Blockspace Under Pressure

An Analysis of Spam MEV on High-Throughput Blockchains

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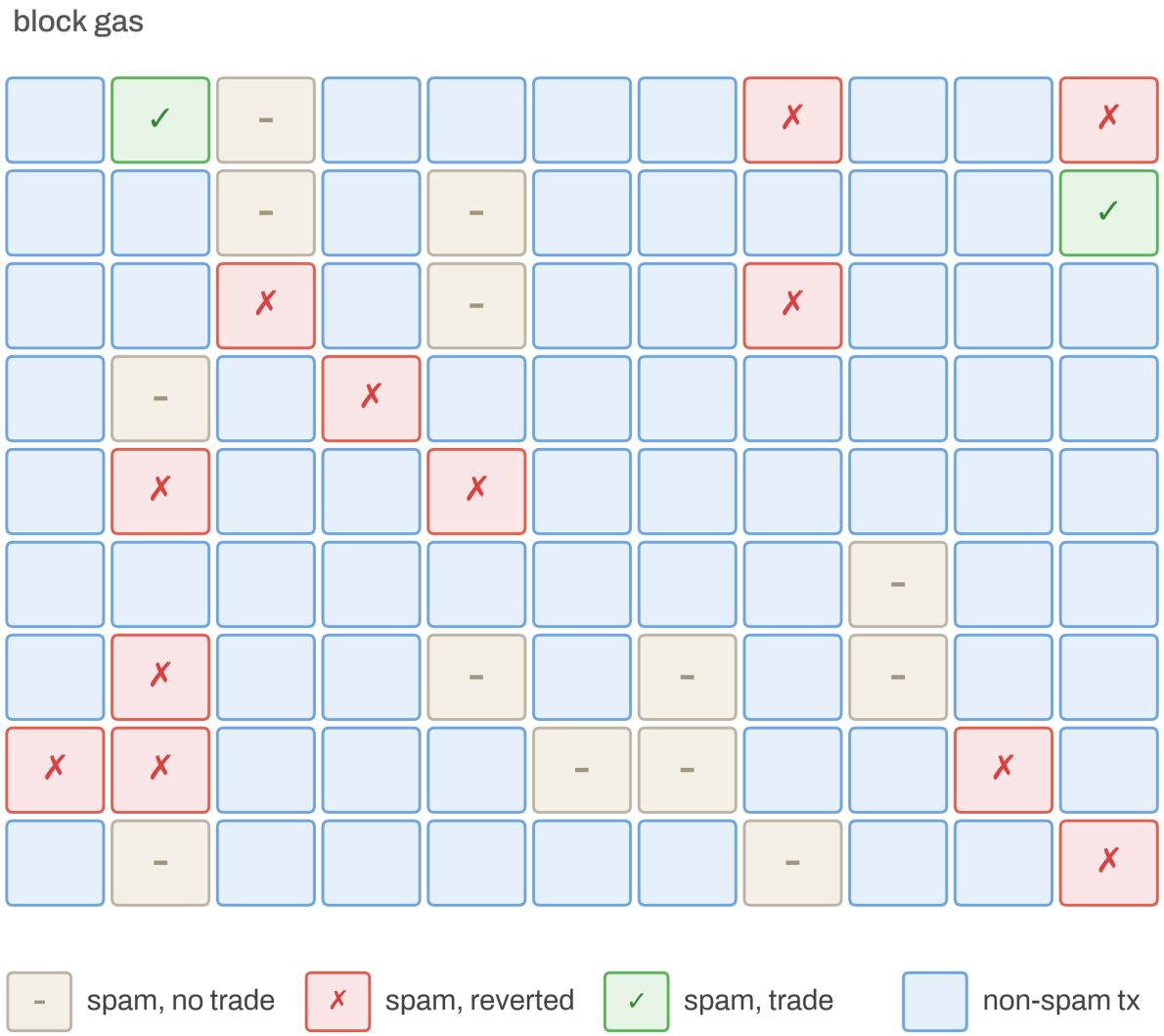
THE PHENOMENON

Spam Consumes a Quarter of Block Gas

~25% of block gas on Base and Arbitrum consumed by spam in 2025. Only a few percent of probes result in a trade.

Searchers flood chains with speculative transactions. Profitability resolved at execution time. Most fail, consuming gas without producing a trade.

We develop a principled framework to understand why spam emerges and the tradeoffs of reducing it.



PART 1

What Is Spam MEV?

TWO MODES OF MEV

Targeted vs Spam MEV

Targeted MEV

identify off-chain → submit tx → profit

Sandwich attacks, cyclic arbitrage, liquidations. Searcher identifies opportunity off-chain and submits with high confidence.

Spam MEV

probe probe probe trade probe probe

Flood chain with speculative probes. Profitability resolved at execution time. On-chain logic checks for opportunity and captures it, or not.

WHY IT IS PREVALENT

Three Conditions for Spam

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Low transaction fees

Failed probes are cheap. Repeated probing is profitable even at low success rates.

⚡

Fast block times

Sub-second blocks leave insufficient time for off-chain computation. Continuous probing dominates.

