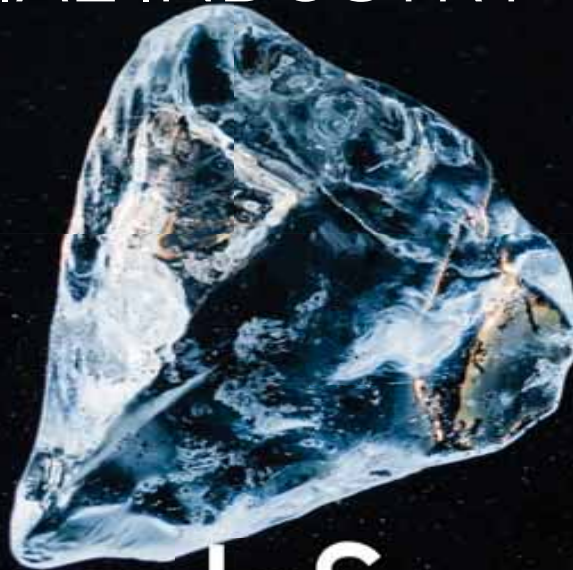


QUANTUM COMPUTING

FOR THE FINANCIAL INDUSTRY



JoS
QUANTUM

Markus C Braun | 6 November 2018



"Nature isn't classical . . . and if you want to make a simulation of Nature, you'd better make it quantum mechanical, and by golly it's a wonderful problem, because it doesn't look so easy."

Richard Feynman, 1981

ECONOMICS LACKS LABS

useful finance takes into consideration the true randomness and complexity of the markets

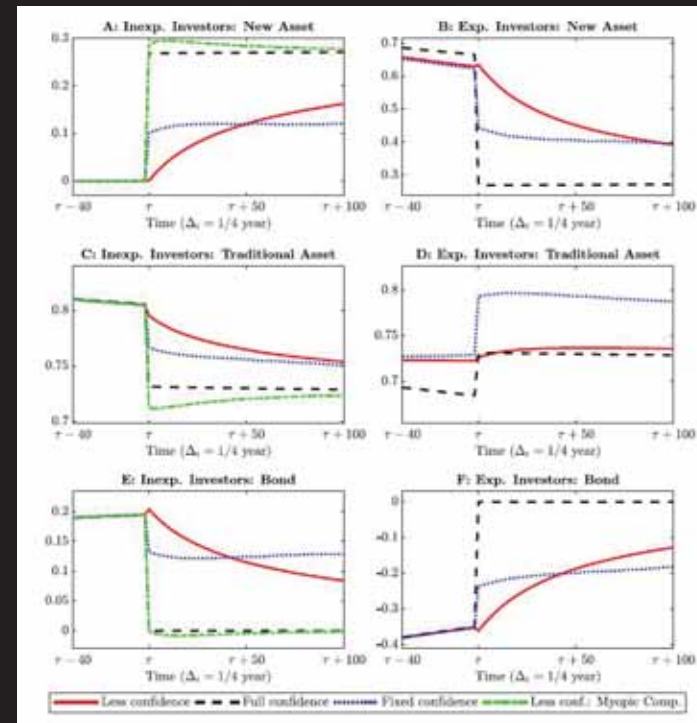
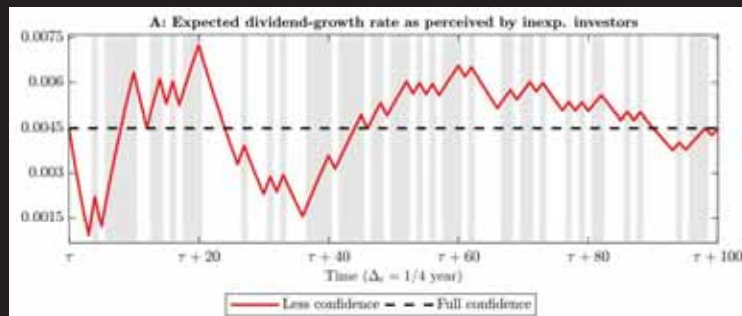


FROM TOY MODELS TO SIMULATIONS

there is no true verification of financial models

Implications of Financial Innovations

- Financial markets are being transformed by the rapid pace of financial innovation
- Optimal asset-allocation decisions of investors that get access to a new asset
- Should we expect inexperienced investors, such as households, who are not fully confident about the new asset, to include it in their portfolios at all?



FRAUD DETECTION LACKS POWER

the amount of global data is rising exponentially



FRAUD AS MASSIVE HPC PROBLEM

quantum computing can massively increase positive positive rates of fraud detection models



recognize dependencies in large matrices



evaluate suspicious behaviour of customers



advance through quantum machine learning

RISK MANAGEMENT LACKS MODELS

current models are only designed to meet regulatory requirements



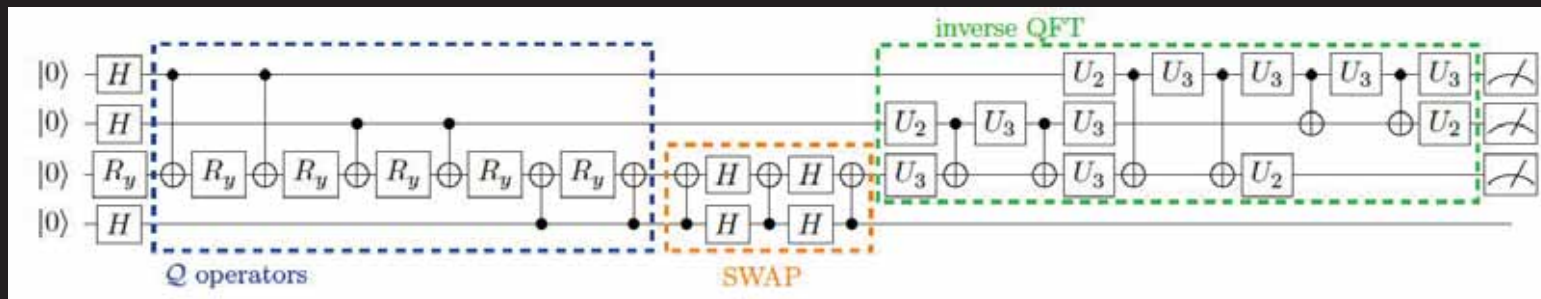
THE MAGIC BULLET MONTE-CARLO

entrenched method for modelling financial pricing and risk using derived risk metrics such as option pricing, risk sensitivities and Value at Risk

