

An Empirical Study of Market Inefficiencies in Uniswap and SushiSwap

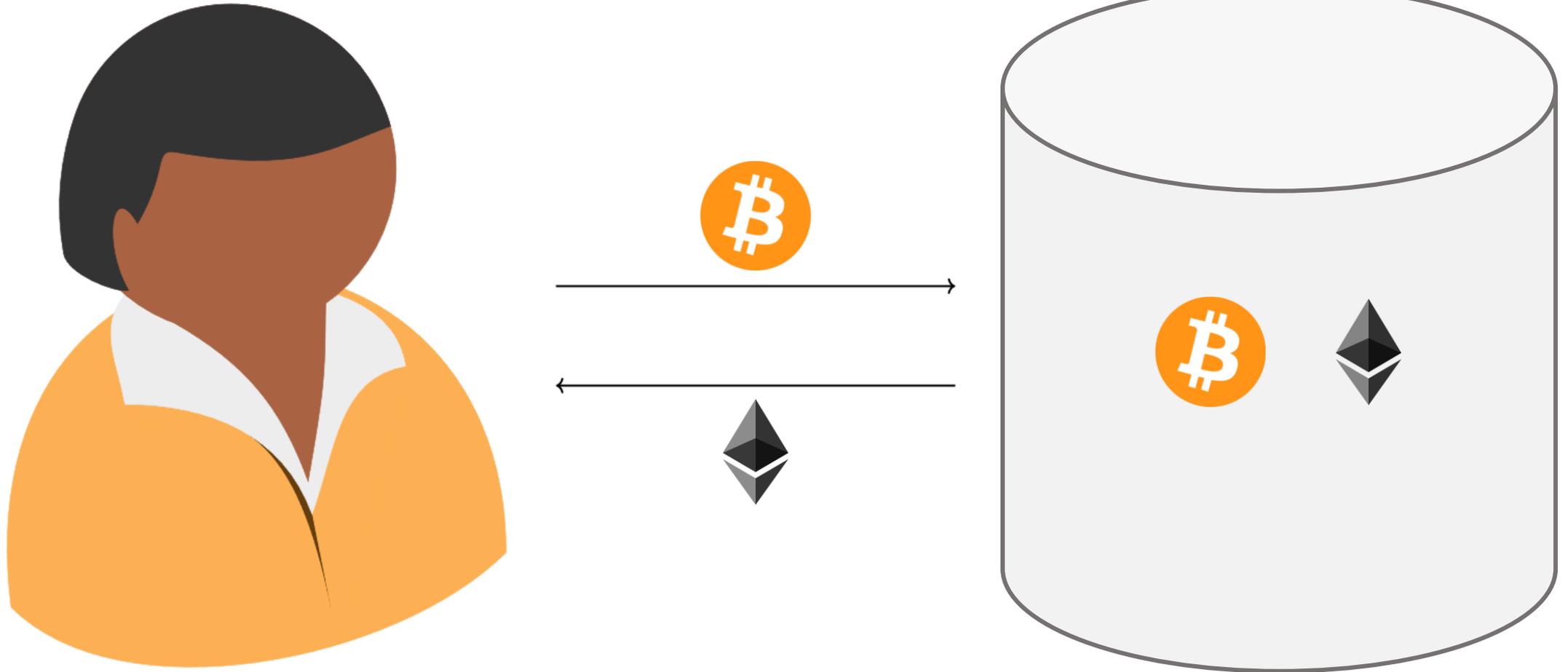


Jan Arvid Berg, Robin Fritsch, **Lioba Heimbach** and Roger Wattenhofer
ETH Zurich – Distributed Computing – www.disco.ethz.ch

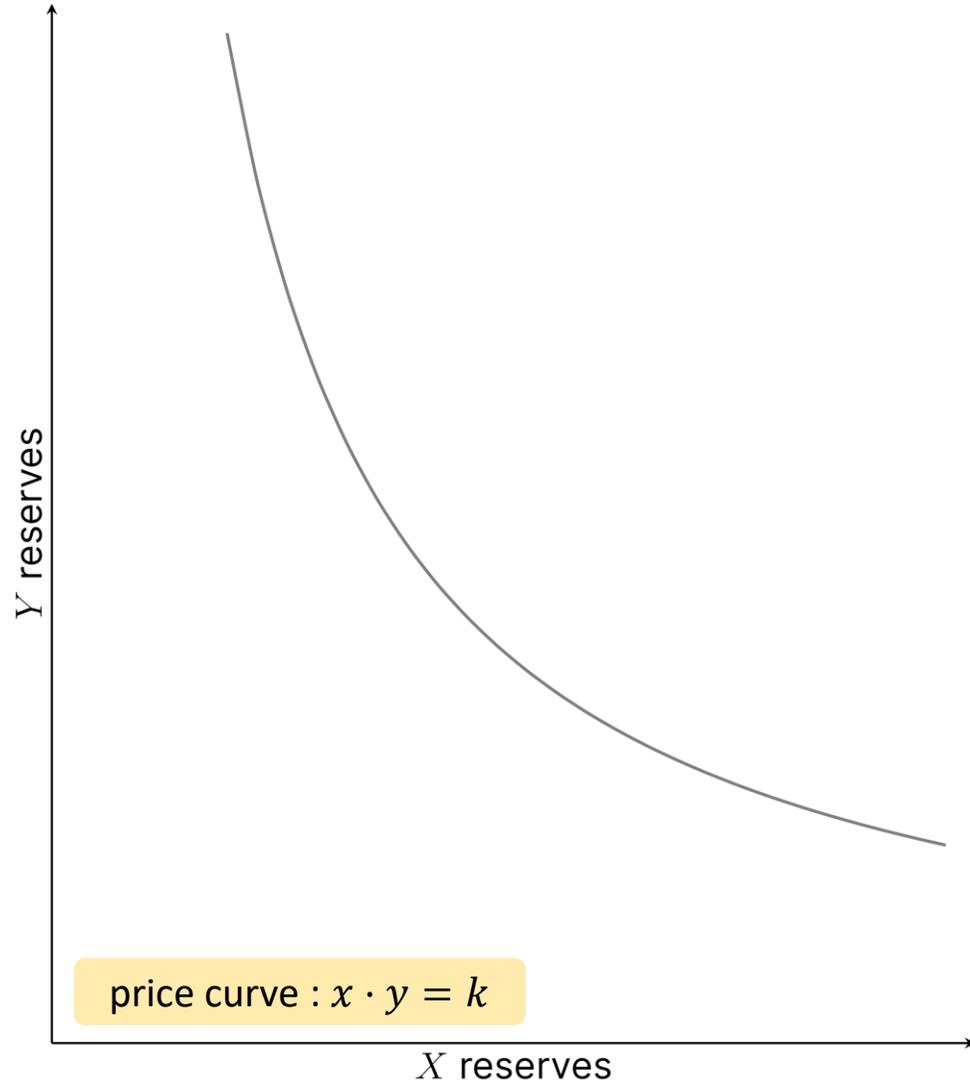
Decentralized exchanges (DEXes)



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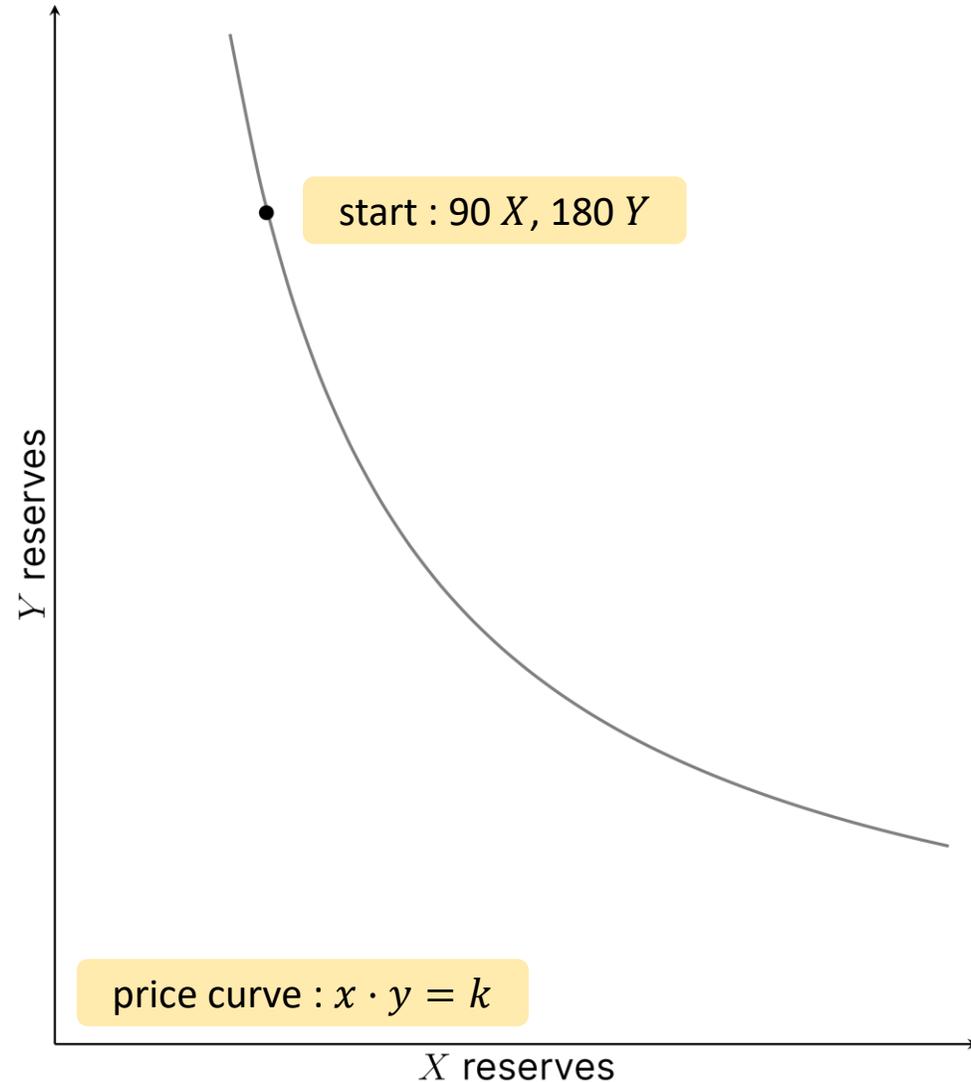


Constant product market makers (CPMMs)



trading along price curve

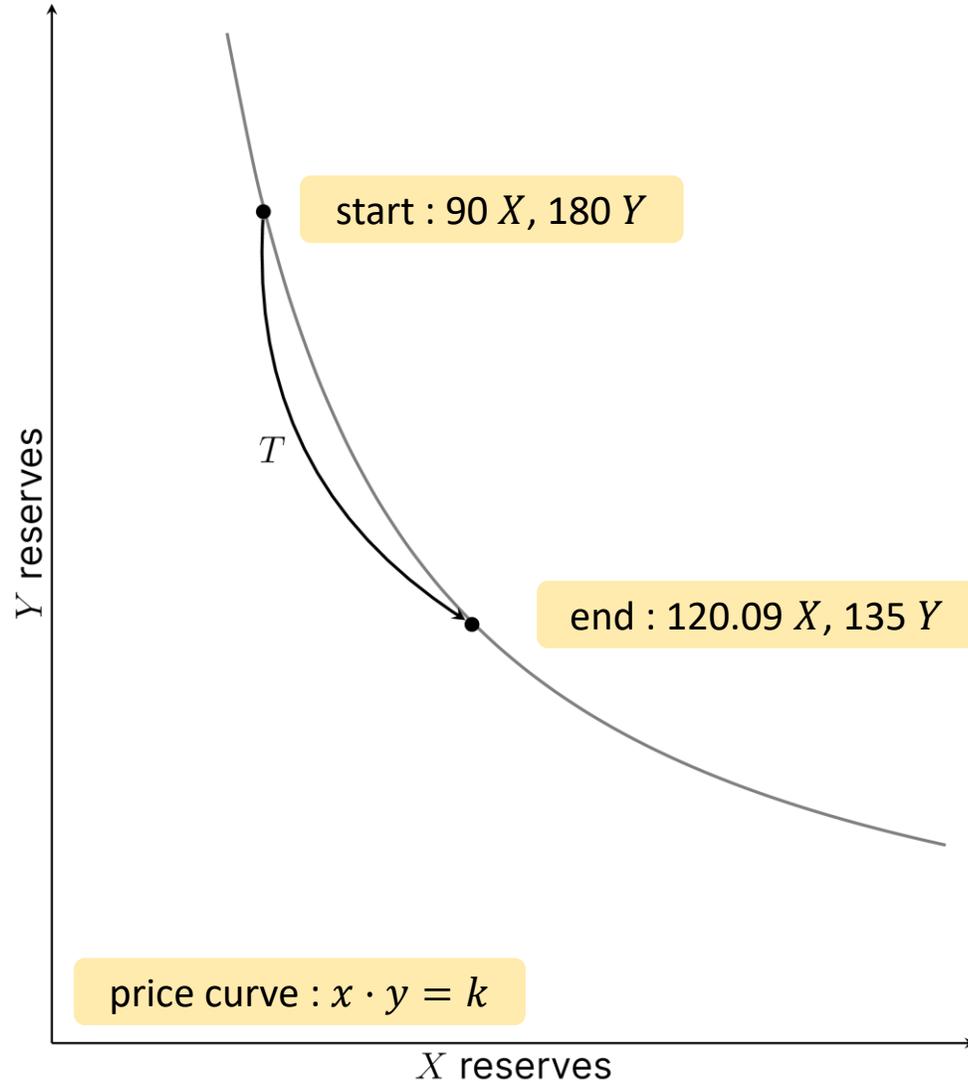
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T : trade $X \rightarrow Y$