∅

No public mempool

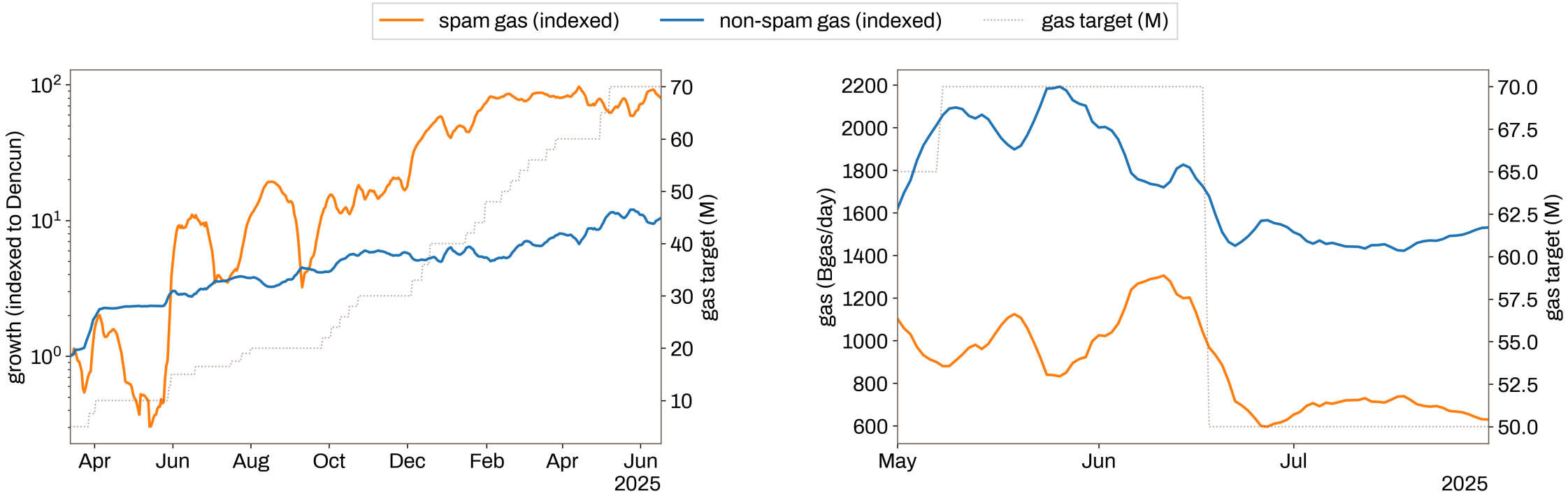
Centralized sequencers with local mempool. Targeted extraction is harder, pushing searchers toward probing.

PART 2

The Industry's Reactive Response

BASE L2

Spam Grew 122x After Dencun

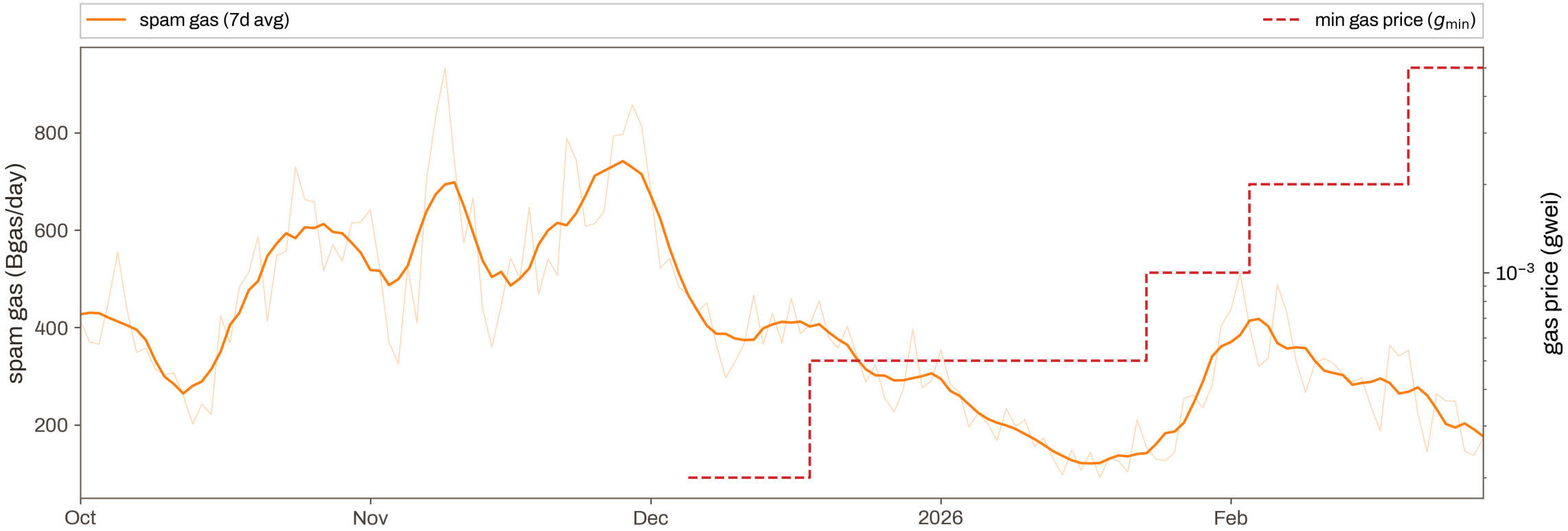


After Dencun (March 2024), Base raised its gas target. Spam gas grew **122x** to its peak. Non-spam gas grew 11.2x. Spam absorbed the majority of added capacity.

When Base cut the gas target (70M to 50M), spam gas fell by **34%** and non-spam gas by 24%. Spam's share dropped from 36% to 32%.

INTERVENTION

Minimum Gas Price Reduced Spam



Base introduced a protocol minimum gas price in December 2025 and raised it in steps. Spam's share fell from ~26% to below 9%. Non-spam gas remained stable or grew.

OTHER CHAINS

Not Just Base

Arbitrum & Aptos

Arbitrum raised its minimum gas price. Aptos introduced one. Both explicitly citing spam reduction.

Monad

Launched with a non-trivial minimum price. Charges based on **gas limit** rather than gas consumed.

DESIGN SPACE

Three Levers for Blockchain Designers

B_{max}

Block space limit

Controls the total capacity available per block. Determines how much demand the chain can absorb.

g_{min}

Minimum gas price

A floor on gas price, independent of block availability. Prevents near-zero prices when capacity exceeds demand.

