

On Blockchain Commit Times

An analysis of how miners choose Bitcoin transactions

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SDBD'20

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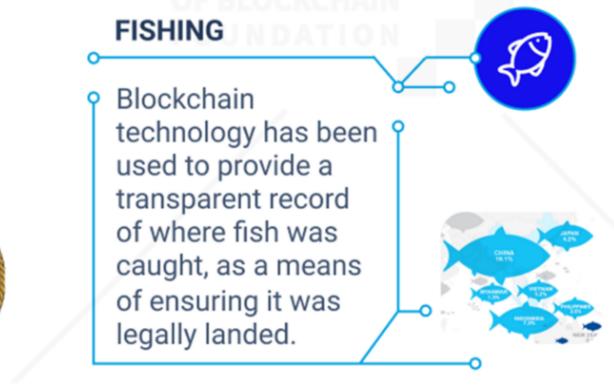
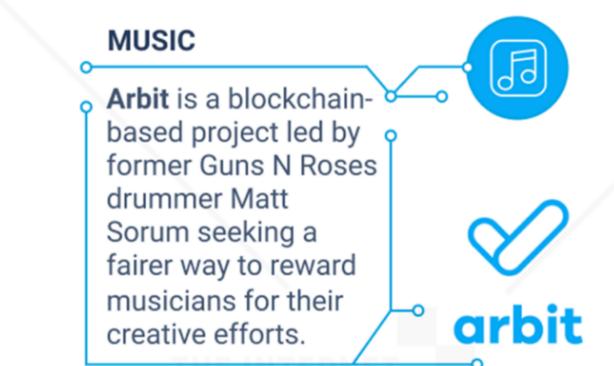
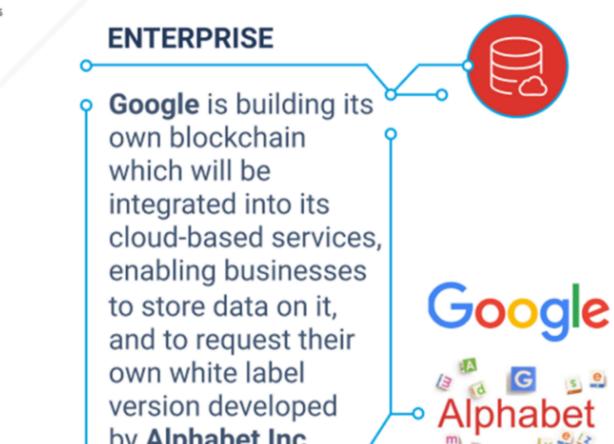
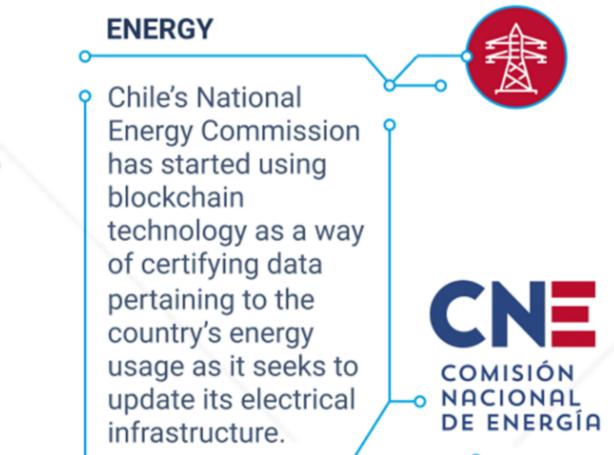
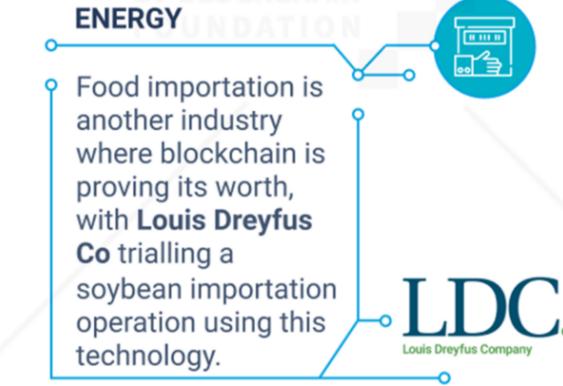
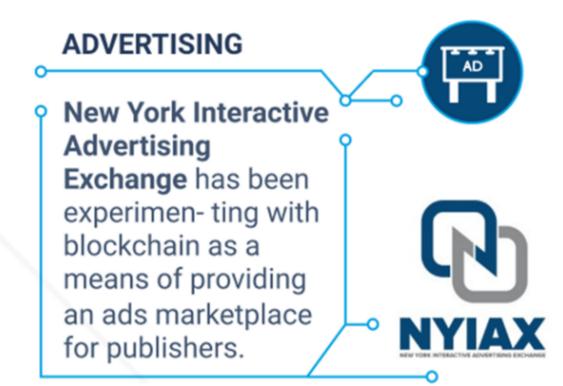
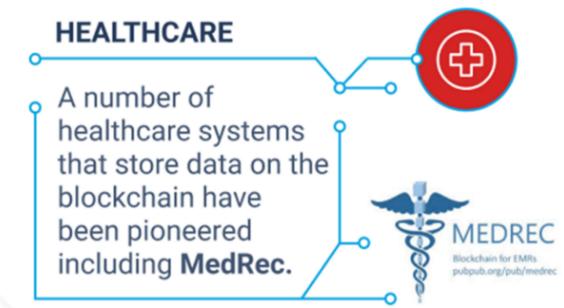
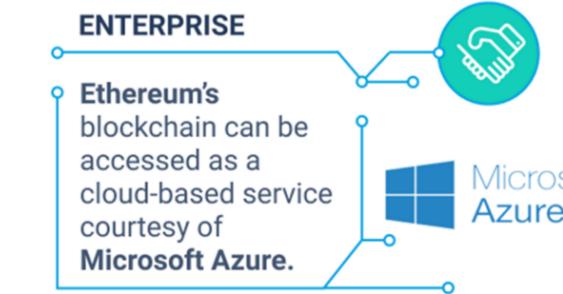
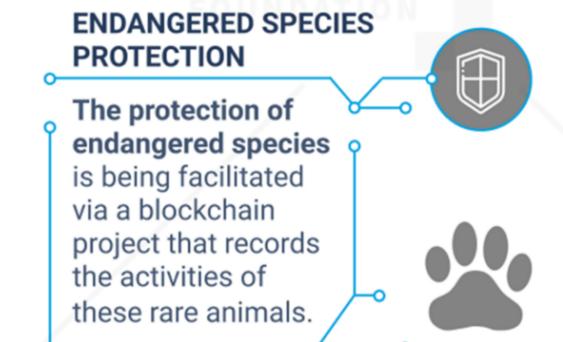
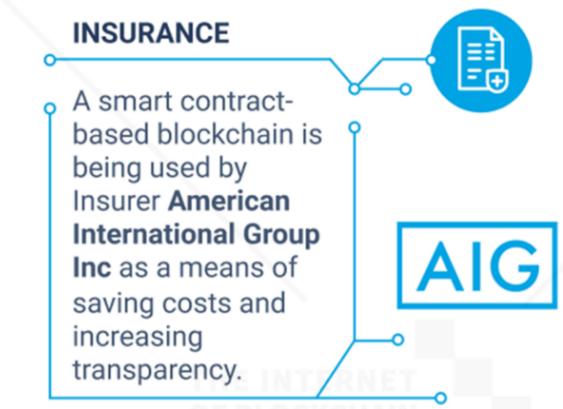
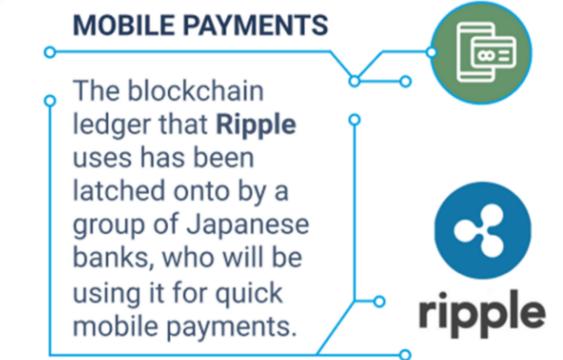


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50+ BLOCKCHAIN REAL WORLD USES CASES