problems in financial engineering focus on estimating a specific value

quantum systems bringing the Monte Carlo Simulation quadratically beyond classical bounds

Improvements are expected and further work on algorithms promise more



FINANCE LACKS IDEAS

current models are based on hardware limitations, this leads to many assumptions



OPTIMIZATION FOR MAX REVENUE

many optimization problems are NP-hard, the area where QC fully shows it's potential

DYNAMIC PORTFOLIO OPTIMIZATION

Computing an optimal trajectory for a portfolio under realistic assumptions

TRADING

Solving of optimal paths for multi-asset arbitrage trading involving large number of assets

OPTION PRICING

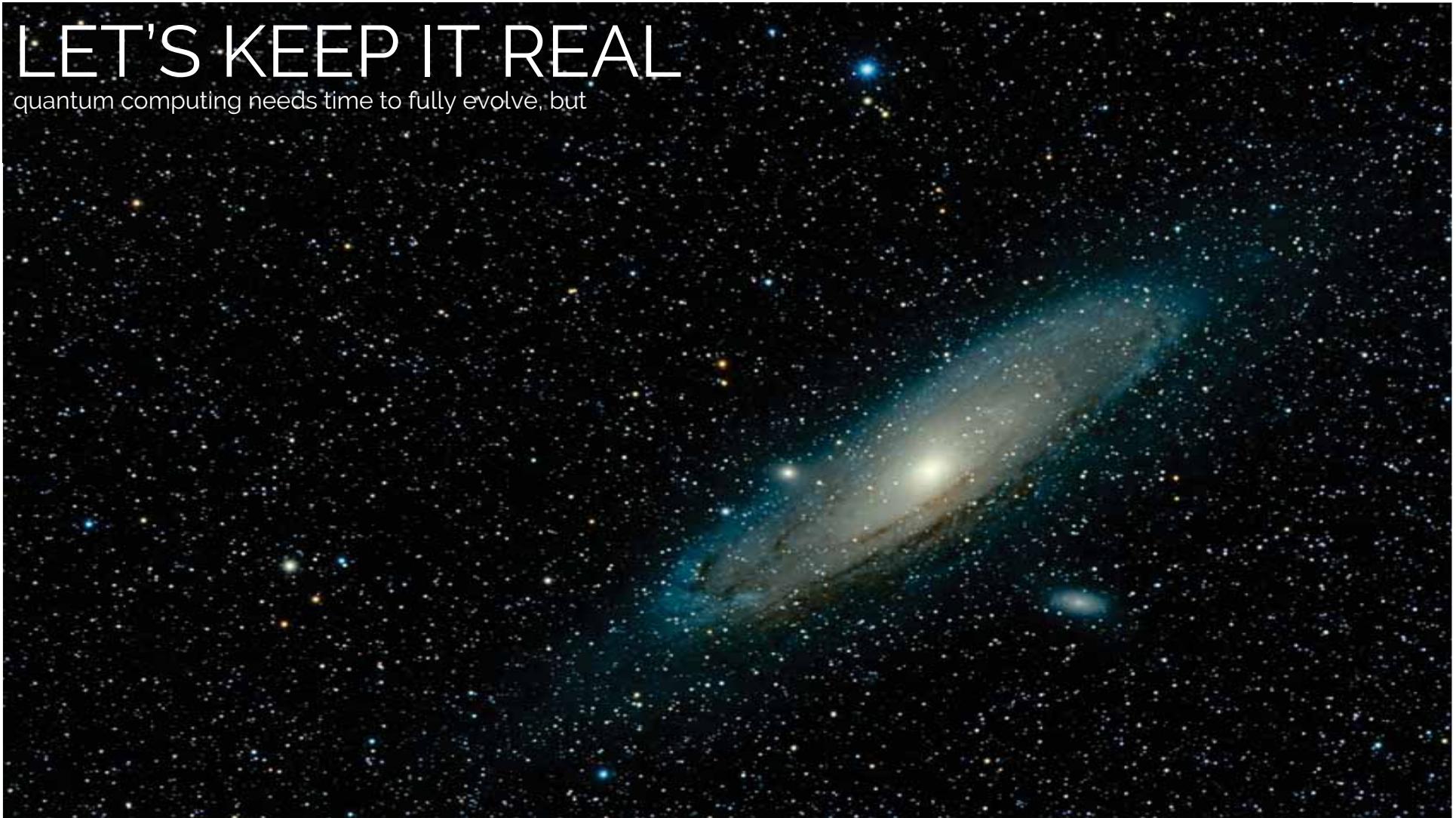
Complex derivatives are path dependent. Evaluating a huge amount of paths within short time.

CLUSTERING

Replace heuristics with a brute force search over a large number of observations

LET'S KEEP IT REAL

quantum computing needs time to fully evolve, but



THANK YOU



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