

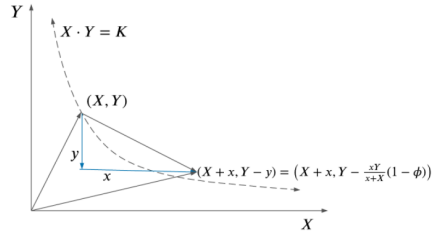
x	X	Slip-Based Fee (used by Sifchain)	Flat-Fee of 0.3% (used by Uniswap)	Fee Savings with Sifchain
1	1000000	0.000180%	0.30%	0.30%
100	1000000	0.01%	0.30%	0.29%
1000	1000000	0.10%	0.30%	0.20%
10000	1000000	0.99%	0.30%	-0.69%
100000	1000000	9.09%	0.30%	-8.79%
1000000	1000000	90.91%	0.30%	-90.61%
10000000	1000000	99.01%	0.30%	-98.71%
1	1000000	0.00%	0.30%	0.30%
10	1000000	0.00%	0.30%	0.30%
100	1000000	0.01%	0.30%	0.29%
1000	1000000	0.10%	0.30%	0.20%
10000	1000000	0.99%	0.30%	-0.69%
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1	5000000	0.00%	0.30%	0.30%
10	5000000	0.00%	0.30%	0.30%
100	5000000	0.00%	0.30%	0.30%
1000	5000000	0.02%	0.30%	0.28%
10000	5000000	0.20%	0.30%	0.10%
100000	5000000	1.96%	0.30%	-1.66%
1000000	5000000	16.67%	0.30%	-16.37%
10000000	5000000	66.67%	0.30%	-66.37%
100000000	5000000	95.24%	0.30%	-94.94%
1	5000000	0.00%	0.30%	0.30%
10	5000000	0.00%	0.30%	0.30%
100	5000000	0.00%	0.30%	0.30%
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1	500	0.20%	0.30%	0.10%
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100000	500	99.50%	0.30%	-99.20%
1000000	500	99.95%	0.30%	-99.65%
10000000	500	100.00%	0.30%	-99.70%
100000000	500	100.00%	0.30%	-99.70%
1	1000000	0.00%	0.30%	0.30%
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1000000	1000000	90.91%	0.30%	-90.61%
10000000	1000000	99.01%	0.30%	-98.71%
4.99999	1000000	0.00%	0.30%	0.30%
499.900015	1000000	0.05%	0.30%	0.25%
4990.01498	1000000	0.50%	0.30%	-0.20%
49014.80247	1000000	4.67%	0.30%	-4.37%
413223.1405	1000000	29.24%	0.30%	-28.94%
1250000	1000000	55.56%	0.30%	-55.26%
413223.1405	1000000	29.24%	0.30%	-28.94%
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49.9990001	5000000	0.00%	0.30%	0.30%

x: Amount of token X added to pool by swapper  
X: Amount of token X already in the pool  
Slip-Based Fee: The fee paid by swappers and collected by poolers

When swappers are swapping low volume relative to the pool, they pay less in fees than on Uniswap. When they are swapping high volume relative to the pool, they pay more in fees than on Uniswap (negative fee savings implies the fee on Sifchain is higher than on Uniswap). Swappers benefit under normal conditions while poolers benefit during periods of high volatility when swappers are willing to pay more in fees to change their position. **In a single market cycle, swappers and poolers "both" profit more under the Sifchain swap fee than the Uniswap fee.** Further research - <https://github.com/Thorchain/Resourses/blob/master/Auditor/THORChain-Gauntlet-CLPReport-Nov2020.pdf>

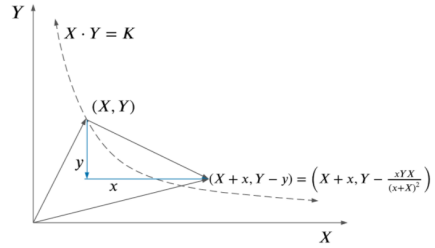
Fee Derivation from <https://hackmd.io/RV6K2LSYJR1yeNCoHpVY2hg>

Constant Product Market Maker: Flat Fee



There is an implementation of uniswap in cadCAD and an overview with video of the model.

Thorchain "Slip fee" (CLP)



This can be viewed as setting the fee  $\phi$  according a regularizing rule that penalizes slippage and thus larger transactions, incentivizing smaller transactions, but also introduces angles for gaming the system to minimize fees. The derivation can be found in the [Thorchain docs](#).

Comparing:

$$y_{if} = \frac{xY}{x+X}(1-\phi)$$

with

$$y_{slp} = \frac{xYX}{(x+X)^2} = \frac{xY}{x+X} \frac{X}{x+X}$$

so

$$(1-\phi) = \frac{X}{x+X} = 1 - \frac{x}{x+X}$$

this is simply choosing a functional fee, as

$$\phi = \frac{x}{x+X}$$

499.900015	5000000	0.01%	0.30%	0.29%		
4990.01498	5000000	0.10%	0.30%	0.20%		
49014.80247	5000000	0.97%	0.30%	-0.67%		
413223.1405	5000000	7.63%	0.30%	-7.33%		
1250000	5000000	20.00%	0.30%	-19.70%		
413223.1405	5000000	7.63%	0.30%	-7.33%		
49014.80247	5000000	0.97%	0.30%	-0.67%		
0.19999992	1000000	0.00%	0.30%	0.30%		
1.999992	1000000	0.00%	0.30%	0.30%		
19.99920002	1000000	0.00%	0.30%	0.30%		
199.920024	1000000	0.02%	0.30%	0.28%		
1992.023936	1000000	0.20%	0.30%	0.10%		
19223.37562	1000000	1.89%	0.30%	-1.59%		
138888.8889	1000000	12.20%	0.30%	-11.90%		
22222.2222	1000000	18.18%	0.30%	-17.88%		
45351.47392	1000000	4.34%	0.30%	-4.04%		
0.19999992	5000000	0.00%	0.30%	0.30%		
1.999992	5000000	0.00%	0.30%	0.30%		
19.99920002	5000000	0.00%	0.30%	0.30%		
199.920024	5000000	0.00%	0.30%	0.30%		
1992.023936	5000000	0.04%	0.30%	0.26%		
19223.37562	5000000	0.38%	0.30%	-0.08%		
138888.8889	5000000	2.70%	0.30%	-2.40%		
22222.2222	5000000	4.26%	0.30%	-3.96%		
45351.47392	5000000	0.90%	0.30%	-0.60%		
19.99920002	5000000	0.00%	0.30%	0.30%		
199.920024	5000000	0.00%	0.30%	0.30%		
1992.023936	5000000	0.04%	0.30%	0.26%		
19223.37562	5000000	0.38%	0.30%	-0.08%		
138888.8889	5000000	2.70%	0.30%	-2.40%		
22222.2222	5000000	4.26%	0.30%	-3.96%		
45351.47392	5000000	0.90%	0.30%	-0.60%		
4950.372516	5000000	0.10%	0.30%	0.20%		
499.5003748	5000000	0.01%	0.30%	0.29%		
19.99920002	50000	0.04%	0.30%	0.26%		
199.920024	50000	0.40%	0.30%	-0.10%		
1992.023936	50000	3.83%	0.30%	-3.53%		
19223.37562	50000	27.77%	0.30%	-27.47%		
138888.8889	50000	73.53%	0.30%	-73.23%		
22222.2222	50000	81.63%	0.30%	-81.33%		
45351.47392	50000	47.56%	0.30%	-47.26%		
4950.372516	50000	9.01%	0.30%	-8.71%		
499.5003748	50000	0.99%	0.30%	-0.69%		
1992.023936	50000	3.83%	0.30%	-3.53%		
19223.37562	50000	27.77%	0.30%	-27.47%		
138888.8889	50000	73.53%	0.30%	-73.23%		
22222.2222	50000	81.63%	0.30%	-81.33%		
45351.47392	50000	47.56%	0.30%	-47.26%		
4950.372516	50000	9.01%	0.30%	-8.71%		
499.5003748	50000	0.99%	0.30%	-0.69%		
49.99500037	50000	0.10%	0.30%	0.20%		
4.99995	50000	0.01%	0.30%	0.29%		
1992.023936	500	79.94%	0.30%	-79.64%		
19223.37562	500	97.46%	0.30%	-97.16%		
138888.8889	500	99.64%	0.30%	-99.34%		
22222.2222	500	99.78%	0.30%	-99.48%		
45351.47392	500	98.91%	0.30%	-98.61%		
4950.372516	500	90.83%	0.30%	-90.53%		
499.5003748	500	49.98%	0.30%	-49.68%		
49.99500037	500	9.99%	0.30%	-8.79%		
4.99995	500	0.99%	0.30%	-0.69%		
0.00499999	1000000	0.00%	0.30%	0.30%		
0.00499990001	1000000	0.00%	0.30%	0.30%		
0.0499900015	1000000	0.00%	0.30%	0.30%		
0.499001498	1000000	0.00%	0.30%	0.30%		
4.901480247	1000000	0.00%	0.30%	0.30%		
41.32231405	1000000	0.00%	0.30%	0.30%		
125	1000000	0.01%	0.30%	0.29%		
41.32231405	1000000	0.00%	0.30%	0.30%		
4.901480247	1000000	0.00%	0.30%	0.30%		
0.0499999	1000000	0.00%	0.30%	0.30%		
0.499990001	1000000	0.00%	0.30%	0.30%		
4.99900015	1000000	0.00%	0.30%	0.30%		
49.9001498	1000000	0.00%	0.30%	0.30%		
490.1480247	1000000	0.05%	0.30%	0.25%		
4132.231405	1000000	0.41%	0.30%	-0.11%		
12500	1000000	1.23%	0.30%	-0.93%		
4132.231405	1000000	0.41%	0.30%	-0.11%		
490.1480247	1000000	0.05%	0.30%	0.25%		

Number of Rowan in swap (x)	Number of Rowan in pool (X)	Number of TKN in pool (Y)	w_x	w_y	Slip Based Swap Fee	Number of TKN received from swap (y)	Percentage increase over equal weight purchasing power
1	1,000,000	1,000,000	0.50000	0.50000	0.000100%	1.00	0.00%
100	1,000,000	1,000,000	0.50000	0.50000	0.01%	99.98	0.00%
1000	1,000,000	1,000,000	0.50000	0.50000	0.10%	998.00	0.00%
10000	1,000,000	1,000,000	0.50000	0.50000	0.99%	9,802.96	0.00%
4000	1,000,000	1,000,000	0.50000	0.50000	0.40%	3,968.19	0.00%
4000	1,000,000	1,000,000	0.60000	0.40000	0.40%	5,946.35	49.85%
4000	1,000,000	1,000,000	0.70000	0.30000	0.40%	9,234.53	132.71%
4000	1,000,000	1,000,000	0.80000	0.20000	0.40%	15,778.16	297.62%
4000	1,000,000	1,000,000	0.90000	0.10000	0.40%	35,149.84	785.79%
4000	1,000,000	1,000,000	0.94000	0.06000	0.40%	60,384.54	1421.71%
4000	1,000,000	1,000,000	0.97000	0.03000	0.40%	120,609.83	2939.42%
4000	1,000,000	1,000,000	0.99000	0.01000	0.40%	325,160.85	8094.18%
4000	1,000,000	1,000,000	0.99900	0.00100	0.40%	977,553.58	24534.74%
4000	10,000,000	10,000,000	0.50000	0.50000	0.04%	3,996.80	0.00%
4000	10,000,000	10,000,000	0.90000	0.10000	0.04%	35,913.74	798.56%
4000	10,000,000	10,000,000	0.99000	0.01000	0.04%	388,030.36	9608.52%
4000	10,000,000	10,000,000	0.99900	0.00100	0.04%	3,292,265.00	82272.48%
4000	10,000,000	10,000,000	0.99990	0.00010	0.04%	9,812,698.67	245413.76%
1000	1,000,000	1,000,000	0.50000	0.50000	0.10%	998.00	0.00%
2000	1,000,000	1,000,000	0.50000	0.50000	0.20%	1,992.02	0.00%
3000	1,000,000	1,000,000	0.50000	0.50000	0.30%	2,982.08	0.00%
4000	1,000,000	1,000,000	0.50000	0.50000	0.40%	3,968.19	0.00%
1000	1,000,000	1,000,000	0.55000	0.45000	0.10%	1,219.65	122.21%
2000	1,000,000	1,000,000	0.55000	0.45000	0.20%	2,434.16	122.20%
3000	1,000,000	1,000,000	0.55000	0.45000	0.30%	3,643.55	122.18%
4000	1,000,000	1,000,000	0.55000	0.45000	0.40%	4,847.86	122.17%
1000	1,000,000	1,000,000	0.60000	0.40000	0.10%	1,496.63	149.96%
2000	1,000,000	1,000,000	0.60000	0.40000	0.20%	2,986.54	149.93%
3000	1,000,000	1,000,000	0.60000	0.40000	0.30%	4,469.77	149.89%
4000	1,000,000	1,000,000	0.60000	0.40000	0.40%	5,946.35	149.85%