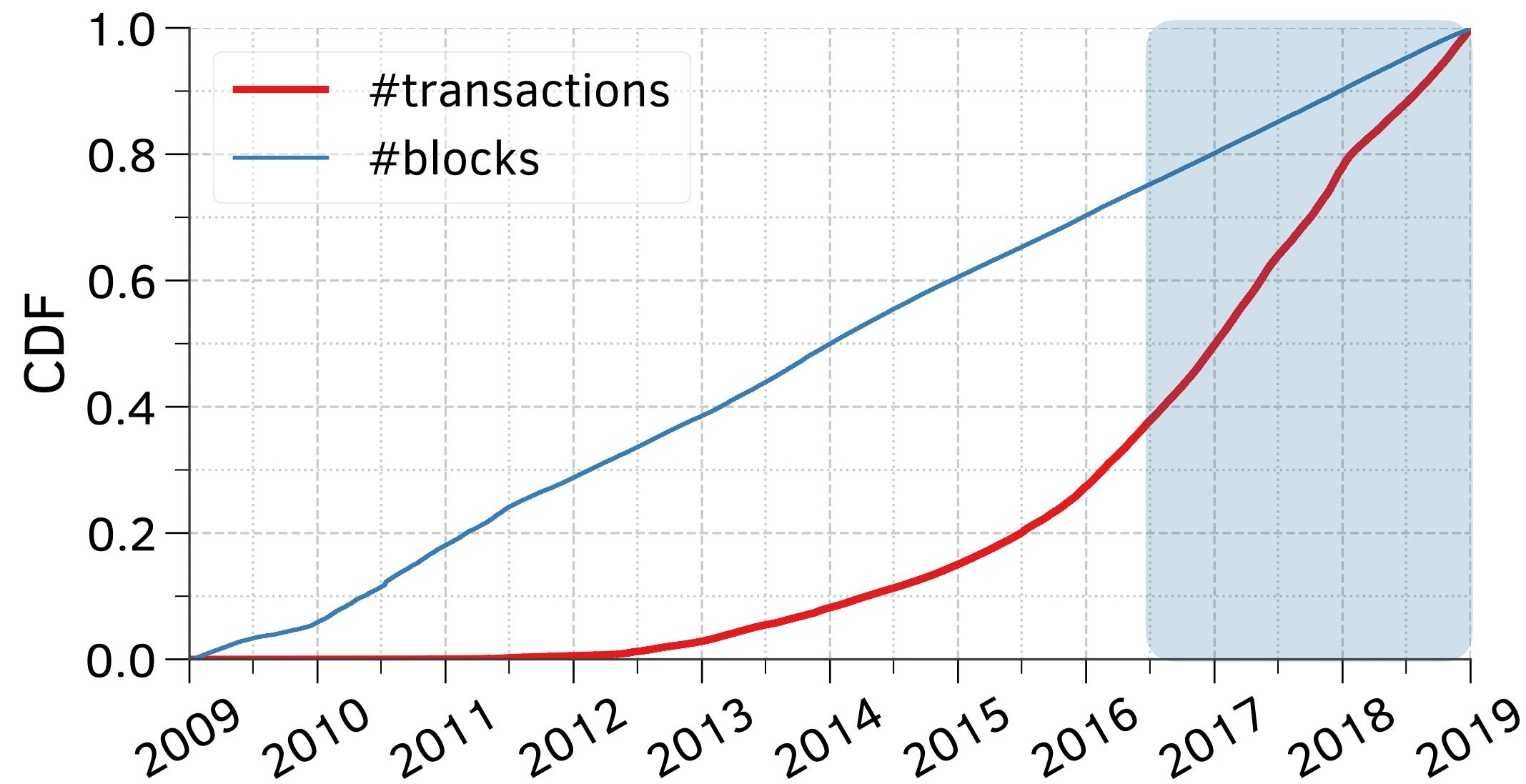


50+ BLOCKCHAIN REAL WORLD USES CASES

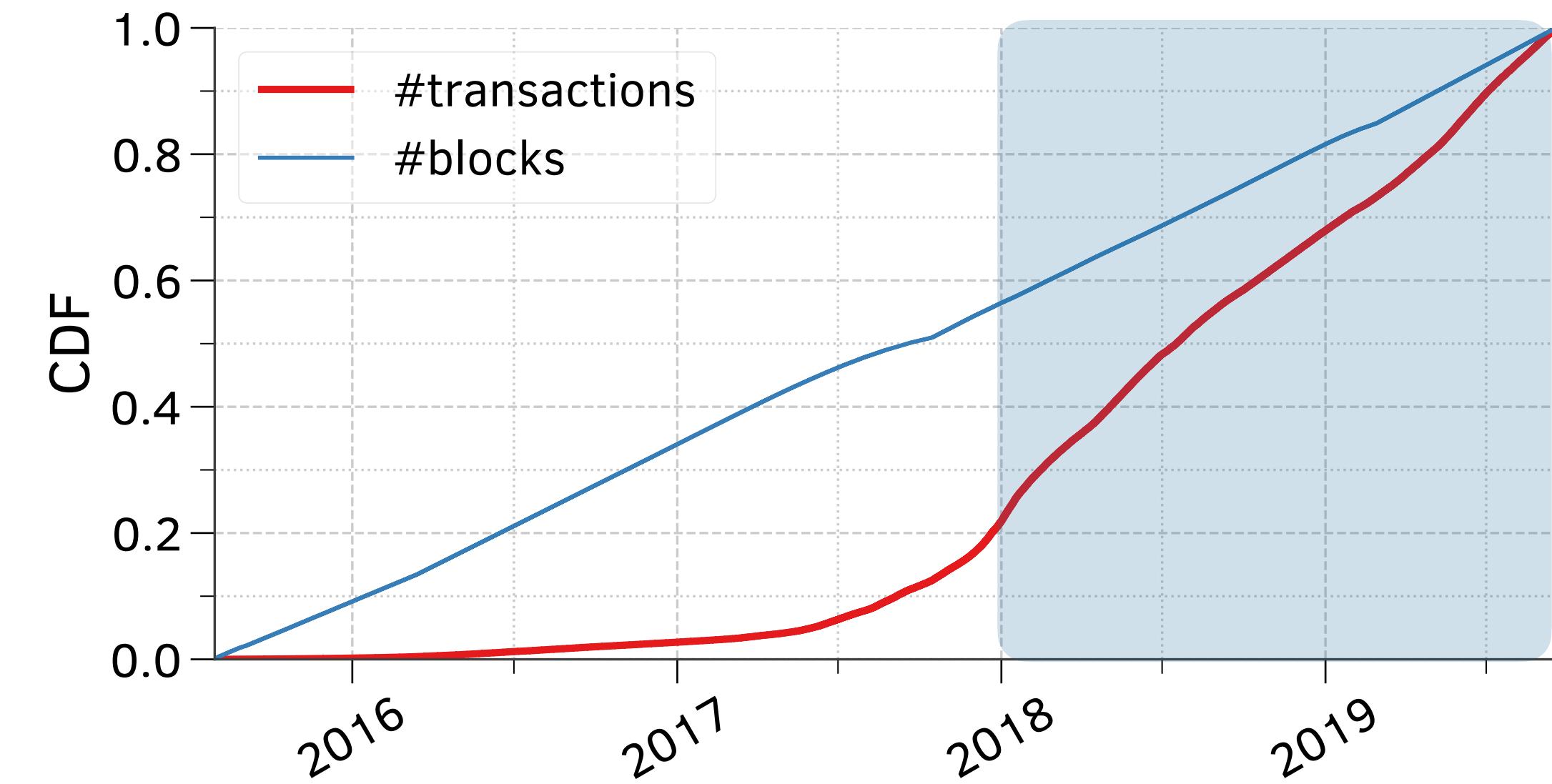


The Current Status of the Top-2 Blockchains

Bitcoin



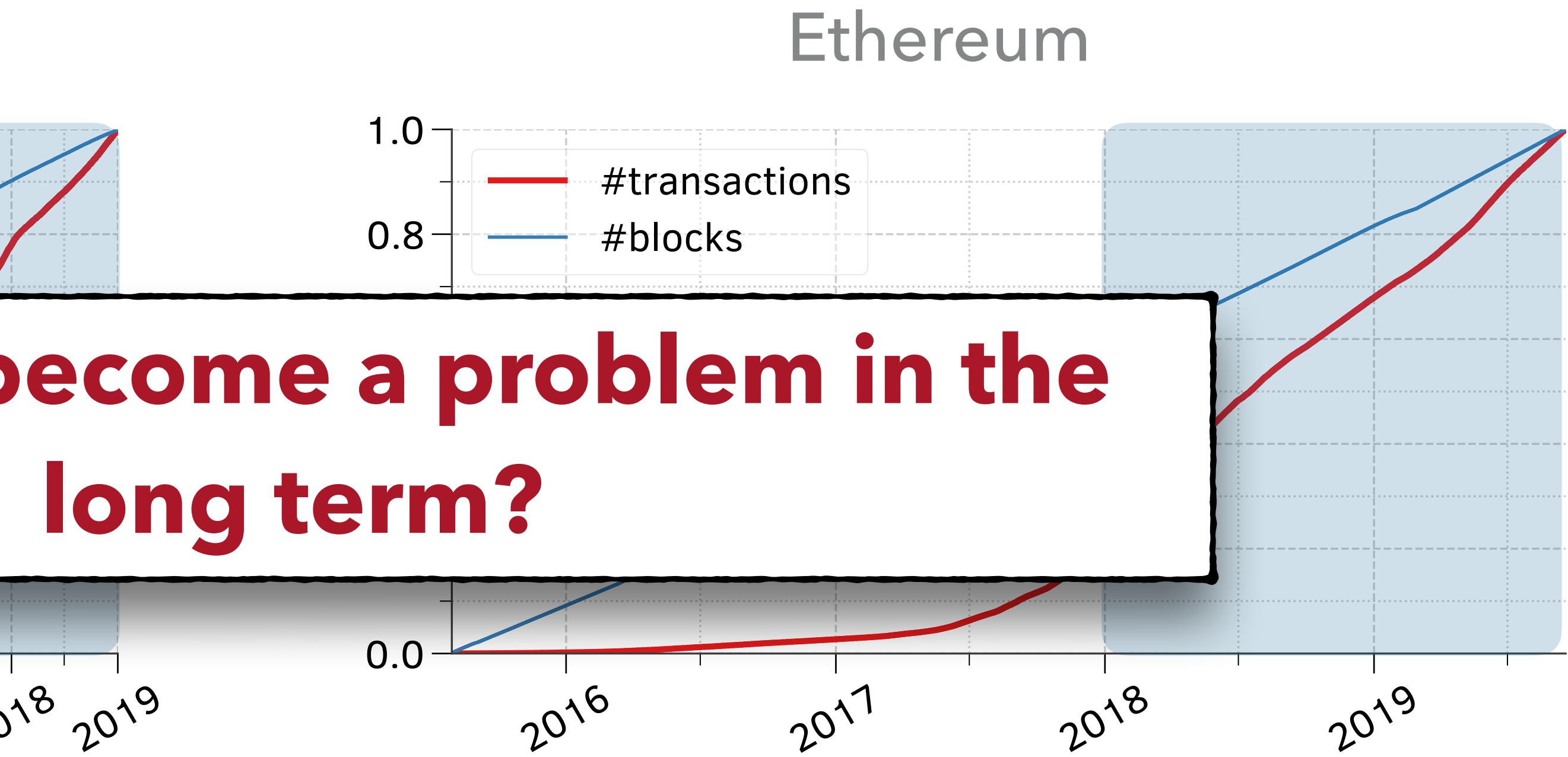
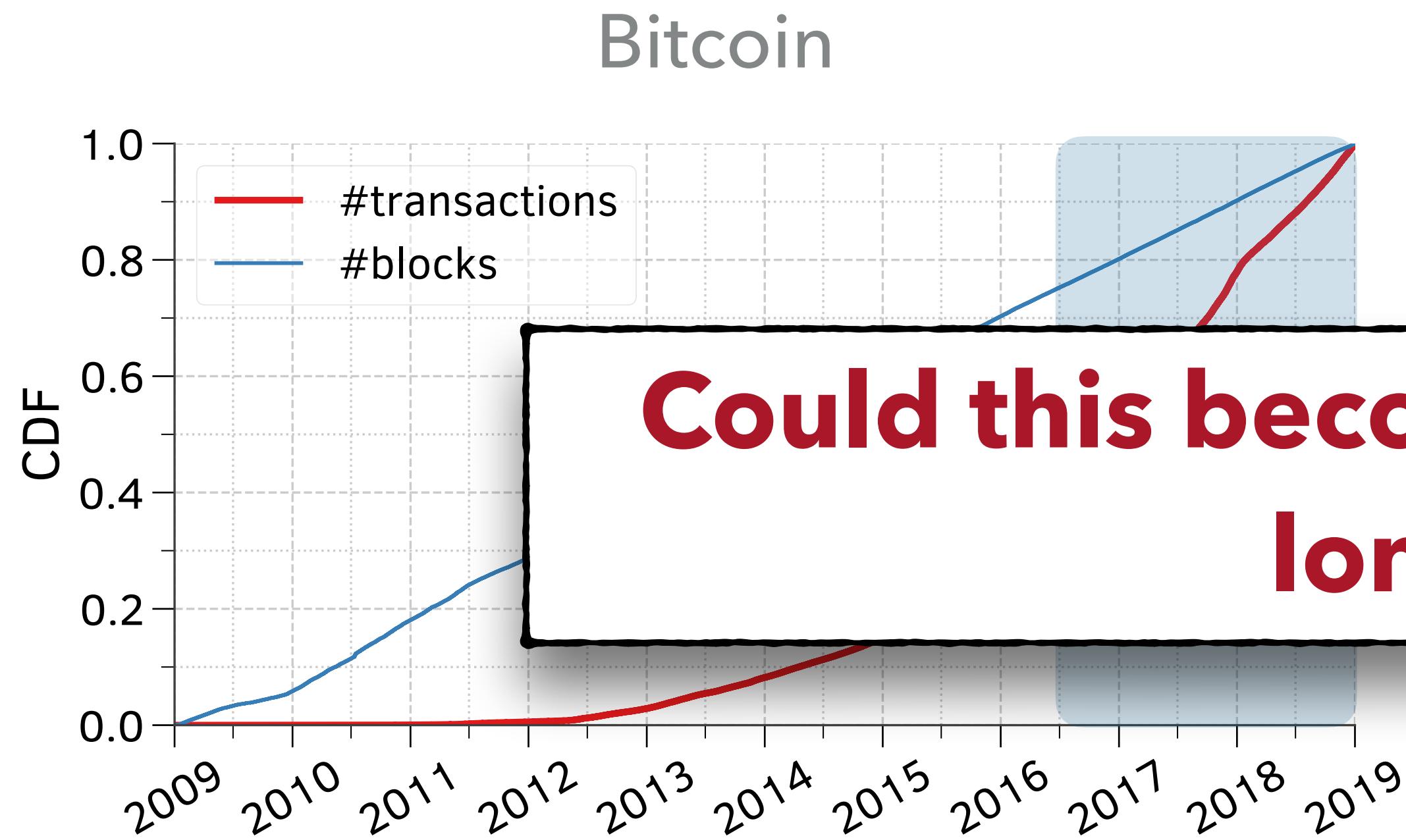
Ethereum



