Cryptos' doppelganger

In the California gold rush, the vendors of picks and shovels famously out-earned the starry-eyed Forty-Niners. The history of the crypto rush of 2017–18 is yet to be written, but Nvidia Corp. (NVDA on the Nasdaq) is the top-ranked pick-and-shovel merchant of the bubble in digital tokens.

Now in progress is a bearish analysis of a certified 21st-century super-stock. Besides being the mainstay chip maker of a crypto-mining stampede, Nvidia is a dominant presence in consumer gaming, artificial intelligence, machine learning, autonomous driving and computer graphics. Its stock is up by 634% since year-end 2015. The arc of the NVDA share price resembles the price chart of the prelapsarian bitcoin.

Nvidia is a one-product company, that one product being the essential general-purpose graphics-processing unit. GPUs power gamers and miners alike, in that order of commercial importance. At the heart of your personal computer, laptop or iPad is a CPU, or central processing unit, a jack-of-all-trades microchip that takes orders from an operating system to run its many programs. A GPU is a specialized chip that performs mathematically complex calculations simultaneously. It relieves the CPU from performing processing-intensive calculations in order, say, to render the changing frames in *The Legend of Zelda* or crunch the equations required to verify changes on a blockchain.

GPUs earmarked for crypto miners accounted for 9% of total Nvidia sales in the quarter ended April 29, the company says. "Earmarked" is the qualifier. As gamer and miner 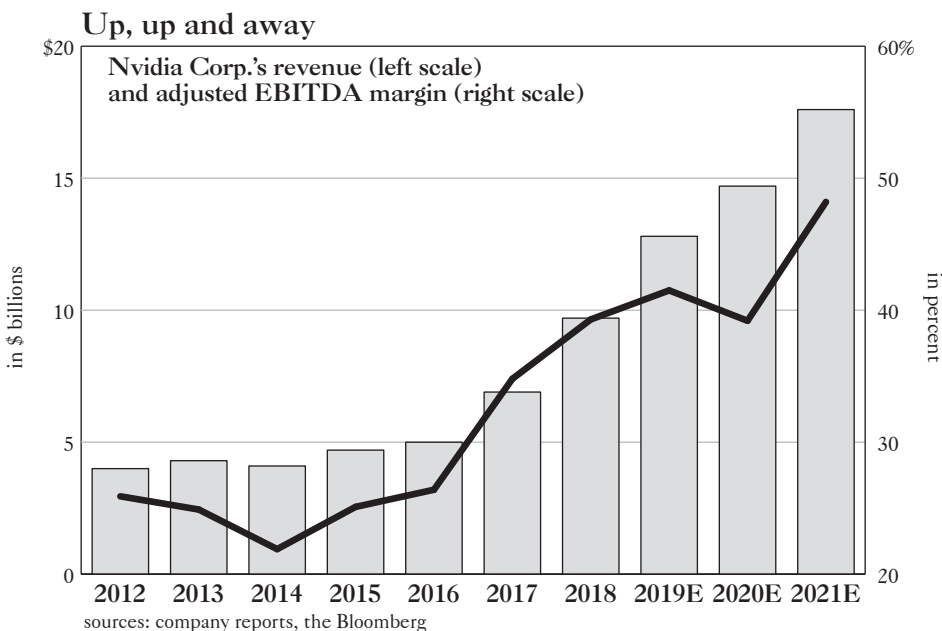GPUs are interchangeable, 9% almost certainly understates the contribution of cryptocurrency mining to Nvidia's resplendent gains. Gamers used to pay $200 to $600 for high-performance memory boards—add-in boards, they're called. Then came the crypto rush, and AIBs commanded as much as $1,500 (the inflated increment filling the pockets of the retailers rather than those of Nvidia). In sync with the decline in prices of crypto tokens (and thus in the profitability of crypto-mining), the prices for AIBs have begun to edge lower.

Nvidia's growth has been just as stunning as you'd expect it to be, with sales leaping by 46%, to $11 billion, in the 12 months through April 29. The gaming and data-center divisions produced 57% and 20%, respectively, of total revenues, followed by "professional visualization," chipping in 9% (applications for industries ranging from media and entertainment to oil and gas production); original equipment manufacturing and intellectual property, another 9% (low price/low performance graphics chips for the PC market and royalty income); and automotive, 5% (entertainment and automated driving).

