OUR 2017 PICKS WERE UP 34% — AND CRUSHED THE MARKET

FORTUNE

FORTUNE.COM
DECEMBER 15, 2017

ASIA PACIFIC EDITION
NUMBER 16

2018 INVESTOR'S GUIDE

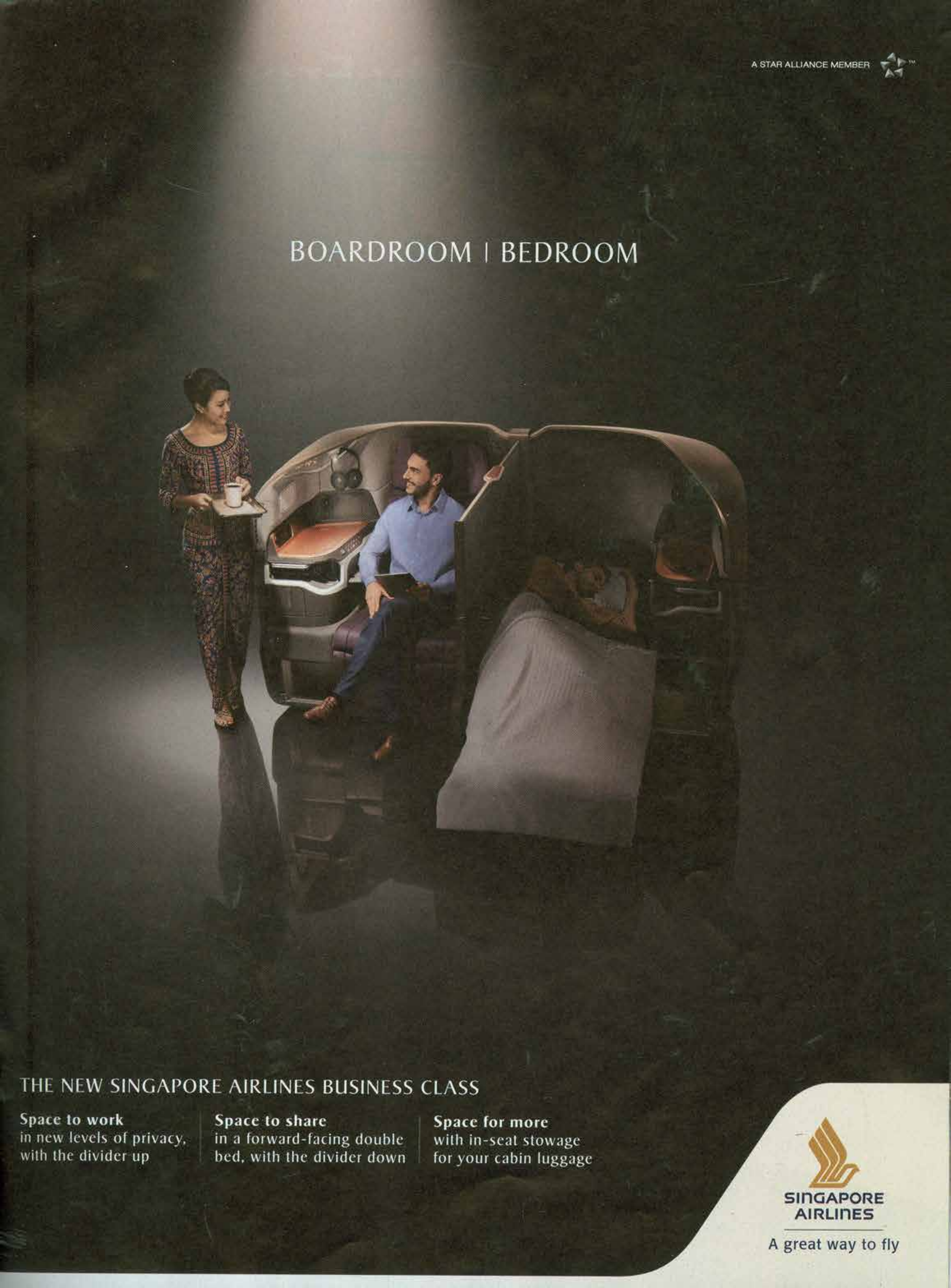
IS "BET ON TECH" THE ONLY STRATEGY YOU NEED?

31 STOCKS THAT ARE READY TO SOAR

THE HEDGE FUND THAT WILL DO ANYTHING TO WIN

THIS MAN IS BUILDING A BETTER BITCOIN


ROLEX
GENEVE
CELLINI MOONPHASE



A STAR ALLIANCE MEMBER
BOARDROOM | BEDROOM
THE NEW SINGAPORE AIRLINES BUSINESS CLASS
Space to work
in new levels of privacy, with the divider up
Space to share
in a forward-facing double bed, with the divider down
Space for more
with in-seat stowage for your cabin luggage
SINGAPORE AIRLINES
A great way to fly


Dubai Duty Free
WORTH FLYING FOR
SHOP AT DUBAI DUTY FREE
Over 38,000 sq. metres of spectacular shopping.
Thousands of limited editions and travel exclusives.
Hundreds of the world's most desirable brands.
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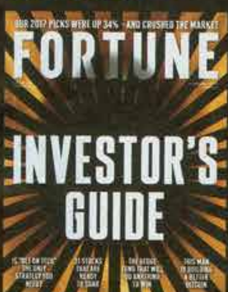
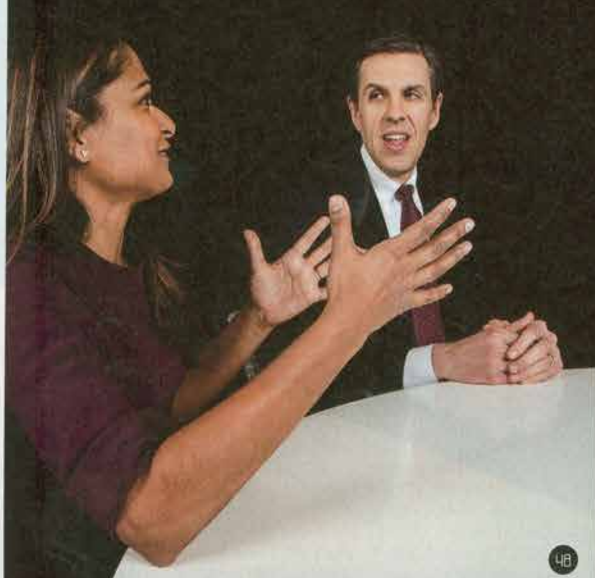


▲ ON THE COVER: PHOTOGRAPH BY STEPHEN LEWIS

Expert analysis from panelists Savita Subramanian, BofA Merrill Lynch, and David Giroux, T. Rowe Price.



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O COURTESY OF IMPOSSIBLE FOODS

Fortune Asia (ISSN 0738-5587) is published monthly, with extra issues in March, June, September, and December, by Time Asia (Hong Kong) Limited. *Fortune* Asia may also publish occasional extra issues. Customer Service and Subscriptions: For 24/7 service, please use our website: fortune.com/customerserviceasia. You may also contact Customer Services Center at 852-3128-5688, or email to enquiries@timeasia.com or write to Time Asia (Hong Kong) Limited, 37/F Oxford House, Taikoo Place, 979 King's Road, Quarry Bay, Hong Kong. Subscribers: If the postal authorities alert us that your magazine is undeliverable, we have no further obligation unless we receive a corrected address within two years. Mailing List: We make a portion of our mailing list available to reputable firms. If you would prefer that we not include your name, please contact Customer Services Center. Member, Audit Bureau of Circulations. *Fortune* Asia is printed in Singapore. Singapore MCI (P) 061/11/2016. Malaysia KKDN permit no. PPS1162/05/2013 (022950).

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CORRECTIONS

"Benioff in Bloom" (Nov. 1) misidentified a company Salesforce acquired as Exact Data. The company Salesforce bought is ExactTarget. The story also misspelled the name of a Salesforce partner, Apttus.

"Alphabet's Guru of Googley Rigor" (Dec. 1) mistakenly said the company's human resources group is part of its "real estate and workplace services" organization. It is a stand-alone organization.

© TOP RIGHT: COURTESY OF NAADAM

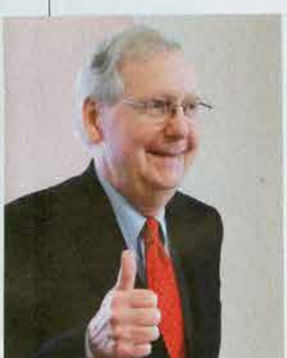
FOREWORD

A MARKET SOBRIETY CHECK

AS THIS ISSUE WAS GOING TO PRESS, the U.S. Senate passed a tax-cut bill that, should it become law, will almost certainly energize the animal spirits of American corporations. Republicans in the Senate and the House still have a bit of cloakroom legerdemain to do before there's a final 500-page piece of legislation for the President to sign. But in the end, businesses will surely get a grab bag of goodies, from a dramatically reduced corporate tax rate to more favorable rules on expensing capital investments—much of which they've been pining after for years.

For investors, the people who actually own these public companies, the news ought to be just as rosy. After all, if corporations are paying less to Uncle Sam, then there will be more profit to parse out to shareholders. Companies might choose to do that indirectly, by reinvesting the extra cash in a new factory or business that will generate future growth—or they might boost their share price by buying back stock. (A number of firms have already suggested they'll do the latter.)

But before you race to your broker with a buy order of your own, please take a few minutes to read Shawn Tully's sobering feature in this issue, "When Will the Profit Boom Fizzle?" (see page 76). Indeed, as much as tax-cut giddiness may fill the market's sails for a while, there are long-term factors that are likely to keep stocks moored. It comes down to earnings, says Tully, a sage and seasoned reporter who has long been *Fortune*'s economy whisperer. A rare confluence of factors, from stagnant labor costs to rock-bottom interest rates to (at least in 2017) a falling dollar, has juiced corporate profits so that their share of America's economic pie "has swelled while the slice going to labor has shrunk," he explains. As a percentage of GDP, corporate profits have paced well above their long-term average, just as wages and salaries have tracked well below theirs.



Senate Majority Leader Mitch McConnell after rounding up the votes to pass the tax-reform bill.

Only now, the rubber band is snapping back, Tully writes: "Labor costs are rising, interest rates are poised to trend higher, and the greenback is starting to strengthen."

If Wall Street has noticed, it doesn't seem to care: It keeps bidding up share prices with the expectation that companies can keep growing profits at a rate much faster than the economy as a whole—as if somehow they could "break loose from economic gravity," says Tully, quoting the late Milton Friedman. The price-to-earnings ratio for the S&P 500 is now a precarious 24.3, up from 18.9 in September 2014. Imagine that index as one big company, Tully says. "Investors who three years ago paid less than $19 for $1 of earnings now pay $24.30"—a nearly 30% premium for the same buck of profit.

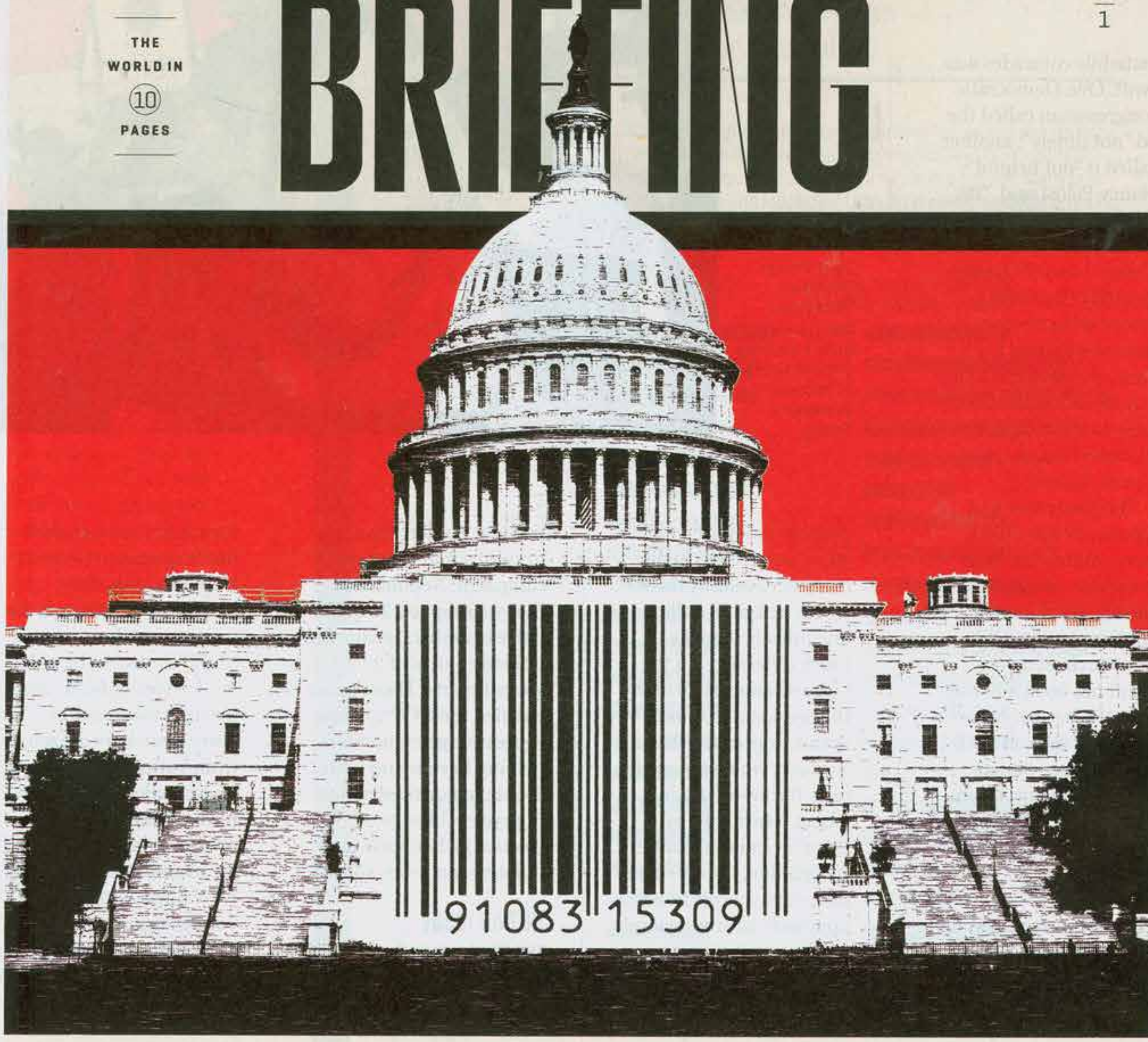
That's not to say there aren't investments well worth making right now—and you'll find 31 of them in "The All-Tech Portfolio" on page 36. (Last year's *Fortune* picks returned 34%, trouncing the broader market.) Features editor Matt Heimer, who has once again masterfully shepherded this year-end guide, also leads a fascinating and informative conversation with five top investing pros (see page 48).

Yes, they've got some views on the tax cut too—but you may be surprised at what our experts say matters to the market perhaps even more.

CLIFTON LEAF
Editor-in-Chief, *Fortune*
@CliftonLeaf

THE WORLD IN 10 PAGES

BRIEFING



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For Most Donors, Politics Is a Lousy Investment

Well-heeled activists love to lavish money on their favorite candidates and causes. But if government really is for sale, why do so few know how to buy it?

By Christopher Glazek

POLITICS

EVERYONE BEMOANS the huge gobs of money swirling through politics. We grouse about K Street lobbyists and backroom deals and the grinding cynicism of TV campaign ads—all fueled by historic levels of outside spending on elections.