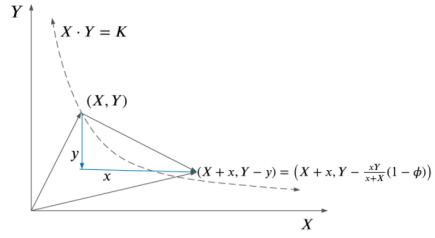
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10000000	500	100.00%	0.30%	-99.70%
100000000	500	100.00%	0.30%	-99.70%
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X: Amount of token X already in the pool  
Slip-Based Fee: The fee paid by swappers and collected by poolers

When swappers are swapping low volume relative to the pool, they pay less in fees than on Uniswap. When they are swapping high volume relative to the pool, they pay more in fees than on Uniswap (negative fee savings implies the fee on Sifchain is higher than on Uniswap). Swappers benefit under normal conditions while poolers benefit during periods of high volatility when swappers are willing to pay more in fees to change their position. **In a single market cycle, swappers and poolers "both" profit more under the Sifchain swap fee than the Uniswap fee.** Further research - <https://github.com/Thorchain/Resourses/blob/master/Auditor/THORChain-Gauntlet-CLPReport-Nov2020.pdf>

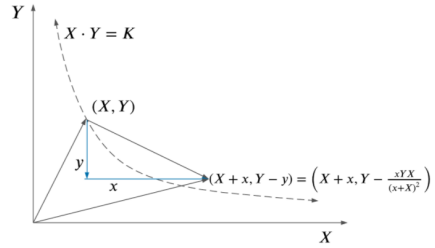
Fee Derivation from <https://hackmd.io/RV6K2LSYJR1yeNCoHpVY2hg>

Constant Product Market Maker: Flat Fee



There is an implementation of uniswap in cadCAD and an overview with video of the model.

Thorchain "Slip fee" (CLP)



This can be viewed as setting the fee  $\phi$  according a regularizing rule that penalizes slippage and thus larger transactions, incentivizing smaller transactions, but also introduces angles for gaming the system to minimize fees. The derivation can be found in the [Thorchain docs](#).

Comparing:

$$y_{sl} = \frac{xY}{x+X}(1-\phi)$$

with

$$y_{slp} = \frac{xYX}{(x+X)^2} = \frac{xY}{x+X} \frac{X}{x+X}$$

so

$$(1-\phi) = \frac{X}{x+X} = 1 - \frac{x}{x+X}$$

this is simply choosing a functional fee, as

$$\phi = \frac{x}{x+X}$$

499.900015	5000000	0.01%	0.30%	0.29%		
4990.01498	5000000	0.10%	0.30%	0.20%		
49014.80247	5000000	0.97%	0.30%	-0.67%		
413223.1405	5000000	7.63%	0.30%	-7.33%		
1250000	5000000	20.00%	0.30%	-19.70%		
413223.1405	5000000	7.63%	0.30%	-7.33%		
49014.80247	5000000	0.97%	0.30%	-0.67%		
0.19999992	1000000	0.00%	0.30%	0.30%		
1.999992	1000000	0.00%	0.30%	0.30%		
19.99920002	1000000	0.00%	0.30%	0.30%		
199.920024	1000000	0.02%	0.30%	0.28%		
1992.023936	1000000	0.20%	0.30%	0.10%		
19223.37562	1000000	1.89%	0.30%	-1.59%		
138888.8889	1000000	12.20%	0.30%	-11.90%		
22222.2222	1000000	18.18%	0.30%	-17.88%		
45351.47392	1000000	4.34%	0.30%	-4.04%		
0.19999992	5000000	0.00%	0.30%	0.30%		
1.999992	5000000	0.00%	0.30%	0.30%		
19.99920002	5000000	0.00%	0.30%	0.30%		
199.920024	5000000	0.00%	0.30%	0.30%		
1992.023936	5000000	0.04%	0.30%	0.26%		
19223.37562	5000000	0.38%	0.30%	-0.08%		
138888.8889	5000000	2.70%	0.30%	-2.40%		
22222.2222	5000000	4.26%	0.30%	-3.96%		
45351.47392	5000000	0.90%	0.30%	-0.60%		
19.99920002	5000000	0.00%	0.30%	0.30%		
199.920024	5000000	0.00%	0.30%	0.30%		
1992.023936	5000000	0.04%	0.30%	0.26%		
19223.37562	5000000	0.38%	0.30%	-0.08%		
138888.8889	5000000	2.70%	0.30%	-2.40%		
22222.2222	5000000	4.26%	0.30%	-3.96%		
45351.47392	5000000	0.90%	0.30%	-0.60%		
4950.372516	5000000	0.10%	0.30%	0.20%		
499.5003748	5000000	0.01%	0.30%	0.29%		
19.99920002	50000	0.04%	0.30%	0.26%		
199.920024	50000	0.40%	0.30%	-0.10%		
1992.023936	50000	3.83%	0.30%	-3.53%		
19223.37562	50000	27.77%	0.30%	-27.47%		
138888.8889	50000	73.53%	0.30%	-73.23%		
22222.2222	50000	81.63%	0.30%	-81.33%		
45351.47392	50000	47.56%	0.30%	-47.26%		
4950.372516	50000	9.01%	0.30%	-8.71%		
499.5003748	50000	0.99%	0.30%	-0.69%		
1992.023936	50000	3.83%	0.30%	-3.53%		
19223.37562	50000	27.77%	0.30%	-27.47%		
138888.8889	50000	73.53%	0.30%	-73.23%		
22222.2222	50000	81.63%	0.30%	-81.33%		
45351.47392	50000	47.56%	0.30%	-47.26%		
4950.372516	50000	9.01%	0.30%	-8.71%		
499.5003748	50000	0.99%	0.30%	-0.69%		
49.99500037	50000	0.10%	0.30%	0.20%		
4.99995	50000	0.01%	0.30%	0.29%		
1992.023936	500	79.94%	0.30%	-79.64%		
19223.37562	500	97.46%	0.30%	-97.16%		
138888.8889	500	99.64%	0.30%	-99.34%		
22222.2222	500	99.78%	0.30%	-99.48%		
45351.47392	500	98.91%	0.30%	-98.61%		
4950.372516	500	90.83%	0.30%	-90.53%		
499.5003748	500	49.98%	0.30%	-49.68%		
49.99500037	500	9.99%	0.30%	-8.79%		
4.99995	500	0.99%	0.30%	-0.69%		
0.00499999	1000000	0.00%	0.30%	0.30%		
0.00499990001	1000000	0.00%	0.30%	0.30%		
0.0499900015	1000000	0.00%	0.30%	0.30%		
0.499001498	1000000	0.00%	0.30%	0.30%		
4.901480247	1000000	0.00%	0.30%	0.30%		
41.32231405	1000000	0.00%	0.30%	0.30%		
125	1000000	0.01%	0.30%	0.29%		
41.32231405	1000000	0.00%	0.30%	0.30%		
4.901480247	1000000	0.00%	0.30%	0.30%		
0.0499999	1000000	0.00%	0.30%	0.30%		
0.499990001	1000000	0.00%	0.30%	0.30%		
4.99900015	1000000	0.00%	0.30%	0.30%		
49.9001498	1000000	0.00%	0.30%	0.30%		
490.1480247	1000000	0.05%	0.30%	0.25%		
4132.231405	1000000	0.41%	0.30%	-0.11%		
12500	1000000	1.23%	0.30%	-0.93%		
4132.231405	1000000	0.41%	0.30%	-0.11%		
490.1480247	1000000	0.05%	0.30%	0.25%		