Margins are lush and—so the analysts say—are bound to become lusher. They've leapt to 39.3% in fiscal 2018 from 26.4% in fiscal 2016, and are supposedly on their way to 48.2% in fiscal 2021 (margins being defined as adjusted EBITDA, or earnings before interest, taxes, depreciation and amortization, divided by sales).

We all should age as gracefully as the digital-gaming business. The customers are hooked early, finding *Grand Theft Auto* more exciting than

Up, up and away

Nvidia Corp.'s revenue (left scale) and adjusted EBITDA margin (right scale)

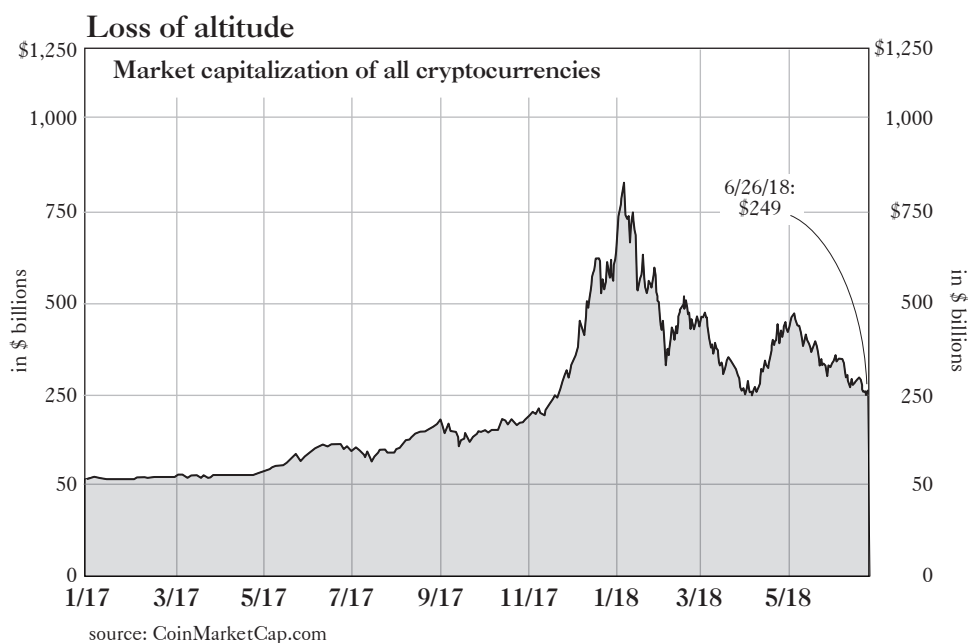sources: company reports, the Bloomberg

their Latin homework. The kids grow up, but they don't grow out of video games. *Minecraft* and *Call of Duty* now soak up spare minutes that might be otherwise spent in studying for the CFA exam or feeding the children. In 2003, according to Nvidia, around three-quarters of gamers were younger than 35, whereas, today, about half are older than 35. Seemingly cognizant of these interesting facts, the World Health Organization has recognized "gaming disorder" in its new International Classification of Diseases.

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GPUs are the brains, or at least the tutors, in artificial intelligence and machine learning. Consider the not-so-simple task of teaching an AI system to recognize the picture of an apple. You can't just point to a McIntosh. You have to teach by main force, parading millions of images through the system, allowing the GPU to discover the mathematical relationships that define the concept of "apple." Nvidia's GPUs are essential for this computationally intensive schooling. The Nvidia datacenter DGX-1 with Tesla V100 can perform 1,000 trillion floating-point math operations per second in deep learning—something no human, perhaps few extraterrestrials, could hope to do by hand.

Nvidia has positioned itself to capture the vast majority of this data-center business. In 2007, it released the first version of a software suite to allow programmers to control every aspect of a GPU. Today, Compute Unified Device Architecture is on version 9.2 and more than 850,000 software developers have trained on the CUDA platform. Advanced Micro Devices, Inc. came up with its answer to CUDA, Radeon Open Compute Platform, only in 2016.