Constant product market makers (CPMMs)



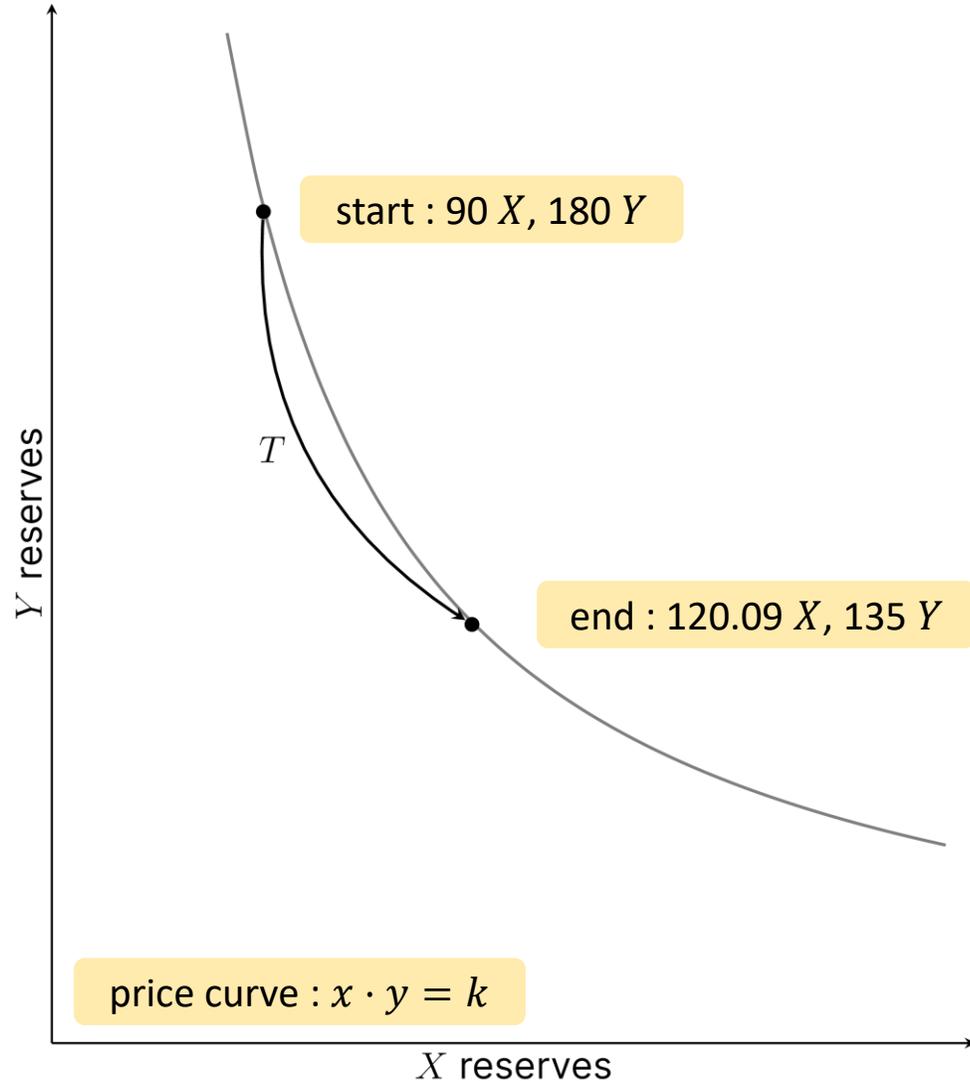
trading along price curve

T: trade $X \rightarrow Y$

input: 30 X + 0.3% fee

output: 45 Y

Constant product market makers (CPMMs)



trading along price curve

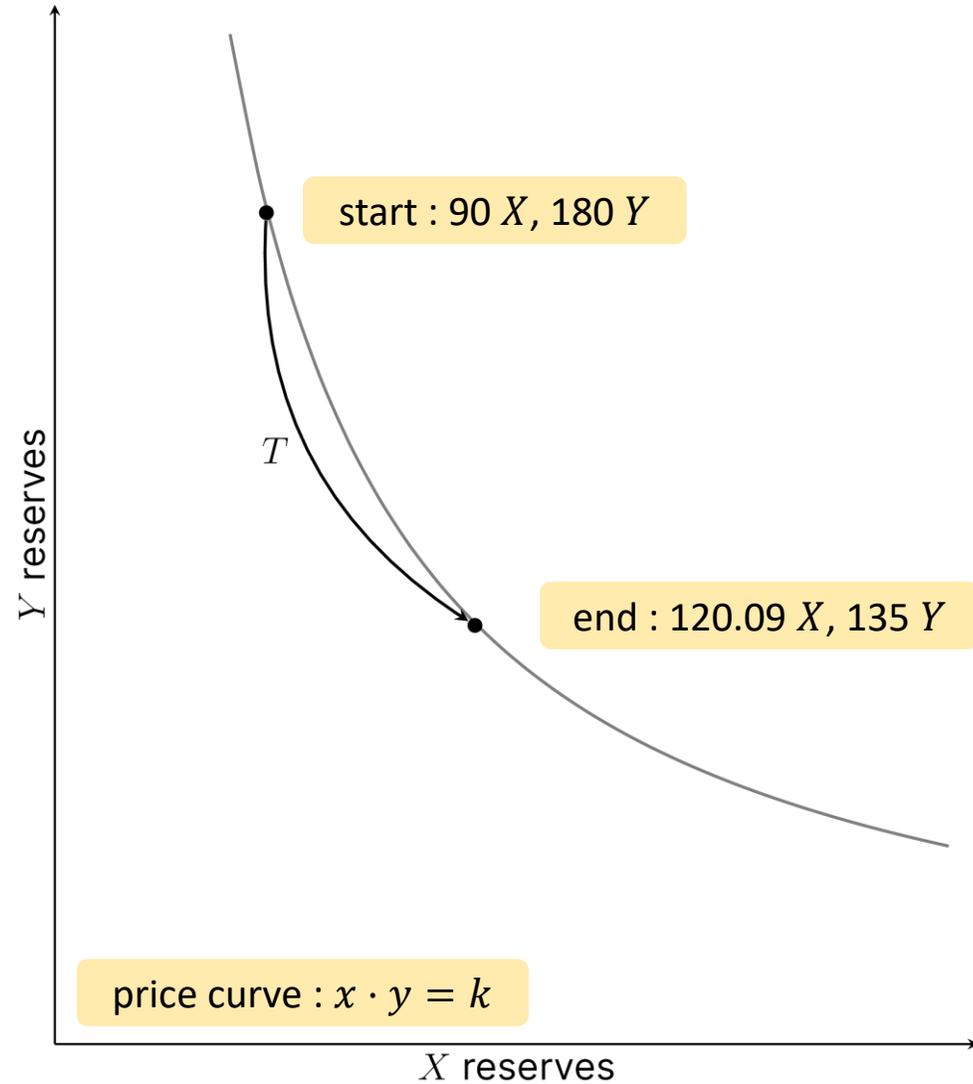
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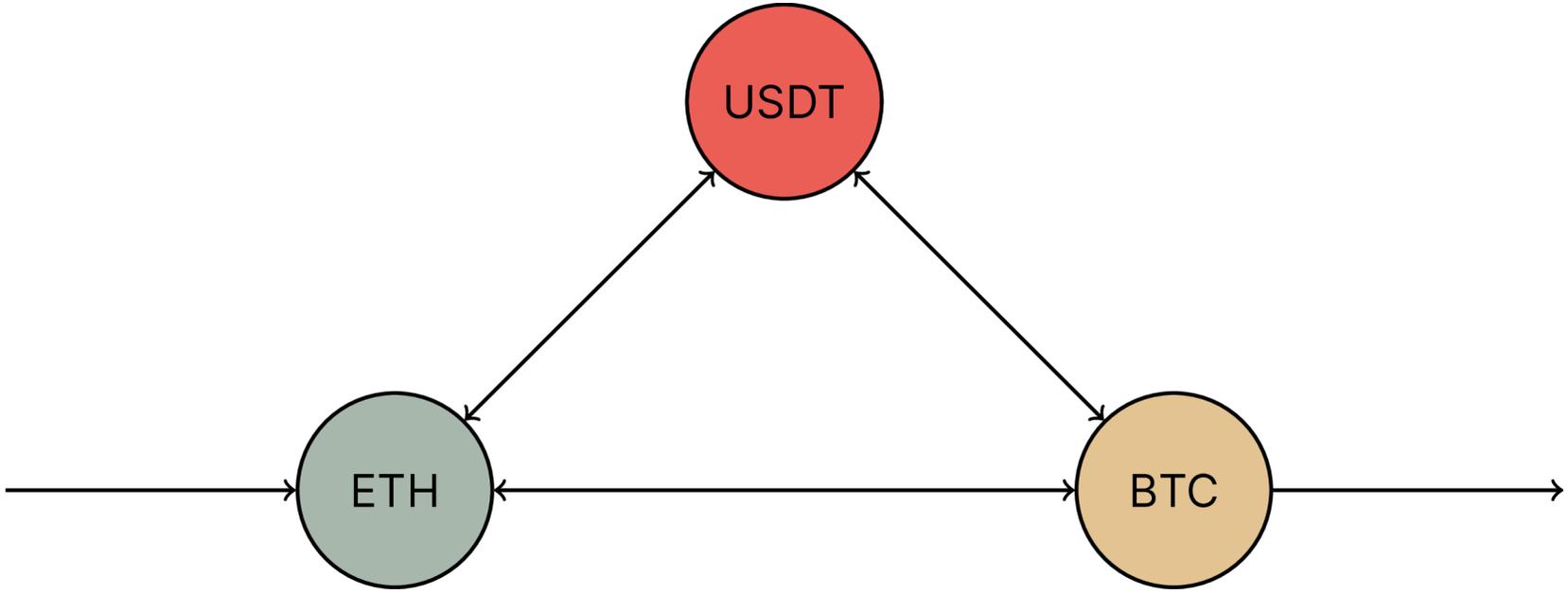
fees received by liquidity providers
for every trade in liquidity pool