60% of all transactions were
added in the last **2.5** years

80% of all transactions were added
in the last **1.5** years

The Current Status of the Top-2 Blockchains

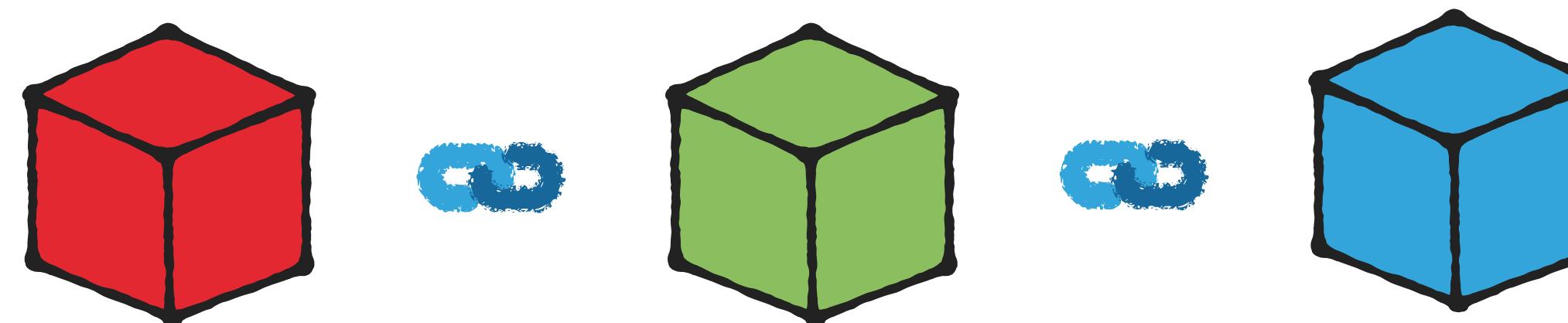


60% of all transactions were added in the last **2.5** years

80% of all transactions were added in the last **1.5** years

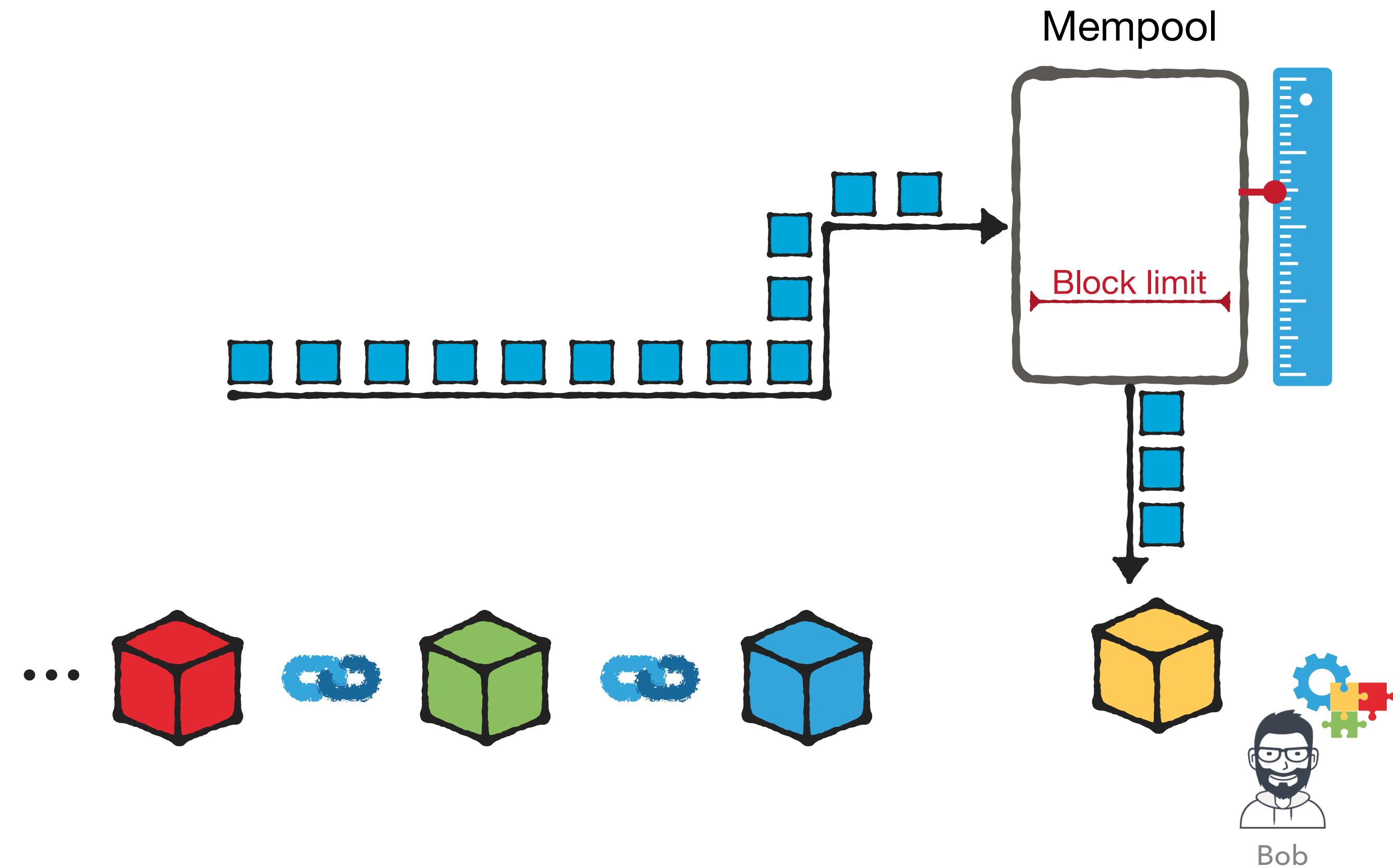
Could This Become a Problem?

- ▶ The common wisdom: transactions are prioritized based on fee-per-byte
 - ▶ There is no guarantee that it has been followed!
- ▶ Are miners "fair" on the transaction order?
- ▶ We want to investigate how miners order transactions!



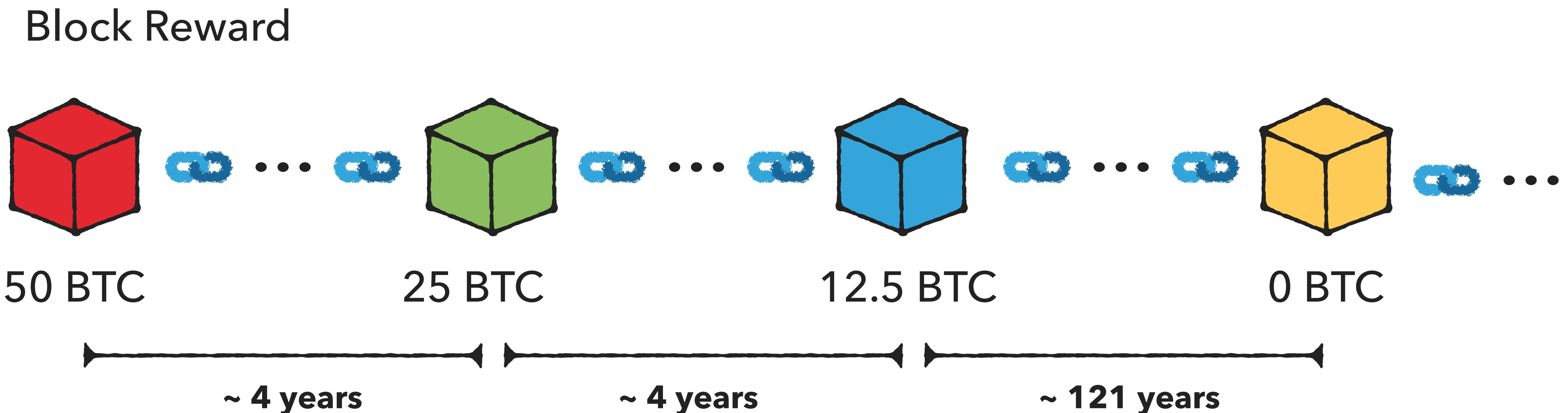
How Transactions Are Selected?

How Transactions Are Selected?



Mining and Rewards

- ▶ Miners get block reward + transaction fees
- ▶ Block reward halves every 4 years
- ▶ In the future, it will become 0!
 - ▶ Fees will be the main mining incentive



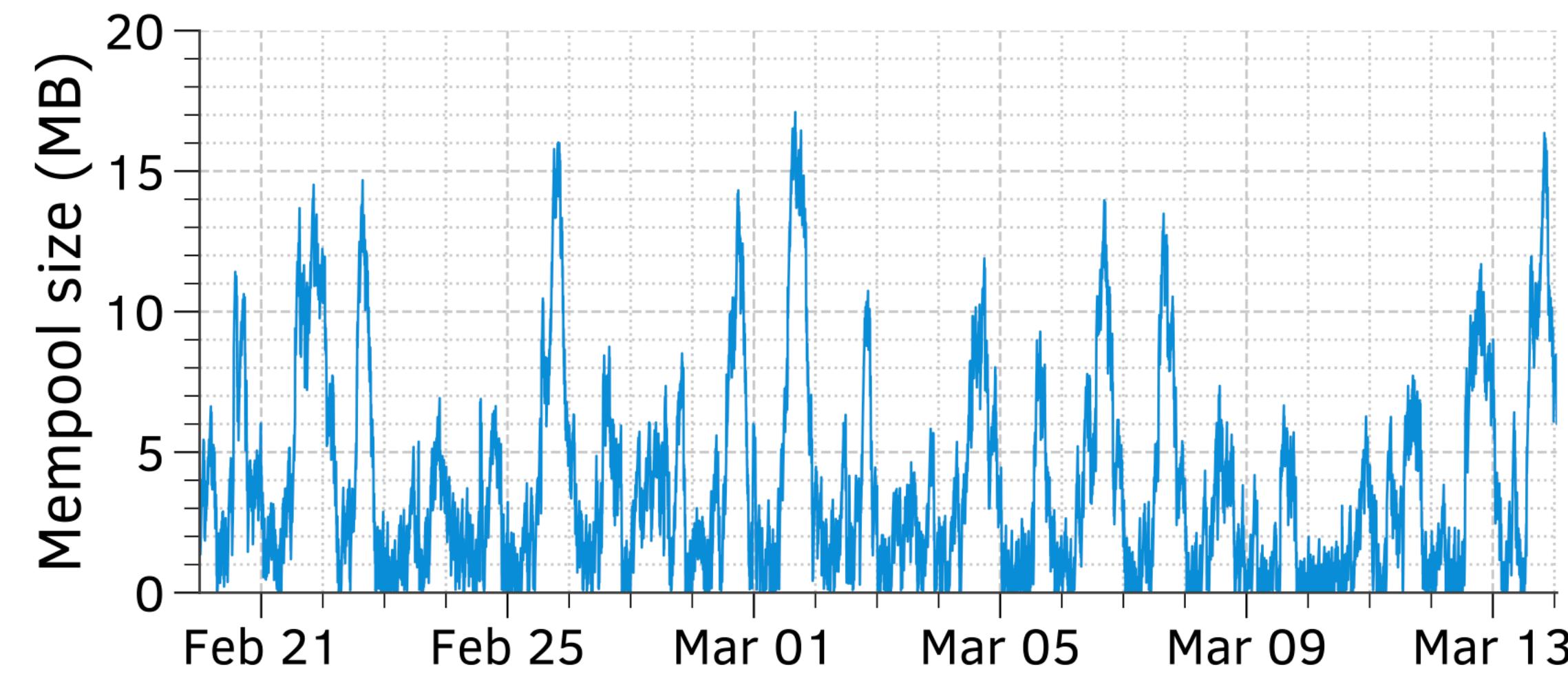
What Do Transactions Look Like?