Management of Nvidia is almost as bullish as the Street on the company it leads. At the March investor day, executives compared the total addressable market for data-center products, $50 billion, with their own $2.2 billion in trailing data-center revenues, as well as the total addressable automotive market, $60 billion, with their own trailing automotive sales of $563 million. A fully autonomous car, explained Nvidia's automotive vice president, Rob Csongor, will need to make "hundreds of trillions of operations per second." Without Nvidia's GPUs, "[t]he only way to do that today is a

Loss of altitude

Market capitalization of all cryptocurrencies

6/26/18: $249

source: CoinMarketCap.com

trunk full of PCs," Csongor continued. "And in this situation, it's running in thousands of watts, tens of thousands of dollars of costs, and obviously, a lot of complexity." In other words, the market needs Nvidia's chips.

No serious competition threatens any key market, the front office went on to assert. "So I believe that our market share is approximately 90-plus-percent today of accelerated data centers," said CEO and co-founder Jen-Hsun Huang. "The reason why I say '90-plus' even though I feel it's probably 100% [is] because I'm just not sure. In fact, I just said something that's consistent for every single market we serve. Our market share of gaming GPUs is 90-plus-percent of revenue share, probably 100% of profit share. Our revenue share of workstations today is 90-plus-percent, 100% of profit share. Our market share of accelerated computing is 90-plus-percent, 100% of profit share."

"This is only slightly hyperbolic," affirms Deputy Editor Evan Lorenz. "Since 2015, Nvidia has lost shares to AMD in the add-in boards desktop GPU gaming market. But Nvidia is the dominant GPU provider in data centers, workstations and accelerated computing."

A short-seller will find no more cause for hope in Nvidia's balance sheet than in its earnings history. As of April 29, cash and marketable securities, net of debt, summed to $5.3 billion. Nvidia trades at 39.6 times trailing adjusted earnings and at 31.7 times trailing en-

terprise value to adjusted EBITDA. Of the 42 analysts who cover the stock, 28 rate NVDA a buy. Only two say sell.

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The bear case begins with the mad rush to mine crypto gold. The combined market cap of the digital tokens crested at more than $800 billion in January, up from less than $18 billion on Dec. 31, 2016. Many a fortune was minted in that $782 billion-plus ascent, and not a few fortunes were erased in the subsequent fall to $249 billion. Still and all, the number of coins outstanding has doubled to 1,590 today from 828 last summer (*Grant's*, July 28, 2017).

Markets proverbially write the news, so crypto prices have plunged to the accompaniment of negative headlines. There was nothing very novel about the $71 million hack this month at a pair of South Korean crypto exchanges—burglary comes with the digital territory. Newsier was the publication of a paper by two academics at the McCombs School of Business at the University of Texas at Austin contending that the price of bitcoin has been systematically rigged. John M. Griffin and Amin Shams, authors of a previous analysis addressing the possibility that the VIX was manipulated, marshal evidence to show that the bitcoin prices levitated on the back of some jiggery pokery with tether.

Tether, no ordinary crypto, is supposedly collateralized by the U.S. dollar—for each tether token there is alleged to be one greenback on deposit. How odd,

then, *Grant's* marveled last year, that Tether, Ltd., which had lost access to U.S. dollar correspondent banking, was nonetheless able to build its market cap to $364.9 million from $53.9 million (see the issue dated Sept. 8, 2017). Little did we know; today, tether outstanding tower in the sum of $2.7 billion.

Tether is no crypto afterthought. Think of it as the coin of the digital-trading realm or a kind of regulatory work-around. Mindful of the heavy penalties for running afoul of the know-your-customer and money-laundering rules, banks for the most part want nothing to do with the crypto exchanges. Thus, according to Griffin and Shams, more crypto transactions are denominated in tether than in U.S. dollars.

Thus, the significance of the fact that corporate Tether, in its management and ownership, is intermingled with Bitfinex, the world's largest cryptocurrency exchange. "By mapping the blockchains of bitcoin and tether, we are able to establish that entities associated with the Bitfinex exchange use tether to purchase bitcoin when prices are falling," write Griffin and Shams. "Such price-supporting activities are successful, as bitcoin prices rise following the periods of intervention. These effects are present only after negative returns and periods following the printing of tether."

It's likewise curious, the authors continue, that tether-funded purchases of bitcoin on Bitfinex typically take place when the price of bitcoin falls below multiples of $500. Odd, too, they note, to discover non-random end-of-month trading patterns during months of heavy tether issuance.