Expected slippage

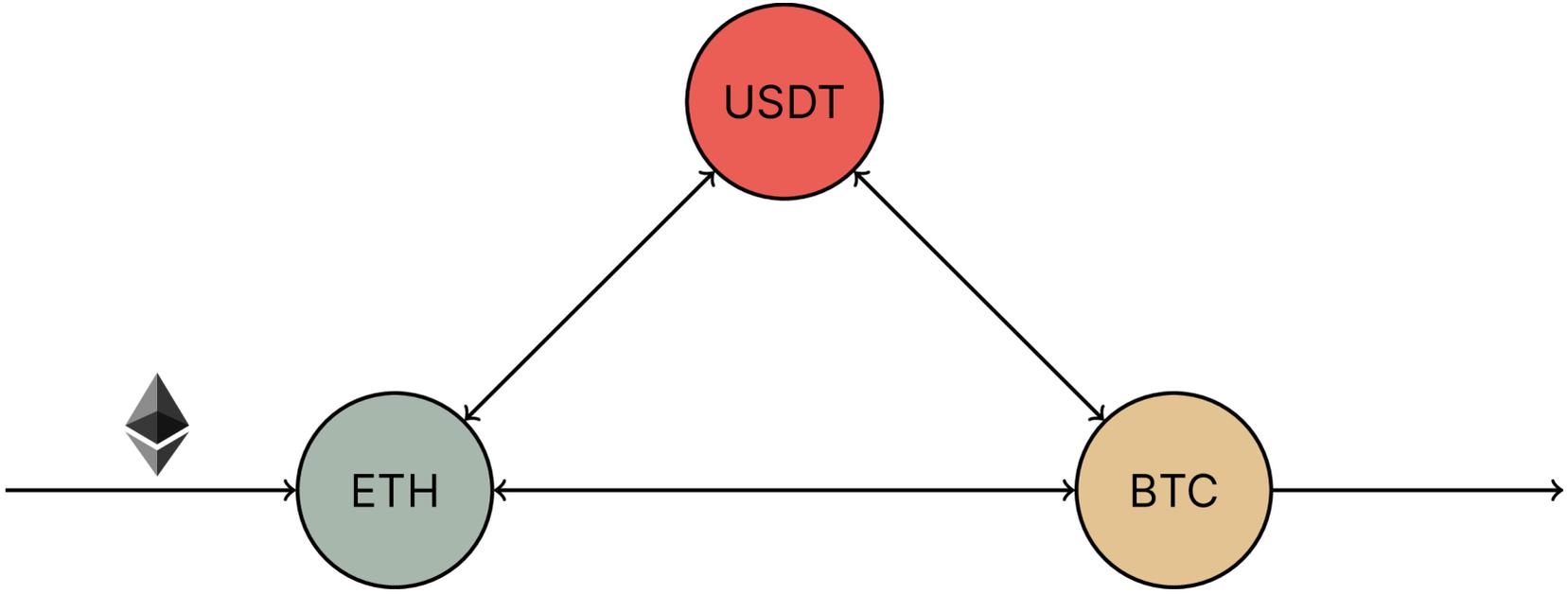


expected slippage
=
expected price decrease

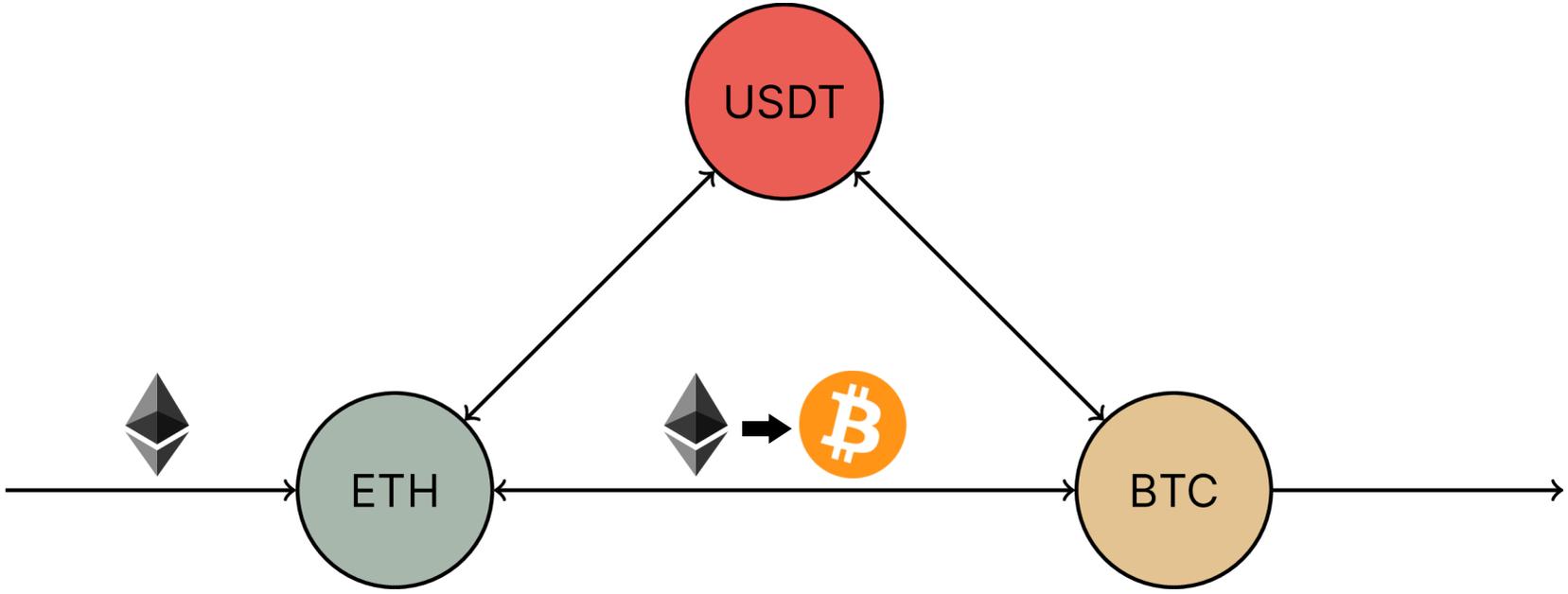
Transaction routing



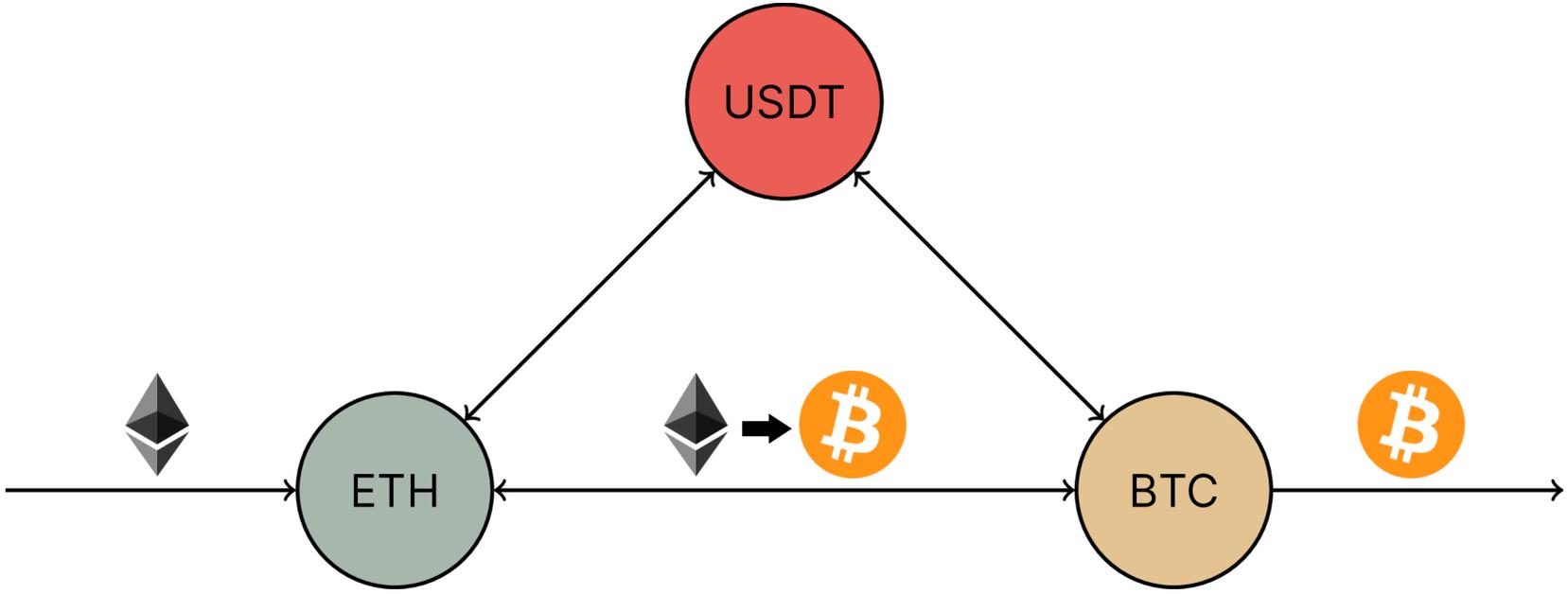
Transaction routing



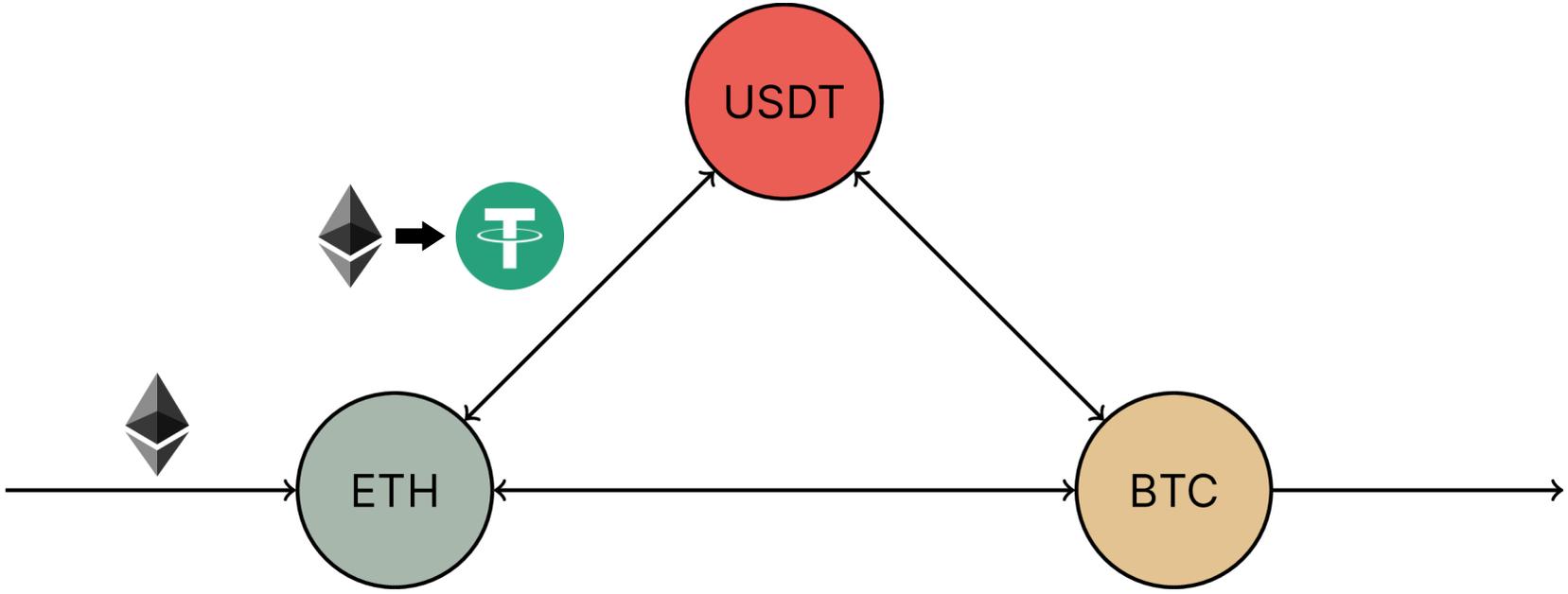
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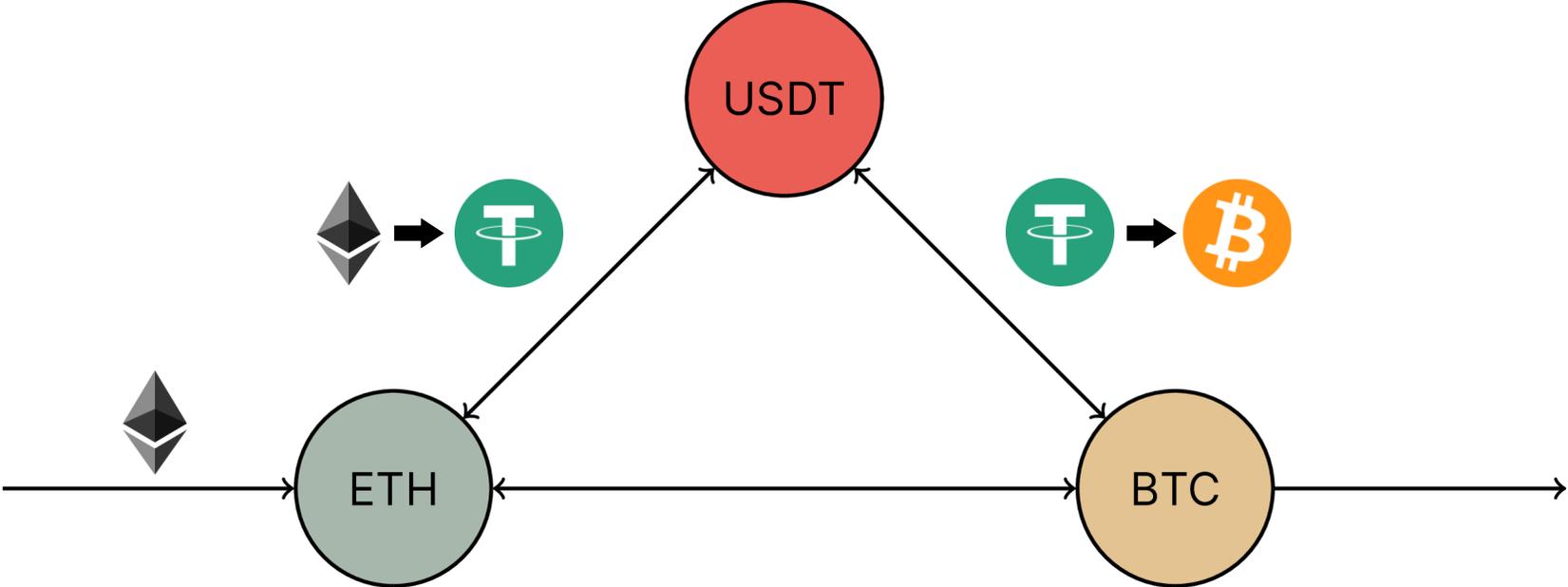
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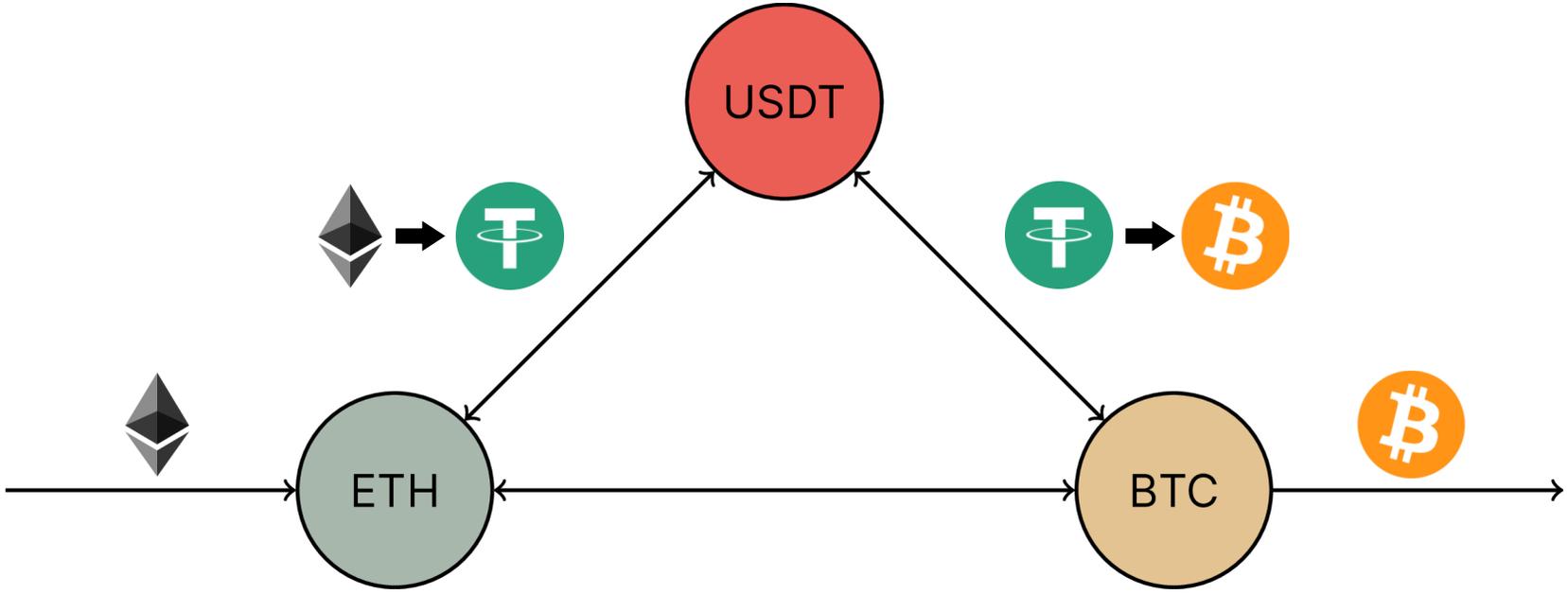
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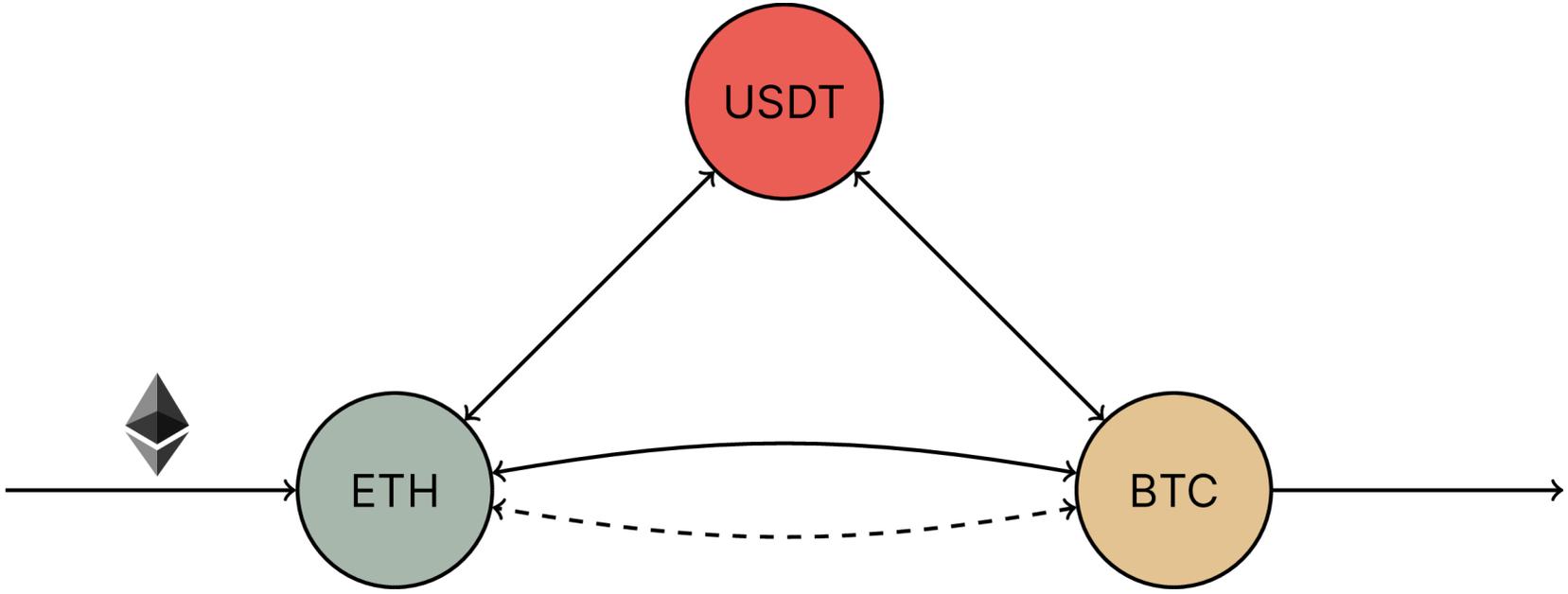