Blockchain Data Set

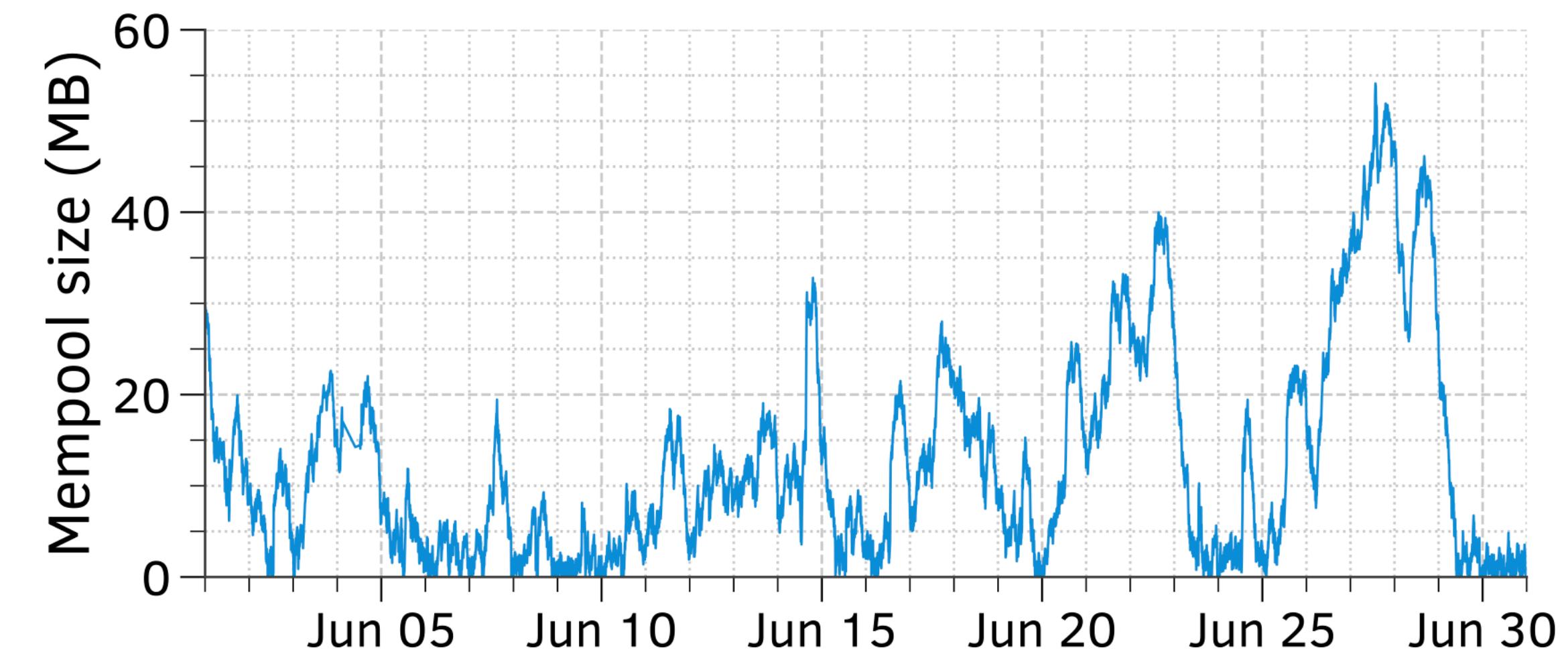
- ▶ We deploy a Bitcoin Full-Node
 - ▶ Gather data from Mempool!

<i>Attributes</i>	<i>Data set A</i>	<i>Data set B</i>
Times span	Feb. 20th – Mar. 13th, 2019	Jun.1st – 30th, 2019
#trans. committed	6,816,375	10,487,966
#blocks	3,119	4,522
#empty-blocks	38	18

Blockchain Data Set



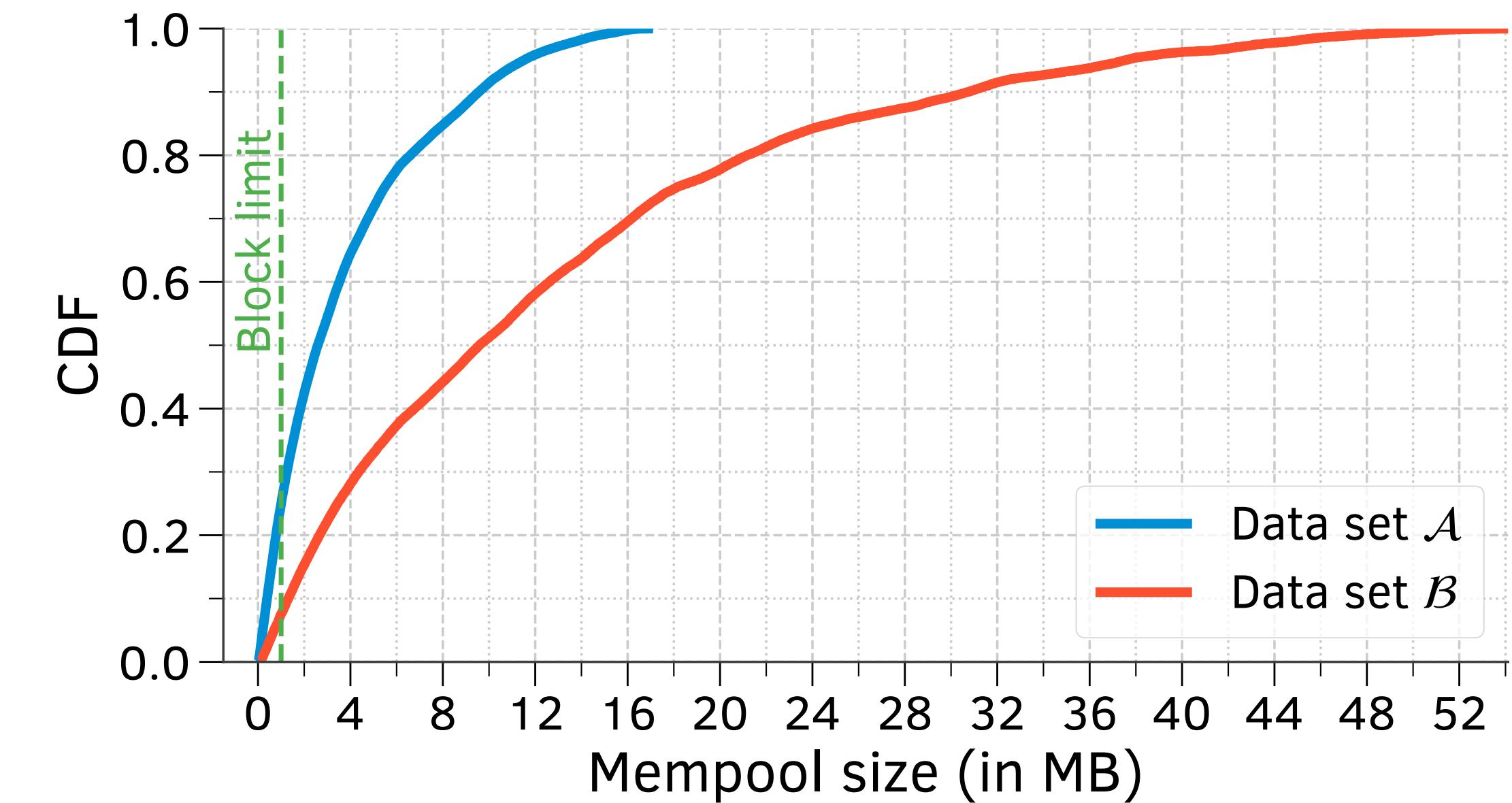
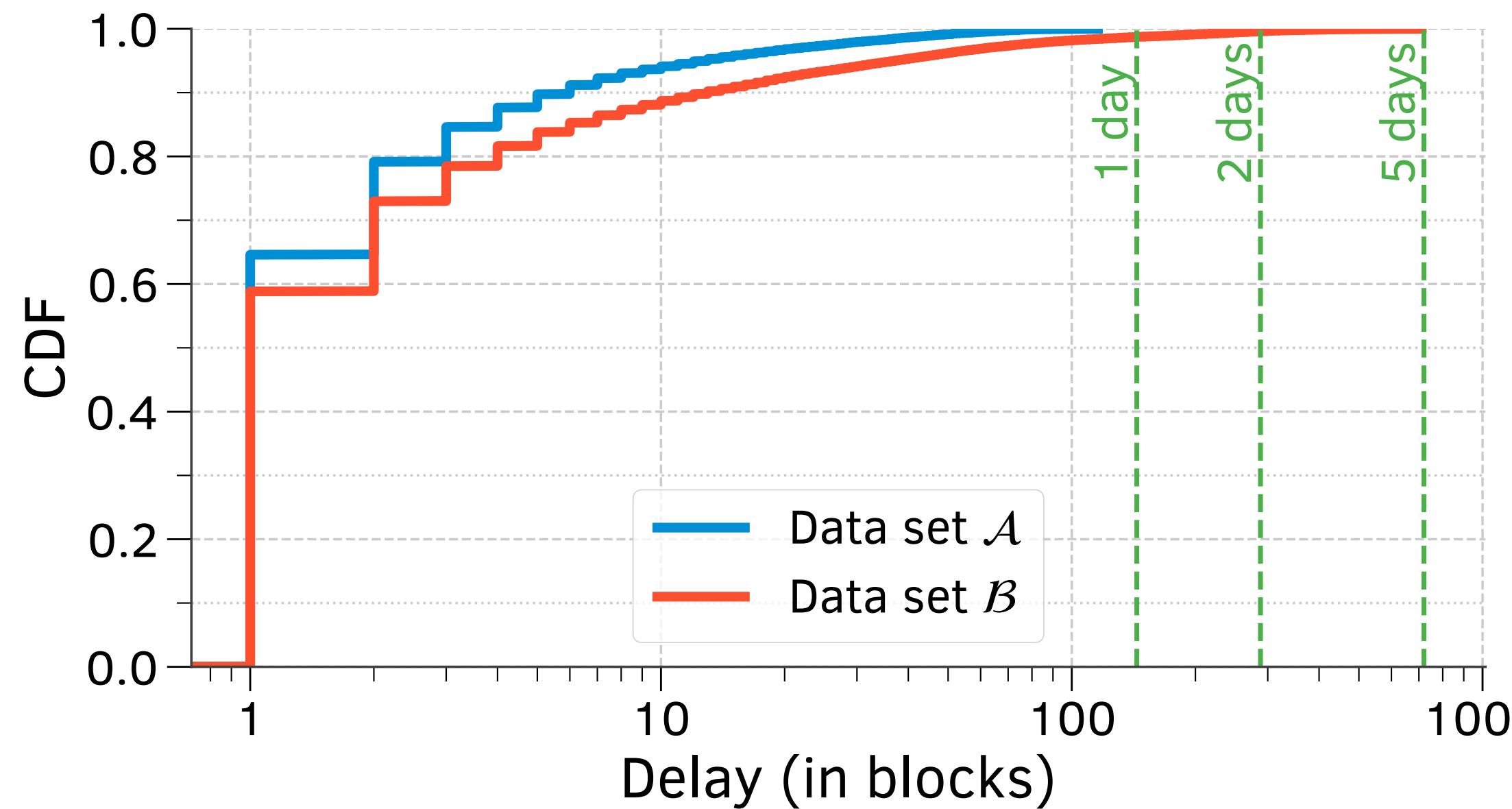
Data set *A*