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Transaction fee mechanism

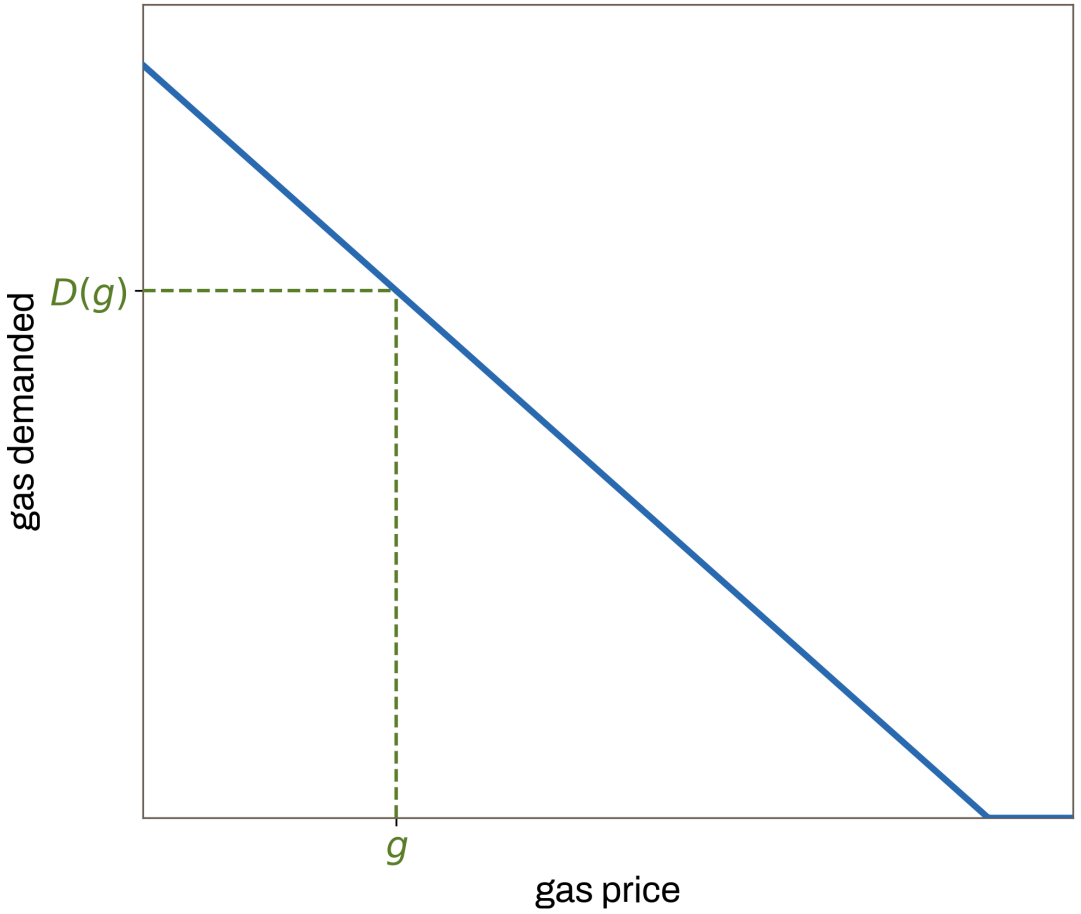
Governs how transactions are priced and ordered within a block.

PART 3

A Framework for Spam Equilibrium

MODEL

User Demand for Block Space



Users have different valuations for transacting on-chain.

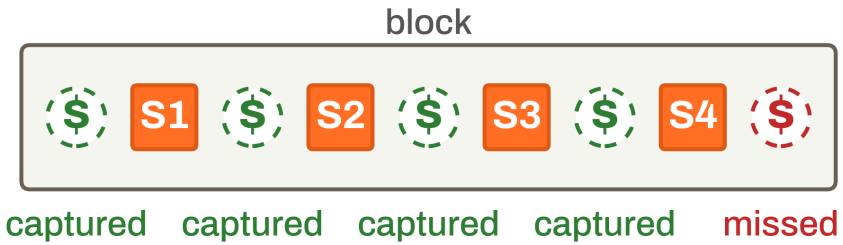
D(g) is the total gas demanded by users with valuation g or higher.

Baseline: all transactions pay the clearing price. Random ordering within the block.

We use a linear demand curve for exposition. Results hold qualitatively for other demand functions (e.g., exponential).

MODEL

Spam Entry and Opportunity Capture



S = 4 spam txs | 5 equally likely positions

$$\Pr[\text{captured}] = \frac{S}{S+1} = \frac{4}{5}$$

User transactions create a single arbitrage opportunity of value **r** per block. The first spam tx after it captures it.

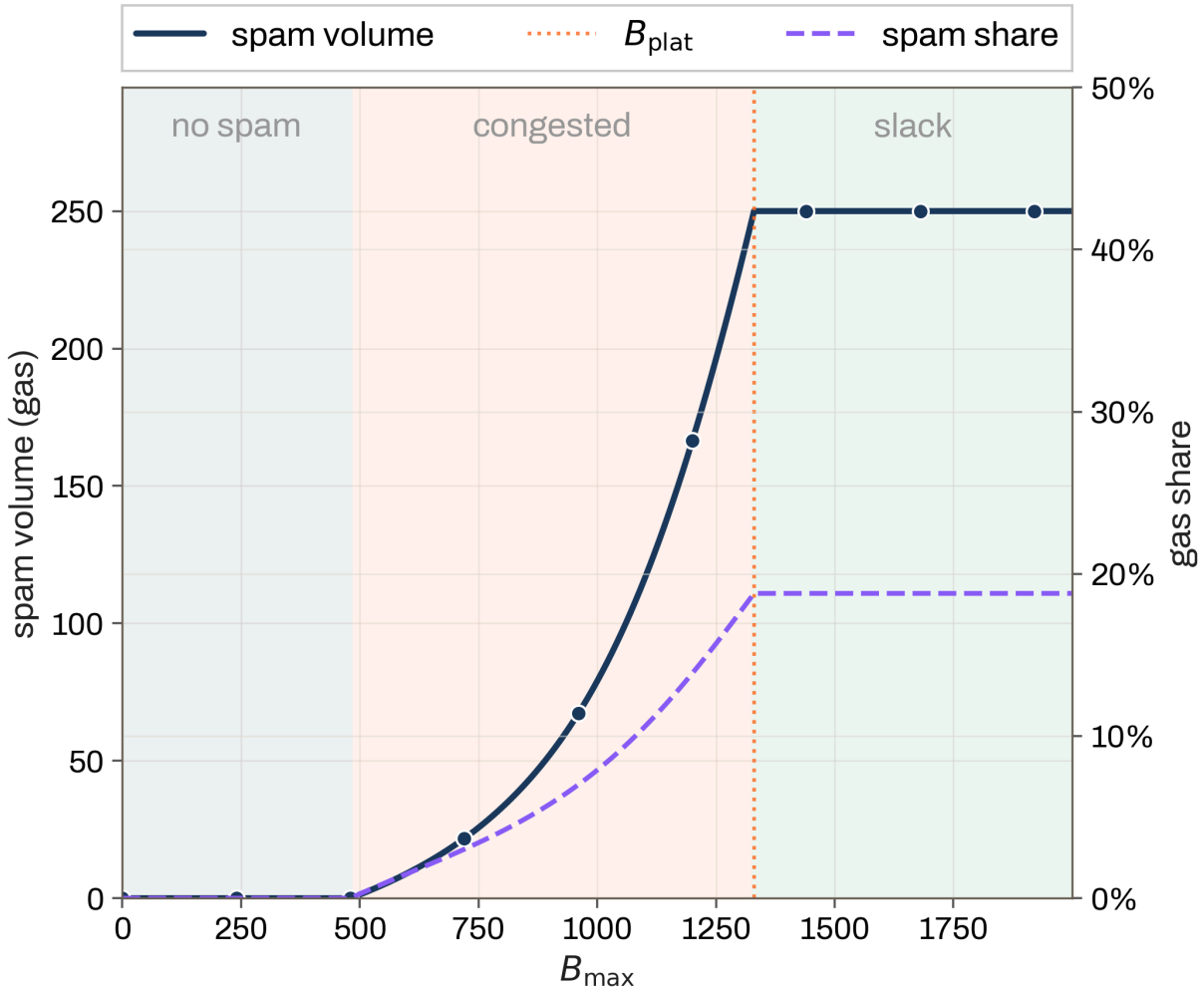
Total spam utility at volume S, where s is the gas per spam tx and g(S) the clearing gas price:

