Time-Bounded Market Efficiency

Sanketh*

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Abstract

We study market efficiency relative to time-bounded agents. Following Hasanhodzic et al. [HLV11], we define a market to be T-*efficient* if no strategy using at most T time can have expected return in excess of equilibrium return. We show that, for polynomial T, T-efficient markets can have market spikes assuming that there exist secure pseudorandom functions. Further, we show that a strategy A with access with asymptotically more time than strategy B can outperform strategy B. Our results can be seen as evidence that volatile markets do not rule out market efficiency.

1 Introduction

Informally speaking, a market is *efficient* if it reflects all available information. One way to formalize this is using the *random walk model* which posits that successive price changes are independent and identically distributed; i.e., prices follow a random walk. See Fama [Fam70] for a survey of theoretical and empirical work on the efficient market hypothesis.

In this paper, we are going to use the computational definition of market efficiency due Hasanhodzic et al. [HLV11].

Definition 1.1 ([HLV11])**.** A market is *efficient* with respect to resources S if no strategy using resources S can generate a substantial profit.

But, in this paper, we are going to fix the resources under consideration to be time.

Definition 1.2. A market is T-*efficient* if no strategy using at most T time can have expected return in excess of equilibrium return.

References

[Fam70] Eugene F. Fama. Efficient capital markets: A review of theory and empirical work. *The Journal of Finance*, 25(2):383–417, 1970. doi:10.2307/2325486.

[HLV11] Jasmina Hasanhodzic, Andrew W. Lo, and Emanuele Viola. A computational view of market efficiency. *Quantitative Finance*, 11(7):1043–1050, 2011. arXiv:0908.4580, doi:10.1080/14697688.2010.541487.

*https://c1own.com

A My Email

This is an email I wrote one of the authors of [HLV11]. This paper is an expansion of this thought.

> Perhaps this is obvious from your paper, but one can shove hard problems into predicting the sign of next return. The native "let's put 3SAT into it" doesn't seem to work but one can instead use a randomly seeded PRF and let the return of the ith day be the output of the PRF on input i. More precisely, you pick a subexponentially secure PRF and run it only polynomially many times (assume that the stock dies after polynomially many days.) You also assume, as usual in TCS, that the agent is polynomial-time bounded. Your main results also seem to hold in this model:
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> 1. spikes are possible, and
> 2. an agent with exponential-time can break the PRF and make a lot of money. (Also, by messing with the PRF you can get an analog of your Claim 2.5 and a more fine-grained version of (2).) (The "feeding-off" stuff may also be possible in this model, but I haven't thought too much about it.)
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> (Technical aside: as usual, the PRF is public knowledge but the seed is kept private.) Of course, all these results would be conditioned on complexity theoretic or cryptographic assumptions.