment	Finding
Foley et al. (2019)	Silk Road shutdown	Bitcoin became legitimate
Makarov & Schoar (2020)	Exchange outages	Arbitrage breakdowns
Griffin & Shams (2020)	Tether printing	Price manipulation evidence
Kapengut & Mizrach (2023)	Ethereum merge	Spread changes
Liu et al. (2025)	Ethereum merge	Volatility reduction

Our Natural Experiments

1. **China Mining Ban**: Exogenous political decision
2. **Ethereum Merge**: Technical upgrade, long-planned

- **Advantage**: Two different types of shocks, same conclusion

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Slide L5: Energy & Mining Literature

Energy Consumption Studies

Study	Focus	Relevant Finding
de Vries (2018)	Environmental impact	73 TWh/year (2018)
Stoll et al. (2019)	Carbon footprint	Location matters
Cambridge (2021)	Real-time index	40-175 TWh range
Guidi et al. (2025)	US mining boom	32.3 TWh from top 34 mines

Mining Economics

Study	Focus	Relevant Finding
Garratt & van Oordt (2020)	Mining profitability	Break-even critical
Alsabah & Capponi (2020)	Pool dynamics	Concentration natural
Easley et al. (2019)	Transaction fees	Future sustainability

Gap We Fill: No study links cumulative energy to price formation

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Slide L6: Behavioral Finance Foundations

Anchoring Bias Literature

- **Tversky & Kahneman (1974)**: Original anchoring experiments
- **Kahneman (2011)**: Anchoring as System 1 heuristic
- **Application to Finance**:
  - George & Hwang (2004): 52-week high anchoring
  - Baker et al. (2012): Reference points in markets
  - Li & Yu (2012): Aggregate anchoring affects prices

Why Energy Creates Anchoring

1. **Observable**: Mining energy is measurable
2. **Salient**: Media coverage of energy use
3. **Irreversible**: Sunk cost nature
4. **Collective**: All participants see same numbers

Our Innovation: First to test cumulative cost anchoring in any market

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Slide L7: Methodological Literature

Time Series in Crypto

- **Corbet et al. (2019)**: Survey of crypto econometrics
- **Standard approach**: OLS with HAC standard errors
- **Key issues**: Non-stationarity, volatility clustering

Structural Break Testing

- **Chow (1960)**: Original test for known break
- **Andrews (1993)**: Unknown break point

- **Bai & Perron (2003)**: Multiple breaks
- **Our approach**: Known break (China ban) → Chow test

Difference-in-Differences

- **Card & Krueger (1994)**: Classic minimum wage study
- **Angrist & Pischke (2009)**: Modern DiD methods
- **Key assumption**: Parallel pre-trends
- **Our validation**: BTC/ETH moved together pre-merge

Slide L8: Literature Summary Table

Topic	Key Papers	Consensus	Our Contribution
Valuation Models	Hayes (2017), Peterson (2018)	No agreement	Regime-dependent costs
Predictors	Ahmed (2022), Sovbetov (2018)	Few robust	CEIR is novel robust predictor
Regulation	Feinstein & Werbach (2021)	No effect	Confirms null
Natural Experiments	Few studies	Powerful method	Two experiments
Energy	Environmental focus	Ignores valuation	Links energy to price
Structural Breaks	None in crypto	Not tested	First documentation

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Slide L9: Theoretical Foundations We Build On

Production Theory

- **Marshall (1890)**: Long-run price = cost of production
- **Application**: Mining cost should bound Bitcoin price
- **Our twist**: Cumulative, not marginal cost matters

Behavioral Finance

- **Shiller (2003)**: Narratives drive prices
- **Application**: Energy narrative anchors value
- **Our twist**: Narrative strength depends on geography

Market Microstructure

- **Kyle (1985)**: Information and price discovery
- **Application**: Concentrated mining improves price discovery

- **Our twist**: Dispersion breaks information aggregation

Slide L10: Why Our Paper Matters

Advances on Existing Literature

1. **First cumulative cost measure** (vs. daily costs)
2. **First structural break test** in crypto fundamentals
3. **First regime-dependent fundamental** documented
4. **Two natural experiments** (vs. typical one or zero)
5. **Behavioral + economic mechanism** (not just correlation)

Falsifiable Predictions

- If mining re-concentrates → Relationship returns
- If other PoW coins concentrate → Should show CEIR effect
- If Bitcoin moves to PoS → Volatility should increase

Opens New Research

- Regime-dependent fundamentals in other markets?
- Other cumulative anchors?
- Geographic concentration in digital markets?