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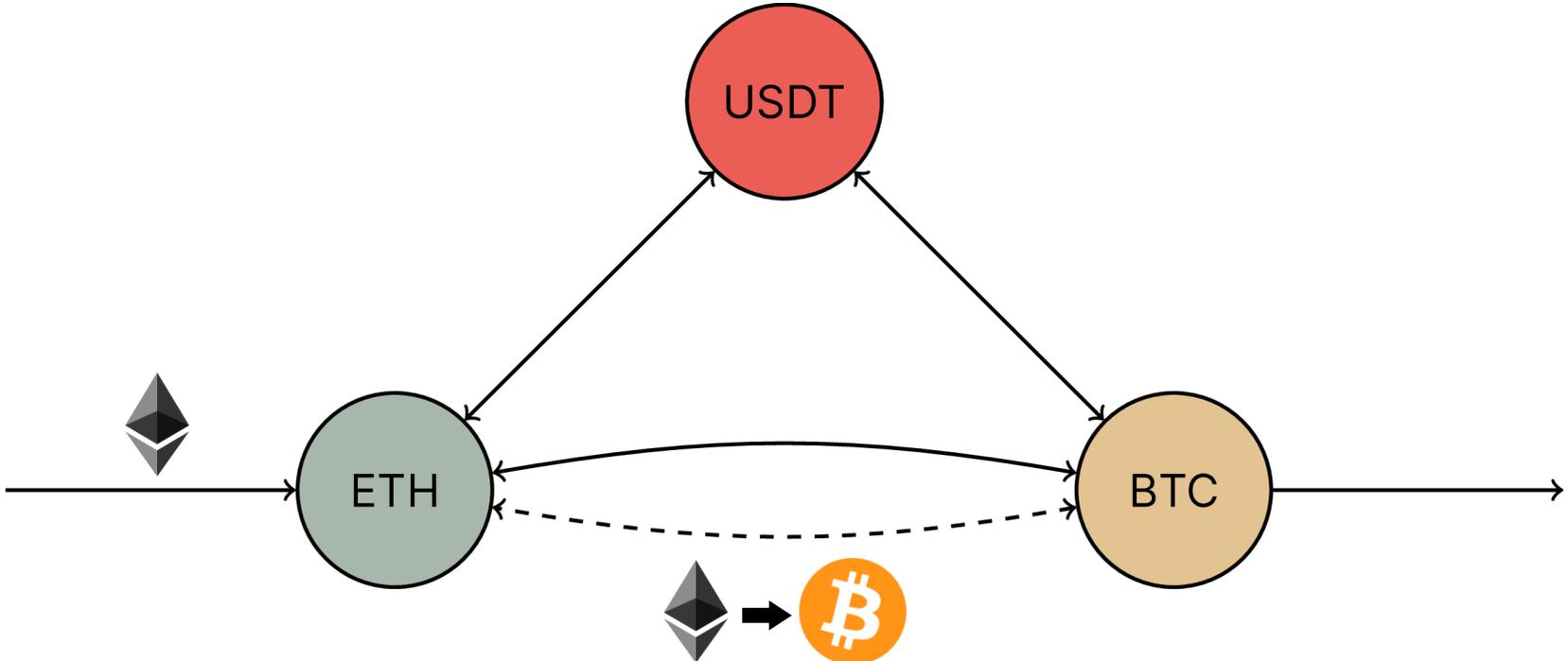
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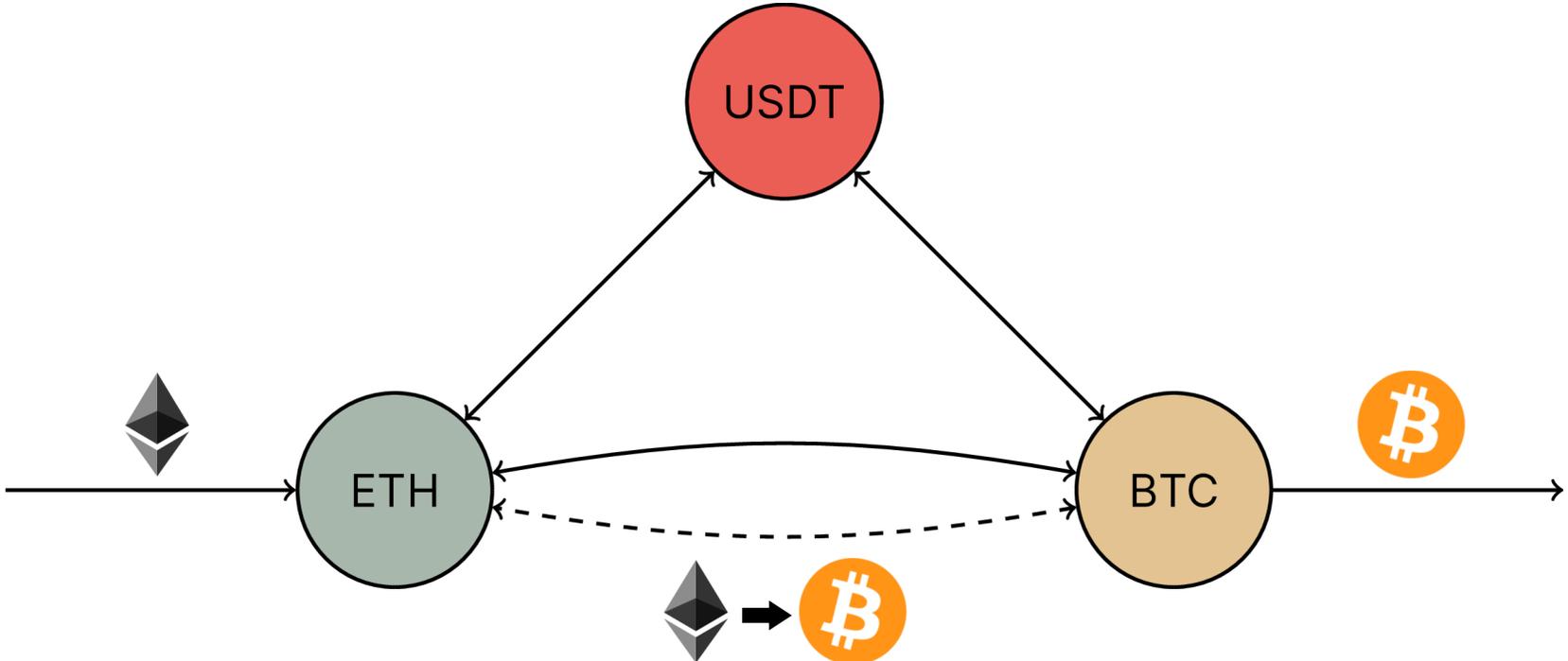
Transaction routing



Transaction routing



Transaction routing



Market efficiency

market efficiency measures how well the prices reflect all relevant information

Market efficiency

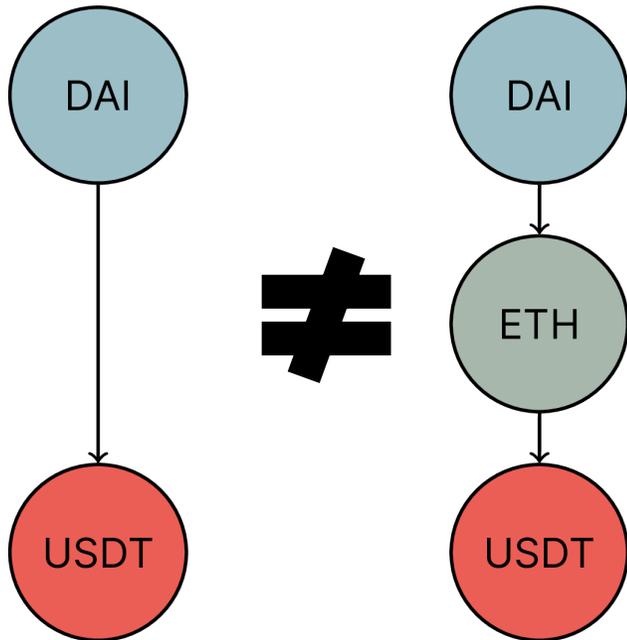
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suboptimal trade execution