"Overall," conclude Griffin and Shams, "our findings provide substantial support for the view that price manipulation may be behind substantial distortive effects in cryptocurrencies." Late last year, the Commodity Futures Trading Commission issued subpoenas to Bitfinex and Tether. In May, the Department of Justice, which is working with the CFTC, launched a criminal investigation into bitcoin price manipulation.

Tether's retort to Griffin and Shams was a June 20 report by the law firm of Freeh, Sporkin & Sullivan, LLP that vouched for the existence of $2.5 billion in deposits at two unnamed banks—though whether those funds collateralized tether alone or were intermingled with Bitfinex accounts was unclear. Last

Friday, Philip Potter, the chief strategy officer of both Bitfinex and Tether and one of only six executives listed on Bitfinex's website, resigned from the two companies. Prior to his departure, Potter had declined to comment to *Grant's*.

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Before the crypto bubble, the demand for high-performance memory boards varied with the quality of new video-game releases. Perhaps it will again. Falling crypto prices, by denting the returns to digital mining, have also dampened the demand for high-end GPUs.

Lorenz explains why, and what may happen next:

Assuming you mine ethereum with an Nvidia GTX 1070 graphics card, which is capable of 32 mega-hashes per second, you will earn only $17.83 per month after deducting the cost of electricity (assuming 11 cents per kilowatt hour), according to CryptoCompare.com. A GTX 1070 retails for around $450 and requires a computer that costs $1,000-plus, i.e., the prospective payback period on such a rig is now 6.8 years.

Then, too, the mineable crypto universe is much smaller than it first appears and will decline in the future. First, some coins, like ripple (an $18.4 billion market cap), eos ($7 billion) and stellar ($3.5 billion), are not mineable. Subtracting the $70 billion worth of non-mineable coins leaves us an addressable market of $179.2 billion.

The algorithm for mining bitcoin is very computationally intensive. While GPUs are good tools for making many calculations simultaneously, they are not optimized to do the specific math required to mine bitcoin. Beginning in 2013, specialty semiconductor companies began producing application-specific integrated circuits (ASICs) to mine bitcoin. These specialized chips are orders of magnitude faster than GPUs at hashing the bitcoin blockchain and do so with less electricity. The widespread adoption of ASICs on computationally intensive blockchains that include bitcoin, litecoin and dash reduces the mineable universe available to GPUs to $54.3 billion.

Bitmain Technologies Ltd., a closely held Chinese company, is the biggest producer of crypto ASICs. Through direct ownership or investments, Bitmain controls approximately half of all the mining pools in bitcoin. If any one group controls 51% or more of a blockchain, that operator can stop, reorder and cancel transactions on that blockchain. This causes understandable angst among the crypto cognoscenti.

To combat the threat of ASICs, newer initial coin offerings have crafted blockchain algorithms that are memory-intensive, rather than computationally-intensive. The biggest of the memory-intensive cryptos is ethereum, which, with a $44.3 billion market cap, comprises 81% of the addressable universe for GPU-based miners. On April 3, Bitmain announced it had created an ASIC designed to mine ethereum.

Not standing still, Vitalik Buterin, the co-founder of ethereum, has announced a change to how the coin will be mined: By the end of the year, coins will be allocated to miners who deposit ethereum for the right to mine (proof-of-stake) rather than miners who do the most hashes on the ethereum blockchain (proof-of-work). This has two important effects: First, it removes the advantage of ASICs over GPUs. Second, it ends the arms race among miners to invest in the fastest GPU as mining essentially becomes a way to earn interest on deposited coins. When this change happens (it is expected later this year), the universe of coins that users can mine by investing in the fastest GPUs will slip to $10.4 billion.

GPU demand for crypto miners is down. On its May 10 earnings call, Nvidia told analysts that it expects sales of its GPUs designed specifically for crypto-mining to decline by 66% between the first and second quarters. As noted earlier, gamers have had trouble sourcing GPUs due to insatiable crypto demand and retailers were able to charge significant premiums to MSRPs. With crypto demand waning, Nvidia expects the second quarter to be buoyed by pent-up gaming demand.

The risk to the gaming division, which accounts for 57% of trailing revenues, has several aspects. First, revenues may decline after demand is satisfied. Miners bought the highest specified, most expensive cards in order to win more coins by mining. As mining demand decreases, Nvidia may sell a greater mix of lower-priced and, perhaps, lower-margin cards. There is also a risk that miners may sell their GPUs if mining is no longer profitable.