$$u(S) = \underbrace{\frac{S/(S+1) \cdot r}{\textit{expected revenue}}}_{} - \underbrace{\frac{S \cdot s \cdot g(S)}{\textit{inclusion cost}}}_{}$$

Competitive equilibrium: free entry, no fixed cost. Any agent can submit spam, paying only the per-tx gas price. Spam enters until $u(S^*) = 0$: expected revenue equals inclusion cost.

EQUILIBRIUM

Three Regimes



1. No Spam

Small blocks push gas prices up. Fee exceeds opportunity value.

2. Congested

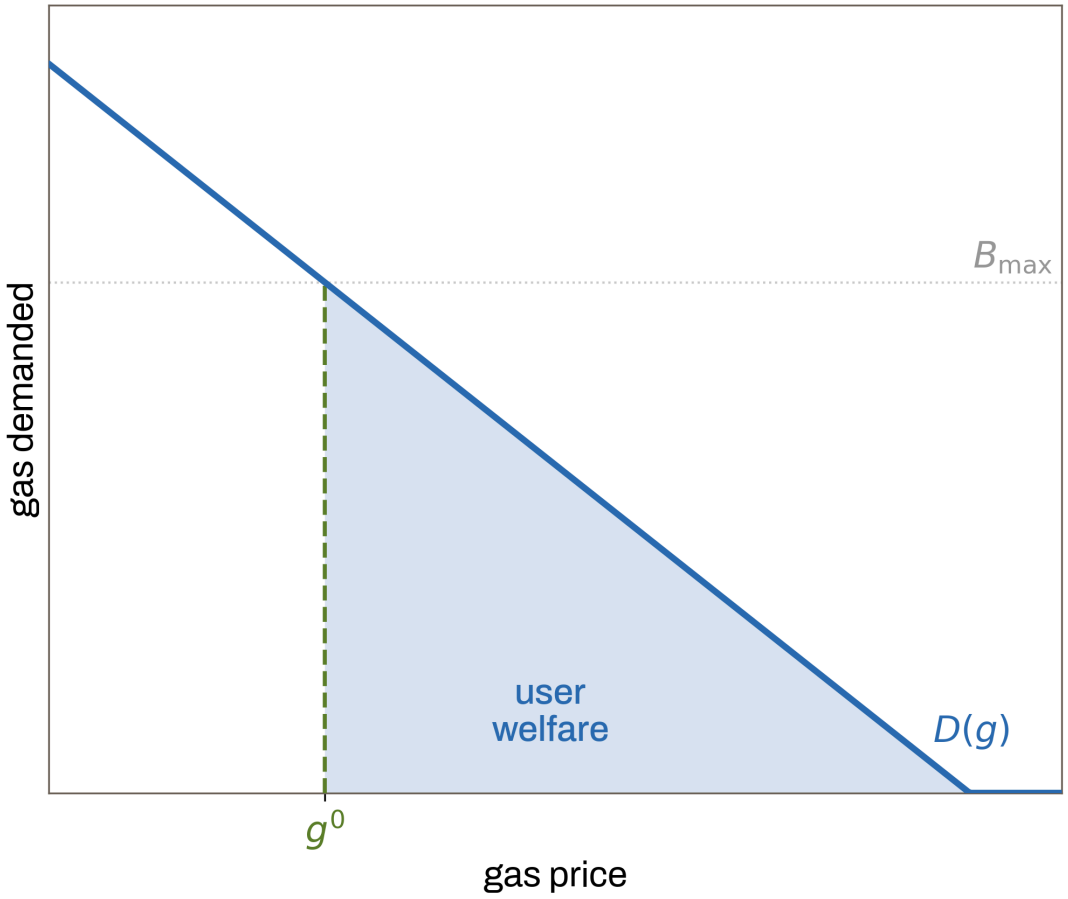
Spam enters and competes with users, pushing prices higher.

3. Slack

Capacity fits all users at g_{min} plus all profitable spam. Beyond B_{plat}, spam and gas price plateau.