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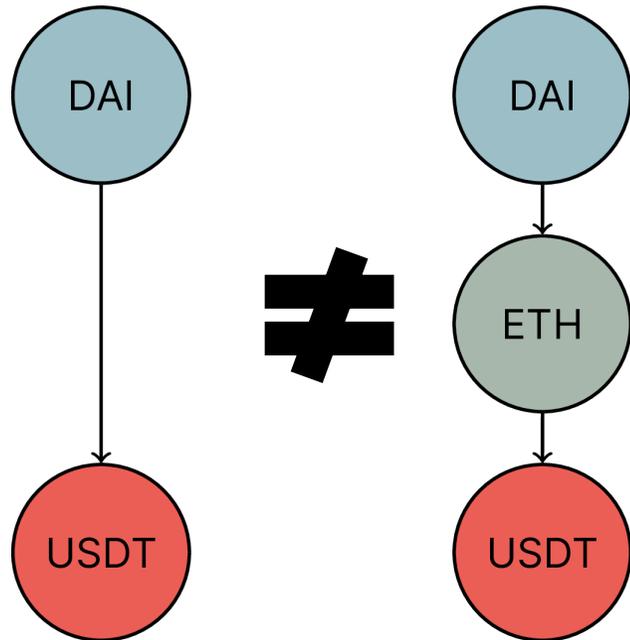


Market efficiency

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suboptimal trade execution

cyclic arbitrage opportunities

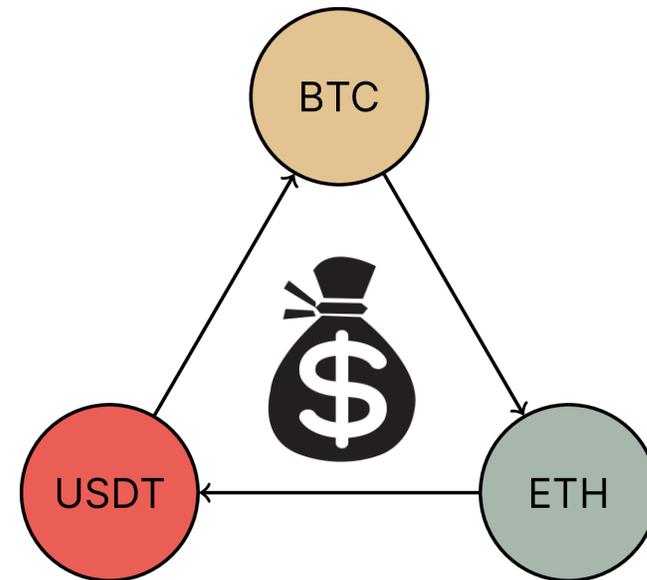
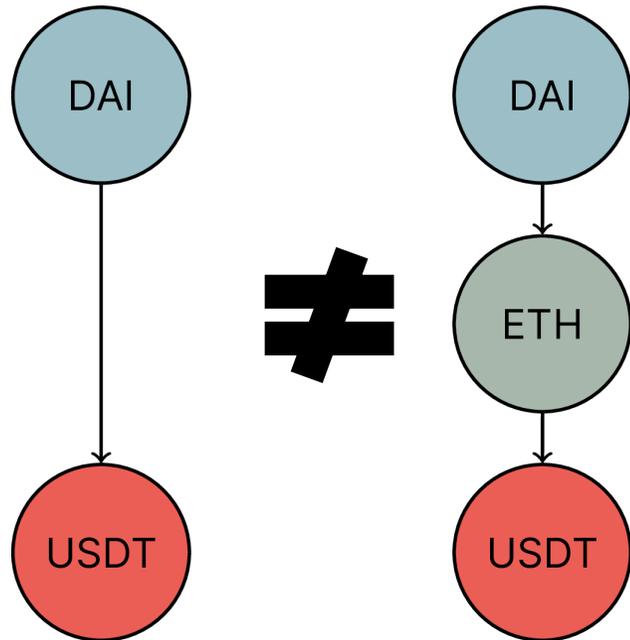


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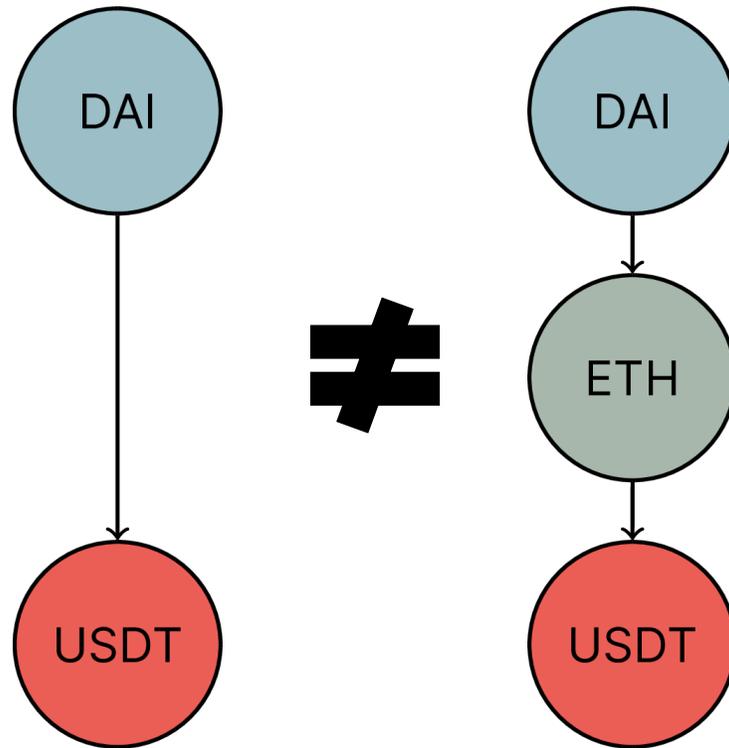
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suboptimal trade execution

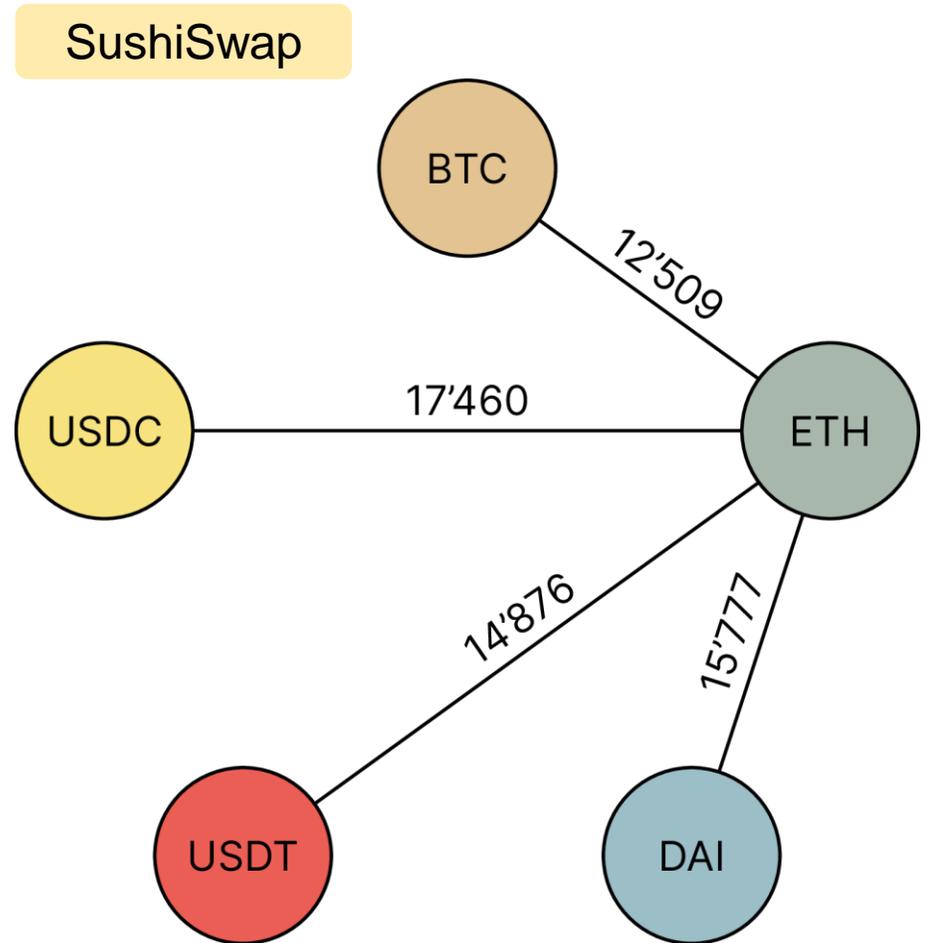
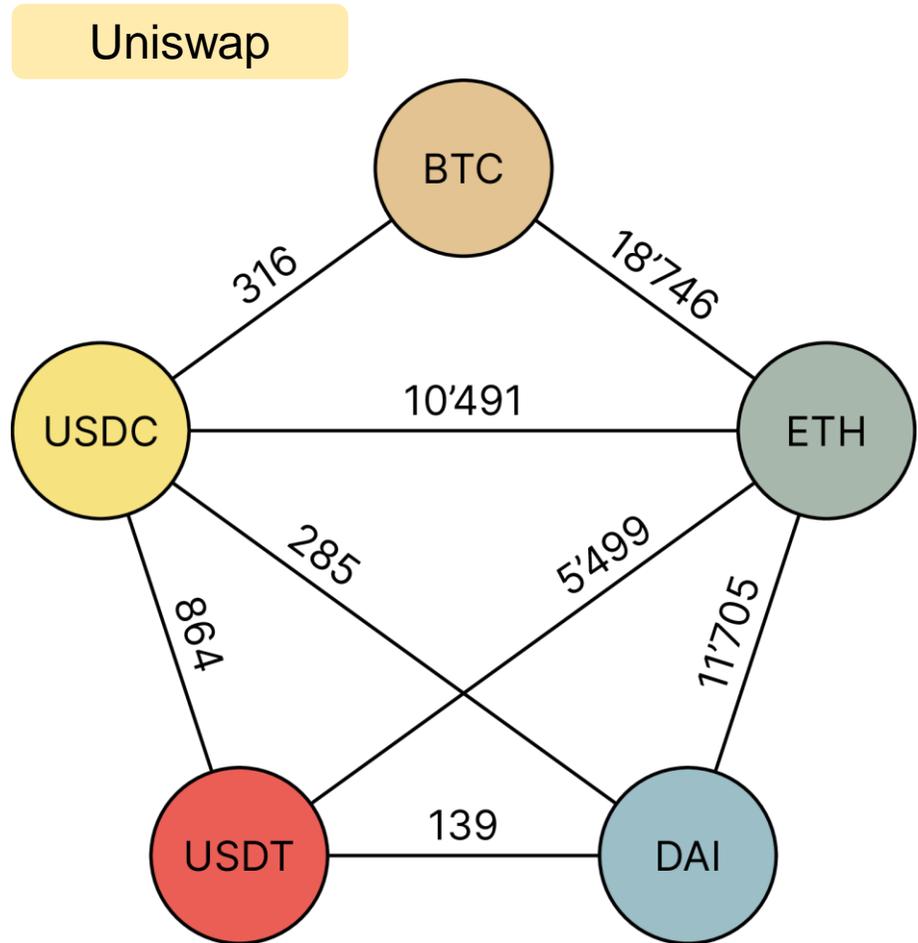
cyclic arbitrage opportunities