"Subjectively, I can tell you that we think we see an increase in that, and that we see newer boards being offered [on auction sites like eBay]," Jon Peddie, the president and eponym of Jon Peddie Research, Inc., a research boutique that focuses on graphics hardware, told *Grant's*. "In the past, if you followed the [add-in boards] offerings on eBay, which we do casually, you would see two- to three-year-old boards being offered as people replaced their previous boards with new ones. Now we're seeing new-generation boards being

offered, which, to me, is an indication that some of the miners are bailing out."

All-purpose GPUs are, for now, the tools of choice to accelerate artificial intelligence and machine-learning systems, as Sewon Chun, senior vice president of memory marketing at Samsung Electronics Co., Ltd., remarked the other day. But GPUs are a "very expensive solution," Chun added. The hunt is on for a cheaper alternative.

Alibaba Group Holding Ltd., Microsoft Corp., Facebook, Inc. and other big tech firms are hiring engineers to develop their own AI/ML chips. Alphabet, Inc., the parent company of Google, announced version 3 of its tensor processing unit in May; the TPU is a chip designed specifically for AI applications. While Google is not selling its TPUs to other firms, anyone can rent TPU processing time on Google cloud servers.

In an April 26 blog post, Elmar Haussmann, co-founder and chief technology officer of RiseML, a machine-learning boutique, found that TPU version 2 compares favorably to Nvidia's top chips. "[T]he current pricing of the Cloud TPU allows [one] to train a model to 75.7% on ImageNet from scratch for $55 in less than 9 hours!" Haussmann exulted. "Training to convergence at 76.4% costs $73. While the [Nvidia] V100s perform similarly fast, the higher price [$88–$129] and slower convergence of

the implementation results in a considerably higher cost-to-solution."

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The competition to win the autonomous-driving race proceeds at 100 miles an hour. According to a June 20 report by the consulting firm AlixPartners, automakers and upstarts like Uber Technologies, Inc. plan to commit $61 billion to develop driverless cars. Unfortunately, the sensors, computing power and systems that make autonomous driving possible do not come cheap. The AlixPartners report pegs the cost at $22,900 per copy. Nvidia reckons its contribution to that cost at a few thousand dollars.

You wonder how the arithmetic works. In May, the average new light vehicle retailed at $35,635 according to *Kelley Blue Book*. Adding $22,900 would raise the price of a new car to $58,535, just shy of a year's median household income. AlixPartners polled consumers about how much they would be willing to pay for the convenience of a car that drives itself: $2,300 came the reply. So, at the moment, there is somewhat of a bid-ask spread.

To date, chips to power entertainment consoles have been Nvidia's automotive mainstay; autonomy remains a hope. The auto segment showed year-over-year growth of 4% in the first quarter of fiscal 2019, a far cry from the 15% recorded in fiscal 2018, let alone the 52% in 2017 and 75% in 2016. The

company is betting on its Drive fleet of products, geared to autonomy, to reaccelerate growth.

The race is too close to call. "I definitely see it as a strong opportunity for Nvidia, but I also feel like Intel with their acquisition of Mobileye is also well-positioned," Abhinav Davuluri, of Morningstar, one of two analysts who rates Nvidia a sell (only because growth will slow, not because he is fundamentally bearish on the business), advises Lorenz. "Mobileye sells a ton of content into cars today for functions like emergency braking, lane-departure warning, etc. They've begun scaling up the capabilities of their solutions to basically bridge the gap from Level 2/3 autonomy to Level 4/5, versus Nvidia, which is focusing on the end-all, be-all [i.e., full autonomy, or Level 5] from the start. I think it is going to be a race to the middle or whatever is feasible."

"Hodler" is the defiantly mistyped self-descriptor of the true-blue bitcoin believer who has learned never to sell his beloved tokens, no matter how steep the pullback. Your editor, a kind of gold hodler, understands the mindset, if not the digital-asset class. Anyway, the Nvidia insiders aren't hodling their superstock. Over the past 12 months they've sold 925,909 shares for net proceeds of $184.2 million. The average price of insider sales is $198.95, 22% below the current price. Follow the leaders.

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