CONGESTED REGIME — WITHOUT SPAM

User Welfare Without Spam

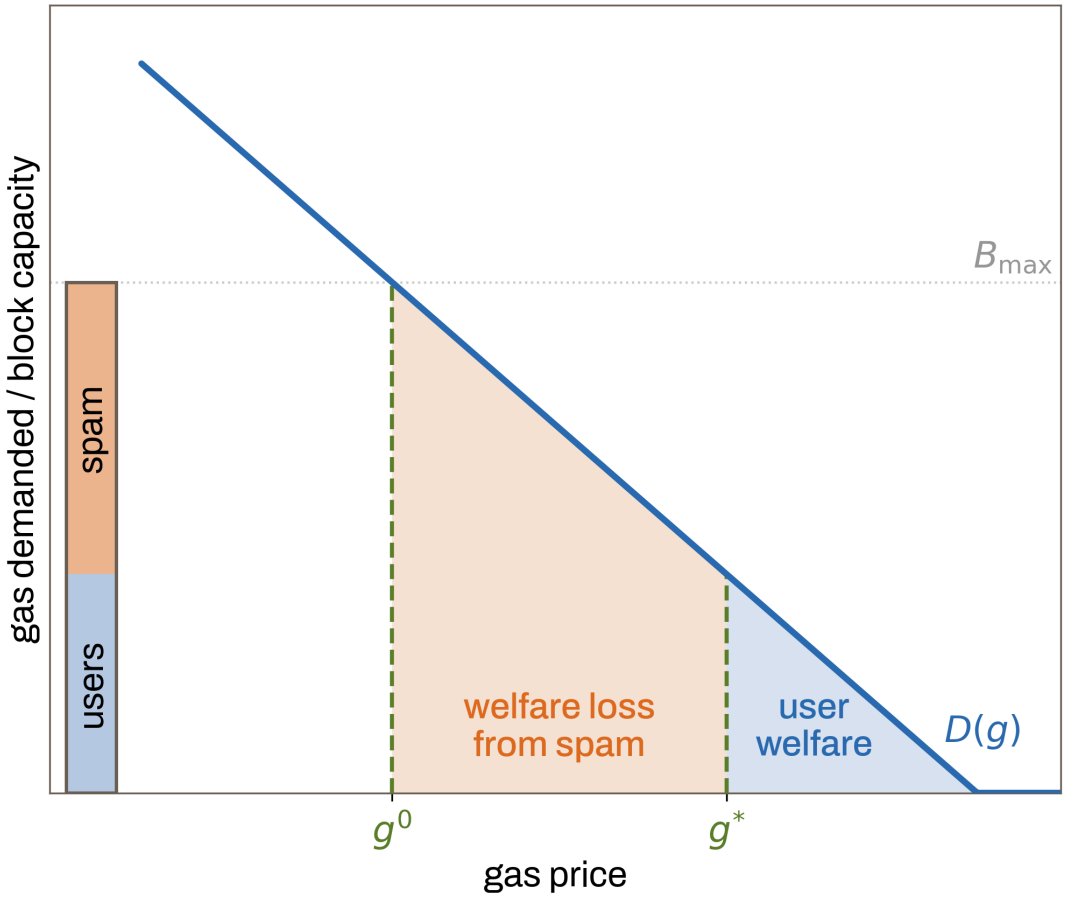


Without spam, the clearing price is g^0. All block space goes to users.

User welfare is the **area under the demand curve** above g^0: the total surplus users get from transacting.

CONGESTED REGIME — WITH SPAM

How Spam Affects Block Composition and User Welfare

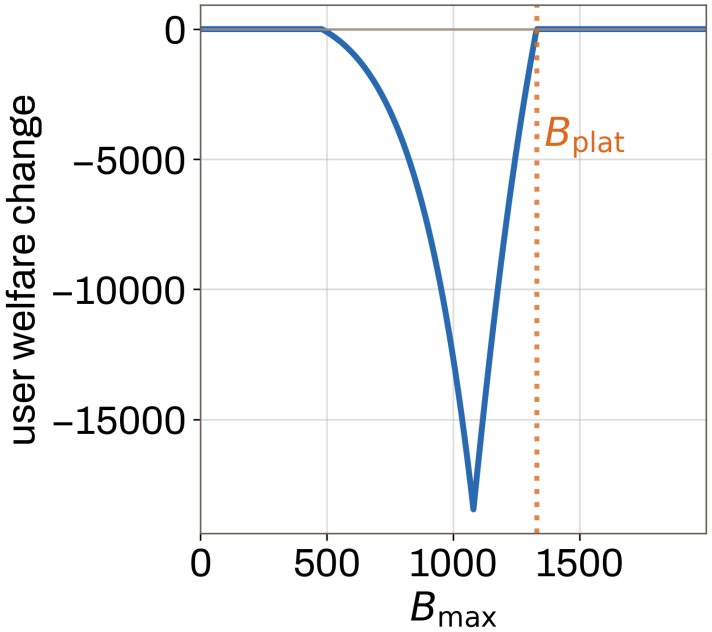


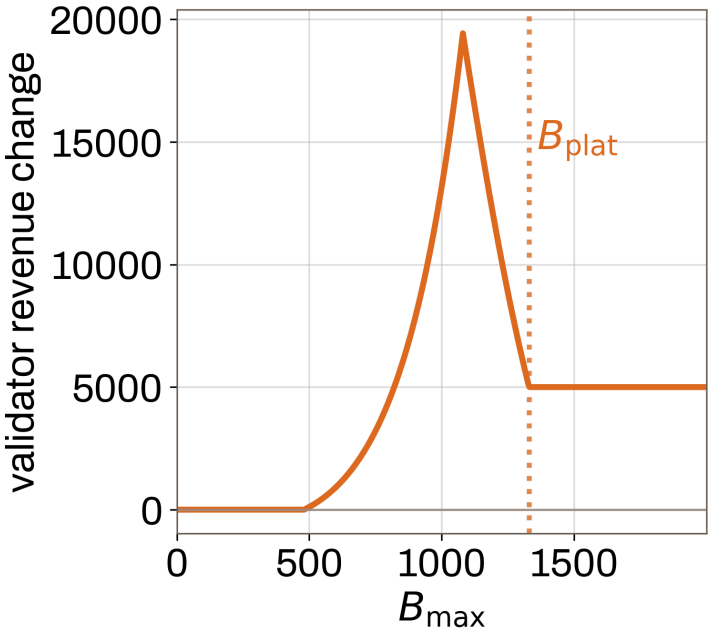
Spam takes block capacity, pushing the clearing price from g^0 to g*.