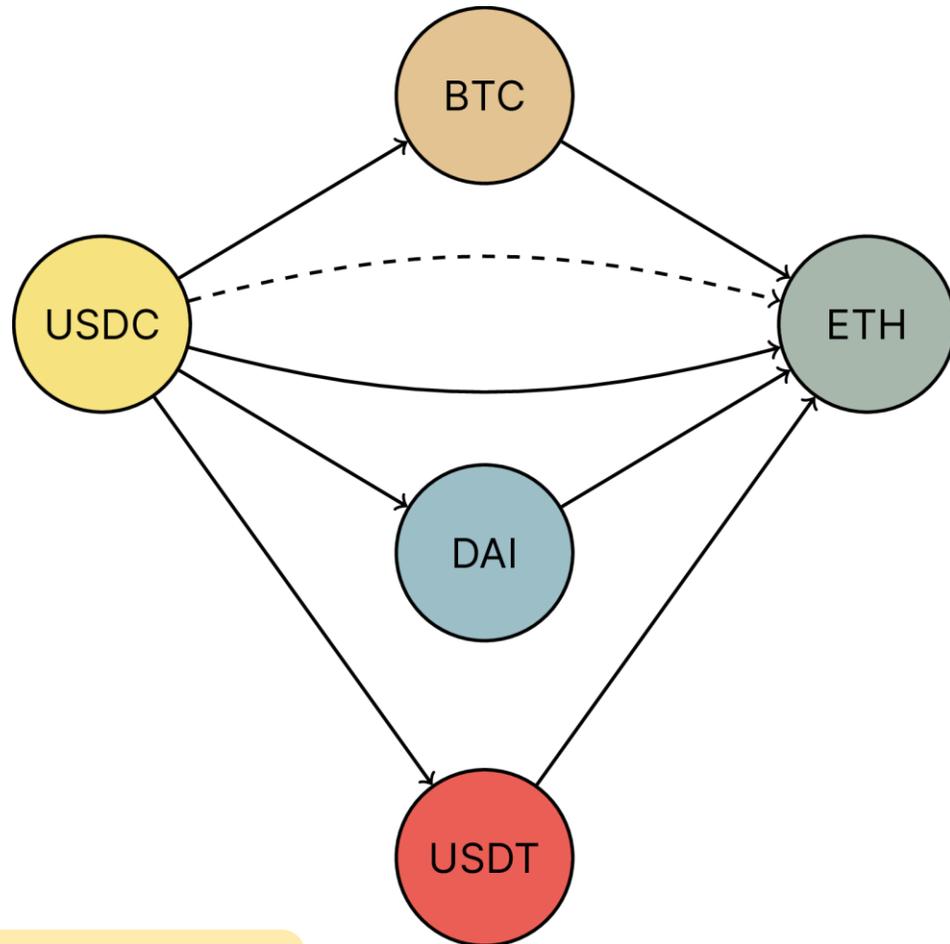
Suboptimal trade execution



Transaction data set

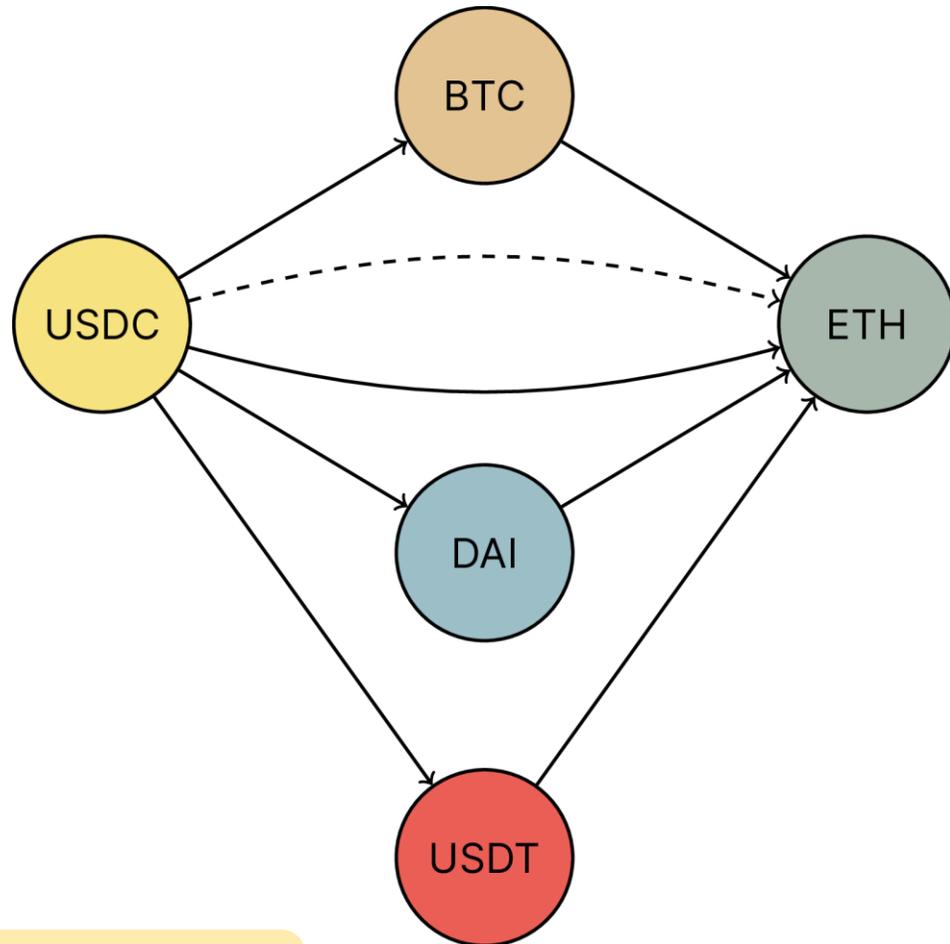


Suboptimal trade execution



— Uniswap
- - - SushiSwap

Suboptimal trade execution

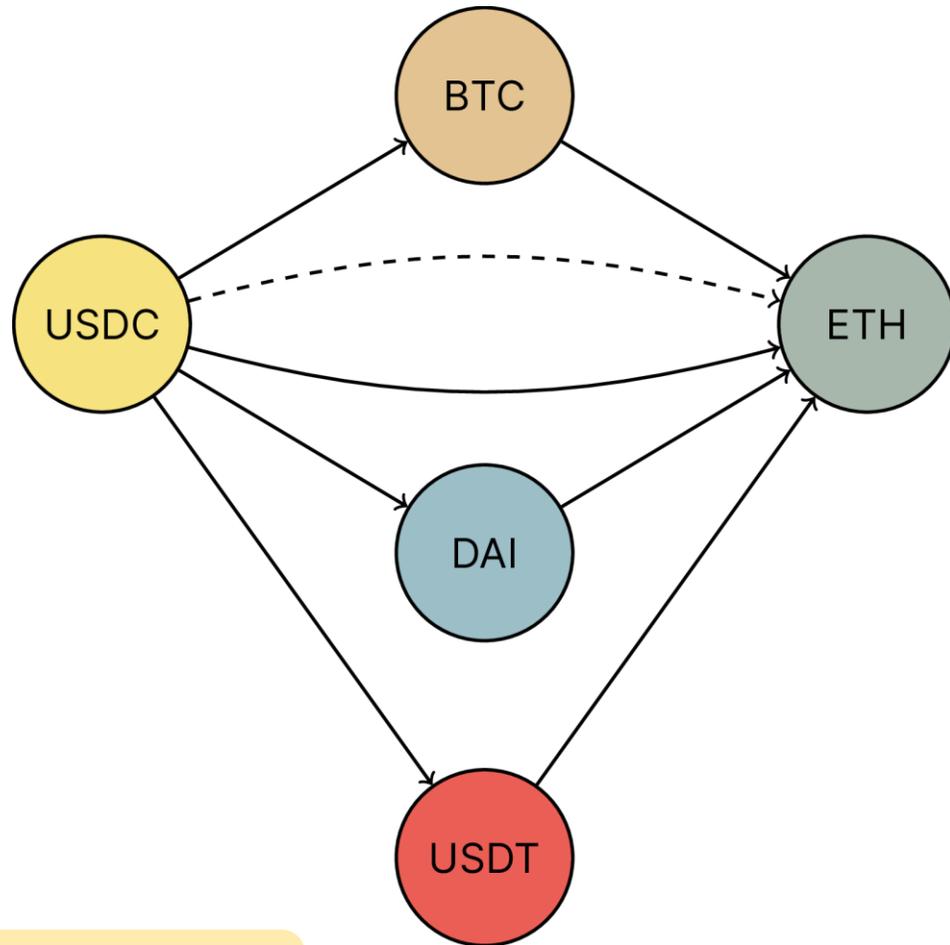


— Uniswap
- - - SushiSwap

optimized transaction gain

	All Trades	Top 5% Trades
Mean Gain	0.15%	0.71%

Suboptimal trade execution

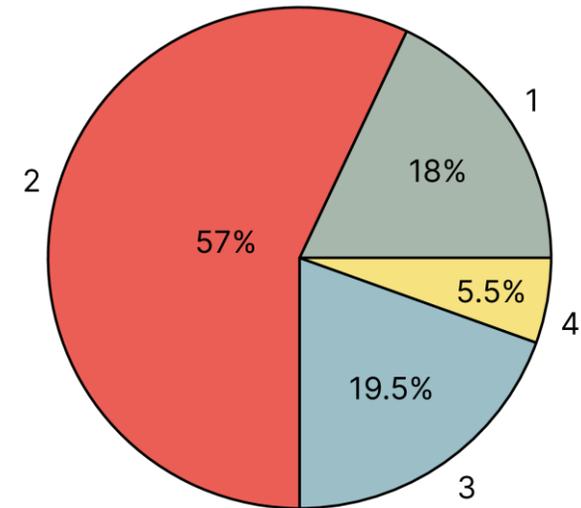


— Uniswap
- - - SushiSwap

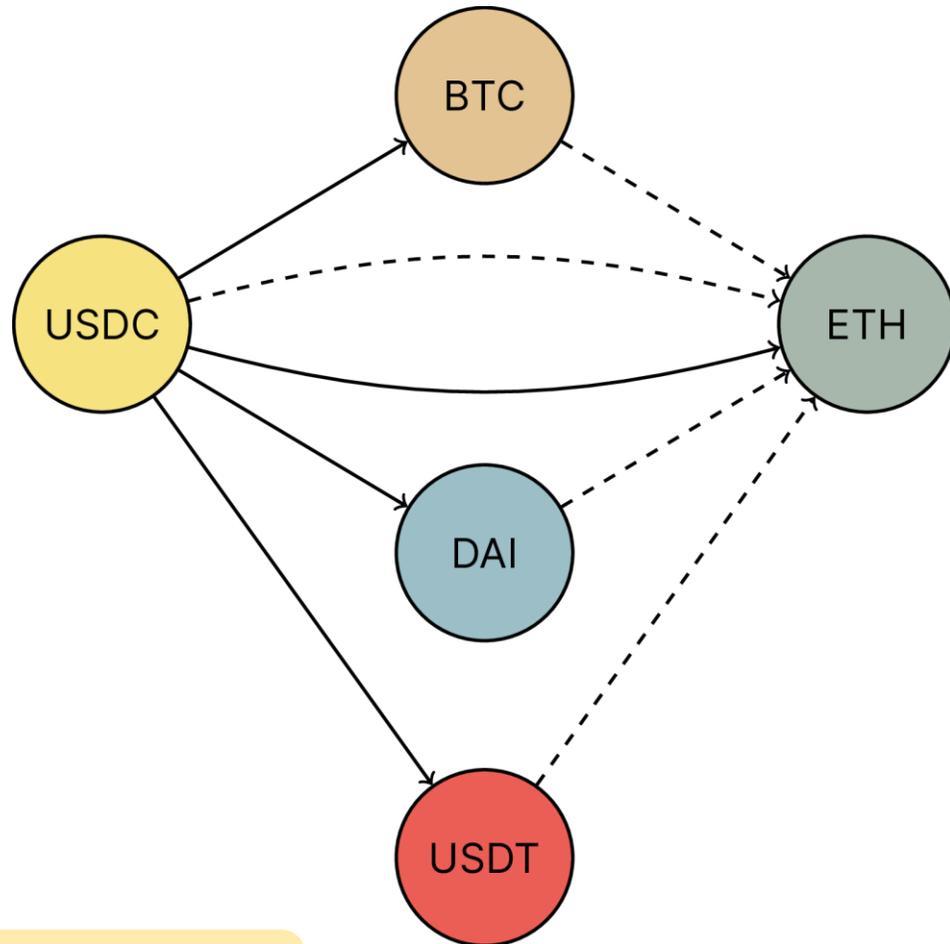
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number of paths

