How do AMMs compare to limit order books (LOBs) with respect to metrics such as complexity and expressiveness? We offer answers to these questions in joint work with @ciamac @Tim_Roughgarden: https://arxiv.org/abs/2302.11652 Details👇 1/n

For example, it is common for people to say that if you had "infinite gas," you would use a LOB and not a CFMM. But there's nothing formal that establishes even an intuition of why this should be the case. 2/n

We introduce a theoretical framework for reasoning about generic exchange mechanisms between two assets that allows us to discuss simultaneously CFMMs and LOBs, as well as more general exchange mechanisms, from the perspective of liquidity providers (LPs). 3/n

In our framework, LPs have preferences (in the form of asset demand curves) that they would ideally submit to the exchange they participate in. An exchange mechanism, however, restricts LPs for efficiency reasons, allowing only conical combinations of predetermined demand curves.

Simple example: consider a CFMM. LPs are constrained in submitting a single "liquidity" parameter to the exchange; the aggregate demand curve of the exchange can then only be a positive multiple of some fixed demand curve (for a Uniswap v2 pool, this fixed demand curve is $1/\sqrt{p}$).

LOBs with discrete ticks are part of our design space of exchange mechanisms, where the restriction is that combinations of limit orders are piecewise constant functions at discrete ticks. 6/n

More generally, we define an exchange's (description) complexity as the size of the minimal set of basis functions that generate, through their conical hull, all the demand functions allowed by the exchange. We classify the complexity of popular AMMs, including Uniswap v3. 7/n

An LP is presumably interested in finding the conical combination of basis functions that allows them to optimally approximate their preferred asset demand curve. But how much approximation error must the LP suffer? 8/n

The key contribution of our work is to quantify the fundamental trade-off between the complexity of an exchange and its expressibility, as measured by its ability to approximate arbitrary preferences of LPs. 9/n

Consider an AMM designer that wants to minimize the worst-case LP approximation error, subject to a constraint on the AMM's complexity. We prove matching (up to constant factors) upper and lower bounds to give such a complexity - approximation error guarantee. 10/n

As a case study, we show how to interpret Uniswap v3's design in terms of our complexity - approximation trade-off. 11/n

Quick note: a demand curve is not the same as the trading curve of a CFMM. For details, check our paper linked above. Comments/feedback/questions on our framework and results are very welcome! 12/n