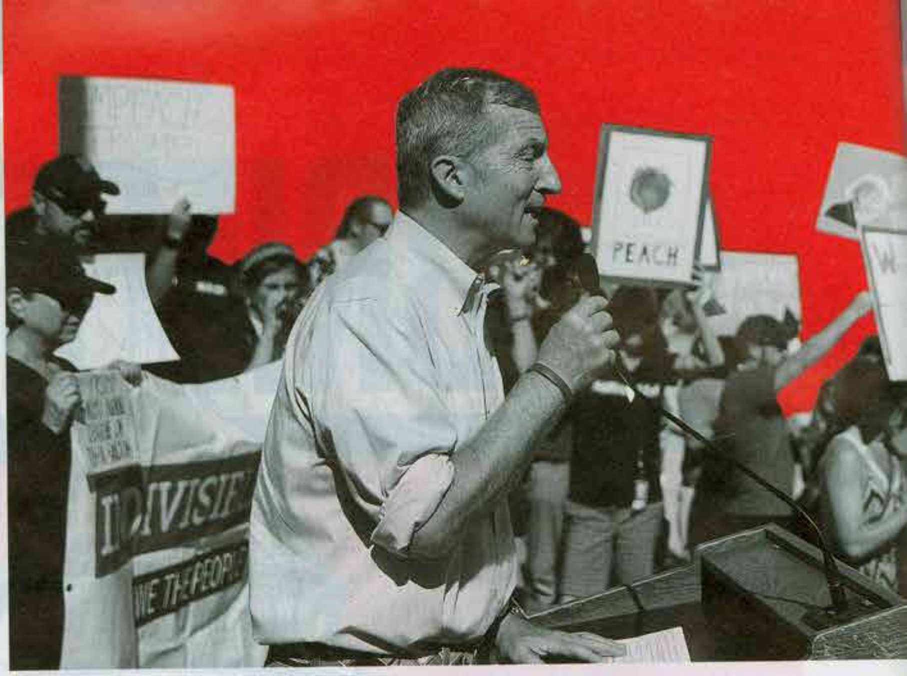
But the truth is, very few big donors are getting much bang for their buck. Witness Tom Steyer: When the hedge fund billionaire turned Democratic sponsor sank $10 million of his personal fortune into a television ad demanding the impeachment of Donald Trump, the blowback from his ▷▷

▲ PHOTO ILLUSTRATION BY **TRES COMMAS**

erstwhile comrades was swift. One Democratic congressman called the ad "not timely"; another called it "not helpful"; Nancy Pelosi said, "It's not someplace I think we should go." And Donald Trump himself taunted gleefully that Steyer "never wins elections." Armed with this feedback, Steyer doubled his buy to $20 million and launched a matching billboard campaign in Times Square.

But the critics had a point. While Steyer, a committed environmentalist, is one of the biggest donors in contemporary politics, his return on investment has been abysmal. In 2014, he spent more than $50 million on TV ads for seven Senate and gubernatorial campaigns. His success rate? Just 43%—worse than a coin toss.

As this is *Fortune*'s annual Investor's Guide, we thought we'd offer a bit of constructive counseling to the Steyers of the world. As with any market, there are good political bets and bad ones—and plenty of arbitrage openings for wily investors of all ideological stripes. If you're going to play kingmaker, you might as well proceed with sophistication.



Tom Steyer [at a San Francisco rally] has spent millions on a campaign to impeach President Trump.

FORGET THE WHITE HOUSE

IN BUSINESS, it's a truism that competition drives profits to zero. In politics, though, capital is often attracted to highly contested, splashy races—where marginal dollars are unlikely to make much difference. In the biggest races, particularly the presidential, most spending goes to television ads, which famously obey the law of diminishing returns. TV is great for building name recognition, but its value decreases sharply as ads approach saturation levels.

The smart money in politics, as in business, seeks to entrench advantages. Perhaps the quintessential example of canny electioneering took place in 2010, with Republicans' Redistricting Majority Project (Redmap). That year, a small group of donors, including the U.S. Chamber of Commerce and a pair of tobacco companies, spent $30 million on several dozen state legislative races. Though unglamorous, those seats held the key to congressional redistricting. For less than the price of a mid-tier Senate campaign, Republicans that year flipped 20 legislative chambers, achieving unified control of 25 state governments. Those gains enabled the GOP to draw aggressive gerrymanders, helping to shore up their House majority even during cycles (like the 2012 election) when their candidates won fewer votes.

BUY AN ISSUE

THE KEY to spending money effectively in politics, says Sean McElwee, a left-wing policy analyst with Demos Action, is to ignore high-profile races in favor of "structural interventions" that fundamentally change the state of play. The best recent example, he says, is the business-backed push by Republicans to pass Right to Work laws in states like Michigan, Missouri, and Wisconsin. The laws, which limit dues collection, hobbled many unions—and in turn throttled a crucial funding stream for state Democrats. A similarly effective strategy for progressive donors, says McElwee, could be pushing for voting rights restoration for ex-felons. Not every state bars citizens from voting after serving a criminal sentence, but in those that do, the impact is huge. In Florida, for example, it affects 1.5 million—10% of the voting-age population in a crucial swing state.

TARGET WISELY

FOR THE GOP, as the 2018 elections loom, consultant Chris Jankowski says Republican donors will need to think creatively to identify opportunities in what is expected to be a bear market for the party. Jankowski, who masterminded Redmap in 2010, recommends tracking concentrations of college-educated voters to inform a strategy of triaging vulnerable incumbents while finding places to play offense. Districts in pricey media markets with lot of college graduates—like the Orange County, Calif., seat held by Darrell Issa—are likely to be money pits. On the other hand, there are areas with large numbers of working-class whites who voted for Trump in 2016 where the GOP may be able to unseat Democratic incumbents. "If you're an outside donor," Jankowski says, "you have to look at a seat as a seat and be honest about the demographics."

On the Democratic side, a clear-eyed strategy may require looking beyond candidate races. Stephen Wolf, elections analyst at the liberal website Daily Kos, says persuasion advertising is less effective in partisan races because, in a hyperpolarized climate, few voters are actually persuadable. Ballot initiatives, on the other hand, are nonpartisan, and are more likely to register an impact from ads. Wolf says proposals that expand the franchise—like automatic voter registration—have a good electoral track record, and could strengthen Democrats' hand in future races.

That kind of slow-burn advocacy, in pursuit of long-term dividends, isn't as sexy as traditional campaign donations to charismatic candidates. But the smart money knows that politics isn't about how well you play—it's about how well you stack the deck. ■

TAX REFORM

HOW OVERTAXED ARE WE?

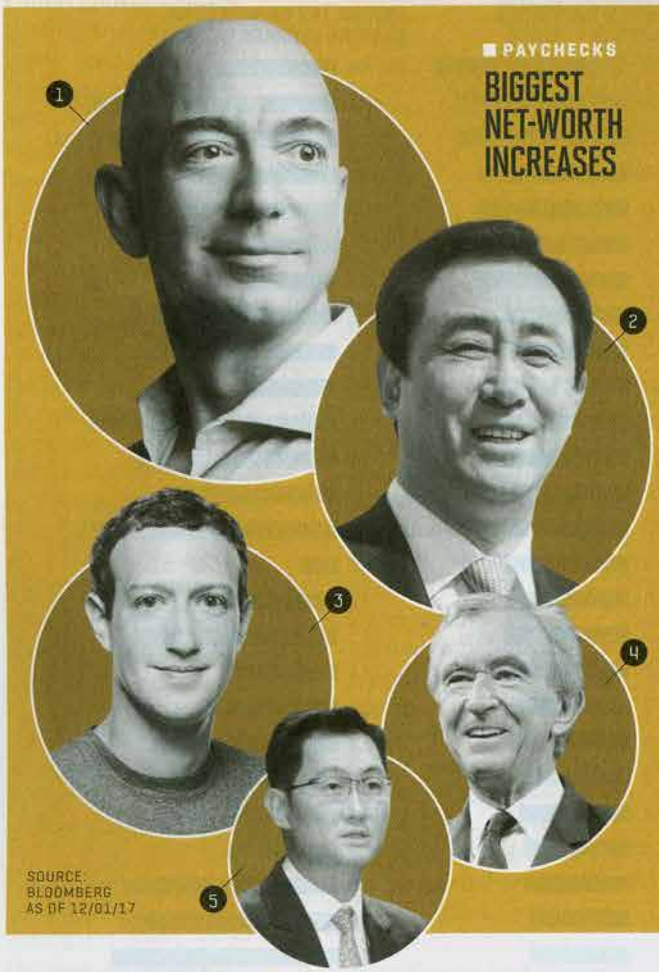
The U.S. has the highest statutory corporate tax rate of any country in the Organization for Economic Cooperation and Development (OECD). But that figure, of course, comes with a caveat. Many businesses use breaks and loopholes to avoid paying the whole amount. And personal income taxes in the U.S. are below average.

	COMBINED CORPORATE INCOME TAX*	INCOME TAX ON WORKERS EARNING AVERAGE WAGES**
UNITED STATES	**38.9%**	**31.7%**
FRANCE	34.4	48.1
BELGIUM	34.0	54.0
GERMANY	30.2	49.4
AUSTRALIA	30.0	28.6
MEXICO	30.0	20.1
JAPAN	30.0	32.4
PORTUGAL	29.5	41.5
GREECE	29.0	40.2
NEW ZEALAND	28.0	17.9
ITALY	27.8	47.8
LUXEMBOURG	27.1	38.4
CANADA	26.7	31.4
AUSTRIA	25.0	47.1
CHILE	25.0	7.0
NETHERLANDS	25.0	37.5
SPAIN	25.0	39.5
KOREA	24.2	22.2
ISRAEL	24.0	22.1
NORWAY	24.0	36.2
DENMARK	22.0	36.5
SWEDEN	22.0	42.8
SWITZERLAND	21.1	21.8
SLOVAK REP.	21.0	41.5
ESTONIA	20.0	38.9
FINLAND	20.0	43.8
ICELAND	20.0	34.0
TURKEY	20.0	38.1
CZECH REP.	19.0	43.0
POLAND	19.0	35.8
SLOVENIA	19.0	42.7
U.K.	19.0	30.8
IRELAND	12.5	27.1
HUNGARY	9.0	48.2

* ALL LEVELS OF GOVERNMENT, TOP MARGINAL CORPORATE TAX RATES **INCL. SOCIAL SECURITY SOURCE: OECD

The 2017 Best in Business

THIS YEAR BROUGHT HEADY DAYS for business: Stocks broke records, we got a new iPhone, and cryptocurrencies soared. But 2017 also saw its share of scandals, purges, and reckonings. Here, *Fortune*'s chronicle of the people, companies, trends, gadgets, hacks, and tweets that mattered most this year.



SOURCE: BLOOMBERG AS OF 12/01/17

■ PAYCHECKS

BIGGEST NET-WORTH INCREASES

1.
JEFF BEZOS
+$33.1 billion
Net worth: $98.5 B

The Amazon chief became the world's richest person this year as his company stock soared.

2.
HUI KA YAN
+$27.5 billion
Net worth: $34.9 B

The real estate tycoon is now China's richest man.

3.
MARK ZUCKERBERG
+$22.3 billion
Net worth: $72.2 B

Facebook blew past Wall Street expectations in 2017.

4.
BERNARD ARNAULT
+$22.1 billion
Net worth: $61.3 B

Luxury was good to the boss of LVMH Moët Hennessy Louis Vuitton.

5.
PONY MA
+$18.2 billion
Net worth: $39 B

Internet giant Tencent kept up its mega-growth.

■ OBSESSIONS

BEST/WORST INVESTMENT, AND WILDEST RIDE: BITCOIN

INVESTING IN BITCOIN is like riding Six Flags' Kingda Ka. The highs are stratospheric, and the lows will crush you under cheek-flapping g-forces. Late this year the price of one Bitcoin surged past $11,000, up from less than $1,000 on Jan. 1—a 1,000% return. But investors also got a taste of what a bust might feel like when the cryptocurrency lost $1,000 in a span of 10 minutes on Nov. 29. Hope you don't get queasy. —**ROBERT HACKETT**

■ BUYING IN BULK

BEST COMMODITIES: INDUSTRIAL METALS

OF ALL MAJOR commodities this year, it was the price of metals (led by zinc) that grew the fastest. Credit strong demand from Chinese industry.

SOURCE: BLOOMBERG

■ EPHEMERA

BIGGEST IPO: SNAP

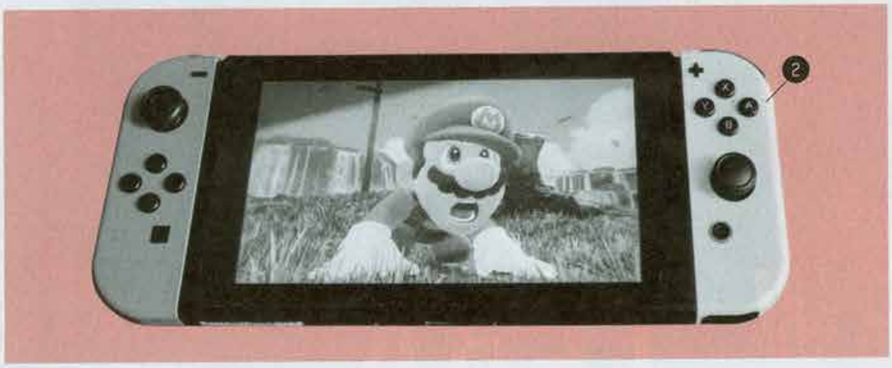
THE MAKER of Snapchat raised $3.4 billion in its IPO (2017's largest). But by year-end, 50% of its shares' peak value had disappeared.

BEZOS: WESLEY MANN; YAN: JUSTIN CHIN—BLOOMBERG VIA GETTY IMAGES; ZUCKERBERG: COURTESY OF FACEBOOK; ARNAULT: CHRISTOPHE MORIN—IP3/GETTY IMAGES; MA: YAN YAN—IMAGINECHINA

■ TECH

MOST GAME-CHANGING NEW GADGETS

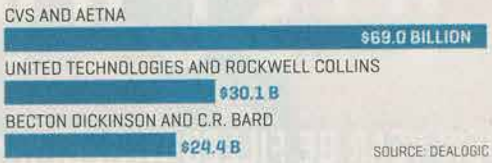
IN FIRST PLACE: the **iPhone X,** Apple's latest and greatest mini-supercomputer, with an OLED screen and groundbreaking facial ID. In second, the **Nintendo Switch,** an ingenious $300 handheld that's also a TV console. Third? **Amazon Key,** a service and camera system that lets the Amazon delivery guy inside your house. (How much do you trust Jeff Bezos?) —**AARON PRESSMAN**



■ CONSCIOUS UNCOUPLING

BIGGEST BREAKUP: **GENERAL ELECTRIC**

GE'S NEW CEO, John Flannery, announced plans this October to unload $20 billion in assets of the ailing conglomerate, in a sale that may include two of its oldest divisions: transportation, and the remainder of the lighting business started by Thomas Edison. The onetime icon of American business is 73% smaller than it was in 2000. —**LUCINDA SHEN**



■ M&A

BIGGEST ANNOUNCED U.S. MERGERS

The pairing of one of the largest drugstores and largest insurers will shake up health care.

