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Our Thoughts on Quantum Computing's Immediate Future

Interesting how fast market sentiments can change. When we wrote this article about 12 days ago the pundits and journalists were greeting Quantum Computing (QC) like the Second Coming of AI and investors were gleefully bidding up every stock that could make even a vague claim to "quantum alignment." Since then, Jim Cramer and Nvidia CEO Jen-Hsun Huang have made statements similar to ours, and stock prices for quantum issues have deflated like a Calvin and Hobbes water-balloon. ***Seldom have we had our position validated quite this quickly.***

Quantum computing stocks (were?) are among the hottest in the market. QC garners interest from institutional and retail investors, driven by its potential to advance the frontiers of (e.g.) cryptography, pharmaceuticals, and materials science.

Investors responded to QC's development potential by spectacularly bidding up shares of several stand-alone QC hardware producers… For 2024,

Quantum Computing (QUBT) up 1,910% (on the strength of its contract with Goddard Space Center)
Rigetti Computing (RGTI) up 1,635%,
D-Wave Quantum (QBTS) up 866%
IonQ (IONQ) and Arquit (ARQQ) look like laggards with "mere" 260% gains.

All these companies except IonQ traded in penny-stock range as late as August of last year, Most were (and remain) pre-revenue or barely producing.

Q: ***With gains like this, why has Cambyses Advisors not urged our clients to buy into QC?*** (We have, after all, been researching and tracking QC companies for nine years now.)

A: ***We believe analysts', pundits', and investors' QC enthusiasm is based on unrealistic assessments and expectations for an immature technology whose path to monetization is anything but assured.*** Whiz Bangs notwithstanding, QC faces technical and market hurdles that make it very difficult, if not impossible, to pick winners and survivors from losers and bankrupts.

Much of the 2024 media and investor enthusiasm for QC centered on hardware. Google's (December 9th) introduction of the Willow chip was the latest breakthrough for QC last year. Willow's ability to perform complex high-speed calculations in minutes instead of septillions of years even sparked and fueled abstruse discussions of multiverse theory. Major players have significant investments in QC technology (e.g., Microsoft, Amazon, Quantiniuum, NASA, US government defense and security agencies, Chinese government agencies)

Qubit numbers are increasing (QC computers getting "bigger"). Fidelity and accuracy remain focal issues. Bottom line, QC's primary data units (qubits) are delicate creatures – information encoded in them is easily and frequently compromised. QC operates exponentially faster than standard technology – errors propogate exponentially as well. IBM and Microsoft-Quantiniuum have introduced error correction code and/or alternative qubit "materials" (logical qubits and trapped ions) to address QC's high error rates: However, until satisfactory ways to sustain qubits' integrity evolve, QC may be truly usable only in applications that employ successive approximations. While that is a critical subset of potential applications (cryptography, simulation, optimization, and modeling algorithms) it may not be a sufficiently large customer universe to sustain the technology's monetization

Quantum hardware faces network scalability and integration issues as well. Only the largest QC producing companies have made the technology available in either a cloud-networked environment or hybrid arenas (e.g., accessible and responsive to the installed base of "standard computer equipment.")

Breakthroughs in QC hardware are largely chimeric. Application software for QC is idiosyncratic in terms of structure, purpose and function. At present and for the foreseeable future, QC can't do anything particularly useful but it sure can do it quickly. There have been no major additions to QC's problem-solving repertoire since the Quantum Approximate Optimization Algorithm debuted in 2014. NISQ (Noisy Intermediate-Scale Quantum) limitations force current quantum algorithms to depend, like their classical counterparts, on approximate-heuristic approaches. The advantage in that is difficult to characterize.

One might think that AI boosts QC. However, massive investments in AI and data center tech, accompanied by QC's ongoing NISQ issues militate against that conclusion. AI can expand in the cloud in relatively incremental economic steps using application tested technology and software, e.g., through Nvidia's evolving GPU technology, Micron's high bandwidth memory (HBM), and ARM's unit cores. These "standard computing solutions," available right now, may preempt and delay QC's introduction.

The upshot here – Quantum Computing is not quite ready for prime time. Absent a "Miracle Scenario" [1] QC's current hardware and software limitations make it extremely unlikely that the upswing we have witnessed in the last 6 months is sustainable. ***Smart investors will wait on the sidelines for 2-3 years and then revisit this segment***.

In the short run, we predict a sharp decline in the lofty valuations that prevail right now – and good luck trying to market -time the decline. In the long term, we predict a whole lot of unhappy speculative investors who forgot a fundamental rule – return on investment depends as much on how long it takes to monetize an advantage as it does on how high that advantage carries the market.

Becoming a "Pioneer Quantum Computing Investor" could be exciting (not necessarily in a good way) but may not be all it is touted to be. It is easy to locate the "Pioneer" in the picture: They are the ones with buffalo hoofprints on their backs.

[1] see Sydney Harris' classic blackboard illustration.