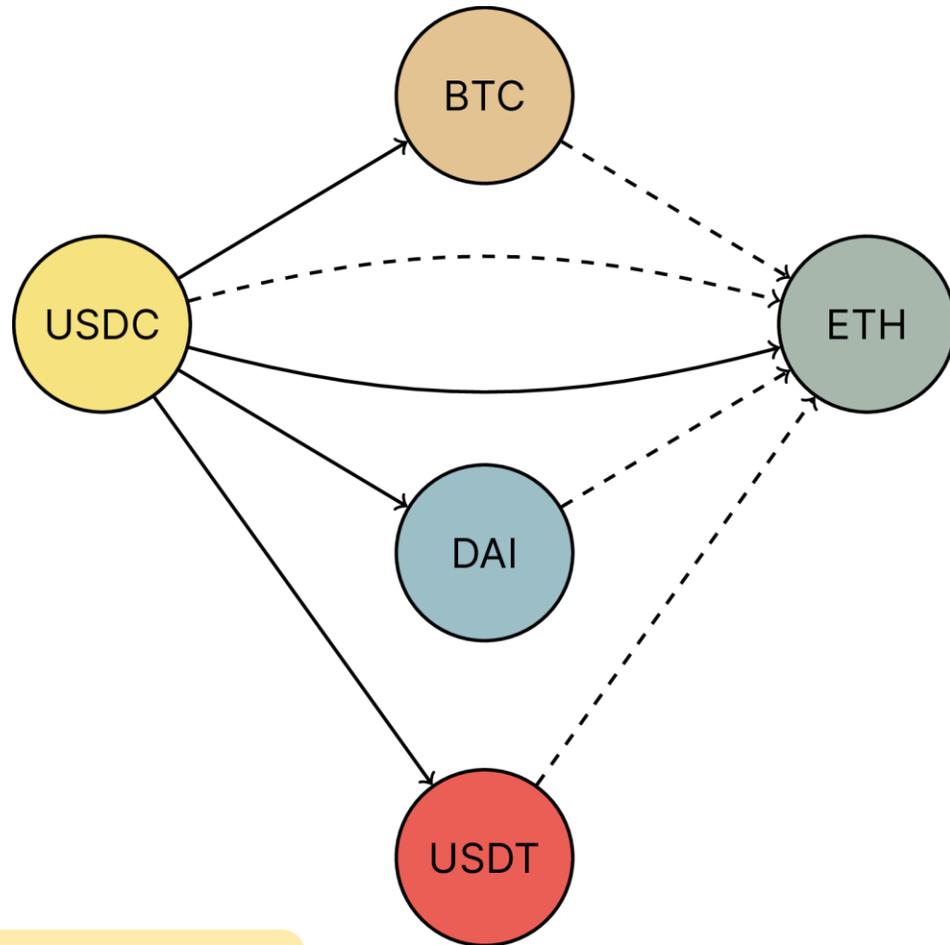


Suboptimal trade execution



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Suboptimal trade execution

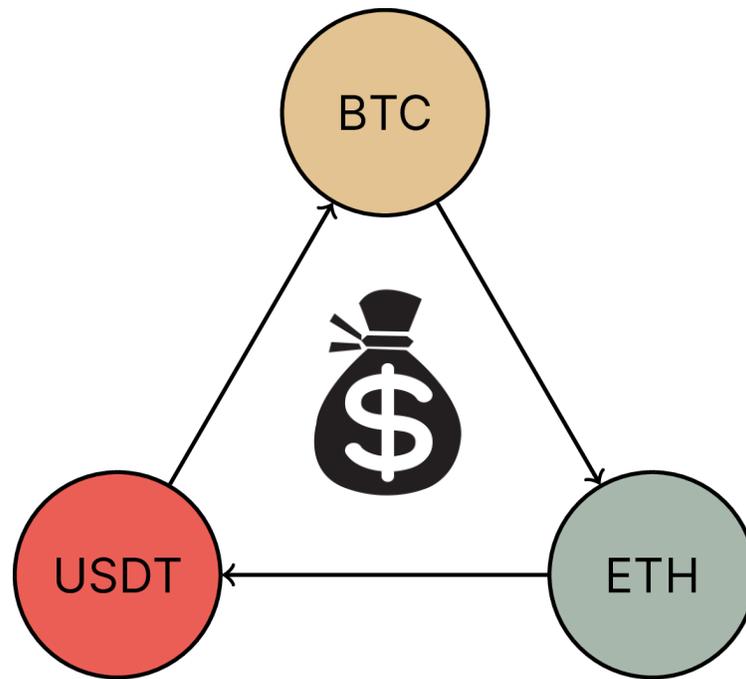


— Uniswap
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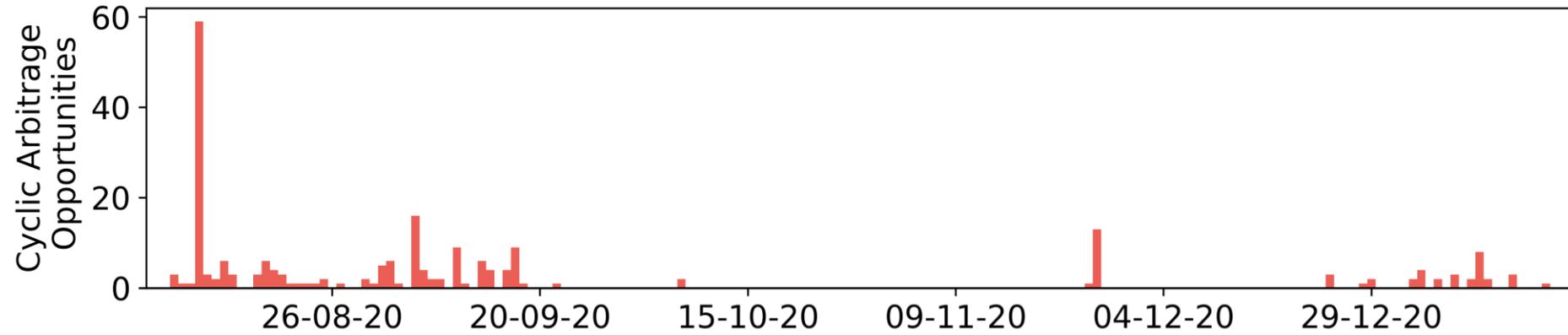
optimized transaction gain