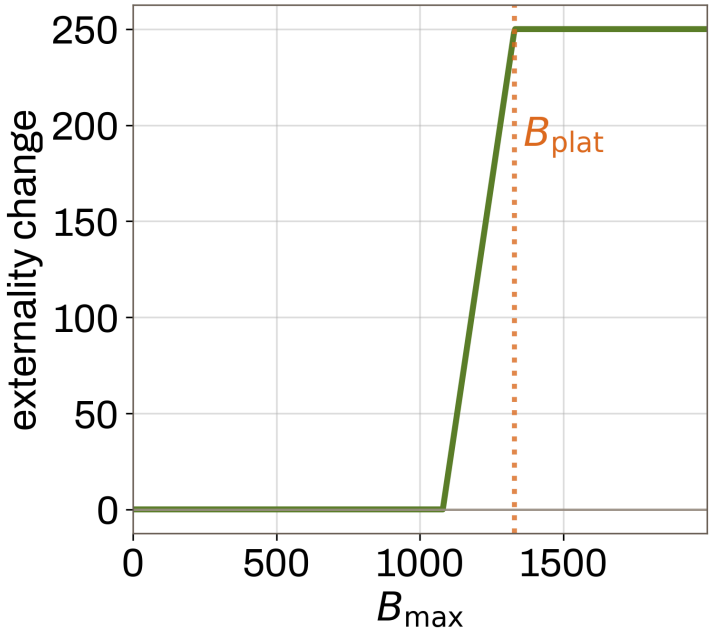
Users are hurt on **both margins**: some are **displaced** from the block, and all remaining users pay a **higher price**.

TRADEOFFS

Impact of Spam on Welfare







Users: spam never increases user welfare. It displaces users and raises the gas price.

Validators: gain from spam filling blocks and pushing up prices.

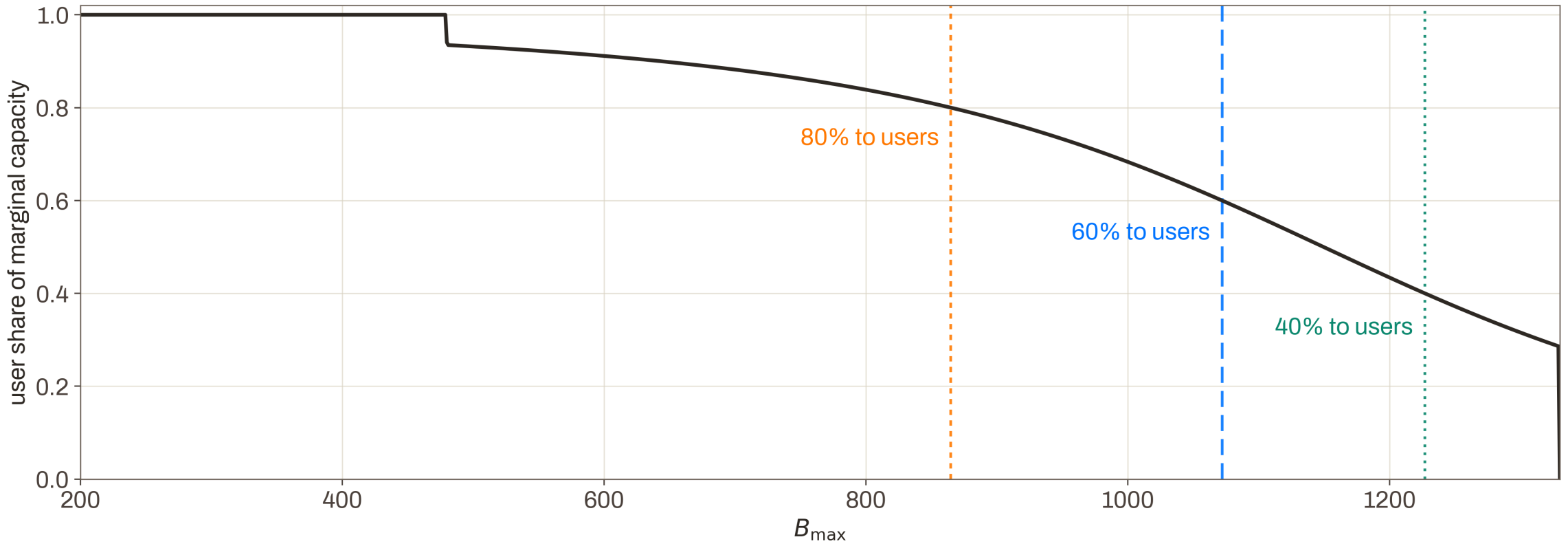
Network: bears higher externality from processing spam transactions.

PART 4

A Favorable Tradeoff

KEY RESULT

Marginal Capacity Goes to Spam



The share of each additional unit of block capacity that goes to spam is **strictly increasing**. The last units are the most spam-heavy.