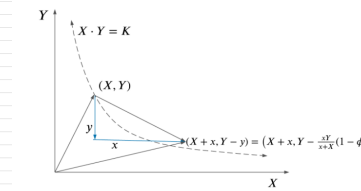
USD Value of Trade for Atom:TKN	USD Value of Pool Depth of Atom:Rowan Pool	USD Value of Pool Depth of Rowan:TKN Pool	Sifchain's Slip-Based Fee for swap of Rowan:Atom	Sifchain's Slip-Based Fee for swap of TKN	Sifchain's Total Slip-Based Fee for swap of Atom:TKN	Uniswap's Flat Fee of 0.3% plus 2% Slippage Allowance for ETH:TKN	Fee Savings with Sifchain
1	5000000	1000000	0.00%	0.00%	0.00%	2.30%	2.30%
100	5000000	1000000	0.00%	0.01%	0.01%	2.30%	2.30%
1000	5000000	1000000	0.02%	0.10%	0.12%	2.30%	2.28%
10000	5000000	1000000	0.20%	0.95%	1.15%	2.30%	2.10%
20000	5000000	1000000	0.40%	1.95%	2.35%	2.30%	
100000	5000000	1000000	1.96%	8.93%	10.89%	2.30%	0.34%
1000000	5000000	1000000	16.67%	45.45%	62.12%	2.30%	-14.37%
10000000	5000000	1000000	66.67%	76.92%	143.59%	2.30%	-64.37%
100000000	5000000	1000000	95.24%	82.64%	177.88%	2.30%	-92.94%
1	5000000	5000000	0.00%	0.00%	0.00%	2.30%	2.30%
10	5000000	5000000	0.00%	0.00%	0.00%	2.30%	2.30%
100	5000000	5000000	0.00%	0.01%	0.01%	2.30%	2.30%
1000	5000000	5000000	0.02%	0.10%	0.12%	2.30%	2.28%
10000	5000000	5000000	0.20%	0.95%	1.15%	2.30%	2.10%
20000	5000000	5000000	0.40%	1.95%	2.35%	2.30%	
100000	5000000	5000000	1.96%	8.93%	10.89%	2.30%	0.34%
1000000	5000000	5000000	16.67%	45.45%	62.12%	2.30%	-14.37%
10000000	5000000	5000000	66.67%	76.92%	143.59%	2.30%	-64.37%
100000000	5000000	5000000	95.24%	82.64%	177.88%	2.30%	-92.94%

x: Amount of token X added to pool by swapper  
 X: Amount of token X already in the pool  
 Slip-Based Fee: The fee paid by swappers and collected by poolers

When swappers are swapping low volume relative to the pool, they pay less in fees than on Uniswap. When they are swapping high volume relative to the pool, they pay more in fees than on Uniswap (negative fee savings implies the fee on Sifchain is higher than on Uniswap). Swappers benefit under normal conditions while poolers benefit during periods of high volatility when swappers are willing to pay more in fees to change their position. **In a single market, cycle, swappers and poolers benefit more under the Sifchain swap fee than the Uniswap fee.** Further research - <https://github.com/Uniswap/UniswapV2/blob/master/Audits/THORChain-Gasifier-CLPReport/Nov2020.pdf>

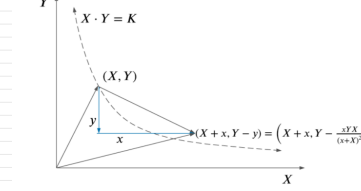
Fee Derivation from <https://hackmd.io/BVKZLSYR7YenNc0h0V2hg>

Constant Product Market Maker: Flat Fee



There is an implementation of uniswap in cadCAD and an overview of video of the model.

Thorchain "Slip fee" (CLP)



This can be viewed as setting the fee  $\phi$  according to a regularizing rule that penalizes slippage and thus larger transactions, incentivizing smaller transactions, but also introduces angles for gaming the system to minimize fees. The derivation can be found in the Thorchain docs.