■ I CAN SEE RUSSIA FROM MY HOME PAGE

BEST DAMAGE CONTROL: **SHERYL SANDBERG**

AFTER EVIDENCE emerged that the Kremlin used Facebook's ad machine to promote political division in the U.S.—including a real-life Texas secession rally—COO Sheryl Sandberg went to Washington to reassure Congress that the company cares about the issue. Facebook's response includes not-so-subtle steps like eliminating the ability to target categories such as "Jew hater" from its ad offerings, and a planned tool that will let users find out if they inadvertently liked or followed Russian propaganda accounts in 2016. Will this be enough to stave off the new regulatory measures Facebook fears? It's too soon to say if Congress will say *da* or *nyet* to the company's proposed solutions. —**JEFF JOHN ROBERTS**

SWITCH: WACHIRAWIT LEMLERKCHAI—ALAMY; IPHONE: COURTESY OF APPLE; CLOUD CAM: COURTESY OF AMAZON; SANDBERG: PATRICK T. FALLON—BLOOMBERG VIA GETTY IMAGES

■ CYBER INSECURITY

THE YEAR'S WORST BREACHES

THE MOST damaging and disturbing corporate data theft revelations of 2017.

146 M

PEOPLE AFFECTED BY EQUIFAX BREACH

For months, a hacker group hoovered up the credit giant's prized data: including names, birth dates, addresses, and Social Security numbers, in an attack that likely affected almost half the U.S. population.

3 B

USER ACCOUNTS COMPROMISED IN YAHOO BREACH

In October, the tech giant revealed it had underestimated by billions the number of people affected by a 2013 data breach [already the world's largest], in which thieves stole names, emails, phone numbers, and more.

57 M

PEOPLE AFFECTED BY UBER BREACH

The ride-hailing giant disclosed this year it had engaged in a cover-up: paying hackers $100,000 to keep quiet about a trove of customer data they stole.

—ROBERT HACKETT

■ BAD WEATHER

BEST DISASTER RESPONSE: **GAP AND TJX**

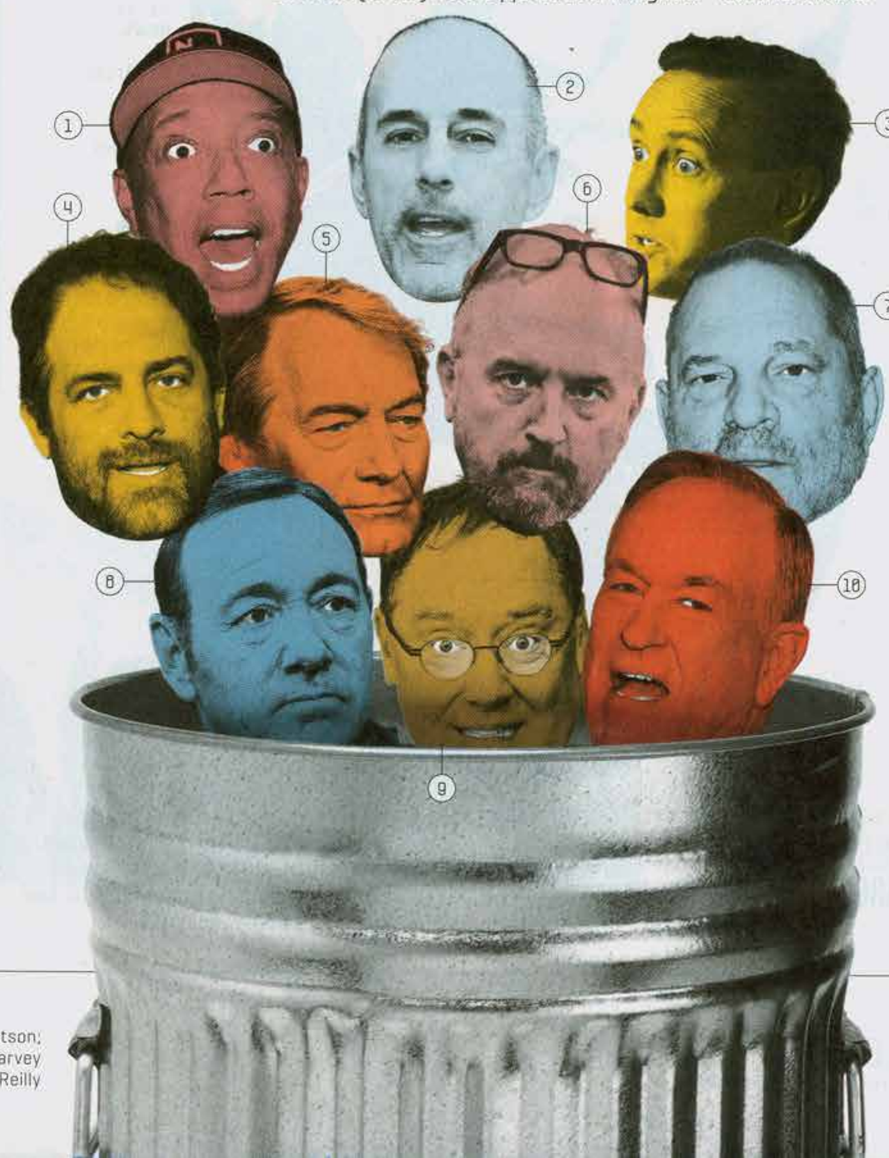
AFTER 2017'S natural disasters in Houston, Puerto Rico, Florida, and California, some companies milked their good works for good PR. But others chose to do the right thing without fanfare. TJX Cos. quietly continued to pay Puerto Rico–based employees of its T.J. Maxx, Marshalls, and HomeGoods chains, even while stores were closed [regardless of how long]. Gap did the same.

—PHIL WAHBA

■ CULTURE SHOCK

BIGGEST PURGE: **THE SEXUAL HARASSMENT TIDAL WAVE**

DOZENS OF POWERFUL MEN have been credibly accused of sexual harassment [or worse] this year, leading to a cross-industry exodus of leading players in tech, media, and entertainment—including Harvey Weinstein and Tesla board member Steve Jurvetson. Notably, though, the accountability seems to be mostly confined to the private sector—politicians like Alabama Senate-hopeful Roy Moore and Minnesota Sen. Al Franken were also accused of misconduct, but have [so far] not dropped out or resigned. **—VALENTINA ZARYA**



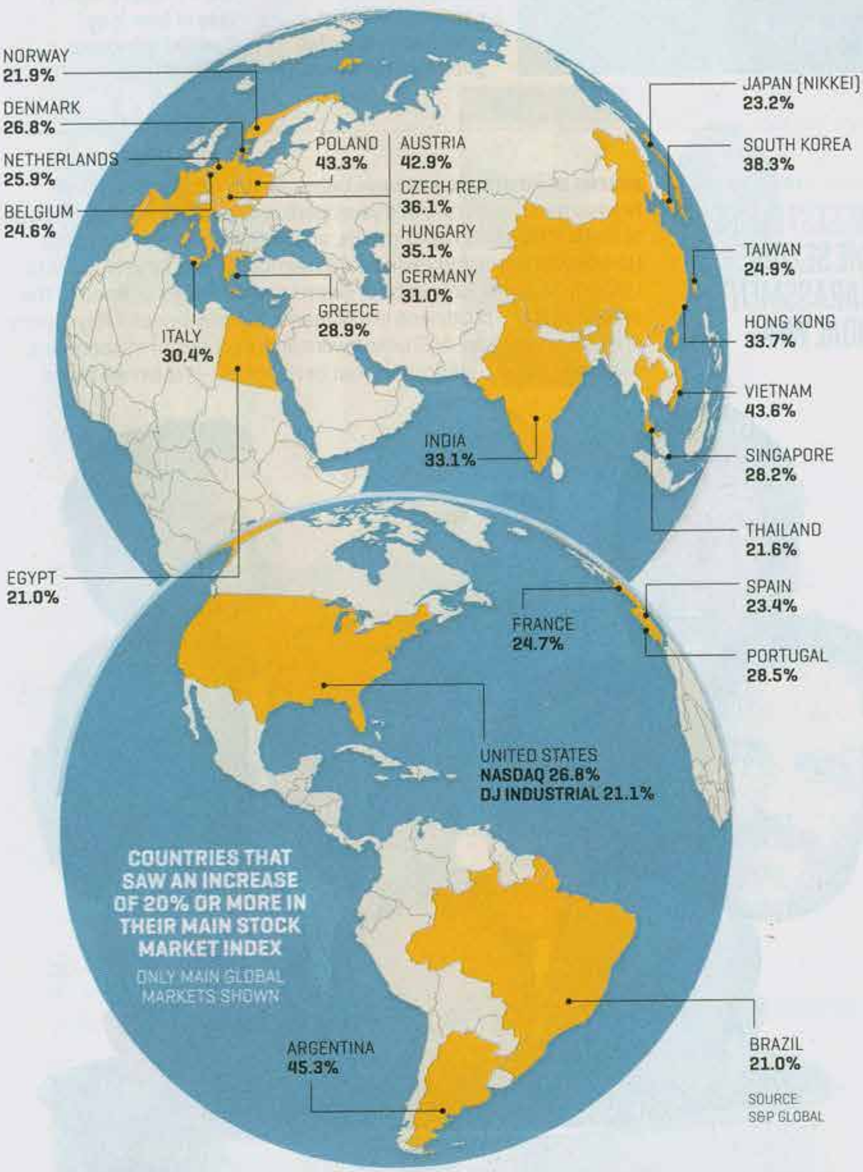
1: Russell Simmons; **2:** Matt Lauer; **3:** Steve Jurvetson; **4:** Brett Ratner; **5:** Charlie Rose; **6:** Louis C.K.; **7:** Harvey Weinstein; **8:** Kevin Spacey; **9:** John Lasseter; **10:** Bill O'Reilly

FLAG: JOE RAEDLE—GETTY IMAGES; CAN: MATTHEW WARD—DORLING KINDERSLEY/GETTY IMAGES; 1: GABRIEL OLSEN—GETTY IMAGES; 2: STEVE GRANITZ—GETTY IMAGES; 3: DAVID PAUL MORRIS—BLOOMBERG VIA GETTY IMAGES; 4: WALTER MCBRIDE—GETTY IMAGES; 5: JB LACROIX—GETTY IMAGES; 6: ADAM GLANZMAN—GETTY IMAGES; 7: JIM SPELLMAN—GETTY IMAGES; 8: DANIEL ZUCHNIK—WIREIMAGE/GETTY IMAGES; 9: JASON LAVERIS—GETTY IMAGES; 10: PAUL ZIMMERMAN—GETTY IMAGES

VOCAB

BEST NEW JARGON: 'CULTURE ADD'

REPORTS OF TOXIC WORK ENVIRONMENTS at Uber and other tech companies have forced many Silicon Valley startups to rethink their values. What's out? Hiring for "culture fit," a.k.a. tech bros recruiting tech bros. What's in? "Culture add," or hiring for diversity. Companies like Pandora and Lyft have already adopted the new lingo, but it remains to be seen whether the new HR buzzwords can have real impact on the tech industry's workforce. —**MICHAL LEV-RAM**



STOCKS

BEST MARKET: ARGENTINA

THE DOW MAY HAVE blown past records to top 24,000, but those gains look paltry compared with the 45.3% run-up in Argentina's Merval index. On top of that, the country's inflation problems look to be gradually coming under control. Cue an influx of foreign investment. —**ANNE VANDERMEY**

BEST TWEET

"HELP ME PLEASE. A MAN NEEDS HIS NUGGS"

—Carter Wilkerson's plea after @Wendys said it would give him a year of free chicken nuggets if he reached 18 million retweets. He set records, with 3.6 million retweets, but still came up short. (Wendy's gave him the nuggs anyway.)

BEST QUOTE

"It took every ounce of will to be able to do the Model 3 event and not look like the most depressed guy around. For most of that day, I was morbid. And then I had to psych myself up: drink a couple of Red Bulls, hang out with positive people and then, like, tell myself: 'I have all these people depending on me. All right, do it!'"

—**Elon Musk**, in a surprisingly relatable interview with *Rolling Stone*, talking about rallying after a breakup

© MUSK: DAVID PAUL MORRIS—BLOOMBERG VIA GETTY IMAGES

■ FEAR AND LOATHING

BEST BOGEYMAN: **AMAZON**

AS JEFF BEZOS'S "everything store" expands into, well, everything, skittish investors are punishing companies caught in the crosshairs. After Amazon announced it would buy Whole Foods for $13.7 billion, grocery chains Kroger, Walmart, Costco, SuperValu, and Target collectively lost $26.7 billion in market value—in a single morning. Even rumors that Amazon *might* be coming were enough to unsettle whole industries this year. Following reports that the company was hiring people with pharmacy backgrounds, signifying a possible health care play, shares of CVS Health and Walgreens fell over 3%. Amazon's flirtation with the delivery and auto parts businesses also spooked UPS and Autozone investors.

—JONATHAN VANIAN

■ ALPHA

THE BEST STOCKS OF THE *FORTUNE* 500 THIS YEAR

IT WAS A GOOD YEAR for the stock market: The Dow broke records, and the S&P 500 climbed 16% before dividends. For a few companies and investors, though, it was a *great* year. Here, the large-company stocks in the U.S. that rose the most in 2017.

STOCKS WITH LARGEST PRICE INCREASE, YEAR TO DATE

SOURCE: S&P GLOBAL

The chemicals company with a $9 billion market cap became a surprise market darling after its spinoff from DuPont.

Though still down from its 2014 highs, investors this year warmed to the energy giant's plans to sell off some assets.

A strengthening economy lifted the homebuilder, which fared better than most after the housing crisis.

The Idaho-based chipmaker got a boost from the rising prices of its memory chips—a key smartphone component.

The online-payments giant has seen double-digit annual revenue growth since spinning off from eBay in 2015.

One of the country's largest homebuilders, the company expects to deliver as many as 52,500 houses in 2018.

People took to the streets to protest United Airlines this spring.

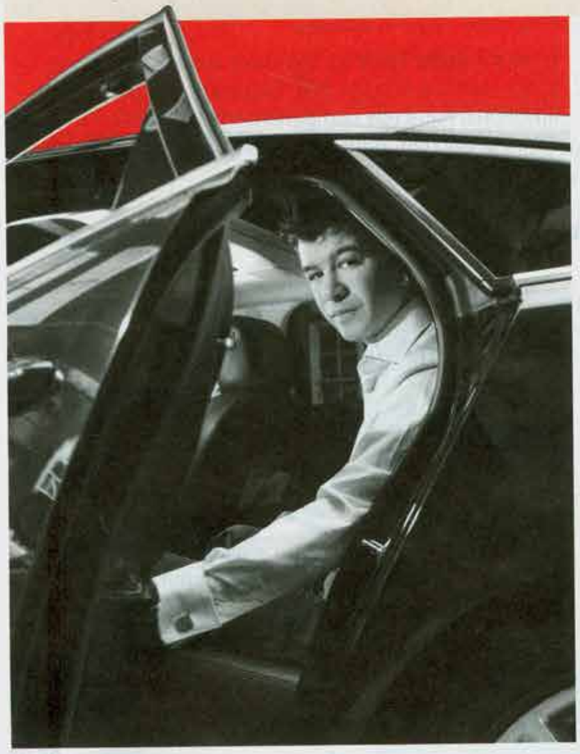
■ BLOODY NOSES

SHORTEST-LIVED EXISTENTIAL CRISIS: **UNITED AIRLINES**

UNITED had a so-so year, but the downs were due to low-cost competition—not the viral video of a man being dragged from one of its planes. Despite the mass outrage, United's stock hit all-time highs a month after the incident.