IMPLICATION

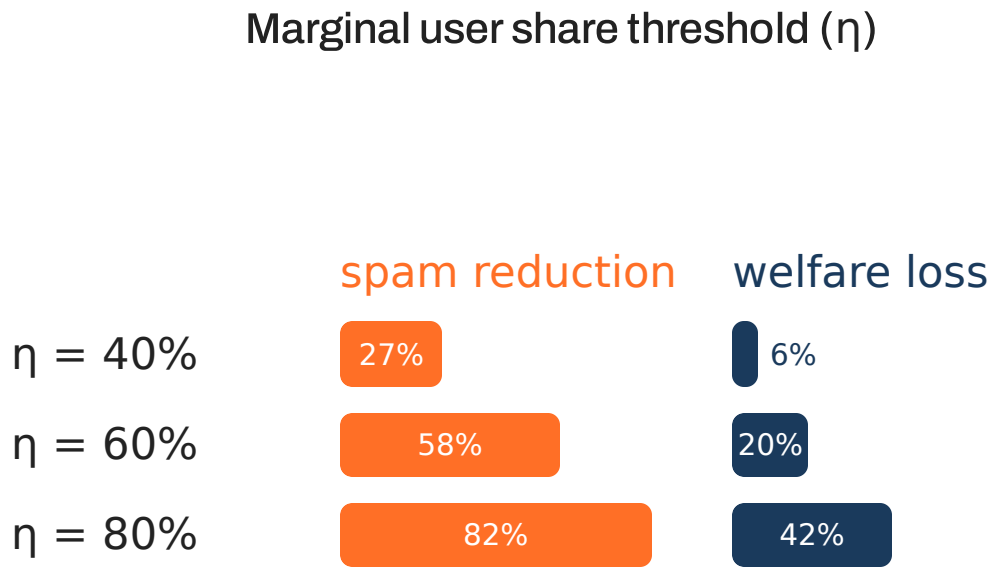
Cut the Last Units of Capacity

B_{max}

The last units of capacity are the most spam-heavy. Cutting B_{max} just before B_{plat} removes a large amount of spam at very little user welfare cost.

g_{min}

A non-trivial price floor prices out spam while remaining comparably small for genuine users.



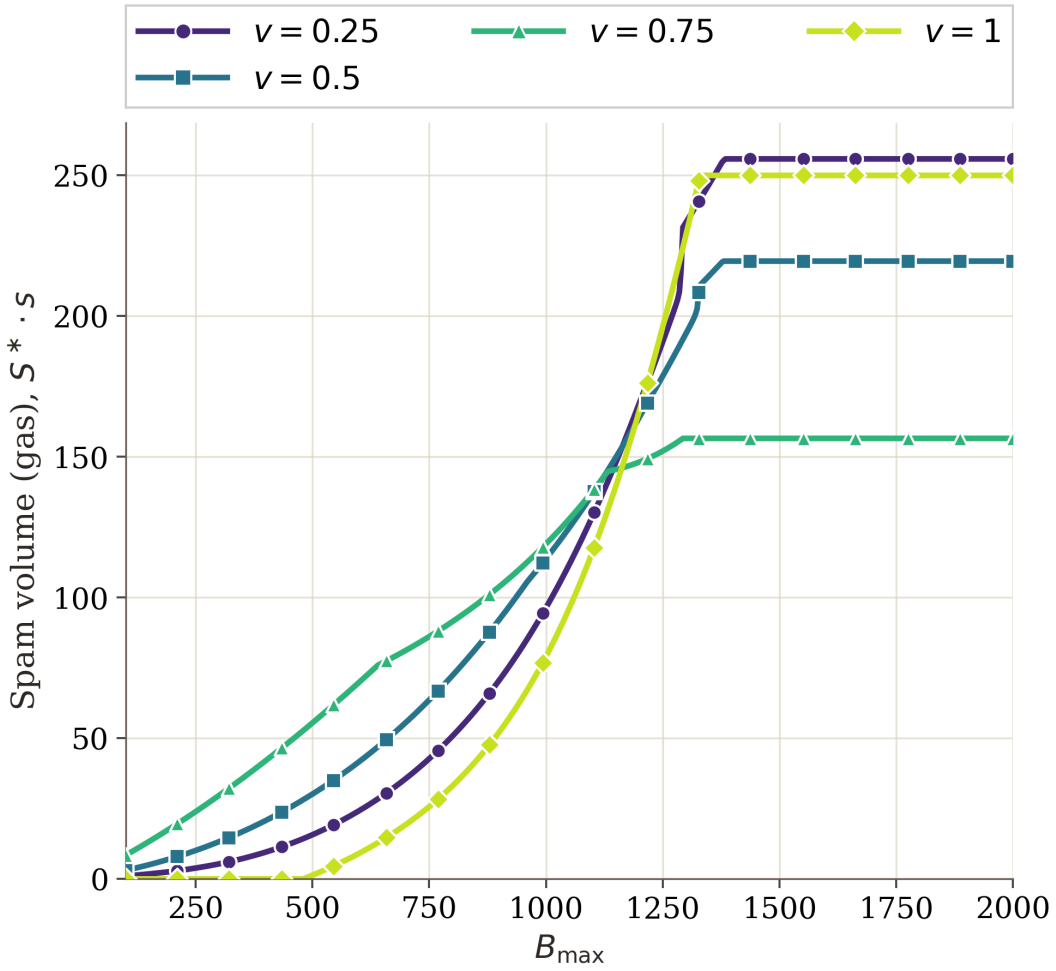
Forgoing a small amount of user welfare eliminates a disproportionate amount of spam and reduces network externality.

PART 5

Does Transaction Ordering Help?

ORDERING

Priority Fee Ordering Reduces Spam



Two-sub-block approximation to PFO: **early** sub-block for high-value flow, **late** sub-block for inclusion. v = fraction of capacity in the early sub-block.

PFO creates **price separation**: spam in the early region pays the **higher clearing price**, the late region limits room for cheap spam.