Comparing:

$$y_{ff} = \frac{xY}{x+X}(1-\phi)$$

with

$$M_{fp} = \frac{xYX}{(x+X)^2} = \frac{xY}{x+X} \cdot \frac{X}{x+X}$$

so

$$(1-\phi) = \frac{X}{x+X} = 1 - \frac{x}{x+X}$$

this is simply choosing a functional fee, as

$$\phi = \frac{x}{x+X}$$

4950.372516	5000000	5000000	0.18%	0.18%	0.28%	2.30%	2.20%			
499.5003748	5000000	5000000	0.81%	0.81%	0.82%	2.30%	2.29%			
19.9920202	50000	5000000	0.84%	0.80%	0.84%	2.30%	2.28%			
199.9201024	50000	5000000	0.48%	0.80%	0.48%	2.30%	1.90%			
1992.023936	50000	5000000	3.83%	0.84%	3.87%	2.30%	-1.53%			
19223.37562	50000	5000000	27.77%	0.28%	28.05%	2.30%	-25.47%			
138888.8889	50000	5000000	73.53%	0.73%	74.26%	2.30%	-71.23%			
22222.2222	50000	5000000	81.63%	0.81%	82.44%	2.30%	-79.33%			
45351.47392	50000	5000000	47.56%	0.47%	48.04%	2.30%	-45.26%			
4950.372516	50000	5000000	9.81%	0.89%	9.18%	2.30%	-6.71%			
499.5003748	50000	5000000	0.99%	0.81%	1.00%	2.30%	1.31%			
1992.023936	50000	5000000	3.83%	0.84%	3.87%	2.30%	-1.53%			
19223.37562	50000	5000000	27.77%	0.28%	28.05%	2.30%	-25.47%			
138888.8889	50000	5000000	73.53%	0.73%	74.26%	2.30%	-71.23%			
22222.2222	50000	5000000	81.63%	0.81%	82.44%	2.30%	-79.33%			
45351.47392	50000	5000000	47.56%	0.47%	48.04%	2.30%	-45.26%			
4950.372516	50000	5000000	9.81%	0.89%	9.18%	2.30%	-6.71%			
499.5003748	50000	5000000	0.99%	0.81%	1.00%	2.30%	1.31%			
49.9950037	50000	5000000	0.18%	0.80%	0.18%	2.30%	2.20%			
4.99996	50000	5000000	0.81%	0.80%	0.81%	2.30%	2.29%			
1992.023936	500	5000000	79.94%	0.81%	79.94%	2.30%	-77.64%			
19223.37562	500	5000000	97.46%	0.81%	97.47%	2.30%	-95.16%			
138888.8889	500	5000000	99.64%	0.81%	99.65%	2.30%	-97.34%			
22222.2222	500	5000000	99.78%	0.81%	99.79%	2.30%	-97.48%			
45351.47392	500	5000000	98.91%	0.81%	98.92%	2.30%	-96.61%			
4950.372516	500	5000000	98.83%	0.81%	98.84%	2.30%	-88.53%			
499.5003748	500	5000000	49.98%	0.80%	49.98%	2.30%	-47.68%			
49.9950037	500	5000000	9.89%	0.80%	9.89%	2.30%	-6.79%			
4.99996	500	5000000	0.99%	0.80%	0.99%	2.30%	1.31%			
0.00499999	1000000	5000000	0.80%	0.80%	0.80%	2.30%	2.30%			
0.00499990001	1000000	5000000	0.80%	0.80%	0.80%	2.30%	2.30%			
0.049990015	1000000	5000000	0.80%	0.80%	0.80%	2.30%	2.30%			
0.499001498	1000000	5000000	0.80%	0.80%	0.80%	2.30%	2.30%			
4.901480247	1000000	5000000	0.80%	0.80%	0.80%	2.30%	2.30%			
41.32231405	1000000	5000000	0.80%	0.80%	0.80%	2.30%	2.30%			
125	1000000	5000000	0.81%	0.80%	0.81%	2.30%	2.29%			
41.32231405	1000000	5000000	0.80%	0.80%	0.80%	2.30%	2.30%			
4.901480247	1000000	5000000	0.80%	0.80%	0.80%	2.30%	2.30%			
0.0499999	1000000	5000000	0.80%	0.80%	0.80%	2.30%	2.30%			
0.4999900001	1000000	5000000	0.80%	0.80%	0.80%	2.30%	2.30%			
4.9990015	1000000	5000000	0.80%	0.80%	0.80%	2.30%	2.30%			
49.9001498	1000000	5000000	0.80%	0.80%	0.81%	2.30%	2.30%			
490.1480247	1000000	5000000	0.85%	0.81%	0.85%	2.30%	2.25%			
4132.231405	1000000	5000000	0.41%	0.88%	0.49%	2.30%	1.89%			
12500	1000000	5000000	1.23%	0.25%	1.48%	2.30%	1.07%			
4132.231405	1000000	5000000	0.41%	0.88%	0.49%	2.30%	1.89%			
490.1480247	1000000	5000000	0.85%	0.81%	0.85%	2.30%	2.25%			