Data set *B*

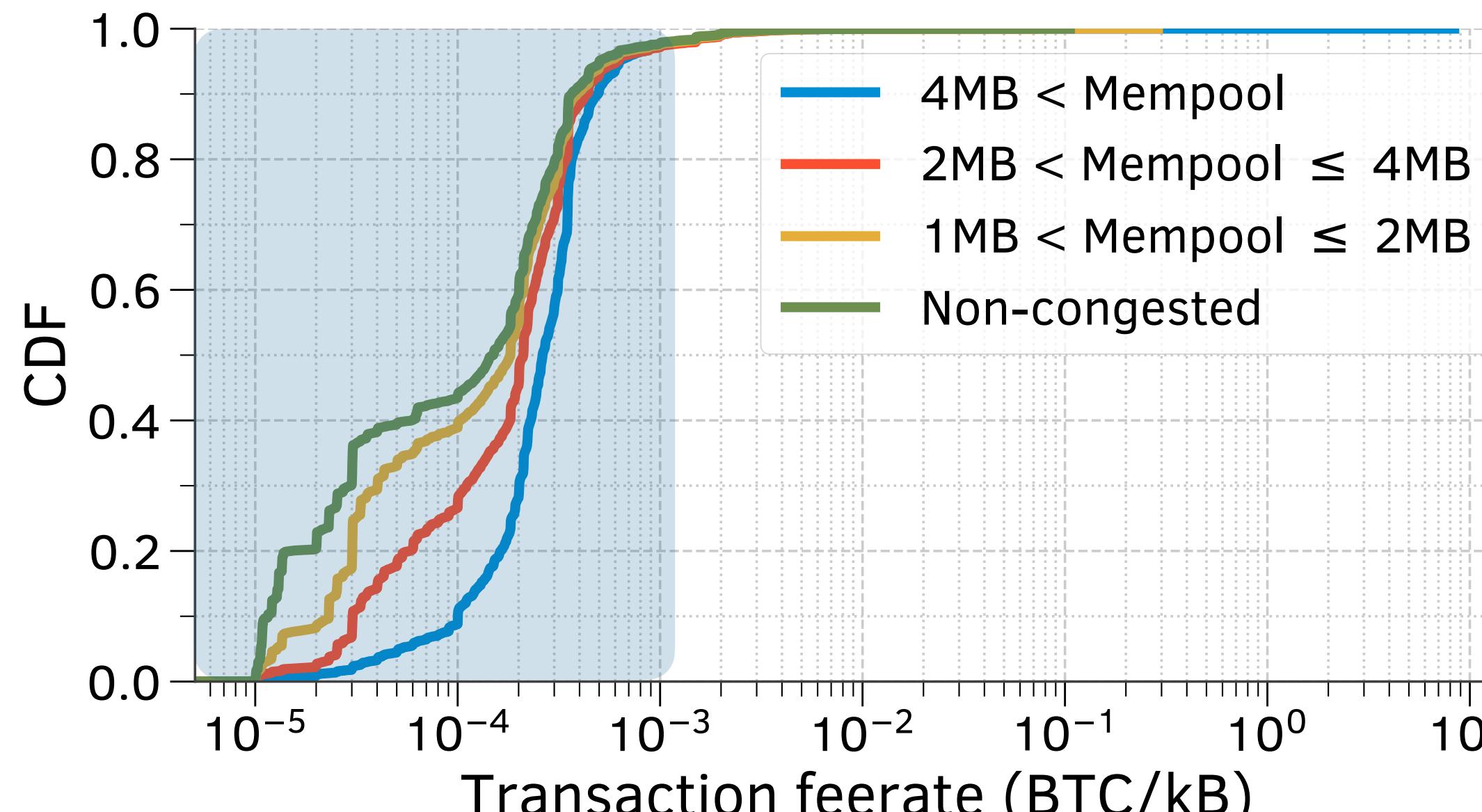
Is Mempool Congested?

- ▶ The fear of the ever-growing commit times
- ▶ Transaction **commit times vary!**
- ▶ Mempool is congested in at least **75%**, and **92%** for data sets *A* and *B*, respectively!

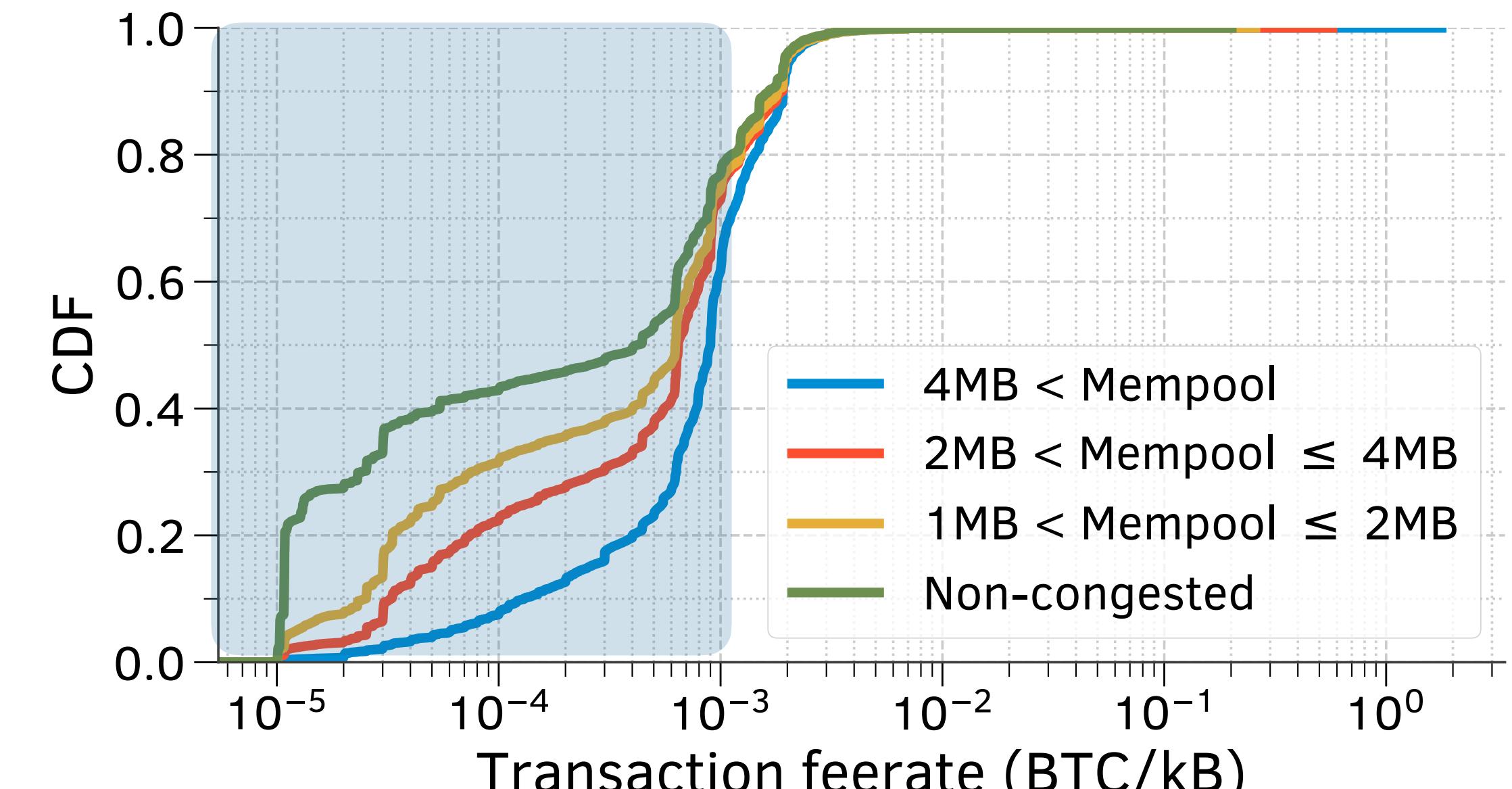


Do People Pay More When There Is Congestion?

- ▶ Fee rate increases during periods of congestion.
- ▶ Transactions fee rate increases proportionally to the level of congestion.