—TOM HUDDLESTON JR.

BOXES: ISTOCK/GETTY IMAGES; UNITED PROTEST: JOSHUA LOTT—AFP/GETTY IMAGES



■ THERE'S NO BUSINESS LIKE RIDE-HAILING

MOST RIVETING CORPORATE DRAMA: **UBER**

ONE OF THE DEFINING characteristics of a soap opera is a story that's too delicious to be true. Wacky, riveting, shocking, titillating? Yes. Completely believable? No.

By that measure, Uber's 2017 was a soap opera for the ages. An already infamous entrepreneur/CEO starts the year by quitting a presidential council amid furor over the company's botched response to a taxi boycott spurred by a new President's policies. A video of the same CEO berating a longtime driver goes viral. An engineer posts a lurid account of sexual harassment. Multiple top executives are jettisoned or otherwise flee. A unit of an early investor (Alphabet's Waymo self-driving car outfit) sues the company for trade theft. The CEO's mother dies in a tragic boating mishap. The CEO himself gets the boot.

All this happened to Travis Kalanick and Uber—in the first half of the year.

Then things get worse. Key backer Benchmark Capital sues Kalanick over allocation of board seats. Uber publicly searches for a new CEO as Kalanick meddles. A credible but little-known candidate, Expedia's Dara Khosrowshahi, takes the top job—only to be forced to reveal a massive hacking attack the company had previously covered up. Oh, and SoftBank offers to invest billions of dollars at a dramatically reduced valuation.

Could 2018 possibly top that?

—ADAM LASHINSKY

■ TRIGGERED

FRIENDLIEST FIRE: **TRUMP CRUSHES GUN STOCKS (WITH LOVE)**

PRESIDENT TRUMP took a lot of credit for the hot stock market this year, but there's one industry whose investors he hurt: guns. Gun sales are often driven by fear of weapons bans (as consumers rush to stock up). Now, under the pro-gun GOP, sales are slumping. American Outdoor Brands' stock fell nearly 40% this year, and Remington Outdoor faces debt trouble.

■ MEDIA & ENTERTAINMENT

BEST MOVIES (NON-*STAR WARS* CATEGORY)

THE 2017 RELEASES THAT MADE THE MOST AT THE BOX OFFICE:

BEAUTY AND THE BEAST
$504,014,165

WONDER WOMAN
$412,563,408

GUARDIANS OF THE GALAXY VOL. 2
$389,813,101

BEST NEW CHARACTER **PORG**

Star Wars: The Last Jedi should drive big toy sales—thanks in no small part to its new alien-penguin hybrid.

SOURCE: BOX OFFICE MOJO, U.S. SALES

© KALANICK: NICK WILSON—CAMERA PRESS/REDUX; WONDER WOMAN: WARNER BROS. PICTURES/COURTESY EVERETT COLLECTION; GUARDIANS: WALT DISNEY STUDIOS MOTION PICTURES/COURTESY EVERETT COLLECTION; PORG: LUCASFILM/DISNEY; AMMO: ETHAN MILLER—GETTY IMAGES

Next Gen Goes Next Level

By Kristen Bellstrom

MOST POWERFUL WOMEN

ON NOV. 13 AND 14, *Fortune* convened our fourth annual Most Powerful Women Next Gen Summit in Laguna Niguel, Calif. The gathering drew startup founders, top *Fortune* 500 execs, political operators, and philanthropists—not to mention an Olympian, a pop phenom, and a rising star of the NASCAR circuit. But while the women who took the stage hailed from vastly different backgrounds, their purpose was the same: to share knowledge, ideas, and inspiration. Read full coverage of the event on Fortune.com.

"FINDING THOSE THINGS WHERE THERE'S BOTH PROFIT AND PURPOSE IS SORT OF OUR SWEET SPOT."

—**Obi Felten**
Head of X Foundry, Google's "moonshot factory"

FROM #METOO TO WHAT NOW

SEXUAL HARASSMENT and the #MeToo movement are dominating conversations everywhere, and Next Gen was no different. Evertoon CEO and founder **Niniane Wang,** for one, called for an end to corporate nondisclosure agreements, saying, "Don't use NDAs to silence women." Other calls to action: Believe those who come forward—and hire more women.

"PEOPLE ARE LOOKING FOR LEADERSHIP—IF YOU FEEL YOU'RE THE RIGHT PERSON, YOU NEED TO SAY IT."

—**Erika Harold**
GOP candidate for Illinois attorney general

LET THE GAMES BEGIN

Liza Landsman, president of Jet.com, talked about the ins and outs of integrating the startup into Walmart—which acquired Jet in 2016. (Pros: massive scale; cons: culture clash.) Landsman also weighed in on how Amazon's acquisition of Whole Foods is changing the face of retail. The move proves that even the digital behemoth believes in the importance of bricks and mortar, she said: "I feel like they're playing our game now."

"IF YOU'RE DOING ANYTHING DISRUPTIVE . . . LET THE NAYSAYERS FUEL YOU TO WORK HARDER AND GO FASTER AND SLEEP LESS."

—**Whitney Wolfe Herd**
founder and CEO of Bumble

▲ PHOTOGRAPHS BY **STUART ISETT FOR *FORTUNE* MPW NEXT GEN**

PRACTICAL EXPERTISE

FOCUS

TECH

SOCIAL CLIMBER

Meridith Valiando Rojas defied convention when she started DigiTour. Now her social media star-studded festival has teens screaming for more.

Interview by Sheila Marikar

Valiando Rojas at DigiTour's Studio City offices in L.A.

▲ PHOTOGRAPH BY MICHAEL LEWIS

HOW DO YOU GET young people to look up? Take the digital stuff on their screens and put it on a physical stage. As the cofounder and CEO of DigiTour, Meridith Valiando Rojas, 30, corrals popular personalities from YouTube, Instagram, and other social media networks into a live show that descends on dozens of major cities each year. Valiando Rojas may be writing the book on social media stardom (*Selfie Made* is due in September) but her digital chops haven't always been welcome. Before founding DigiTour in 2010, she pushed a musician to embrace a new medium—and was promptly fired.

What gave you the idea for DigiTour?
My career started in the music business. In 2008, I was managing an artist for Capitol Records. He was 15 years old and supposed to be the next big thing. A year went by and the label had spent a ton of money with no real results. It was ready to drop him. So I sat down with the president of Capitol, who went through a laundry list of things needed to save the artist: first, social media; second, tour... then I tuned out. A social media tour—nothing like that existed. I figured we could create one, put him in the mix with some YouTubers, and hope their magic rubbed off on him. I thought this was the solution of all solutions. The artist was a lot less excited. He fired me. I said to my boyfriend, now husband, "Let's do the tour anyway."

How did you cultivate relationships with YouTube creators given that you were new to that community yourself?
We rounded up the top, most subscribed YouTubers of that year. That was in 2011. All of them were sort of on the brink of something big. They were a lot more accessible than they are now, and much more open to cold calls. In 2013, we started to do festivals. The first was in New York City, and it was wall-to-wall with teenage girls. It was a light-bulb moment: This is who we need to focus on. Once we realized that, it was obvious who we needed to book: lifecasters, these heartthrobs who are the boy bands of today. We focused on guys who can tweet and get thousands of hyperventilating girls to show up.

MERIDITH VALIANDO ROJAS

COFOUNDER AND CEO, DIGITOUR

AGE: 30

FROM: Redding, Conn.

TRACK RECORD: Valiando Rojas was a member of the inaugural class of the Clive Davis Institute of Recorded Music at NYU's Tisch School of the Arts.

MIC CHECK: In 2011, she assisted Mark Burnett Productions during the casting of NBC's popular singing-competition series *The Voice*.

BREAK POINT: Valiando Rojas was an intern at J Records at age 15, working with artists such as Alicia Keys and Maroon 5.

Did you have to convince people that social media stars were worth paying attention to?
In the early days. Now, nobody would argue that fact. The reason I was fired by that artist was because of the stigma around YouTube talent. He thought YouTubers were not real talent. For the first two or three years of our business, a lot of people thought we were rounding up bedroom performers. There was an education process where I had to say that their true talent is that they can communicate to and activate 5 to 10 million people at a time. That is incredibly valuable.

Your investors include mainstream media players like Viacom and Ryan Seacrest. They compete for the same demographic that DigiTour attracts. How does that work?
These people have invested because they know things are changing. Generation Z has different behaviors than millennials. The Internet is dominating trends, and traditional media is, in many cases, one step removed. Our investors see us as an insider, someone whose finger is on the pulse, and a resource to them in terms of providing data and commercial partnerships. We collaborate with Viacom's businesses, presenting ideas for MTV and packaging talent for Nickelodeon. We're showing them what we know best. It doesn't come without challenges. It's a big building.

How do you plan to grow DigiTour?
Our dream is to create the biggest teen festival in the world. We'll be doing well over 150,000 tickets next year. We have kids wearing DigiTour T-shirts to school as a badge of honor. How do we take that to the next level? As the Internet takes over our lives, people need to engage IRL—in real life. ■

THE NEXT (R)EVOLUTION

The commercial trucking industry is facing its biggest transformation in 40 years. Automakers and tech companies are vying for pole position.

By Kirsten Korosec

AS ADAM "MCA" YAUCH'S BASS LINE fuzzed through the speakers, and the crowd—encouraged by Tesla Motors CEO Elon Musk to "jump over the barriers"—flooded the airplane hangar just outside Los Angeles, there was talk of an impending revolution. It certainly felt that way to onlookers. Excited energy crackled in the crisp California air.

In truth, the revolution—or evolution, depending on who is talking—was already underway. But that didn't stop Musk from making his grand entrance in the sleek Tesla Semi, an all-electric heavy-duty truck that could well disrupt the commercial trucking industry.

Dozens of companies, from truckmakers like Daimler and Navistar to startups like Chanje and Embark—plus Uber's Otto and Waymo, the erstwhile Google self-driving project—are pursuing what they believe is the next generation of trucking. Their vision includes electric powertrains, autonomous driving technology, and oodles of wireless connectivity—a vision now shared, naturally, by Tesla and Musk.

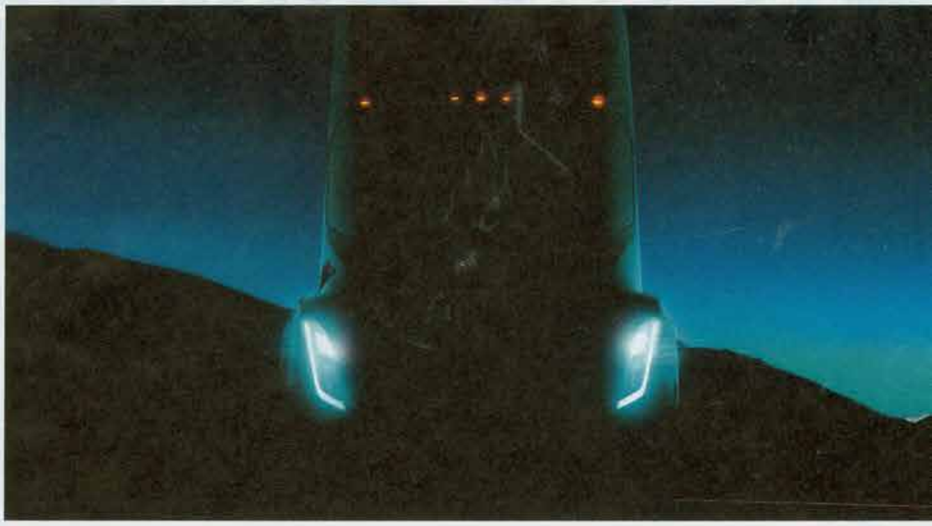
There are good reasons why so many companies are suddenly fixated on modernizing a century-old

Tesla Semi: The electric-auto maker's bid to build a better truck.

© COURTESY OF TESLA MOTORS

industry. Stricter carbon emission regulations play a part. The swift rise of e-commerce does too. And technological breakthroughs, particularly around autonomous driving, are advancing far beyond the proving ground.

But above all, it's business opportunity—and trucking is the physical embodiment of a thriving economy. Trucks moved more than 70% of all U.S. freight and generated $676 billion in revenue in 2016, according to the American Trucking Associations. Some 33.8 million trucks were registered for business purposes in 2016. Almost 4 million of them were categorized Class 8, denoting the largest freight trucks.



Without the trucking industry, the economy would screech to a standstill. So it stands to reason that anyone who can make it more efficient can collect profits from coast to coast.

Technology leads the way. The newest trucks on the road, such as those made by Volvo and Freightliner, employ driver assistance technologies similar to the adaptive cruise control and lane-keeping features found in modern passenger cars. The technologies make driving a truck less stressful, safer, and more fuel efficient. Autonomy promises further improvement.

Starsky Robotics CEO and cofounder Stefan Seltz-Axmacher believes trucking is on the verge of radical change that hasn't been seen since the industry was deregulated in 1980. "Billions of dollars were lost and made," he says. "Autonomous trucks are going to be an even bigger change than that."

Seltz-Axmacher's company, which is based in San Francisco, uses software, radar, and computer vision cameras to enable long-haul trucks to drive by themselves on the highway, then cede control to a remote operator to travel from exit to final destination. In September, a Starsky Robotics truck drove 68 miles on a Florida highway with zero intervention by a human.

Other autonomous trucking startups are in hot pursuit. TuSimple, a company that has operations in China and San Diego and is backed by Nvidia and Sina Corp., plans to test fleets on two routes: one 120-mile stretch between Tucson and Phoenix and another segment in Shanghai. Meanwhile Nikola Motor is designing and building its own driverless, hydrogen fuel cell–powered Class 8 truck—"the iPhone of trucking," says CEO Trevor Milton. "In the next eight years, you're going to see a complete transformation of trucking," he adds.