x	X	Slip-Based Fee (used by Sifchain)	Flat-Fee of 0.3% (used by Uniswap)	Fee Savings with Sifchain
1	30000	0.08%	0.30%	0.30%
100	30000	0.33%	0.30%	-0.03%
600	30000	1.96%	0.30%	-1.66%
10000	30000	25.08%	0.30%	-24.70%
100000	1000000	9.09%	0.30%	-8.79%
1000000	1000000	50.00%	0.30%	-49.70%
10000000	1000000	90.91%	0.30%	-90.61%
100000000	1000000	99.01%	0.30%	-98.71%
1	1000000	0.00%	0.30%	0.30%
10	1000000	0.00%	0.30%	0.30%
100	1000000	0.01%	0.30%	0.29%
1000	1000000	0.10%	0.30%	0.20%
10000	1000000	0.99%	0.30%	-0.69%
100000	1000000	9.09%	0.30%	-8.79%
1000000	1000000	50.00%	0.30%	-49.70%
10000000	1000000	90.91%	0.30%	-90.61%
100000000	1000000	99.01%	0.30%	-98.71%
1	5000000	0.00%	0.30%	0.30%
10	5000000	0.00%	0.30%	0.30%
100	5000000	0.00%	0.30%	0.30%
1000	5000000	0.02%	0.30%	0.28%
10000	5000000	0.20%	0.30%	0.10%
100000	5000000	1.96%	0.30%	-1.66%
1000000	5000000	16.67%	0.30%	-16.37%
10000000	5000000	66.67%	0.30%	-66.37%
100000000	5000000	95.24%	0.30%	-94.94%
1	50000000	0.00%	0.30%	0.30%
10	50000000	0.00%	0.30%	0.30%
100	50000000	0.00%	0.30%	0.30%
1000	50000000	0.02%	0.30%	0.28%
10000	50000000	0.20%	0.30%	0.10%
100000	50000000	1.96%	0.30%	-1.66%
1000000	50000000	16.67%	0.30%	-16.37%
10000000	50000000	66.67%	0.30%	-66.37%
100000000	50000000	95.24%	0.30%	-94.94%
1	500000000	0.00%	0.30%	0.30%
10	500000000	0.00%	0.30%	0.30%
100	500000000	0.00%	0.30%	0.30%
1000	500000000	0.02%	0.30%	0.28%
10000	500000000	0.20%	0.30%	0.10%
100000	500000000	1.96%	0.30%	-1.66%
1000000	500000000	16.67%	0.30%	-16.37%
10000000	500000000	66.67%	0.30%	-66.37%
100000000	500000000	95.24%	0.30%	-94.94%
1	5000000000	0.00%	0.30%	0.30%
10	5000000000	0.00%	0.30%	0.30%
100	5000000000	0.00%	0.30%	0.30%
1000	5000000000	0.02%	0.30%	0.28%
10000	5000000000	0.20%	0.30%	0.10%
100000	5000000000	1.96%	0.30%	-1.66%
1000000	5000000000	16.67%	0.30%	-16.37%
10000000	5000000000	66.67%	0.30%	-66.37%
100000000	5000000000	95.24%	0.30%	-94.94%
1	50000000000	0.00%	0.30%	0.30%
10	50000000000	0.00%	0.30%	0.30%
100	50000000000	0.00%	0.30%	0.30%
1000	50000000000	0.02%	0.30%	0.28%
10000	50000000000	0.20%	0.30%	0.10%
100000	50000000000	1.96%	0.30%	-1.66%
1000000	50000000000	16.67%	0.30%	-16.37%
10000000	50000000000	66.67%	0.30%	-66.37%
100000000	50000000000	95.24%	0.30%	-94.94%
1	500000000000	0.00%	0.30%	0.30%
10	500000000000	0.00%	0.30%	0.30%
100	500000000000	0.00%	0.30%	0.30%
1000	500000000000	0.02%	0.30%	0.28%
10000	500000000000	0.20%	0.30%	0.10%
100000	500000000000	1.96%	0.30%	-1.66%
1000000	500000000000	16.67%	0.30%	-16.37%
10000000	500000000000	66.67%	0.30%	-66.37%
100000000	500000000000	95.24%	0.30%	-94.94%
1	5000000000000	0.00%	0.30%	0.30%
10	5000000000000	0.00%	0.30%	0.30%
100	5000000000000	0.00%	0.30%	0.30%
1000	5000000000000	0.02%	0.30%	0.28%
10000	5000000000000	0.20%	0.30%	0.10%
100000	5000000000000	1.96%	0.30%	-1.66%
1000000	5000000000000	16.67%	0.30%	-16.37%
10000000	5000000000000	66.67%	0.30%	-66.37%
100000000	5000000000000	95.24%	0.30%	-94.94%
1	10000000	0.00%	0.30%	0.30%
10	10000000	0.00%	0.30%	0.30%
100	10000000	0.01%	0.30%	0.29%
1000	10000000	0.10%	0.30%	0.20%
10000	10000000	0.99%	0.30%	-0.69%
100000	10000000	9.09%	0.30%	-8.79%
1000000	10000000	50.00%	0.30%	-49.70%
10000000	10000000	90.91%	0.30%	-90.61%
100000000	10000000	99.01%	0.30%	-98.71%
1	100000000	0.00%	0.30%	0.30%
10	100000000	0.00%	0.30%	0.30%
100	100000000	0.00%	0.30%	0.30%
1000	100000000	0.01%	0.30%	0.29%
10000	100000000	0.10%	0.30%	0.20%
100000	100000000	0.99%	0.30%	-0.69%
1000000	100000000	9.09%	0.30%	-8.79%
10000000	100000000	50.00%	0.30%	-49.70%
100000000	100000000	90.91%	0.30%	-90.61%
1000000000	100000000	99.01%	0.30%	-98.71%
4.99999	10000000	0.00%	0.30%	0.30%
499.900015	10000000	0.05%	0.30%	0.25%
4990.01498	10000000	0.50%	0.30%	-0.20%
49014.80247	10000000	4.67%	0.30%	-4.37%
413223.1405	10000000	29.24%	0.30%	-28.94%
1250000	10000000	55.56%	0.30%	-55.26%
413223.1405	10000000	29.24%	0.30%	-28.94%
49014.80247	10000000	4.67%	0.30%	-4.37%
4.99999	50000000	0.00%	0.30%	0.30%
49.9990001	50000000	0.00%	0.30%	0.30%

x: Amount of token X added to pool by swapper

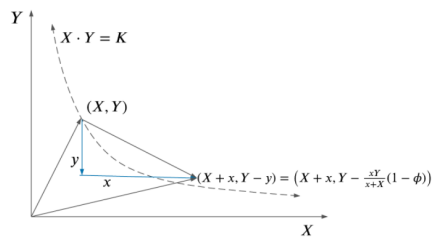
X: Amount of token X already in the pool

Slip-Based Fee: The fee paid by swappers and collected by poolers

When swappers are swapping low volume relative to the pool, they pay less in fees than on Uniswap. When they are swapping high volume relative to the pool, they pay more in fees than on Uniswap (negative fee savings implies the fee on Sifchain is higher than on Uniswap). Swappers benefit under normal conditions while poolers benefit during periods of high volatility when swappers are willing to pay more in fees to change their position. **In a single market cycle, swappers and poolers "both" profit more under the Sifchain swap fee than the Uniswap fee.** Further research - <https://github.com/Thorchain/Resourses/blob/master/Auditor/THORChain-Gauntlet-CLPReport-Nov2020.pdf>

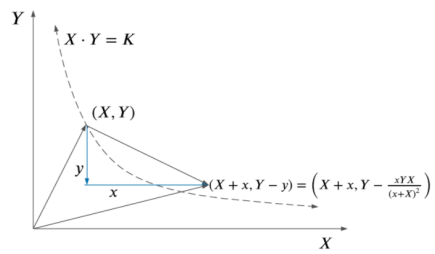
Fee Derivation from <https://hackmd.io/RV6K2LSYJR1yeNCoHpVY2hg>

Constant Product Market Maker: Flat Fee



There is an implementation of uniswap in cadCAD and an overview with video of the model.