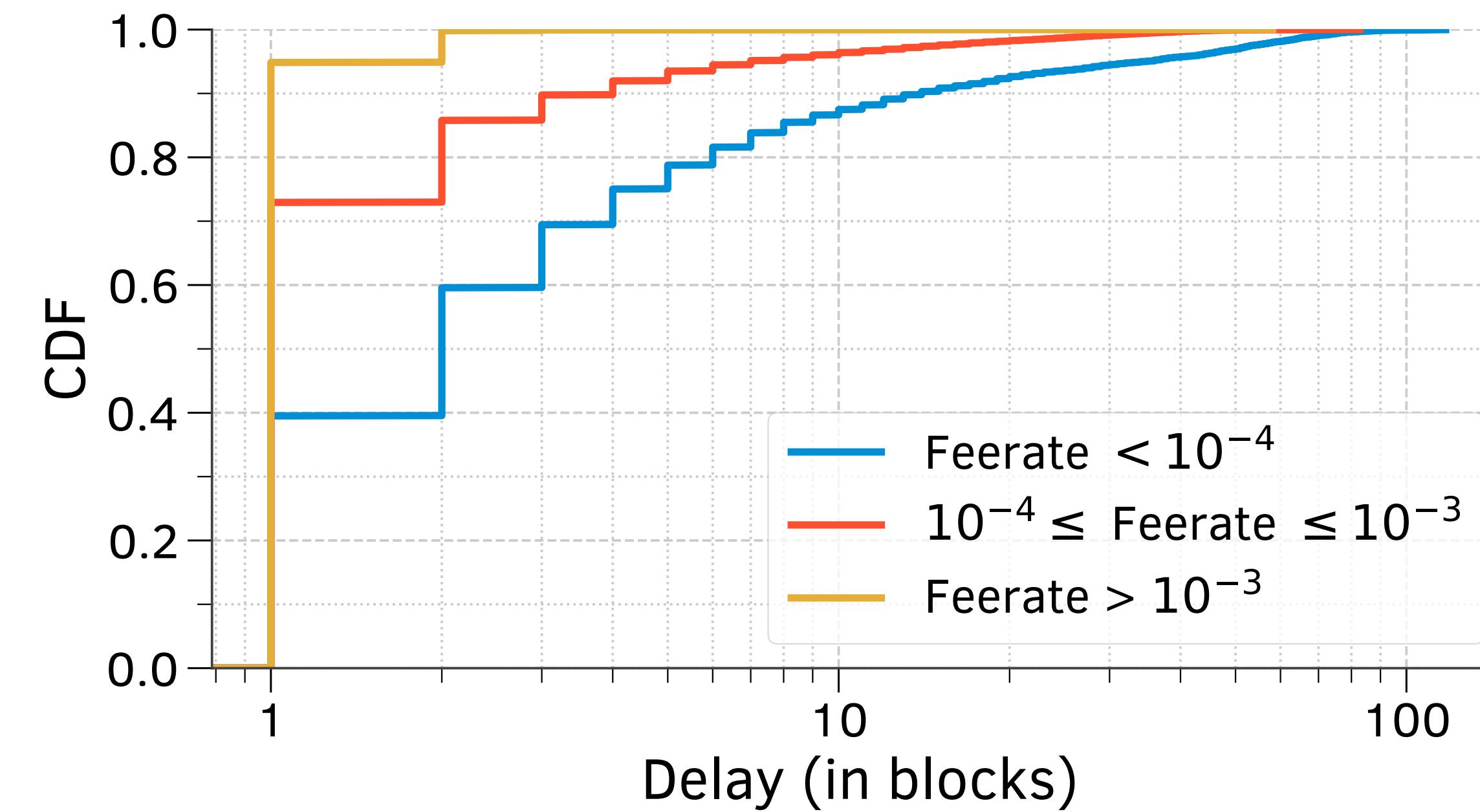
Dataset A



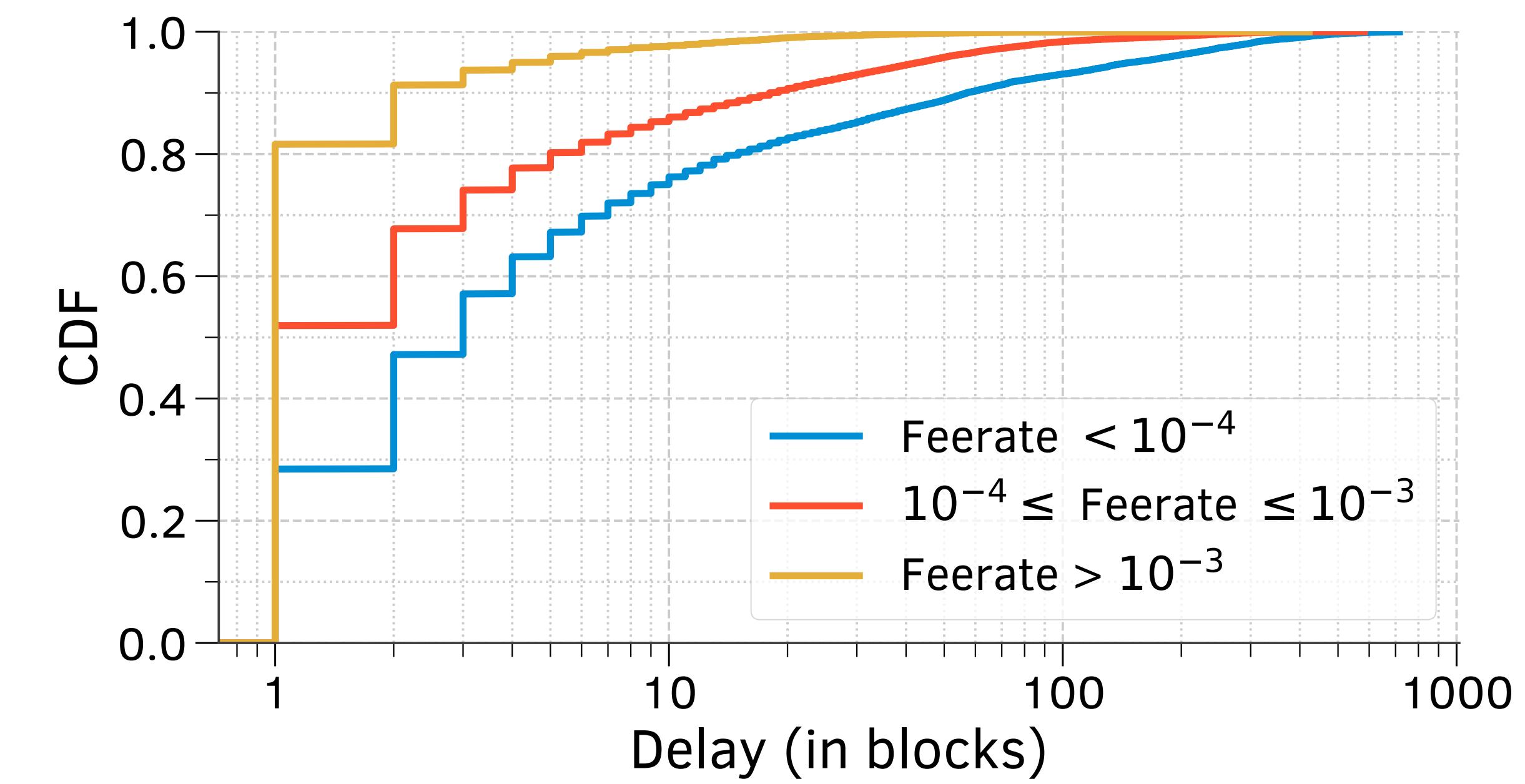
Dataset B

Do High Feerate Transactions Suffer Fewer Delays?