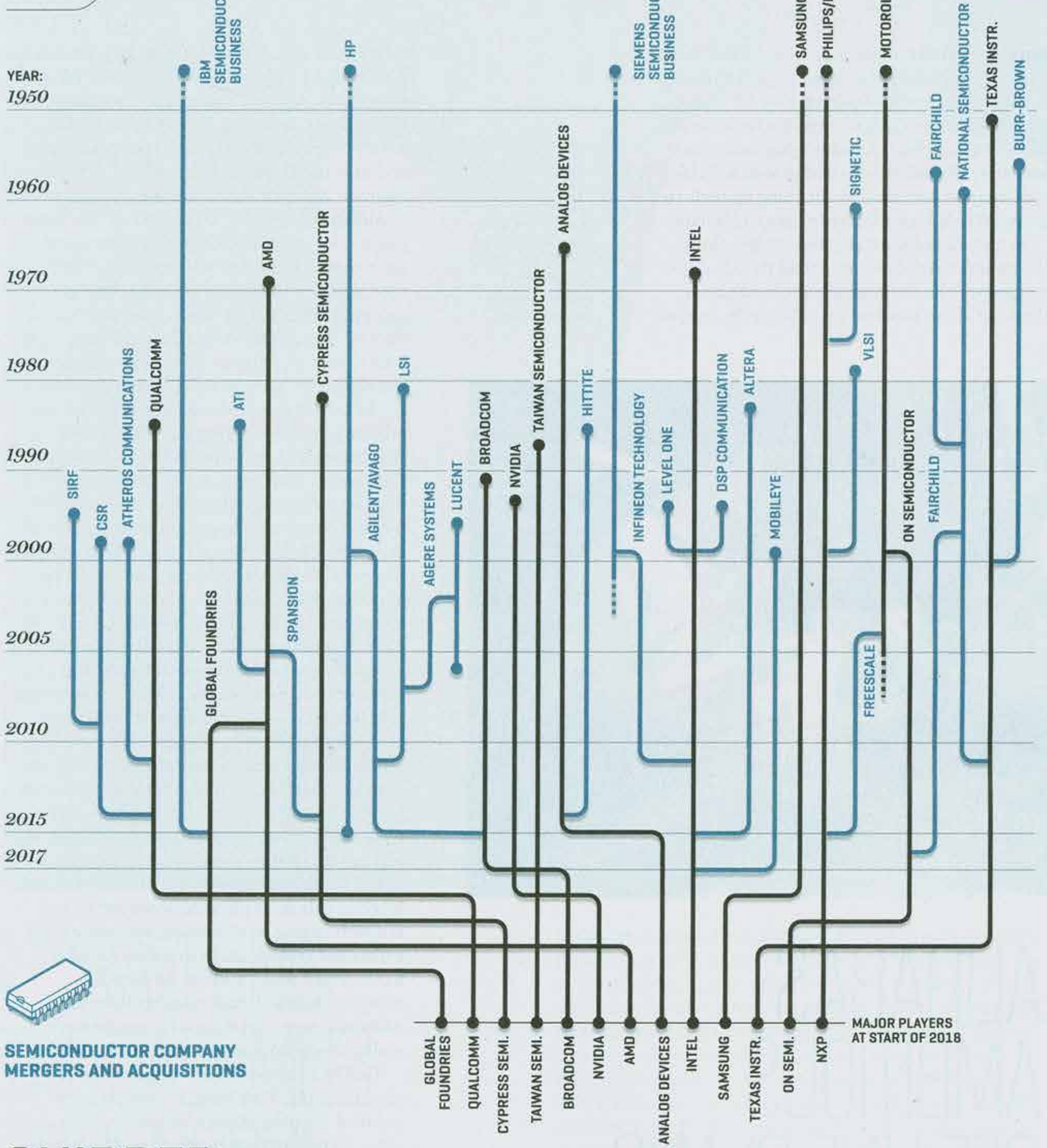
So where does that leave a company like Daimler, whose first truck arrived to market in 1896? In embrace of the long view. Daimler, which sells more than 400,000 trucks globally each year, is treading carefully as it brings technology to its commercial vehicles. "It's definitely an evolution," says company spokesman Florian Martens. Not, he hints, a revolution.

Tesla insists otherwise. Its $180,000 Semi promises up to 500 miles on a single charge—four times the range of an electric truck that Daimler is developing. Customers like Walmart and Meijer have made reservations for a Tesla Semi prototype expected in 2019, but skeptics remain. "These orders are for publicity and the halo effect of seeing a quiet, clean electric truck and not a black-smoke-belching diesel engine," says Darren Gosbee, vice president of engineering for Navistar. (Tesla declined to comment.)

In other words, the trucking industry tends to embrace technology slowly. It took time to adopt electric propulsion and autonomy, Gosbee says. "Connectivity has proven to be the only exception," he says. "And that's because the benefits have been so revolutionary that the customers can't get enough of it."

Perhaps that's what Musk is betting on. ■

The Tesla Semi is one of several solutions in development by companies that see business opportunity in the inefficiencies of the commercial trucking industry.



SEMICONDUCTOR COMPANY MERGERS AND ACQUISITIONS

CHIPPED INTO SHAPE

A wave of consolidation continues to sweep through the semiconductor industry, due to the climbing costs of new chip-fabrication plants and increasing appeal of efficiencies at scale. The culmination? Broadcom's record-breaking $100 billion bid for Qualcomm, which could create a third titan alongside Intel and Samsung. But none of this happened overnight. Chipmakers have been consolidating for quite some time. Here's a look at how the industry got here. Note: While some companies have been voracious acquirers, others like Nvidia have grown largely without dealmaking. So far, anyway. —*Aaron Pressman*

▲ GRAPHIC BY **NICOLAS RAPP**

WHEN NEWS BROKE in late November that Alibaba was investing nearly $3 billion for a 36% stake in China "hypermart" operator Sun Art Retail, it looked like the Chinese e-commerce titan was stealing a page from Amazon's playbook. Amazon, after all, had months earlier stunned U.S. supermarket operators by snapping up high-end grocer Whole Foods for more than $13 billion.

In fact, Alibaba already was further along the online-to-off-line curve than its U.S. doppelgänger. The Chinese behemoth has been thinking about physical retail for years, part of an effort to attract customers to its e-commerce platforms by helping to digitize old-fashioned merchants. Alibaba has pumped billions into investments including its own grocery chain, a shopping mall group, an electronics retailer, and now the Walmart-like Sun Art. (Indeed, Walmart and Sun Art compete in China.)

An employee assists a customer while she selects live seafood at one of Alibaba's Hema stores in Shanghai.

ALIBABA'S AMBITIOUS OFF-LINE PLANS

Having successfully dominated online shopping in China, Alibaba now sees enormous opportunity in brick-and-mortar stores. **By Adam Lashinsky**

Alibaba has proved itself a canny innovator, prompting speculation about its intentions. It's not simply a hunt for new revenues. "We don't view this as purely physical retail, but rather as an opportunity to transform from physical to digital," says Alibaba CEO Daniel Zhang in an interview with *Fortune*. "We still need physical stores, but we want to redefine the experience."

The purest manifestation of Alibaba's online/off-line ambitions is Hema, a digital-first supermarket chain it incubated in Shanghai. Consumers shop using a mobile app, either in person or remotely. Shopping options include buying food to take home, purchasing in store and getting help cooking a meal, and buying online with 30-minute delivery. Zhang calls Hema a "new animal" that caters to the "lifestyle of our customers." Alibaba has opened 20 stores and plans a rapid expansion, including franchises.

Alibaba portrays its move into physical as consistent with its history of helping merchants sell their goods—and taking a cut in the process. (Unlike Amazon, Alibaba isn't an online retailer; rather it's a marketplace for other merchants.) Zhang notes that e-commerce accounts for only 15% of consumption in China, making for fertile ground to collaborate with (read: sell services to) off-line merchants. Thus, Alibaba tested cashierless checkout at Hema—Amazon is trying this at its physical bookstores—and is now bringing it to Sanjiang Shopping Club, a discount grocery chain in which Alibaba has invested $300 million. At shopping mall company Intime Retail, another investment, Alibaba is experimenting with augmented-reality shopping features.

There's a subtler benefit to investing in physical retail. Dali Yang, a Chinese-born political scientist at the University of Chicago, points out that supporting off-line retail helps preserve domestic jobs, which pleases employment-conscious Chinese government officials. Amazon also frequently trumpets its job-creation prowess. It all makes one wonder: At what point will the world not be big enough for Alibaba and Amazon to coexist? F

QILAI SHEN—BLOOMBERG/GETTY IMAGES

TIME
WELL SPENT

PASSIONS

FAIR TRADE

Sustainable luxury: men's cashmere Henley ($94) and women's pullover ($296) by Naadam.

UNRAVELING THE CASHMERE CONUNDRUM

For Mongolian nomadic farmers, cashmere is the ultimate cash crop. But increased global demand is exacting its toll on the rugged lands where they raise their goats. Can the luxury garment industry help fix the problem?

By Valentina Zarya

CASHMERE, A FABRIC THAT REMAINED the exclusive domain of European nobility in the 19th century, is now as ubiquitous at fast-fashion retailers at it once was in royal palaces. As a growing global middle class demands more—the market was estimated at $4.7 billion in 2016, according to Bain & Co.—retailers are keeping pace and using quantity to drive down prices. As this story went to print, H&M was selling cashmere sweaters for $20 (on sale), while Uniqlo's standard price for the item was $80. Not the price tags you expect to see for what's traditionally been considered the finest of fine fabrics. But then again, are they truly luxe?

The answer, according to Ronnie Lamb, a 30-year ▷▷

COURTESY OF NAADAM

▷▷ textiles industry veteran and cashmere supply-chain consultant, is a resounding no. Any sweater priced in the double digits, Lamb says, is unlikely to be fit for an empress.

The high price is due to the strict guidelines for what constitutes cashmere: The fiber must come from the undercoat of the cashmere goat, indigenous to a tiny portion of northern Asia, as well as be very, very fine—with a diameter one-fifth the size of a human hair. But what's marketed as cashmere today is often not the real thing, and it's not uncommon for Chinese herders to crossbreed cashmere goats with bigger species of the animal in hopes of yielding more hair. The result is, predictably, a less fine fiber.

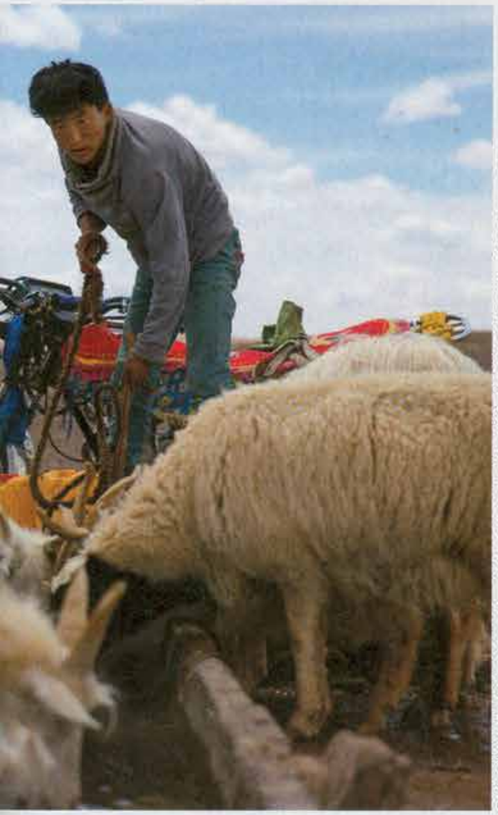
So luxury goods companies have increasingly opted to source their cashmere not from China but rather from its northern neighbor, Mongolia. As a result, that nation's exports of cashmere garments have nearly tripled from 2009 to 2016, according to a 2017 report by the Mongolia International Capital Corp. (MICC), a regional investment bank.

This increase in demand is both a gift and a curse for nomadic herders, who make up about 50% of the population. Cashmere goats are by far the most lucrative of livestock, but keeping up with booming demand is proving unsustainable. Herders have at least doubled—if not tripled—the size of their flocks over the past decade, says William Danforth, author of the MICC report. The resultant overgrazing, combined with climate change, has led to desertification, seriously endangering the cashmere trade—and with it, the nomadic way of life.

The Mongolian government is ill-equipped to handle the classic tragedy-of-the-commons problem, so private international actors are stepping in. Paris-based Kering Group, which owns brands like Gucci, Yves Saint Laurent, and Balenciaga, is partnering with nonprofits to develop more sustainable models for cashmere production. The group's focus is educating herders on pasture management and animal welfare, but there is much work to be done further down the supply chain.

Cashmere manufacturing is a complex ecosystem riddled with middlemen who sell the processed fabric for $150 per kilogram, while herders themselves get only $20 of that. Tackling this particular issue are Matthew Scanlan and Diederik Rijsemus, the cofounders of cashmere startup Naadam. Neither has a background in fashion or textiles—Scanlan worked in finance, Rijsemus in economics—but Lamb, who advises the company, says that has proved to be an asset in the

Mongolian herders tend to their flocks of cashmere goats. It takes fibers from up to four goats to produce cashmere for one Naadam sweater [top left].



CLOCKWISE FROM TOP LEFT: COURTESY OF NAADAM (3); MICHEL SETBOUN—CORBIS VIA GETTY IMAGES

1,000-year-old industry. "Naadam really is the vanguard there."

The company was founded in 2014 when American Scanlan decided to pay a visit to his Dutch friend Rijsemus in the Mongolian capital, Ulaanbaatar, where the latter was interning. One day, Scanlan says, the duo hopped in a car with two locals, thinking they would be going to the Mongolian countryside for a weekend; they ended up living with a family of goatherds in the Gobi desert for a month. When they came back West, they made it a mission to help the people who had housed and fed them.

After experimenting with different business models, the two decided the best way to help the herders was to get them more money by streamlining the supply chain and cutting out the agents. Thus, in 2015, Scanlan, the company's CEO, loaded $2.5 million in loaned cash in the back of an SUV and drove back to the desert. He bought as much cashmere as he could—60 tons—and paid about $35 per kilo (a 75% premium) to get his pick of the best material, betting that by selling direct to consumers at a lower price point, Naadam could compete with industry mainstays like Loro Piana.

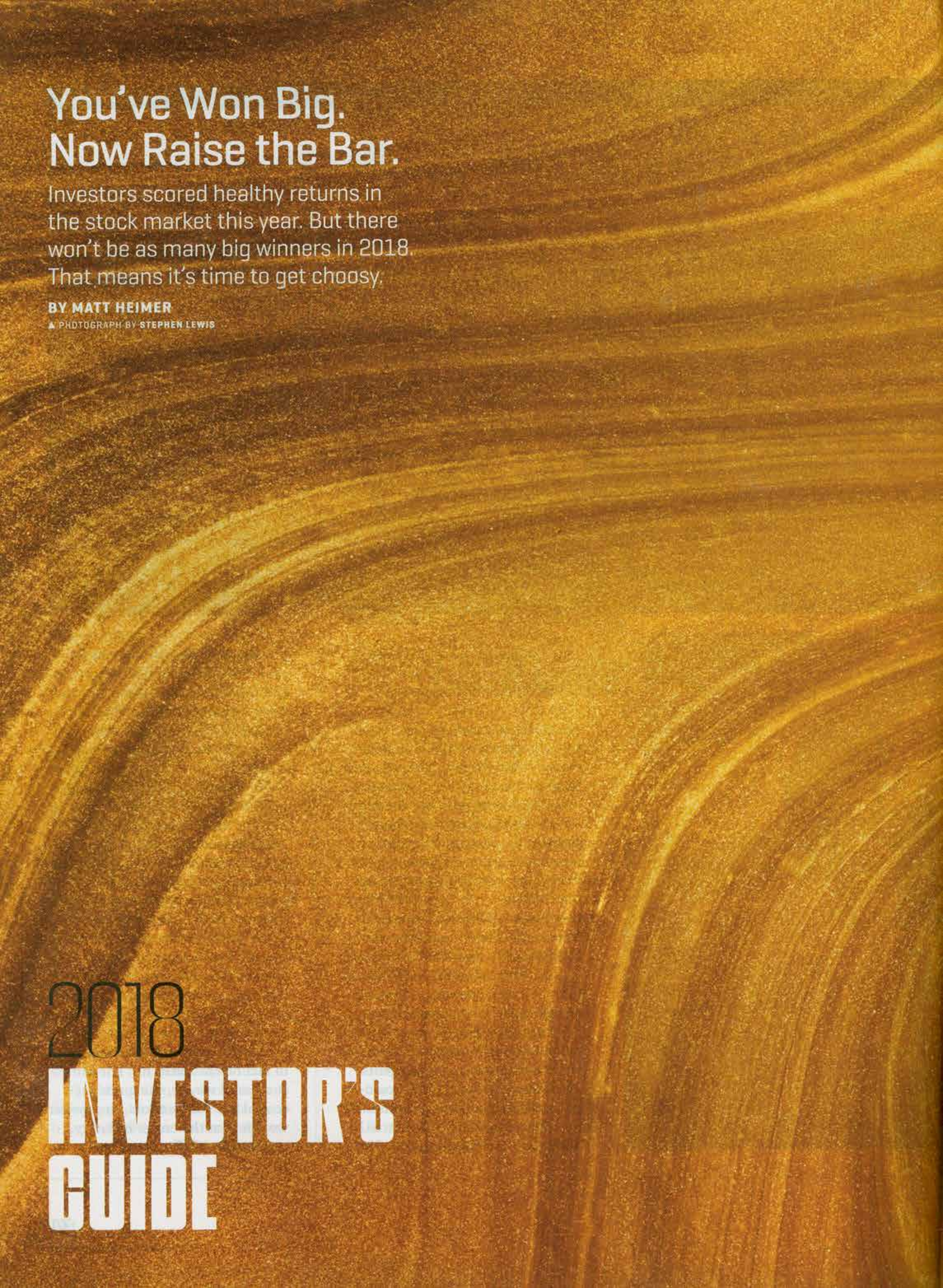
That bet looks as if it will pay off: The already profitable company's revenues are projected to be $20 million this year, a 400% increase over 2016. And the company is ready to scale, Scanlan says, with a plan to raise $5 million to $10 million in venture capital in early 2018. Another signal of success—newcomer Leimere launched in the spring, making the same promise of a leaner supply chain and lower prices. But the competition doesn't faze Scanlan; in fact he embraces it: "The more successful we are, the more successful our competitors, the sooner we can turn the entire industry upside down." ■

You've Won Big. Now Raise the Bar.