Thorchain "Slip fee" (CLP)



This can be viewed as setting the fee  $\phi$  according a regularizing rule that penalizes slippage and thus larger transactions, incentivizing smaller transactions, but also introduces angles for gaming the system to minimize fees. The derivation can be found in the [Thorchain docs](#).

Comparing:

$$y_{sl} = \frac{xY}{x+X}(1-\phi)$$

with

$$y_{slp} = \frac{xYX}{(x+X)^2} = \frac{xY}{x+X} \frac{X}{x+X}$$

so

$$(1-\phi) = \frac{X}{x+X} = 1 - \frac{x}{x+X}$$

this is simply choosing a functional fee, as

$$\phi = \frac{x}{x+X}$$



499.900015	5000000	0.01%	0.30%	0.29%		
4990.01498	5000000	0.10%	0.30%	0.20%		
49014.80247	5000000	0.97%	0.30%	-0.67%		
413223.1405	5000000	7.63%	0.30%	-7.33%		
1250000	5000000	20.00%	0.30%	-19.70%		
413223.1405	5000000	7.63%	0.30%	-7.33%		
49014.80247	5000000	0.97%	0.30%	-0.67%		
0.19999992	1000000	0.00%	0.30%	0.30%		
1.999992	1000000	0.00%	0.30%	0.30%		
19.99920002	1000000	0.00%	0.30%	0.30%		
199.920024	1000000	0.02%	0.30%	0.28%		
1992.023936	1000000	0.20%	0.30%	0.10%		
19223.37562	1000000	1.89%	0.30%	-1.59%		
138888.8889	1000000	12.20%	0.30%	-11.90%		
22222.2222	1000000	18.18%	0.30%	-17.88%		
45351.47392	1000000	4.34%	0.30%	-4.04%		
0.19999992	5000000	0.00%	0.30%	0.30%		
1.999992	5000000	0.00%	0.30%	0.30%		
19.99920002	5000000	0.00%	0.30%	0.30%		
199.920024	5000000	0.00%	0.30%	0.30%		
1992.023936	5000000	0.04%	0.30%	0.26%		
19223.37562	5000000	0.38%	0.30%	-0.08%		
138888.8889	5000000	2.70%	0.30%	-2.40%		
22222.2222	5000000	4.26%	0.30%	-3.96%		
45351.47392	5000000	0.90%	0.30%	-0.60%		
19.99920002	5000000	0.00%	0.30%	0.30%		
199.920024	5000000	0.00%	0.30%	0.30%		
1992.023936	5000000	0.04%	0.30%	0.26%		
19223.37562	5000000	0.38%	0.30%	-0.08%		
138888.8889	5000000	2.70%	0.30%	-2.40%		
22222.2222	5000000	4.26%	0.30%	-3.96%		
45351.47392	5000000	0.90%	0.30%	-0.60%		
4950.372516	5000000	0.10%	0.30%	0.20%		
499.5003748	5000000	0.01%	0.30%	0.29%		
19.99920002	50000	0.04%	0.30%	0.26%		
199.920024	50000	0.40%	0.30%	-0.10%		
1992.023936	50000	3.83%	0.30%	-3.53%		
19223.37562	50000	27.77%	0.30%	-27.47%		
138888.8889	50000	73.53%	0.30%	-73.23%		
22222.2222	50000	81.63%	0.30%	-81.33%		
45351.47392	50000	47.56%	0.30%	-47.26%		
4950.372516	50000	9.01%	0.30%	-8.71%		
499.5003748	50000	0.99%	0.30%	-0.69%		
1992.023936	50000	3.83%	0.30%	-3.53%		
19223.37562	50000	27.77%	0.30%	-27.47%		
138888.8889	50000	73.53%	0.30%	-73.23%		
22222.2222	50000	81.63%	0.30%	-81.33%		
45351.47392	50000	47.56%	0.30%	-47.26%		
4950.372516	50000	9.01%	0.30%	-8.71%		
499.5003748	50000	0.99%	0.30%	-0.69%		
49.99500037	50000	0.10%	0.30%	0.20%		
4.99995	50000	0.01%	0.30%	0.29%		
1992.023936	500	79.94%	0.30%	-79.64%		
19223.37562	500	97.46%	0.30%	-97.16%		
138888.8889	500	99.64%	0.30%	-99.34%		
22222.2222	500	99.78%	0.30%	-99.48%		
45351.47392	500	98.91%	0.30%	-98.61%		
4950.372516	500	90.83%	0.30%	-90.53%		
499.5003748	500	49.98%	0.30%	-49.68%		
49.99500037	500	9.99%	0.30%	-8.79%		
4.99995	500	0.99%	0.30%	-0.69%		
0.00499999	1000000	0.00%	0.30%	0.30%		
0.00499990001	1000000	0.00%	0.30%	0.30%		
0.0499900015	1000000	0.00%	0.30%	0.30%		
0.499001498	1000000	0.00%	0.30%	0.30%		
4.901480247	1000000	0.00%	0.30%	0.30%		
41.32231405	1000000	0.00%	0.30%	0.30%		
125	1000000	0.01%	0.30%	0.29%		
41.32231405	1000000	0.00%	0.30%	0.30%		
4.901480247	1000000	0.00%	0.30%	0.30%		
0.0499999	1000000	0.00%	0.30%	0.30%		
0.499990001	1000000	0.00%	0.30%	0.30%		
4.99900015	1000000	0.00%	0.30%	0.30%		
49.9001498	1000000	0.00%	0.30%	0.30%		
490.1480247	1000000	0.05%	0.30%	0.25%		
4132.231405	1000000	0.41%	0.30%	-0.11%		
12500	1000000	1.23%	0.30%	-0.93%		
4132.231405	1000000	0.41%	0.30%	-0.11%		
490.1480247	1000000	0.05%	0.30%	0.25%		