- ▶ High fee rate results in decreasing the commit delays!
- ▶ In both data sets



Dataset A



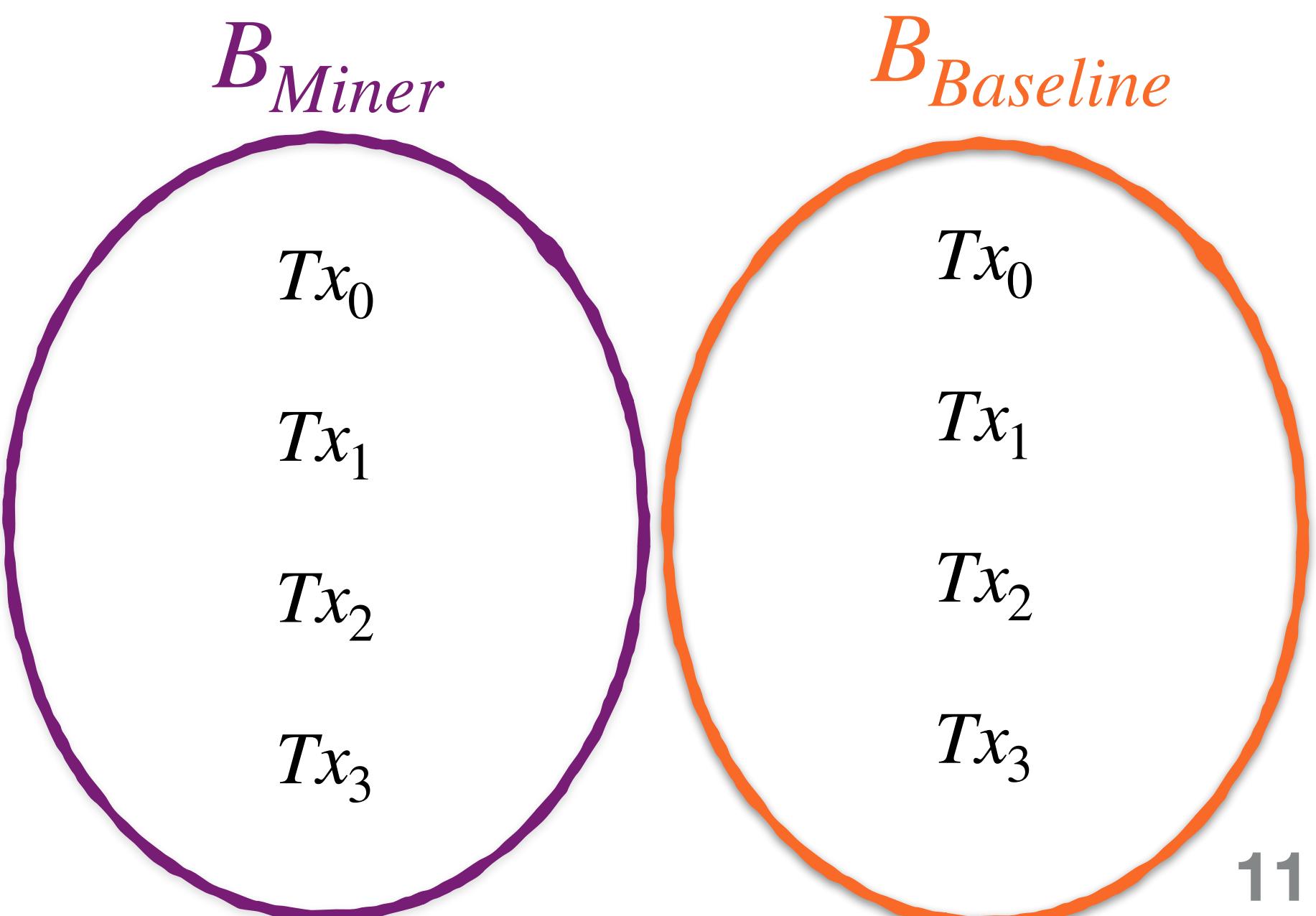
Dataset B

10

**Do Miners Follow the
Common Wisdom?**

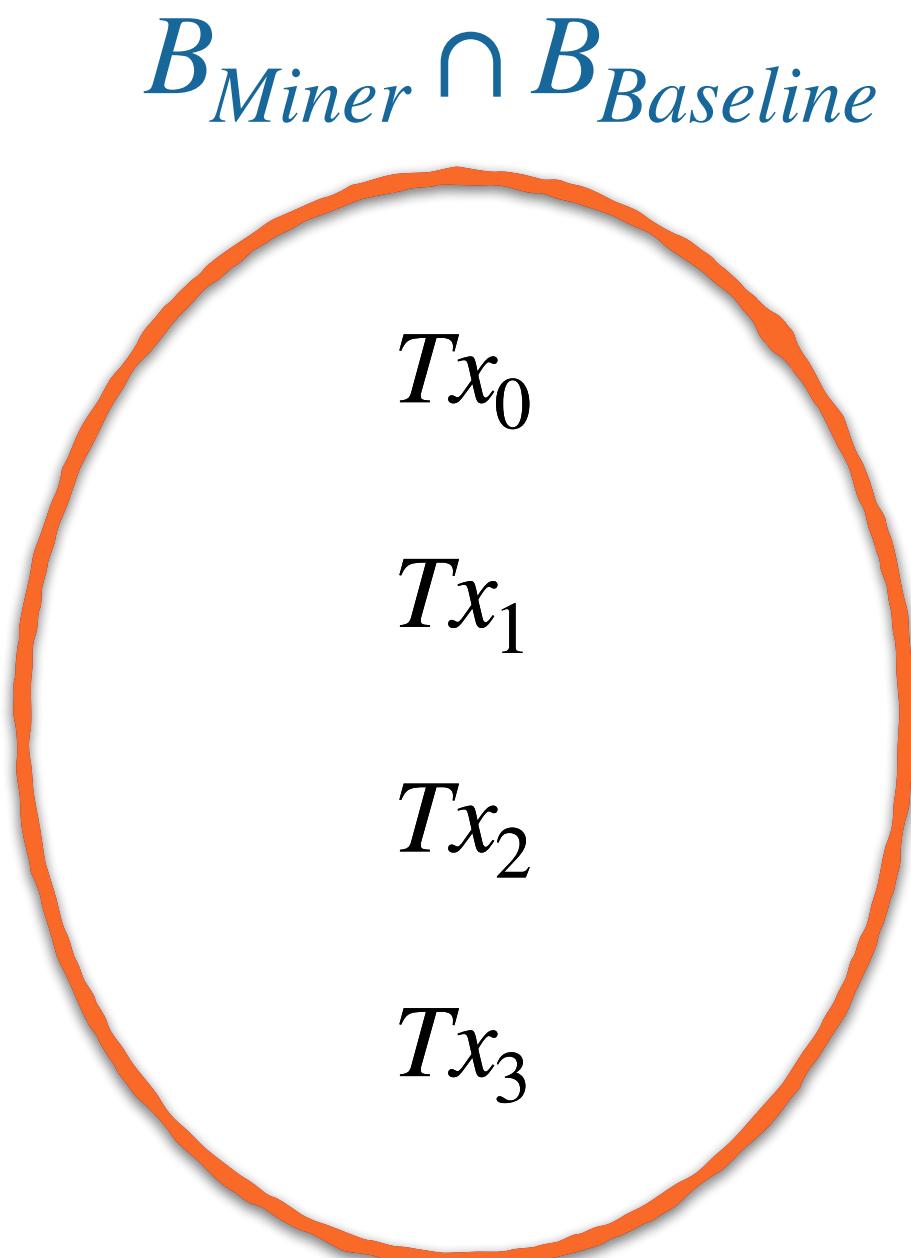
Establishing a Baseline

- ▶ Actual block: B_{Miner}
- ▶ Baseline (fee-per-byte ordering): $B_{Baseline}$



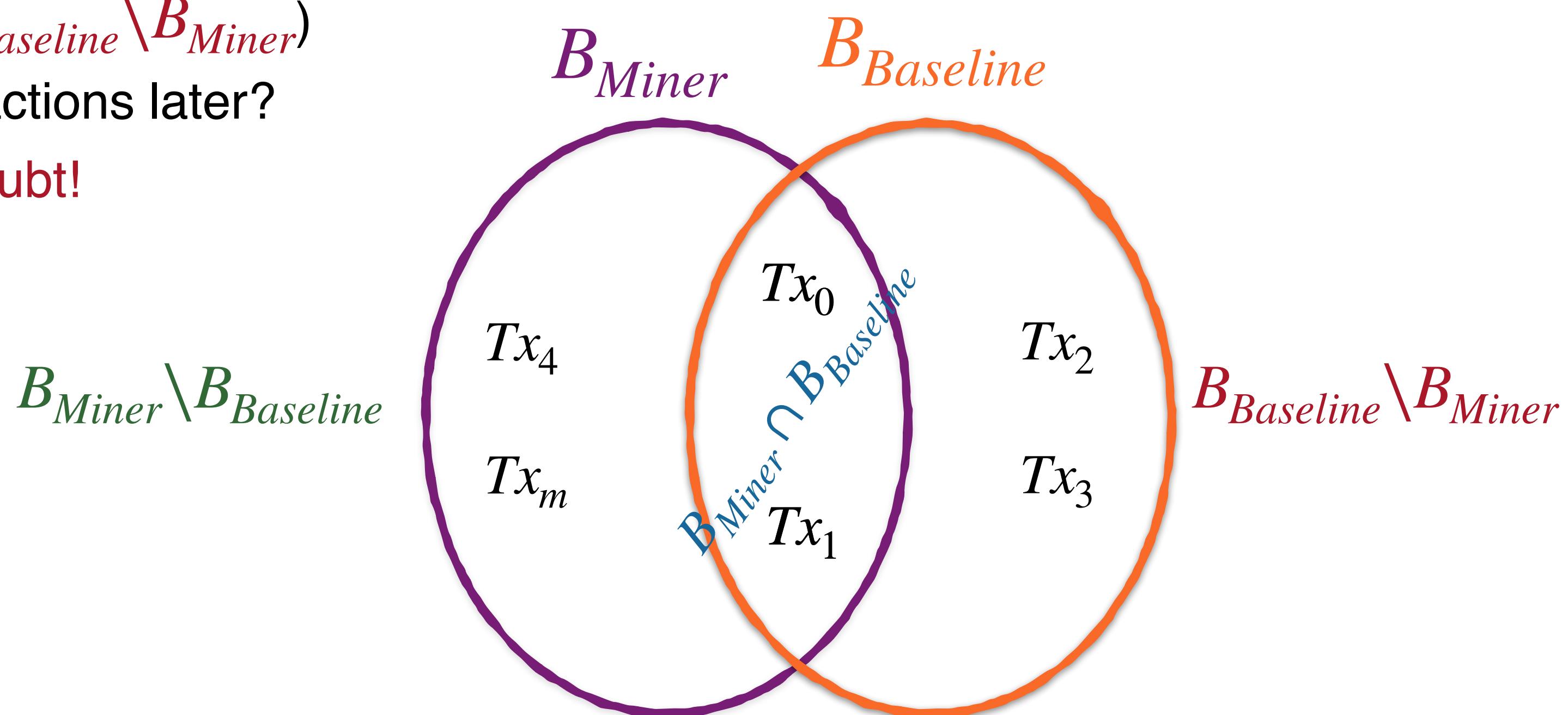
Establishing a Baseline

- ▶ Actual block: B_{Miner}
- ▶ Baseline (fee-per-byte ordering): $B_{Baseline}$
- ▶ Miners follow the fee-per-byte ordering ($B_{Miner} \cap B_{Baseline} = 100\%$)
 - ▶ Do they follow?

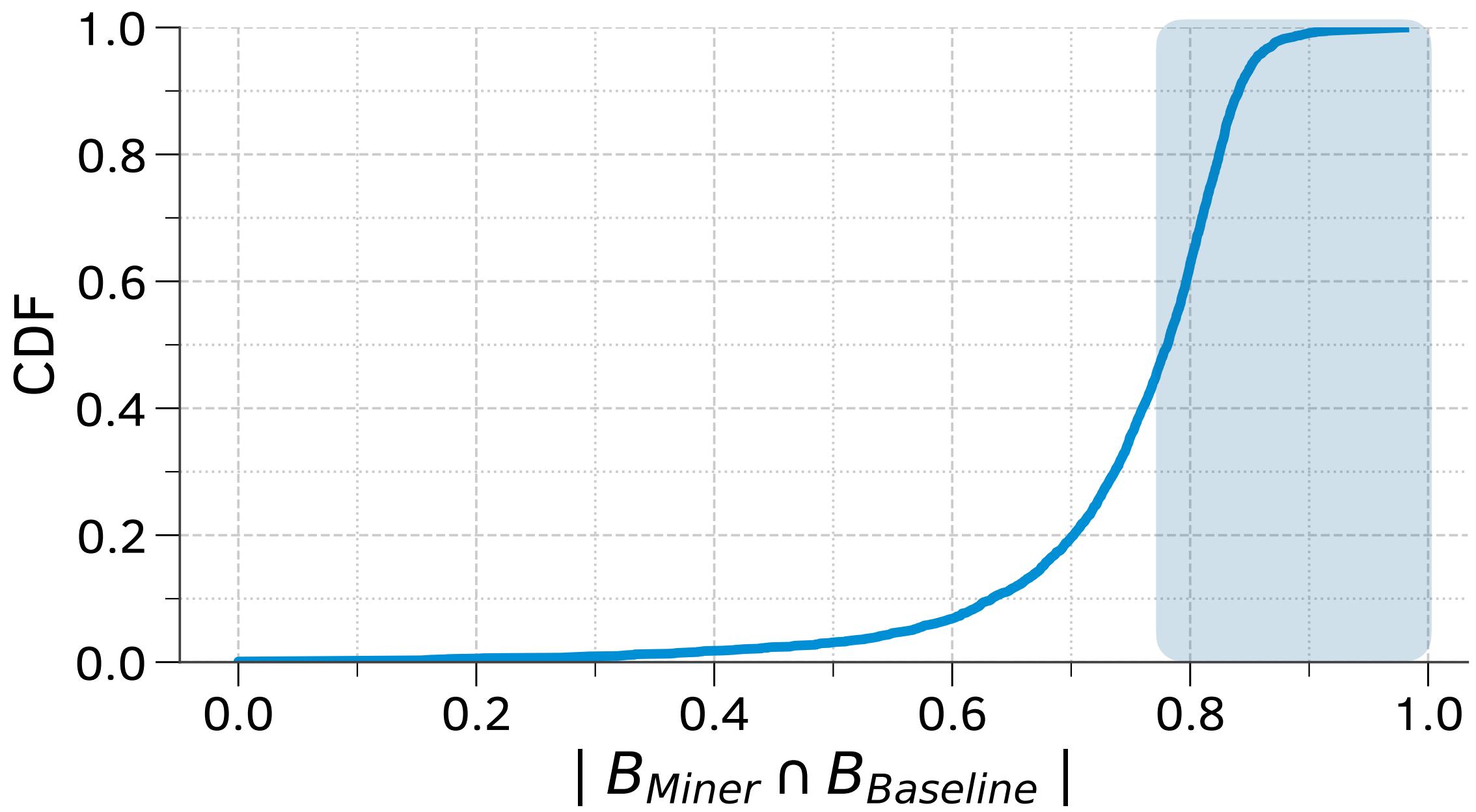


When "our View" Differs

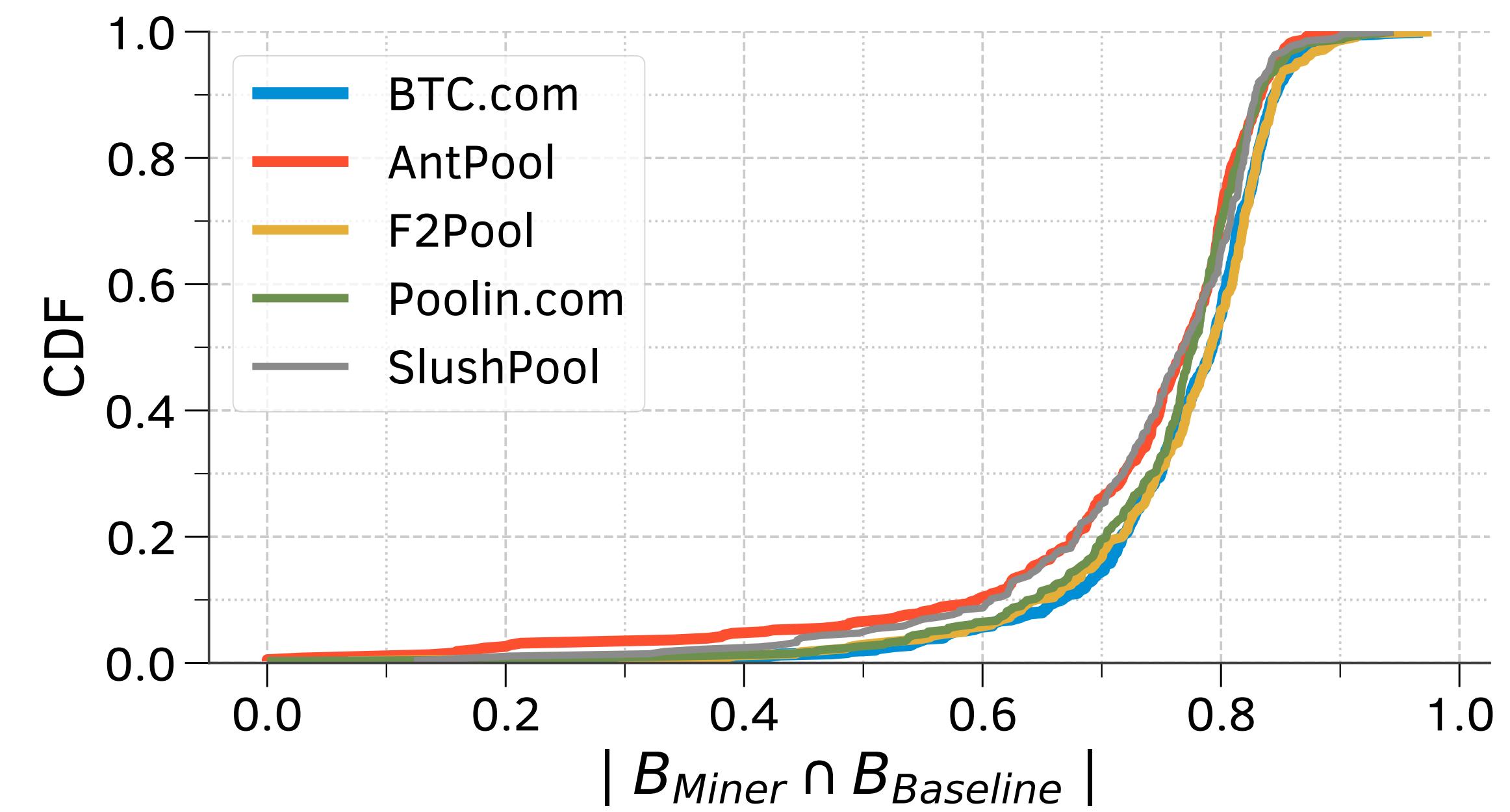
- ▶ Actual block: B_{Miner}
- ▶ Baseline (fee-per-byte ordering): $B_{Baseline}$
- ▶ Miners selected the same transactions as in our baseline ($B_{Miner} \cap B_{Baseline}$)
- ▶ Where "our view" is at fault ($B_{Miner} \setminus B_{Baseline}$)
 - ▶ Did our node receive the transactions later?
- ▶ Where "their view" is at fault ($B_{Baseline} \setminus B_{Miner}$)
 - ▶ Did miners receive the transactions later?
- ▶ We give miners the benefit of doubt!



Do Miners Deviate?