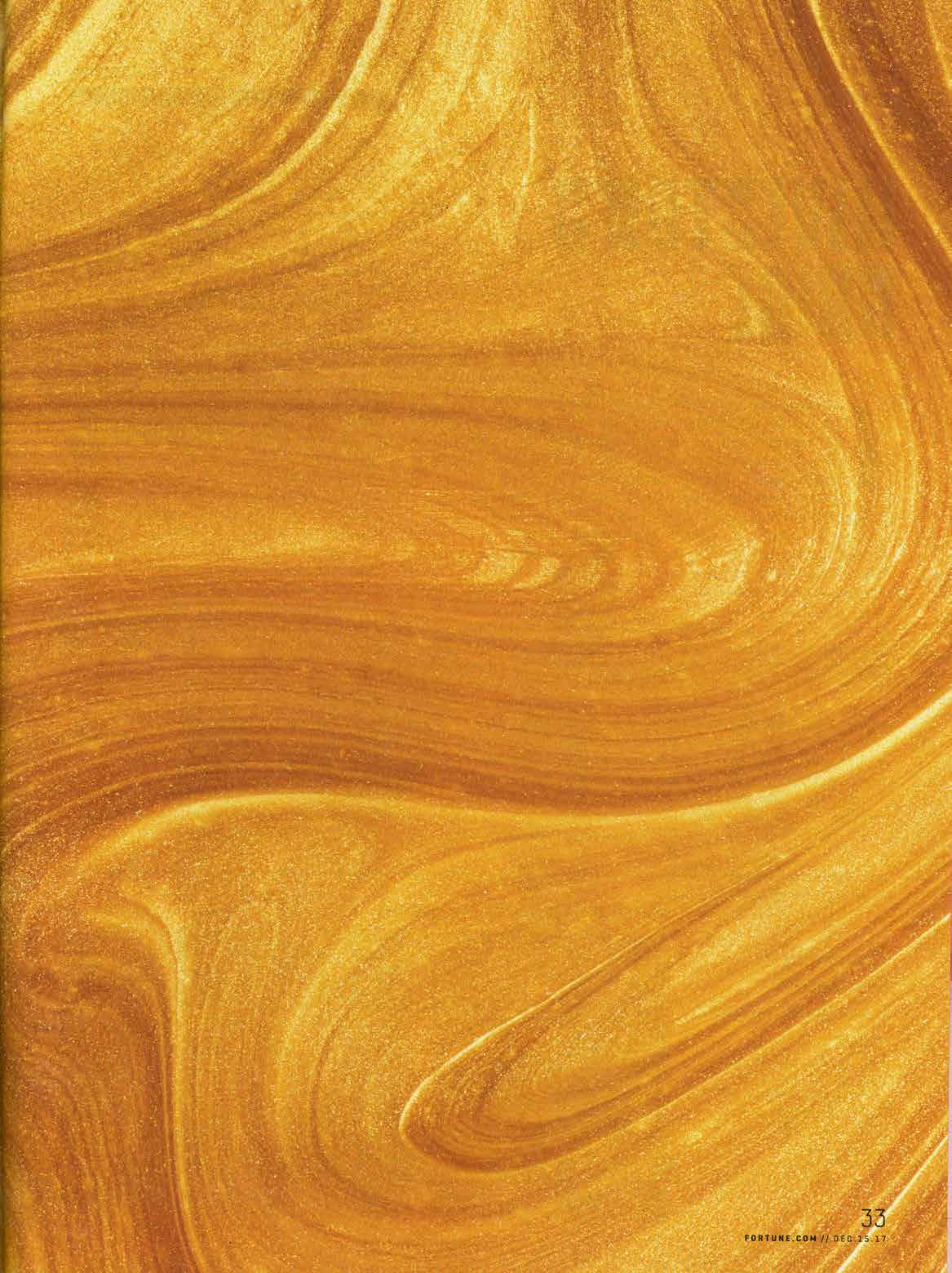
Investors scored healthy returns in the stock market this year. But there won't be as many big winners in 2018. That means it's time to get choosy.

BY MATT HEIMER

▲ PHOTOGRAPH BY **STEPHEN LEWIS**



2018 INVESTOR'S GUIDE



2018 INVESTOR'S GUIDE

YOU HAD TO WORK PRETTY HARD to *lose* money in the stock market this year. Of the stocks in the S&P 500, only 128—barely a quarter—were down for the year when this issue went to press in early December. Over the previous 12 months, the index was up a skepticism-crushing 23.3%, including dividends, and 2017 was on pace to be the fourth-best year for stocks in this no-longer-new century.

Stocks rose, of course, on the flood current of a strong economy—and on hopes that a GOP-controlled Congress and White House would deliver corporate tax cuts. As of this writing, those wishes appeared to have come true (a tax-reform bill was being tweaked en route to President Trump's desk). But *now* things get interesting, because 2018 seems likely to be the year that the rising tide stops lifting all boats. As Savita Subramanian of Bank of America Merrill Lynch noted during *Fortune*'s annual investor roundtable (page 48), if everybody gets a tax cut, nobody has an edge: "When you have a windfall from a lower corporate tax rate," she says, "a lot of that benefit is actually competed away."

Put another way: Everybody-gets-a-cookie tax reform won't be the factor that drives great stock returns in 2018. Now that the tax opportunity is here, corporate leaders have to deliver. The ones whose strategic choices pay off will deliver the biggest gains for shareholders.

And that's the way we like it. *Fortune* practices bottom-up, business-first stock picking, basing our recommendations on the underlying strengths and strategies of the companies behind the stocks, rather than on technical indicators and "quant" prognostication. Over the past year, that approach paid off: Our 2017 picks returned 34%, handily beating a hot market.

The most important challenges in business today, of course, revolve around technological change—and the companies that excel at generating it, incorporating it, or adapting to it are the ones offering investors the biggest rewards. That's the concept that shapes our lead story, "The All-Tech Portfolio." Senior writer Jen Wieczner makes a convincing case that the most successful companies of today's economy are tech-driven, even if they aren't in the tech sector—making it not just possible but savvy to invest in an all-star roster of "tech" stocks that stretches across dozens of industries.

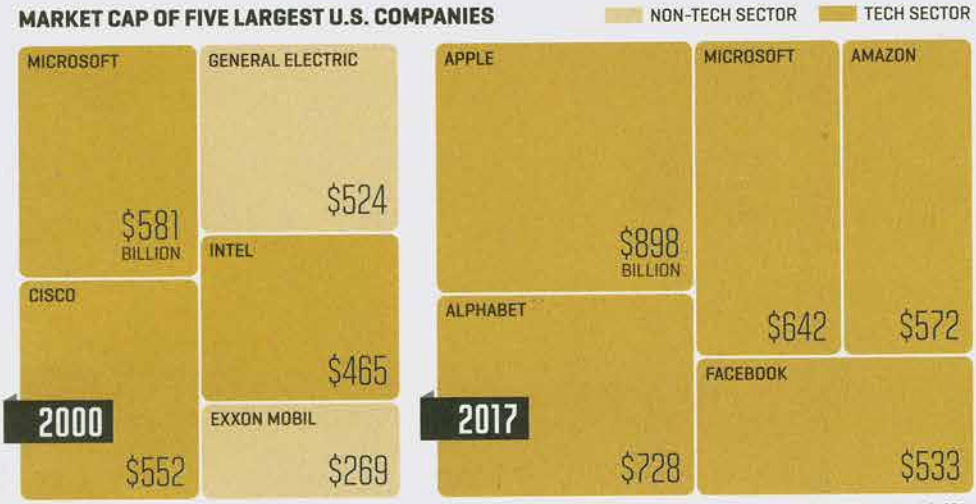
Other stories in our guide underscore the connection between business experience and an investment edge. Jeff John Roberts's profile of venture capitalist Alan Patricof shows a lion of the industry, at age 82, figuring out how to pick winning companies in their embryonic stages. And Wieczner's deep, provocative dive into hedge fund Elliott Management ("How Far Will This Fund Go?" page 82), depicts a firm that's browbeating complacent executives into performing better for shareholders—and shattering behavioral norms along the way.

The theme these pieces share? In the long run, every great investment story is a great business story. Find more such stories, and more advice, at fortune.com/investors-guide-2018. ■

Changing of the Guard

Since this June, the five biggest American companies by market value have all been tech companies. That's a historic first, unmatched even in the dotcom era.

MARKET CAP OF FIVE LARGEST U.S. COMPANIES



AS OF 3/24/00 AND 11/24/17 SOURCES: BLOOMBERG, S&P GLOBAL

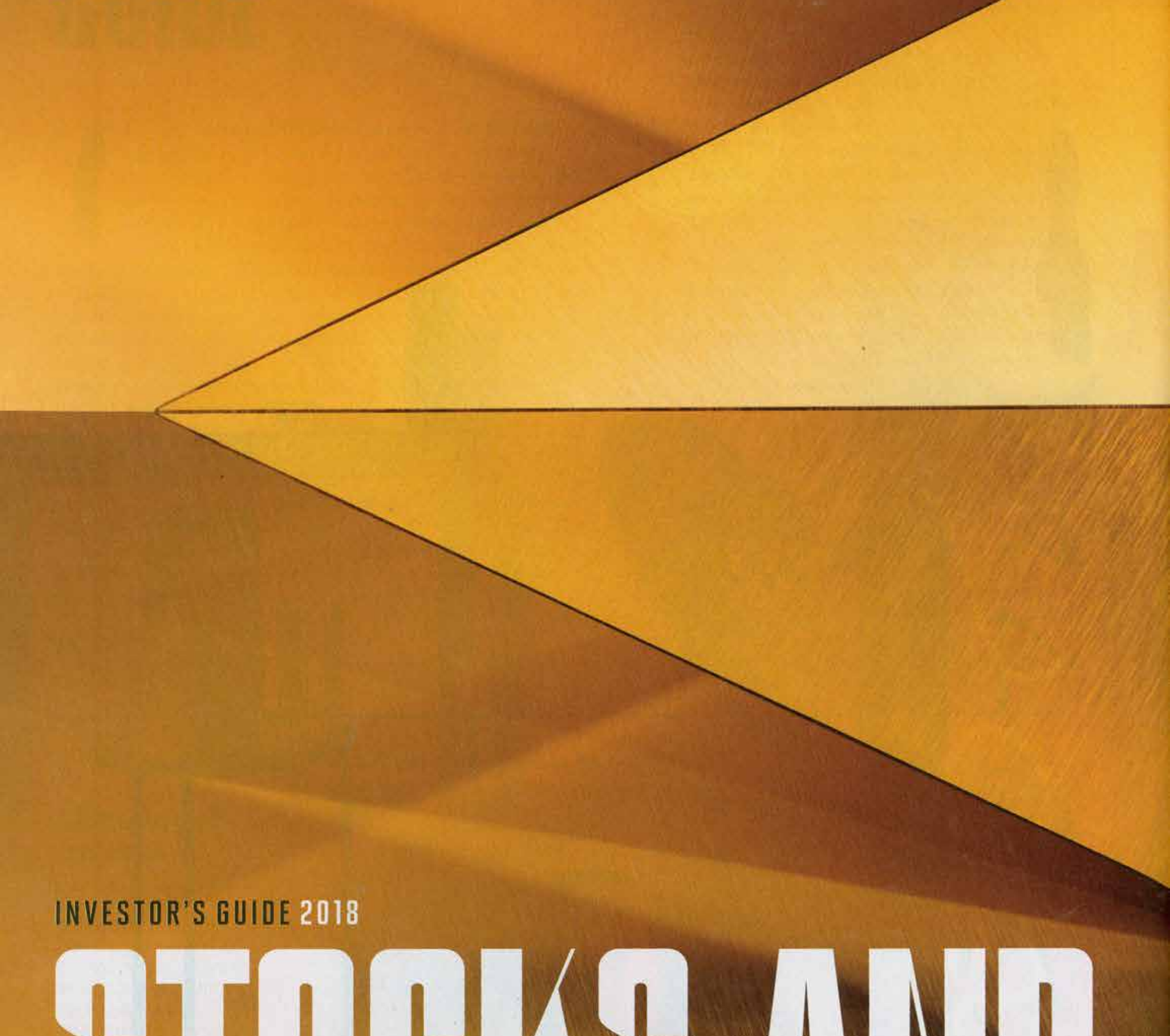
OPENING SPREAD: STYLING BY JILL NICHOLS

The All-Tech Portfolio

Thanks to sweeping technological changes in business, there are now "tech" companies in every sector of the economy. We found 31 stocks that can help you profit from the revolution without taking radical risks.