<a href="#">Swap ETH for erow...</a>	<a href="#">Swap ETH for erow...</a>	<a href="#">Swap erowan for ETH</a>		\$3,931
\$3,931	\$3,931	\$1,341		\$3,931
1.6791	1.6791	2,198		\$1,341
ETH	ETH	erow...		\$1,638
6,517	6,517	0.5853		\$1,638
erow...	erow...	ETH		\$4,374
<a href="#">0x5285...d214</a>	<a href="#">0x5285...d214</a>	<a href="#">0x0d4a...1852</a>		\$884.99
37 minutes ago	38 minutes ago	3 hours ago		\$884.99
<a href="#">Swap ETH for erow...</a>	<a href="#">Swap ETH for erow...</a>	<a href="#">Swap erowan for ETH</a>		\$114.41
\$1,638	\$1,638	\$4,374		\$954.36
0.7	0.7	7,000		\$954.36
ETH	ETH	erow...		\$5,680
2,784	2,784	1.9115		\$542.20
erow...	erow...	ETH		\$542.20
<a href="#">0xfdb9...3a6c</a>	<a href="#">0xfdb9...3a6c</a>	<a href="#">0x322e...cd90</a>		\$403.14
44 minutes ago	45 minutes ago	3 hours ago		\$2,338
<a href="#">Swap erowan for ETH</a>	<a href="#">Swap erowan for ETH</a>	<a href="#">Swap ETH for erowan</a>		\$2,338
\$884.99	\$884.99	\$114.41		\$4,969
1,518	1,518	0.05		\$1,211
erow...	erow...	ETH		\$1,211
0.3781	0.3781	178.6617		\$1,356
ETH	ETH	erow...		\$162.37
<a href="#">0x811b...954f</a>	<a href="#">0x811b...954f</a>	<a href="#">0x6a3d...6ffa</a>		\$162.37
45 minutes ago	46 minutes ago	3 hours ago		\$6,139
<a href="#">Swap ETH for erow...</a>	<a href="#">Swap ETH for erow...</a>	<a href="#">Swap ETH for erowan</a>		\$5,843
\$954.36	\$954.36	\$5,680		\$5,843
0.4085	0.4085	2,482		\$3,497
ETH	ETH	ETH		\$2,719
1,631	1,631	9,096		\$2,719
erow...	erow...	erow...		\$4,697
<a href="#">0x73d5...ed75</a>	<a href="#">0x73d5...ed75</a>	<a href="#">0x6367...8925</a>		\$2,434
54 minutes ago	54 minutes ago	3 hours ago		
<a href="#">Swap ETH for erow...</a>	<a href="#">Swap ETH for erow...</a>	<a href="#">Swap erowan for ETH</a>		
\$542.20	\$542.20	\$403.14		
0.232	0.232	664.3322		
ETH	ETH	erow...		
932.3409	932.3409	0.1761		
erow...	erow...	ETH		
<a href="#">0x28fd...b0fe</a>	<a href="#">0x28fd...b0fe</a>	<a href="#">0xa9bd...ed49</a>		
55 minutes ago	56 minutes ago	3 hours ago		
<a href="#">Swap ETH for erow...</a>	<a href="#">Swap ETH for erow...</a>	<a href="#">Swap erowan for ETH</a>		
\$2,338	\$2,338	\$4,969		
1	1	8,000		

ETH	ETH	erow...		
4,071	4,071	2.1711		
erow...	erow...	ETH		
<a href="#">0x300d...ea86</a>	<a href="#">0x300d...ea86</a>	<a href="#">0x7a25...488d</a>		
1 hour ago	1 hour ago	3 hours ago		
<a href="#">Swap erowan for F</a>	<a href="#">Swap erowan for F</a>	<a href="#">Swap ETH for erowan</a>		
\$1,211	\$1,211	\$1,356		
2,138	2,138	0.593		
erow...	erow...	ETH		
0.5194	0.5194	2,138		
ETH	ETH	erow...		
<a href="#">0x0c24...2d63</a>	<a href="#">0x0c24...2d63</a>	<a href="#">0x15d4...abbb</a>		
1 hour ago	1 hour ago	3 hours ago		
<a href="#">Swap ETH for ero</a>	<a href="#">Swap ETH for ero</a>	<a href="#">Swap ETH for erowan</a>		
\$162.37	\$162.37	\$6,139		
0.07	0.07	2.6839		
ETH	ETH	ETH		
285.0524	285.0524	10,000		
erow...	erow...	erow...		
<a href="#">0xedf5...eb79</a>	<a href="#">0xedf5...eb79</a>	<a href="#">0xaf1c...ee61</a>		
1 hour ago	1 hour ago	3 hours ago		
<a href="#">Swap erowan for F</a>	<a href="#">Swap erowan for F</a>	<a href="#">Swap ETH for erowan</a>		
\$5,843	\$5,843	\$3,497		
10,009	10,009	1.53		
erow...	erow...	ETH		
2.506	2.506	5,950		
ETH	ETH	erow...		
<a href="#">0x10b1...376f</a>	<a href="#">0x10b1...376f</a>	<a href="#">0x7a51...1857</a>		
1 hour ago	1 hour ago	3 hours ago		
<a href="#">Swap erowan for F</a>	<a href="#">Swap erowan for F</a>	<a href="#">Swap erowan for ETH</a>		
\$2,719	\$2,719	\$4,697		
4,500	4,500	8,000		
erow...	erow...	erow...		
1.1705	1.1705	2.0561		
ETH	ETH	ETH		
<a href="#">0x7a25...488d</a>	<a href="#">0x7a25...488d</a>	<a href="#">0x7a25...488d</a>		
1 hour ago	1 hour ago	4 hours ago		