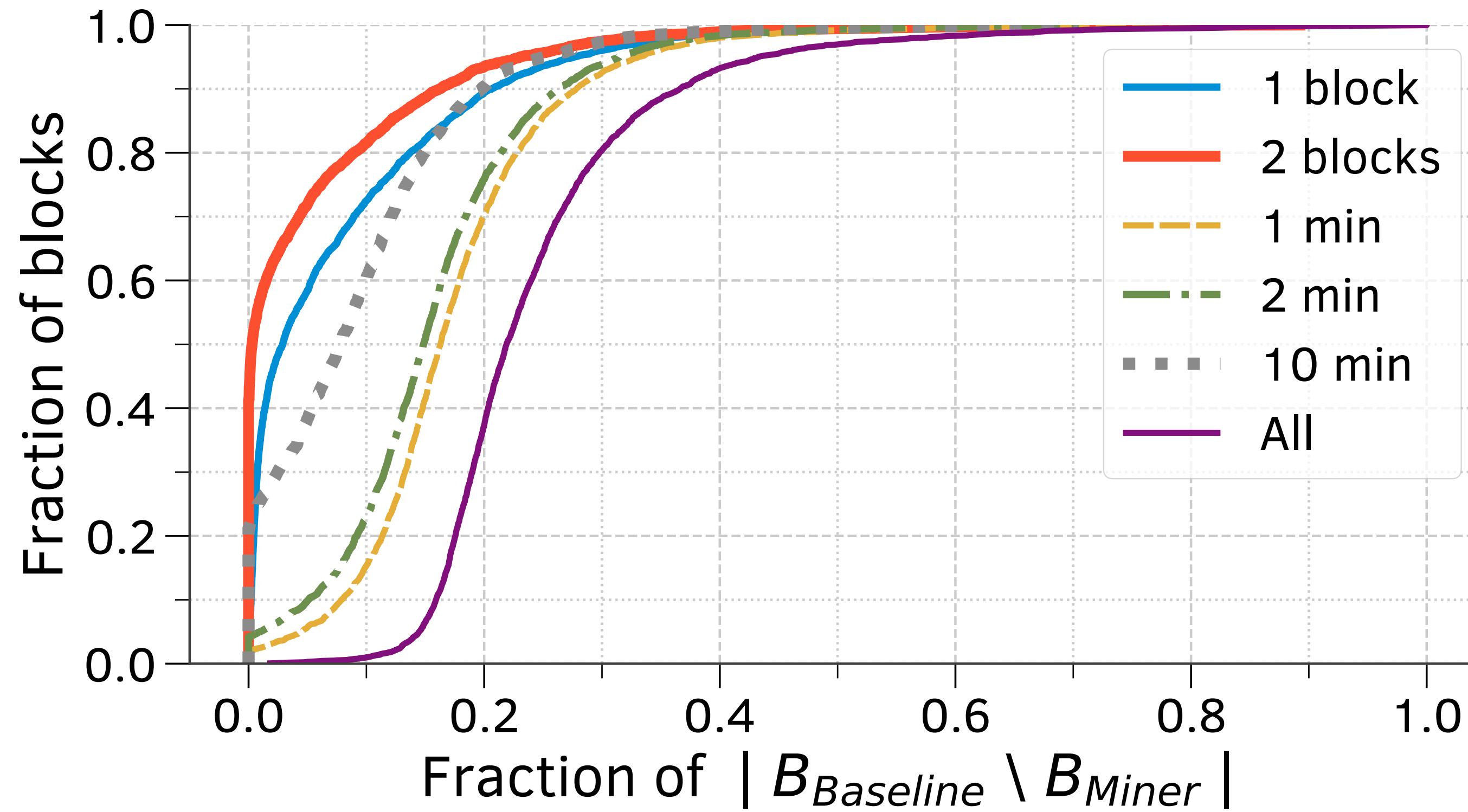


In the median, **78%** of the transactions in baselines appear in the corresponding actual blocks



Observations are consistent across the top-5 mining-pool operators.

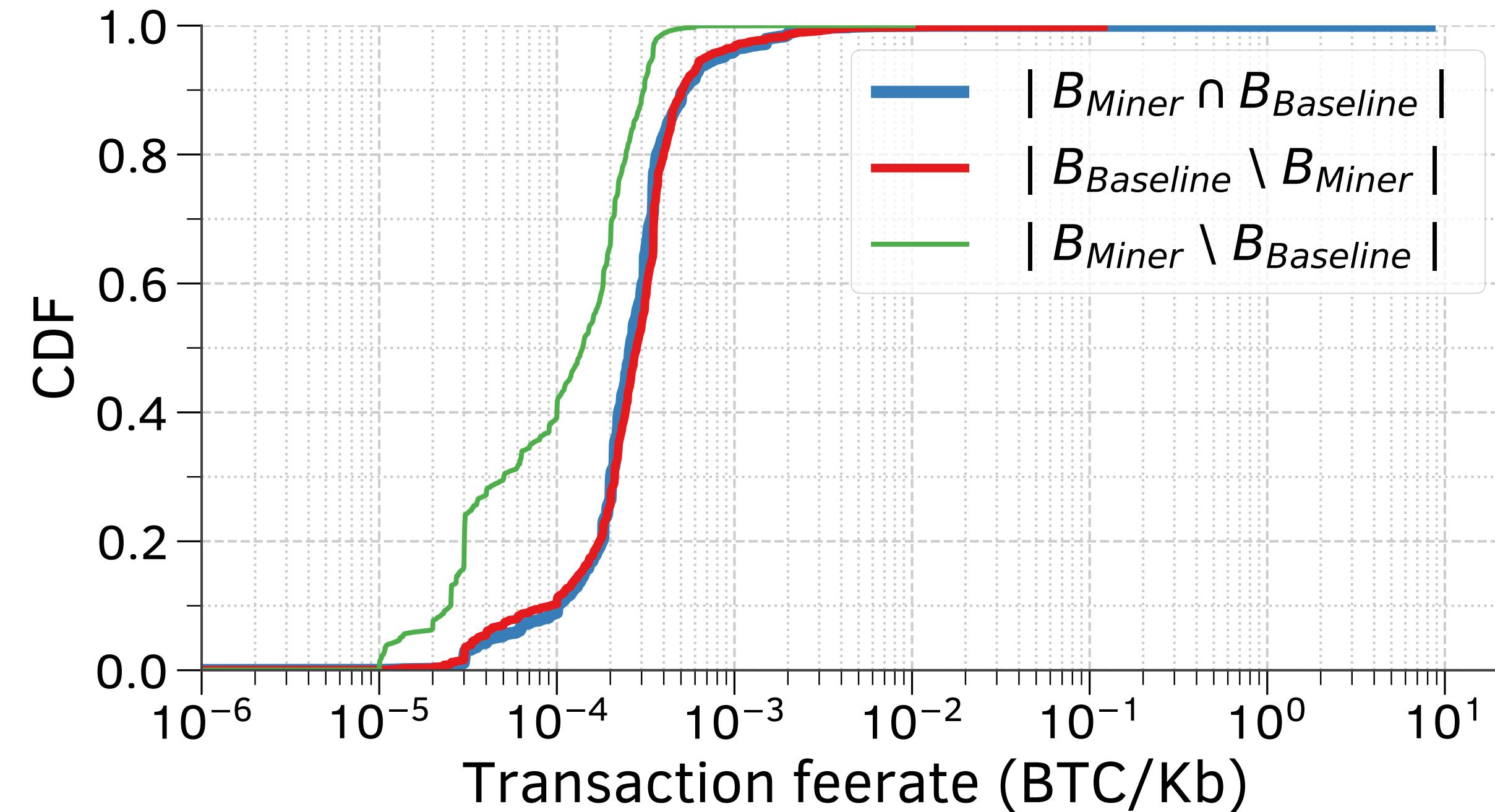
Did Miners Receive the Transactions Later?



Even with a **2-block cutoff** period, miners ignored some transactions

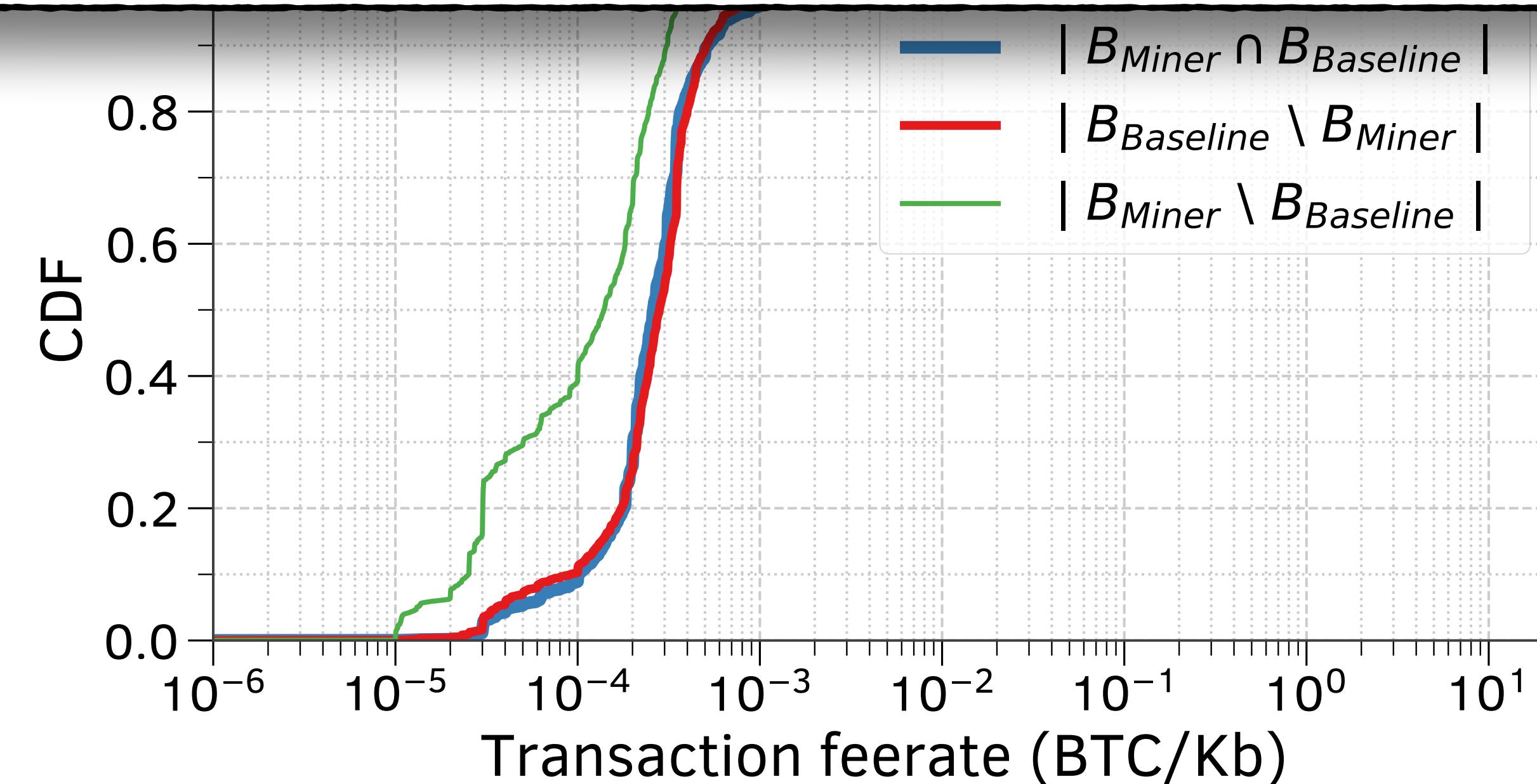
Do Miners Use a Different Protocol?

- ▶ Transactions in $B_{Miner} \setminus B_{Baseline}$ have lower *fee-per-byte* compared to those in $B_{Miner} \cap B_{Baseline}$
- ▶ Miners ignore transactions and prioritize others
 - ▶ Perhaps miners are using a different protocol, in addition to the fee-per-byte



Do Miners Use a Different Protocol?

- ▶ Transactions in $B_{Miner} \setminus B_{Baseline}$ have lower *fee-per-byte* compared to those in $B_{Miner} \cap B_{Baseline}$
- ▶ Miners ignore transactions and prioritize others
- ▶ Perhaps **Miners somehow deviate!**



Conclusion

Conclusions and Future Work

- ▶ Fee-per-byte only does not explain the dequeuing ordering
 - ▶ Users cannot only rely on this metric to offer a proper fee
- ▶ Mining pool operators behaviors do not make their rank ordering transparent
 - ▶ Can we ensure everyone follows the same prioritization?
- ▶ Why do miners deviate?
 - ▶ Could it be due to the stratum protocol?
 - ▶ Could it be due to transactions accelerator services?
- ▶ Apply our methodology on other blockchains (e.g., Ethereum)
- ▶ Build a predictor to help users with the proper transaction fee

thank you!

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