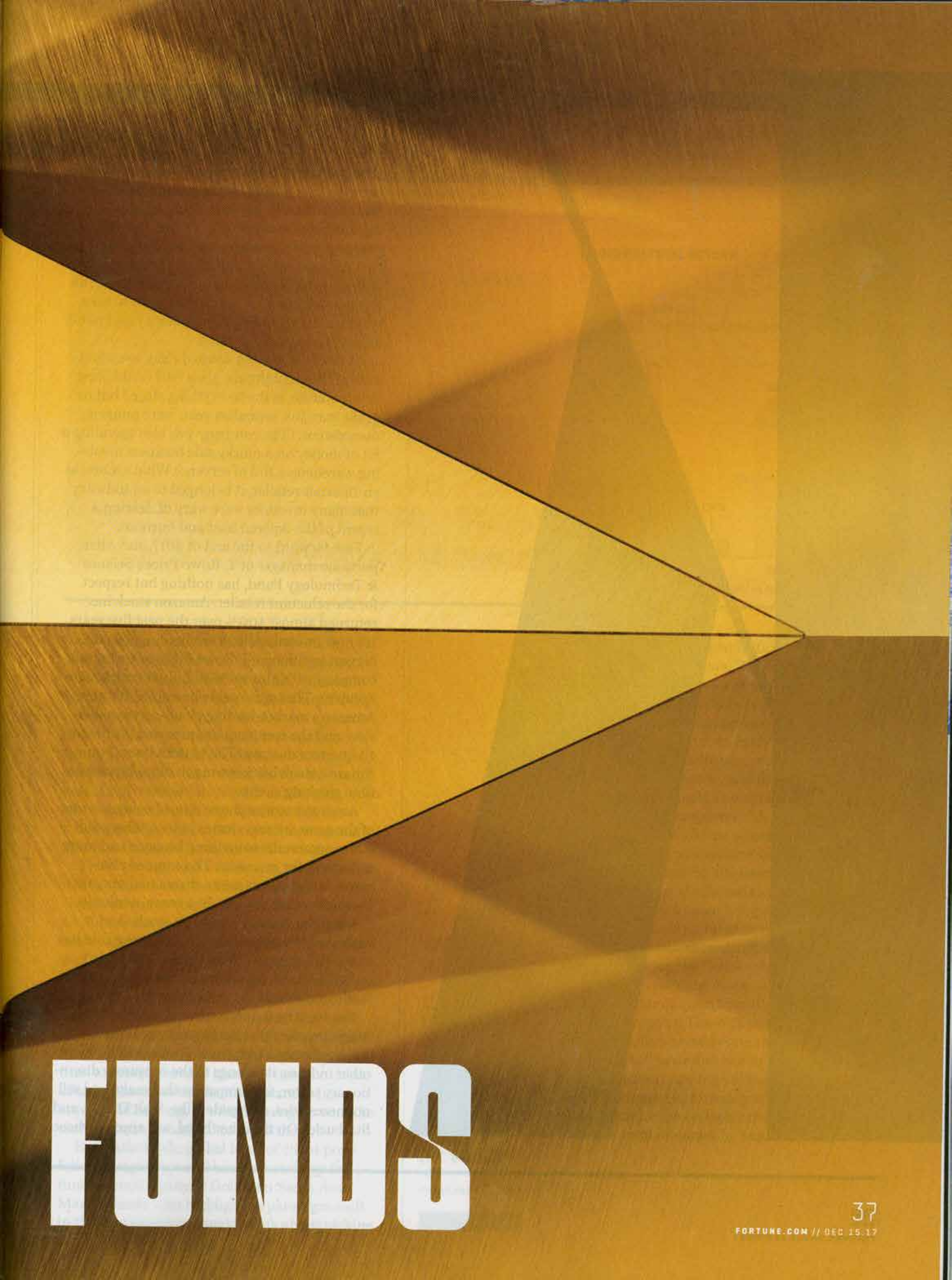
BY JEN WIECZNER with SCOTT DECARLO

▲ PHOTOGRAPH BY STEPHEN LEWIS



INVESTOR'S GUIDE 2018

STOCKS AND



FUNDS

KEN ALLEN HAS A FAVORITE STORY about a man who turned a case of cold feet into a small fortune. Back in 2012, the guy was considering going into retail and opening a store. But the prospective shopkeeper couldn't shake the fear that Amazon, whose impact on commerce was only growing, would eventually put him out of business. At the 11th hour, he decided to take what was going to be his seed money and put it all in Amazon stock instead.

At the time, the bet seemed risky, even foolhardy. The e-commerce giant had established its reputation as the "everything store," but its profit margins, year after year, were puny or nonexistent. (The company was also spending a lot of money on a quirky side business involving warehouses full of servers.) What's more, as an Internet retailer, it belonged to an industry that many investors were wary of, fearing a repeat of the dotcom bust and burnout.

Fast-forward to the end of 2017, and Allen, portfolio manager of T. Rowe Price's Science & Technology Fund, has nothing but respect for the reluctant retailer. Amazon stock has returned almost 400% over the past five years. It's now not only Allen's top holding, but the biggest position of T. Rowe Price as a whole, a company with almost $950 billion under management. That quirky side business? It's now Amazon's market-leading cloud-services division, and the company has reported profits for 10 quarters in a row. The bottom line: Owning Amazon stock has been much more lucrative than stocking shelves.

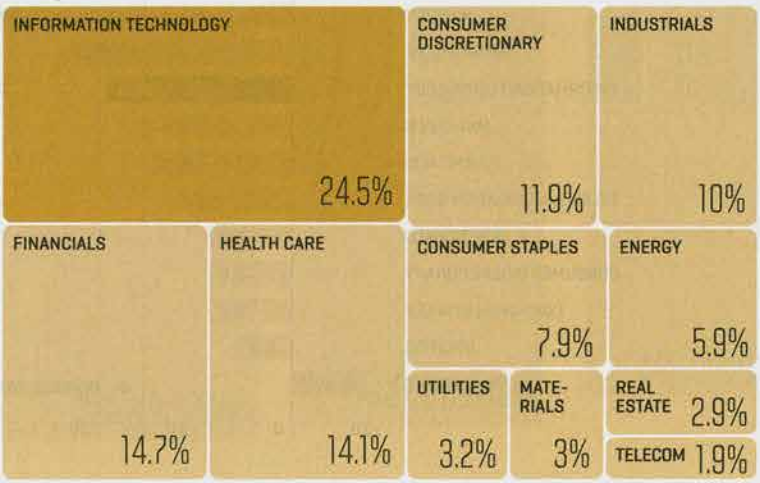
Amazon's stratospheric rise, of course, is one of the great success stories in technology. But it also represents something broader and more important for investors. The company has expanded to encompass a diversified range of businesses that make it, in a sense, a microcosm of the market in a single stock. And it embodies the powerful wave of change that has swept the economy since the financial crisis—one that has broken down the barriers between "tech stocks" and the rest of the market.

For starters, it may come as a surprise to many investors that, technically speaking, Amazon is not a tech stock. In the S&P 500 and other indexes, it belongs to the consumer discretionary sector, for companies that make and sell nonnecessities, alongside Nike, Walt Disney, and Starbucks. On the other hand, ask anyone whose

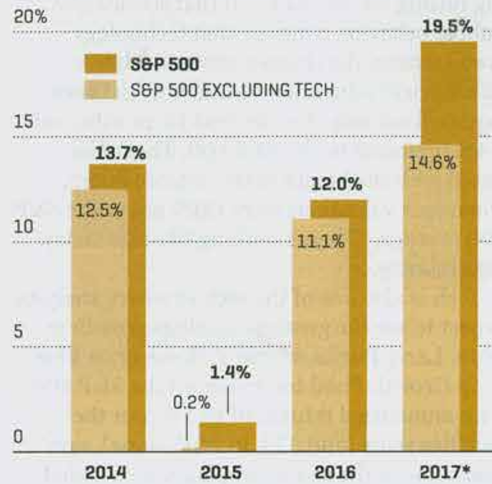
OPENING SPREAD: STYLING BY JILL NICHOLS

The Market's New Bellwether The tech sector has become the biggest factor in the performance of the stock market overall—and tech advances are driving gains in other sectors too.

S&P 500 SECTOR BREAKDOWN (AS OF OCT. 31, 2017)



12-MONTH TOTAL RETURN



* AS OF NOV. 28, 2017 SOURCE: S&P GLOBAL

toilet paper automatically arrives via Amazon subscription, and the e-commerce company seems more like a consumer staple. Amazon's house-brand batteries now outsell Duracell online, and the company will now get upwards of $16 billion a year in annual revenue from a grocery store—Whole Foods, which it acquired over the summer. Add to that its $16 billion-a year cloud business, its Netflix-challenging video streaming, and rumblings that it may enter the pharmacy market, and there's a sense that there's no industry Amazon won't conquer.

The evolving reach of Amazon has coincided with a reconstitution of the U.S. stock market. Tech companies now dominate the market to an unprecedented extent, comprising the five most valuable companies: Apple, Google parent Alphabet, Microsoft, Amazon, and Facebook. Without the tech sector, the S&P 500 would have returned 14.6% this year through late November; instead it returned 19.5%. And while its relentless expansion has made many investors nervous, money managers argue that it's time to accept the tech giants as the blue chips of today. In other words, if you want to have any shot of beating, or even keeping up with the market, you can't afford to avoid them.

But Katie Koch, global head of client portfolio management and business strategy for fundamental equity at Goldman Sachs Asset Management, also highlights a paradigm shift in the way investors should think about picking stocks and about diversification itself. Own tech's Big Five, she says, "but be cognizant of the disruption that they're trafficking in, and how that can create other winners and losers." That disruption is omnipresent because there are now tech companies everywhere in the economy—companies whose central missions are technology-centric, and those in other sectors that are making technical innovations central to their business models.

The upshot of all this is that it's now possible—and maybe sensible—to build an all-tech portfolio that can tap the incredible growth that technological innovation offers, while still being diversified enough to protect investors from risk. It's akin to that period a few years ago when dietitians inverted the food pyramid, rethinking the "base"—the foods we were supposed to eat most often—and swapping out carbs in favor of more bountiful helpings of fruit and veggies. These days, for a healthy rate of growth, tech should form the foundation of the typical investor's portfolio, going where banks and perhaps Big Oil used to be.

At the same time, money management pros are lightening up on industries where profits have been undercut by new technologies.

PICKS

↓

AMAZON (AMZN: $1,162)

—

ALPHABET (GOOGL: $1,025)

—

MICROSOFT (MSFT: $84)

—

FACEBOOK (FB: $175)

—

PRICES AS OF 12/01/17

Doug Ramsey, who oversees $1.5 billion as chief investment officer of the Leuthold Group, holds no energy, consumer staples, utilities, or telecom stocks. But he does have about a third of his portfolio in tech, and is considering raising his allocation. If that sounds like bubble behavior, consider that technology is still among the cheaper sectors, relative to historical valuations. It trades at 19 times expected earnings for the next 12 months, only a 4% premium to the S&P 500. That's compared with the height of the dotcom boom, when tech valuations were 121% above the S&P 500 average. "There's nothing like that today," says Ramsey.

Tech is also one of the sectors where analysts expect to see the greatest earnings growth in 2018. Larry Puglia, whose T. Rowe Price Blue Chip Growth Fund has trounced the S&P 500 with annualized returns of 18.5% over the past five years (and 37% in 2017 alone), says that some of the same companies he avoided around the turn of the millennium are now among the biggest holdings in his portfolio, including **Amazon, Alphabet,** and **Microsoft.** (**Facebook,** which came a generation later, is his No. 2 position.) One draw for Puglia: The switch to subscription pricing that has accompanied their growth. "Many of the technology business models have become more necessary and durable over time," adds Puglia.

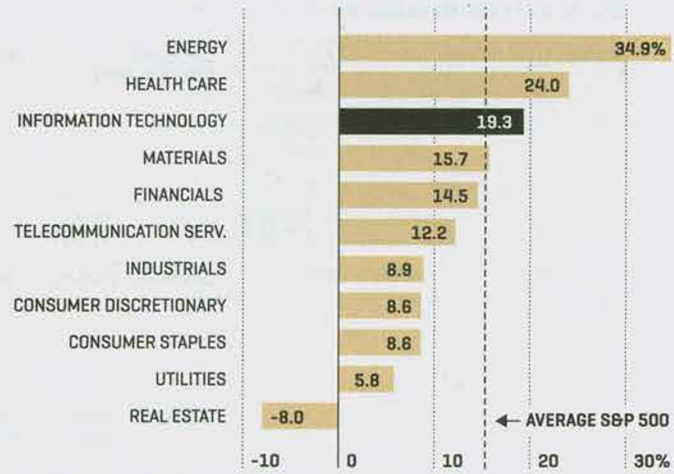
Can Main Street investors responsibly bet the bulk of their savings on such high-growth technology companies? Investors are finding that a more fluid definition of that category helps when crafting a market-beating portfolio. "Tech isn't even its own stand-alone sector, because it has tentacles into all the other industries," says Koch, ticking off its impact in retail (e-commerce), automotive (self-driving cars), banking (mobile payments), health care (big-data genomics), and more. Put another way: What isn't a tech stock these days? "There are going to be very, very big supertrends happening," Koch says, "but you need to be invested well outside the tech sector to get exposure to all of this, and maybe also outside the U.S."

With that in mind, we talked with top money managers who helped us build a portfolio that's 100% invested in technology—defined broadly—while still broadly diversified.

Here are our picks for 2018.

Tech's Win-Win Tech companies have been able to accomplish

ESTIMATED GROWTH IN EARNINGS PER SHARE, 2017-18 SOURCE: S&P GLOBAL



IT HARDWARE & SOFTWARE

Investing in the chips, bits, and clouds that keep the business world running.

PICKS

NVIDIA (NVDA: $198)

APPLIED MATERIALS (AMAT: $52)

INFINEON (ETR:IFX: $27)

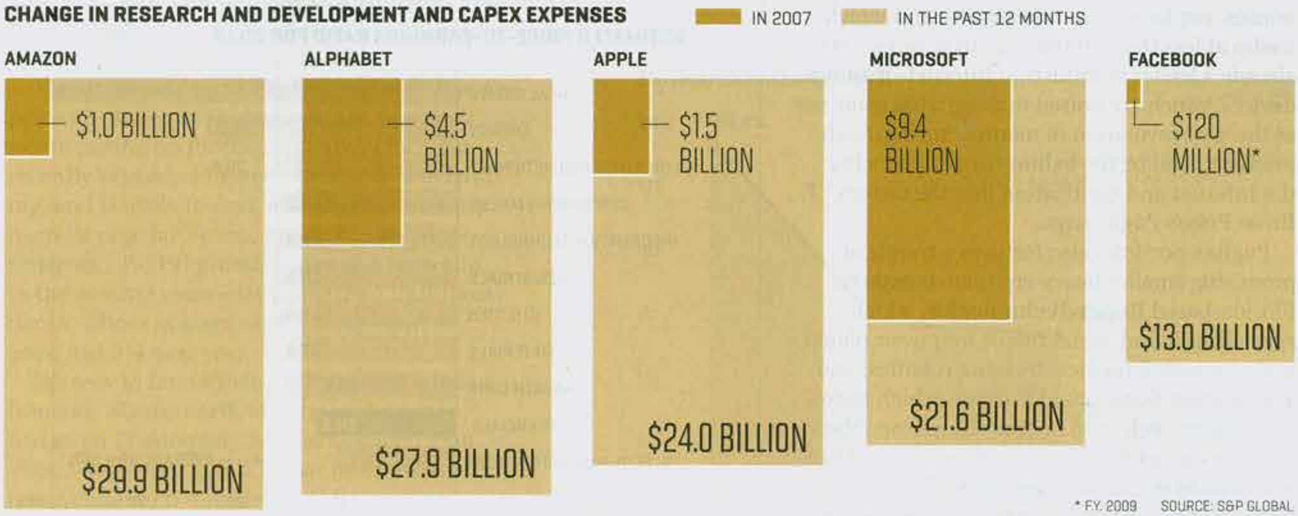
CISCO (CSCO: $38)

PRICES AS OF 12/01/17

WHEREAS RAILROADS and Detroit automakers used to be the nuts and bolts of a well-rounded portfolio, today's world runs on silicon chips and bits. There's a reason **Nvidia** has been one of the S&P 500's best stocks two years in a row. The largest semiconductor maker by market capitalization is benefiting from virtually every tech trend—with its chips powering everything from Tesla's self-driving cars, to Amazon's and Microsoft's cloud services, to the machines that mine the digital currency Bitcoin. Though Nvidia stock, at 47 times next year's earnings, isn't cheap, analysts expect revenue to soar 37% in the next fiscal year, justifying that price tag.