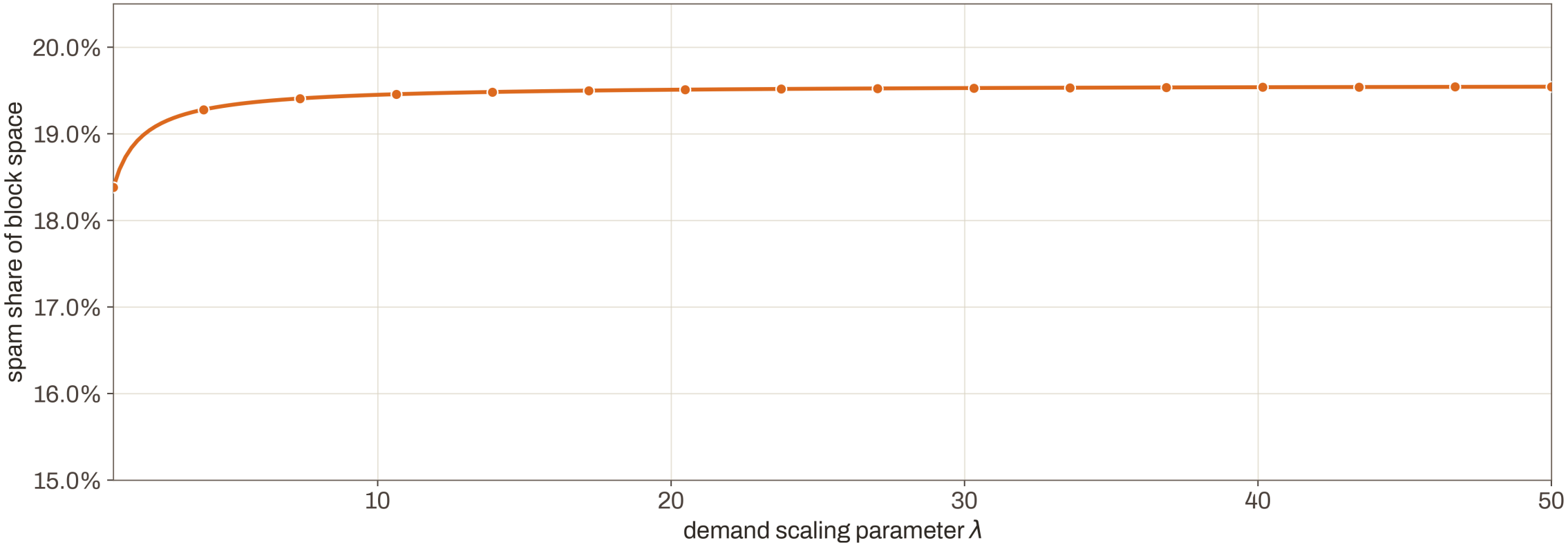
The spam reduction is **strongest** when the capacity split is balanced. Extreme values of v keep cheap blockspace **available** for spam.

PART 6

Does Spam Limit Scaling?

SCALING

Spam's Share Stabilizes as Chains Grow



When user demand scales by λ and block capacity expands to match, spam's share increases initially but settles at a **bounded level**. Spam does not compound without bounds.

PART 7

Empirical Validation

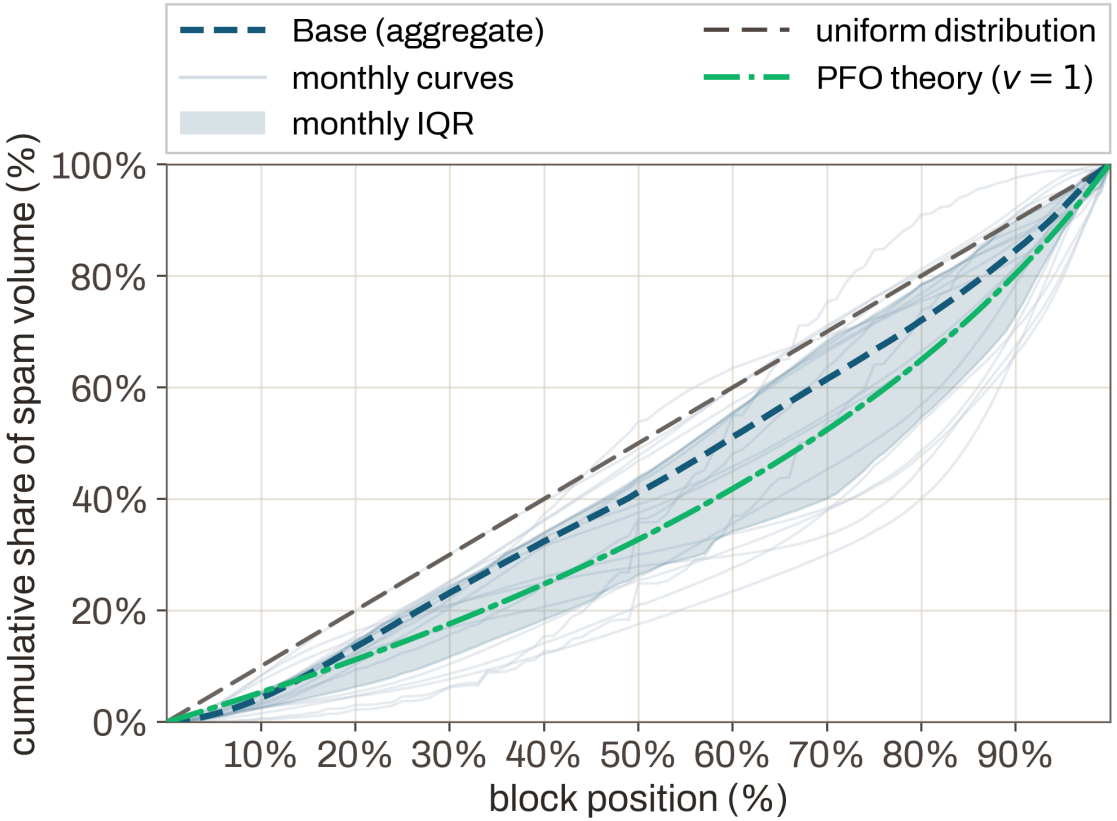
EMPIRICAL VALIDATION

Model Predictions Confirmed

Marginal capacity: spam grew **122x** when Base expanded (non-spam: 11x). When cut, spam fell **34%**, non-spam only 24%.

Fee floor: g_{min} reduced spam share from **26% to below 9%**. Non-spam gas grew +9% to +18% across steps.

Block position: spam concentrates toward the **end** of blocks. Only 41% of spam lands before the median position — consistent with priority ordering reducing spam in early positions.



SUMMARY

Key Takeaways

1

Spam disproportionately occupies the margin

Well-chosen capacity reductions remove more spam than they cost in user welfare.

2

Priority fee ordering reduces spam

PFO creates price separation across block positions, making spam more expensive and reducing its volume.

3

Spam's share stabilizes as chains grow

When demand and capacity scale together, spam settles at a bounded level.

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arxiv.org/abs/2604.00234