	More Liquid Pools	Less Liquid Pools
Mean Gain	0.15%	0.16%

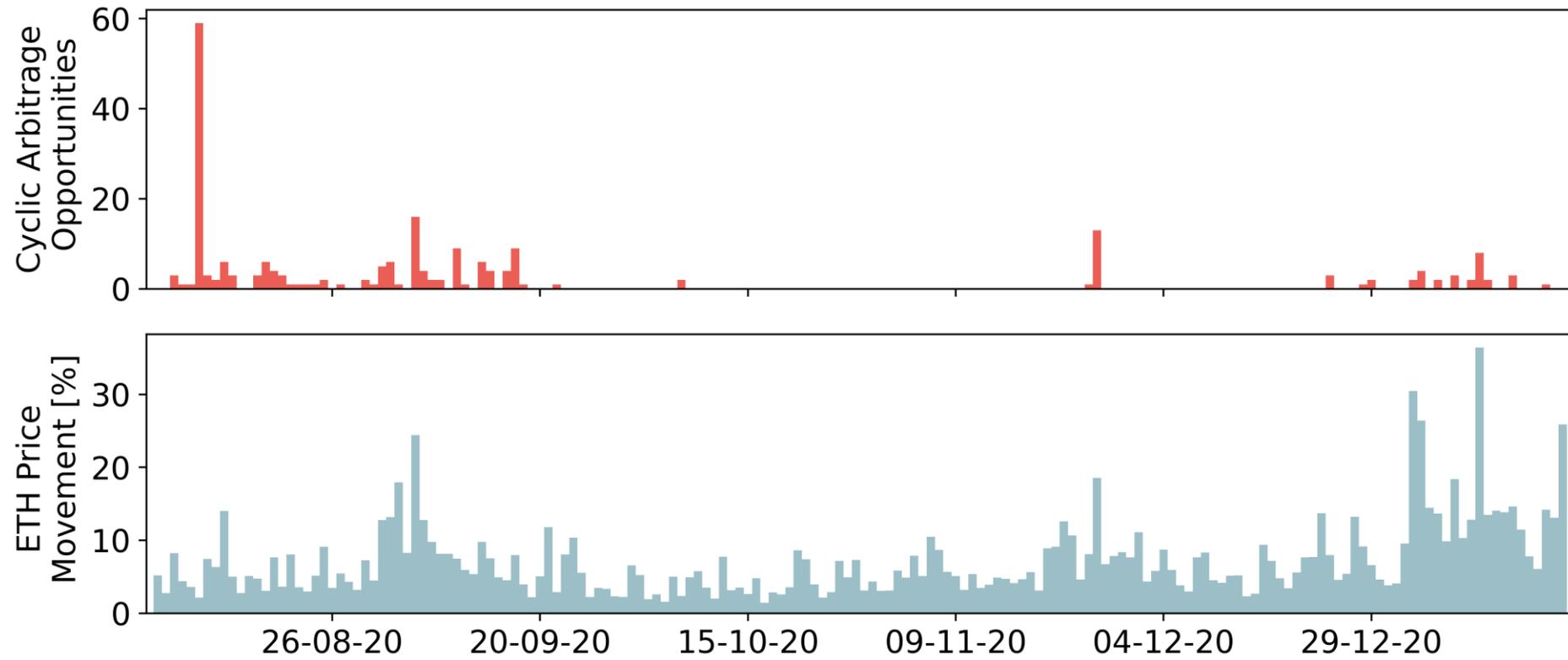
Cyclic arbitrage opportunities



Cyclic arbitrage opportunities

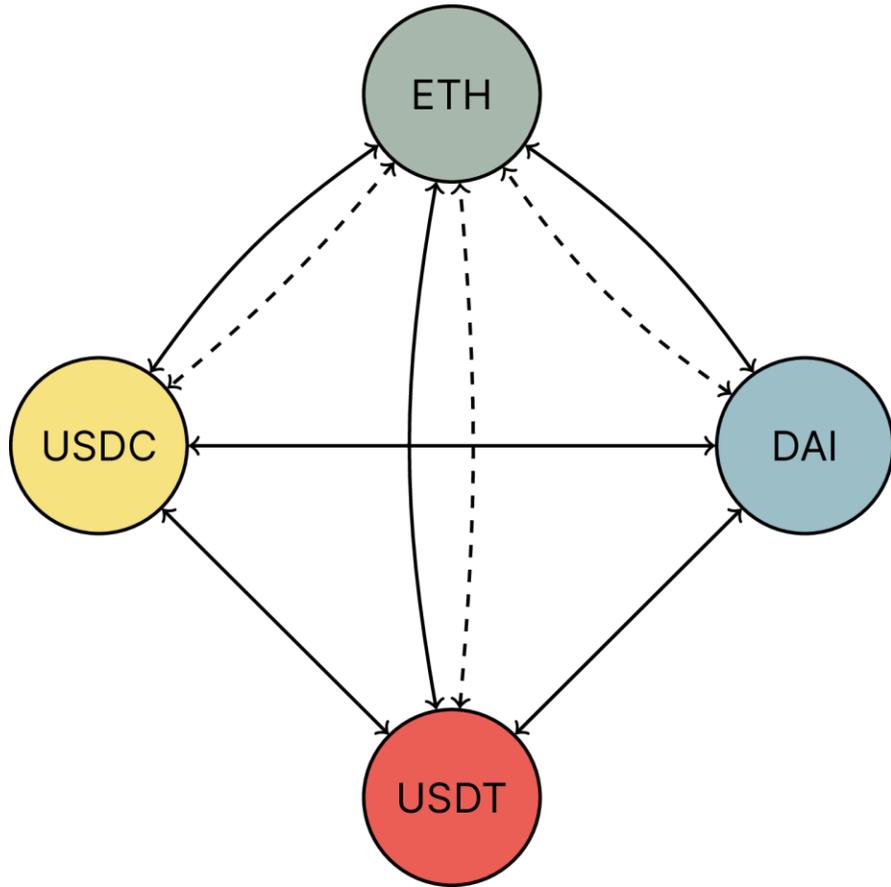


Cyclic arbitrage opportunities

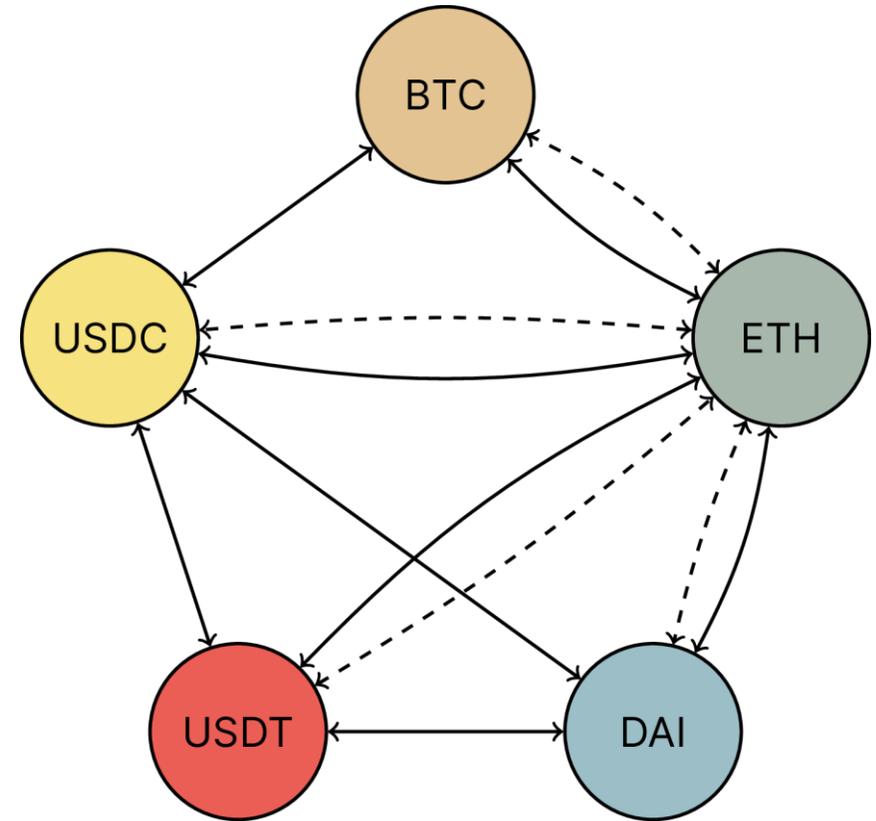


Pool network

— Uniswap
- - - SushiSwap

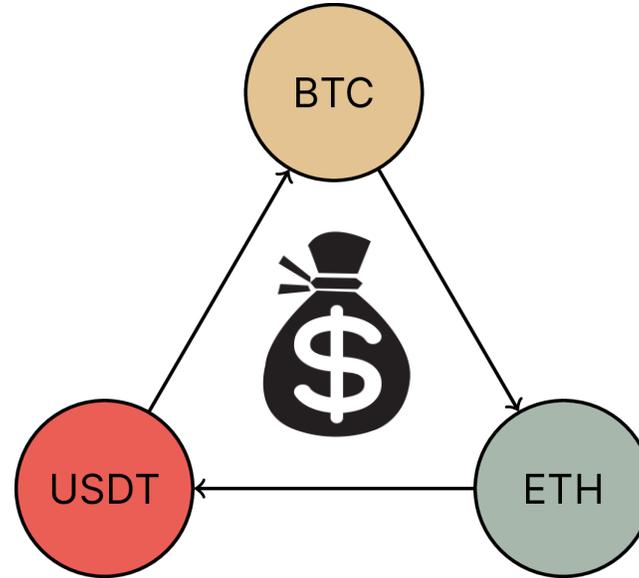


11.09.2020 - 3.10.2020



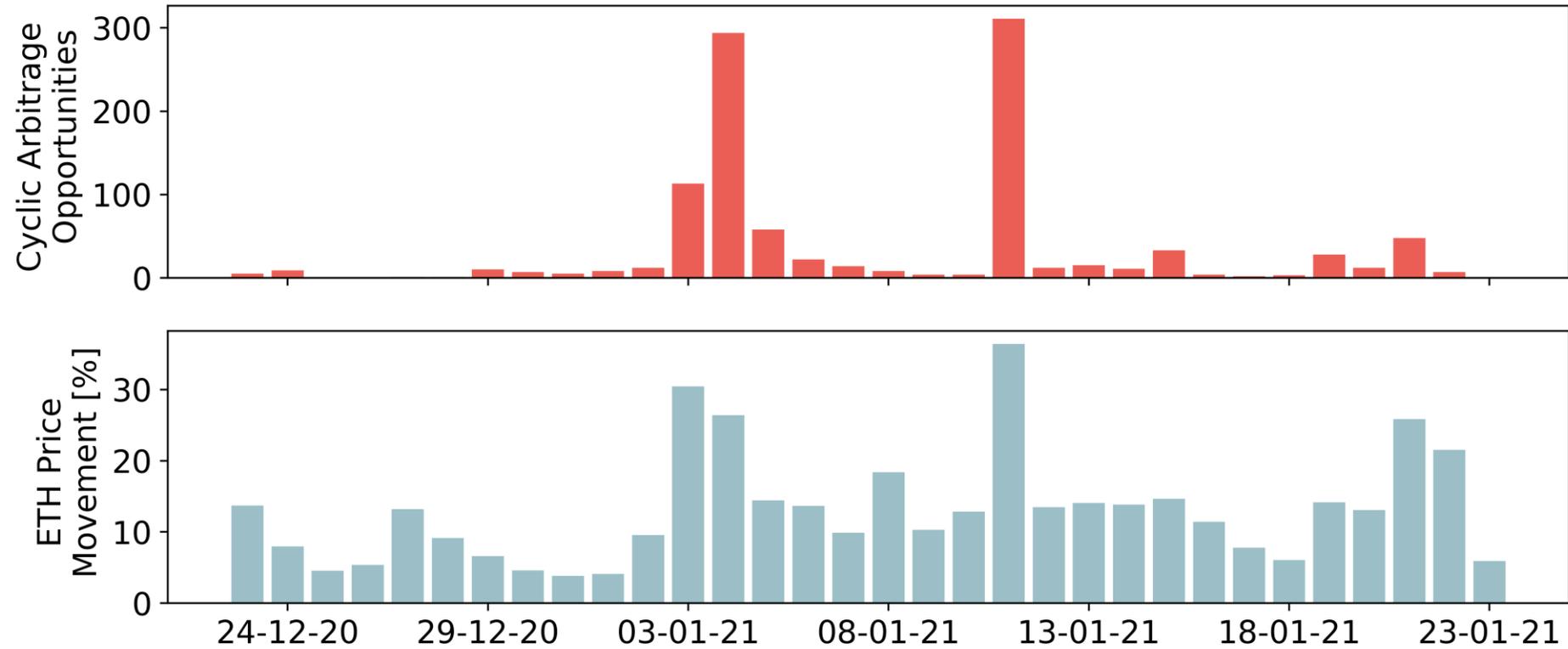
23.12.2020 - 23.01.2020

Cyclic arbitrage opportunities

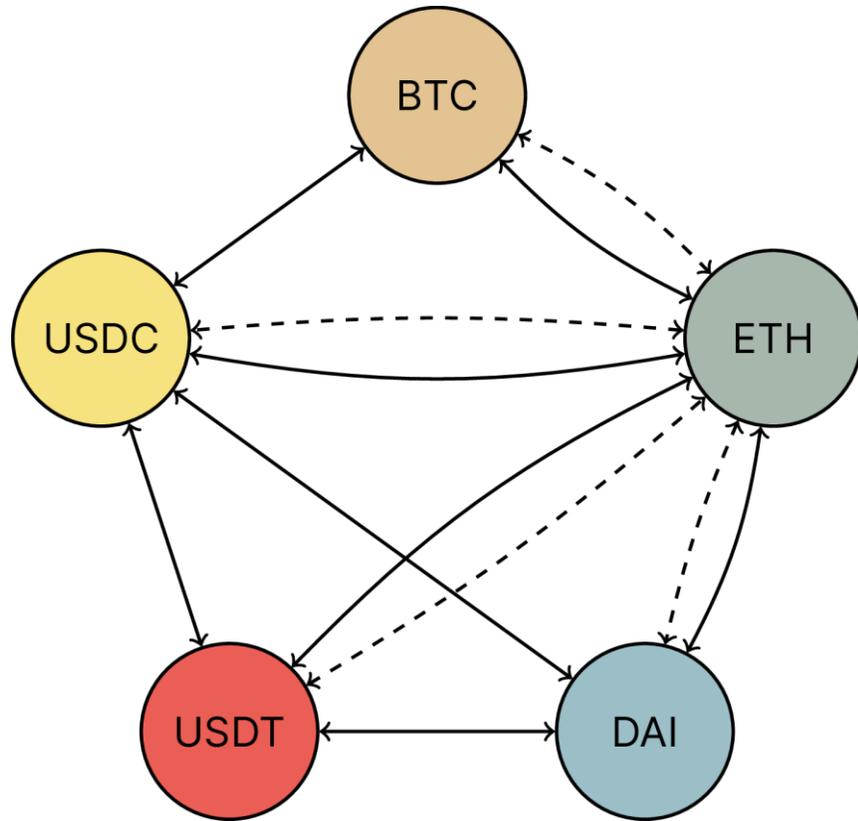


	Blocks with Cyclic Arb.	Mean Profit	Avg. Duration
11.09.20 - 03.10.20	84	0.24%	2.33 blocks
23.12.20 - 23.01.21	1'061	0.35%	1.43 blocks

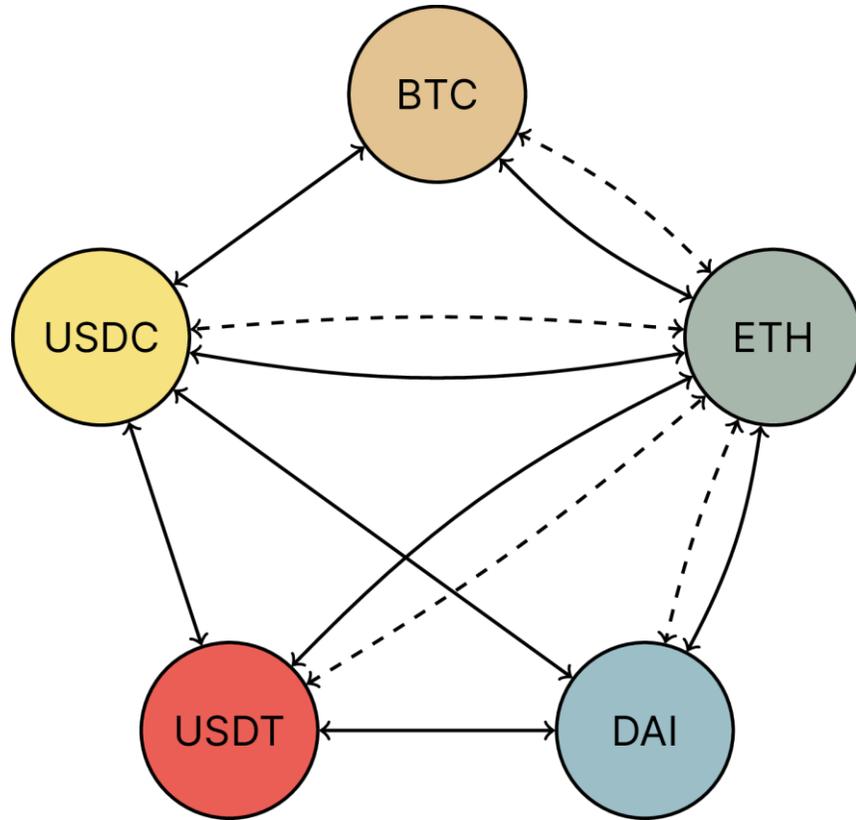
Cyclic arbitrage opportunities



Conclusion

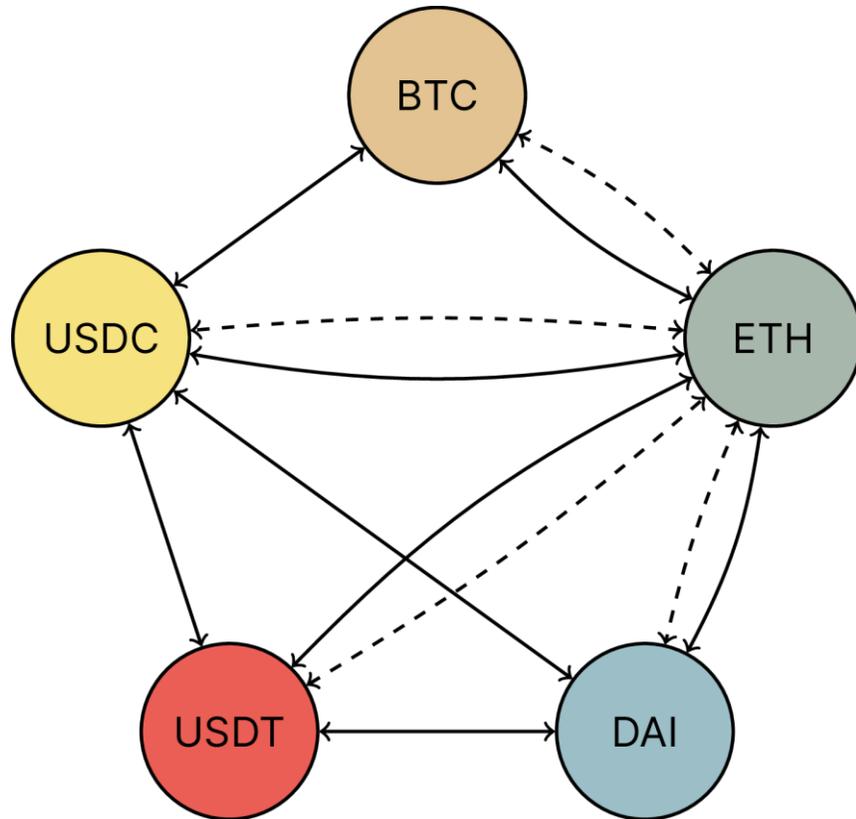


Conclusion



~ 30% of analyzed trades
executed at unfavorable prices

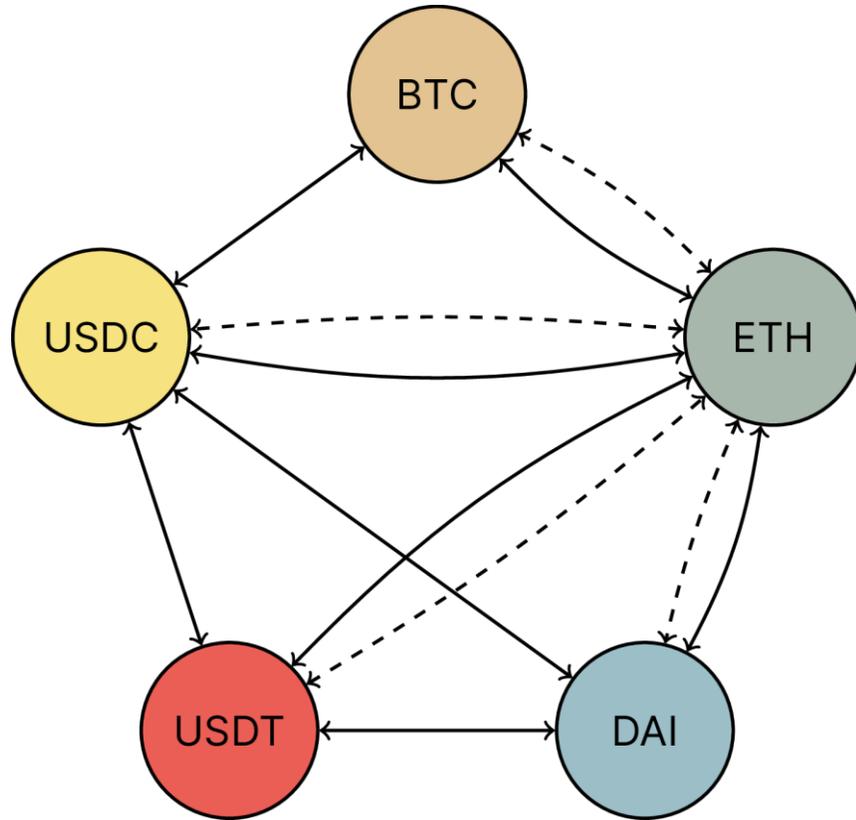
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initially phase:
more market inefficiencies

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initially phase:
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cryptocurrency price volatility
creates market inefficiencies

Thank You!
Questions & Comments?



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