Ian Mortimer, comanager of the top-performing Guinness Atkinson Global Innovators Fund, is bullish on Nvidia. Further down the supply chain, he also likes **Applied Materials,** which manufactures the equipment to make the chips, and trades at just 14 times 2018 earnings. In the past, such stocks have traded at a discount because they tended to have long down-cycles—slow periods between, say, the new iPhone or PlayStation launch. But the boom in A.I.-driven technology means semiconductors are far less cyclical, if not entirely

a rare double feat—increasing their earnings while also expanding their spending on research and capital investments.



recession-proof. "The demand is coming from other places that didn't use to exist—smart homes, smart cars, etcetera," Mortimer says.

While Nvidia's chips are used in "the brain of the car," Mortimer says, he also owns German chipmaker **Infineon,** whose sensors facilitate a host of more practical functions—from automatically opening and locking doors to detecting obstacles—that are nevertheless increasingly essential to electric and modern vehicles from Tesla, BMW, and many others. Infineon trades at 25 times earnings.

For income-conscious investors, tech also has more dividend-paying stocks than ever. In 2000, when Microsoft and **Cisco** were the two most valuable companies in the S&P 500, neither paid a dividend. Now, Cisco, which paid its first dividend in 2011, yields more than 3%; the S&P 500 average is around 2%. What's more, after being nearly written off as a washed-up "cash cow," Mortimer says, Cisco expects revenue to grow this quarter for the first time in two years. Pushing into cybersecurity and cloud services has put Cisco on the precipice of a comeback—reminiscent, in a way, of where Microsoft (whose dividend yields about 2%) was a few years ago, when its transition to cloud computing was just beginning to revive its growth. "There's also some reassurance in the staying power of the older stalwarts, Mortimer adds: "It gives you a little bit more of that diversification, without having all your eggs in very high-growth companies that may or may not come through."

PICKS

↓

HONEYWELL (HON: $154)

—

ROPER TECHNOLOGIES (ROP: $261)

—

FORTIVE (FTV: $75)

—

BOEING (BA: $271)

—

FANUC (FANUY: $25)

—

STANLEY BLACK & DECKER (SWK: $169)

—

PRICES AS OF 12/01/17

INDUSTRIALS

The world's manufacturers turn to robotics for better returns.

AUTOMATION AND ARTIFICIAL intelligence could become both the greatest economic boons and the greatest economic challenges of the next few decades. Patrik Schöwitz, a global strategist of multi-asset solutions for J.P. Morgan Asset Management, forecasts that technology will boost productivity so significantly, U.S. GDP could nearly double on those gains alone. But a creeping fear has begun to take hold that those same innovations will eventually eliminate scores of human jobs faster than other forces can create new ones."

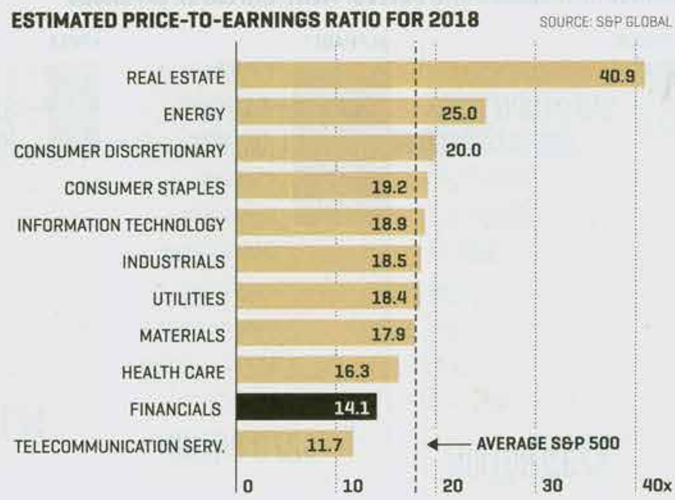
Of course, there's an easy way to hedge the risk of becoming unemployed in the meantime: "Just own the damn robots," Joshua Brown, CEO of Ritholtz Wealth Management, wrote recently. "What price is too high to pay for a company's stock if the company spends every waking minute trying to replace you?" Brown's ironic take aside, investors are seeing promising opportunities in the industrial sector that are driven by robotics advances. One innovator whose stock is priced particularly reasonably is **Honeywell,** whose A.I.-powered machines are becoming ubiquitous in e-commerce warehouses, airplanes, and households, and which trades at less than 20 times 2018 earnings. It's already a leader in industrial Internet-of-things devices, which are poised to drive what some see as the next revolution in manufacturing. Such products "will be the hallmark of introducing the Internet and digitization into the factory," T. Rowe Price's Puglia says.

Puglia's portfolio also features a couple of promising smaller heavy-equipment makers: Florida-based **Roper Technologies,** which specializes in industrial robots for power plants and also makes medical imaging robotics; and Washington State–based **Fortive,** which makes automation tech used in everything from Mars explorers to artificial hearts. With expected 2017 revenues of $4.7 billion and $6.6 billion, respectively, neither Roper nor Fortive is a household name, but both are poised to capitalize as more companies automate their factories.

Other companies are using robotics to cut their own costs. Once considered largely an aerospace and defense manufacturer, **Boeing** is now unquestionably a tech company in its own right, Guinness Atkinson's Mortimer says, generating fat returns on the nearly $3.5 billion it has invested annually in R&D. The robotics it has installed in its factories have helped it crank out its 737 airplanes about 60% faster than it did five years ago. Such progress has propelled Boeing's stock to return 77% so far this year, but Mortimer thinks it has room to run. Mortimer also owns Japanese robotics company **Fanuc,** a big supplier to Chinese factories. Those factories currently have only three robots per thousand workers, says Koch of Goldman Sachs, meaning there's a huge untapped market there. "That's where Japan was 30 years ago," she adds.

Then again, sometimes there's no substitute for good old-fashioned human handiwork. **Stanley Black & Decker,** the 175-year-old maker of the iconic toolbox, has managed to continue innovating in its old age, Puglia says. Its newer line of rechargeable and "smart" connected power tools has been a growth driver, while acquisitions have helped the toolmaker solidify its lead in the category. Stanley Black & Decker has increased its dividend for the past 50 years in a row, and now yields 1.5%.

Opening the Vault for Investors Financial stocks could be among next year's investment bargains.



FINANCIALS

An industry reinvents itself as more consumers say goodbye to cash.

PICKS

↓

FISERV (FISV: $130)

—

INTERCONTINENTAL EXCHANGE (ICE: $72)

—

PAYPAL (PYPL: $75)

—

MASTERCARD (MA: $150)

—

WIRECARD (ETR: WDI: $107)

—

PRICES AS OF 12/01/17

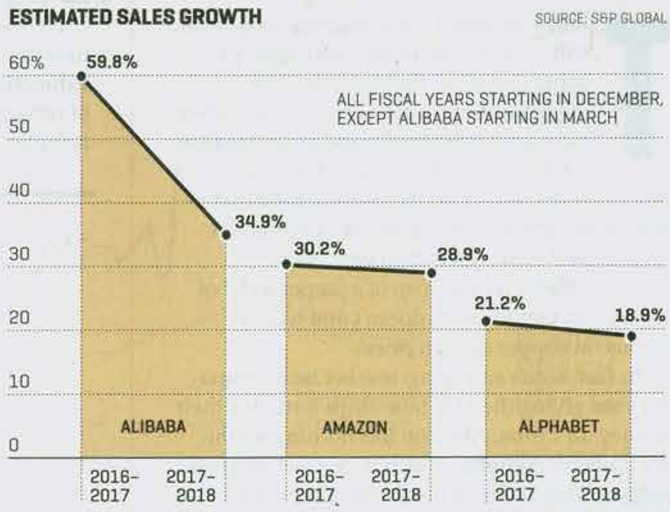
THOUGH IT MAY seem stodgy—not to mention highly regulated—compared with Silicon Valley, the financial sector offers some of the best ways to play tech trends. After all, technology is bringing financial services to unbanked corners of the world and allowing consumers to pay for goods using just their smartphones. And there's nary a financial institution that isn't exploring blockchain, the technology underpinning Bitcoin and the ways it could transform the movement of money. Puglia likes **Fiserv,** which provides the banking industry with payment processing services and palm-scanning biometric authentication technology, and has grown earnings for 25 years straight. "They generate a lot of recurring revenues," Puglia notes.

For a play on big data and A.I., Guinness Atkinson's Mortimer likes **Intercontinental Exchange.** Though best known as the owner of the New York Stock Exchange, the company now gets more than $2 billion, or nearly half, of its revenues from its burgeoning market data and analytics business, which has found a lucrative niche in the age of quantitative and A.I.-driven hedge funds. "That becomes a quite valuable commodity," Mortimer says, adding that the valuation is more attractive than some of the IPO companies listing on the NYSE. "I wouldn't have thought you could have a [company that's both a] banking company and a technology company trading at less than 20 times next year's earnings," he adds.

Mortimer also owns **PayPal,** whose P/E is a pricier 31 times 2018 earnings. He thinks it's worth paying up for the company, which has recently expanded from e-commerce into lending, and is likely to soon realize more revenue from its popular Venmo payment app. Mortimer sees PayPal growing sales at a 20% clip in the coming years—far faster than traditional banks, whose average sales are expected to grow just 5% next year.

It's easy to forget that PayPal's plastic-based frenemy, **Mastercard,** is technically classified as an IT company. More diversified than Visa, Mastercard gets a higher proportion of its revenue from outside the U.S., positioning it to win as consumers around the world switch from cash to electronic payments and from bricks and mortar to e-commerce, says Greg Dunn, comanager of the Thornburg International Growth Fund. "They have built a really defensible business that benefits from those secular trends," he says. Across the pond, Dunn also owns **Wirecard,** a German payment processor that facilitates online transactions for global airlines and retailers such as Ikea. In recent years, Wirecard's business has steadily expanded geographically, and Dunn expects it will soon go truly global.

China Gets an "A" Its growth has slowed as it matures, but Alibaba has proved it can keep up with U.S. tech giants when it comes to revenue growth.



CONSUMER STOCKS

Simple innovations keep customers happy—and Amazon at bay.

WHEN IT COMES to retail—from clothing to groceries—it's impossible to discount the Amazon effect. "You have to accept the thesis that technology is just going to disrupt everything," says Goldman Sachs's Koch. Instead, experts recommend seeking out the Amazon equivalent in other industries.

For online travel bookings, **Priceline** may come the closest. The company gets as much as 88% of its more than $10 billion in gross profits from Europe, where it beat its peers to the punch in establishing hotel relationships. That leaves Priceline a lot of room to conquer the rest of the world, says Thornburg's Dunn. "I think there's still room on a global basis for more and more bookings to happen online," he says. Priceline is expected to grow revenue 17% this year, a pace Dunn believes will largely continue for the foreseeable future.

Technological innovations are also shaking up a historically low-tech industry: fast food. Puglia of T. Rowe Price owns Pizza Hut parent **Yum Brands** along with **McDonald's,** both consistent dividend payers, for just this reason. Following in the footsteps of rival Domino's, whose stock soared after it introduced digital ordering, Pizza Hut now allows people to order pies on Facebook and Twitter or by asking "Alexa," the Amazon Echo home assistant. In October the company promised to deliver pizzas as much as 15 degrees hotter, by transporting them in new pouches made of the same thermal insulation found in ski jackets. Innovation needn't be "esoteric," Puglia adds: "If you find a way to get a warm pizza with the cheese still melted more quickly," he adds, "that is a use of technology to drive more value."

McDonald's, for its part, is in the process of installing digital self-order kiosks in all of its restaurants. Combined with its new nationwide mobile ordering app, the initiatives are driving an acceleration in same-store sales, which investors hope will in turn boost earnings.

PICKS

↓

PRICELINE (PCLN: $1,735)

—

YUM BRANDS (YUM: $83)

—

MCDONALD'S (MCD: $173)

—

PRICES AS OF 12/01/17

EMERGING MARKETS

A host of fast-growing companies close the tech gap with America.

THOUGH AMERICA'S technological prowess is still unmatched, money managers are going to Asia to find high-reward opportunities—a chance, they say, to buy the equivalent of a Google or an Amazon 20 years ago. "It's the first time that emerging markets is really having a rally that is not about commodities as much as it is about tech," says J.P. Morgan's Schöwitz. Some investors think it's the cusp of a "supercycle" of expansion that for once doesn't end with a plunge in copper or corn prices.

In fact, some emerging-market tech companies are giving the U.S. blue chips a run for their money. In China, Amazon has nothing on the incumbent, **Alibaba,** which is on track to grow sales 35% in the next fiscal year after a 60% rise this year (the latter is twice as fast as Alphabet's growth). Puglia owns Alibaba along with Chinese Internet company **Tencent,** which is also capitalizing on mobile payments. Both trade at cheaper valuations than Amazon. "Smartphone technology has revolutionized mobile payments," says Goldman's Koch. "And this is an area where emerging markets are going to lead the U.S."

Rather than own Apple, Mortimer of Guinness Atkinson owns two of its major suppliers: Taiwan-based **Catcher Technology,** which makes glass casings for iPhones, and Hong Kong's **AAC Technologies,** the maker of so-called haptics, which create button-clicking sensations and other vibrations. Both companies have operating margins greater than 25%—higher than Apple's—and have much lower P/E ratios: Catcher, for one, trades at just nine times 2018 estimated earnings. And even if the iPhone X fails to be a hit, the suppliers have plenty of other quickly growing customers in Asia, including smartphone maker Huawei.

Neither of those stocks trade on U.S. markets, but one of Mortimer's picks that's easier for Americans to buy is **New Oriental Education and Technology Group.** It's the largest Chinese provider of private tutoring and coursework—both in-school and virtual—and it trades on the New York Stock Exchange.

PICKS

↓

ALIBABA
(BABA: $175)

TENCENT
(HKG: 0700: $49)

CATCHER TECHNOLOGY
(TPE: 2474: $11)

AAC TECHNOLOGIES
(HKG: 2018: $19)

NEW ORIENTAL EDUCATION AND TECHNOLOGY GROUP
(EDU: $84)

STOCK PRICES AS OF 12/01/17

An Industry With Healthy Prospects

Turmoil over Obamacare hasn't dimmed the outlook for most health care stocks. **BY SY MUKHERJEE**

AS FAR AS INDUSTRIES GO, few are quite as complex, multifaceted, and, as T. Rowe Price Health Sciences fund portfolio manager Ziad Bakri puts it, "idiosyncratic" as health care. The sector spans the gamut from drugs and devices that can produce biological miracles to the actuarial business of insurance. Oh, and it just happens to be one of the nation's most-battered political piñatas.

Yet for all its complexity, and all the flak surrounding the fate of the Affordable Care Act, financial experts see health care as a sector with strong prospects for 2018. Analysts expect earnings in the sector to rise a stunning 24% next year, with an assist from promising tech. But price/earnings ratios for health care stocks are among the lowest in the S&P 500.

Securing a healthy return over the next year will mean choosing carefully among health subsectors. Pharmaceuticals and biotech could be smart bets, as could insurers, Bakri says. Hospitals, in contrast, will face some growing pains as they face more pressure from payers to lower costs.

Here are four stocks that look particularly promising.

BIOTECH

DURING AND after his presidential campaign, Donald Trump bashed biopharma over high drug prices and extravagant price hikes. And it wasn't long ago that biotech stocks would lose billions in market value every time he spoke out on the issue (such as when he said Big Pharma was "getting away with murder" in January).

Those days are pretty much gone. "The things the administration is focusing on to tackle drug prices are actually things that are good for the industry," says Brad Loncar, an investor who manages a biotech fund focused on cancer immunotherapy drugs. Loncar notes that the White House and Food and Drug Administration commissioner Scott Gottlieb have been pushing for initiatives to speed drug approvals and cut red tape at the FDA.

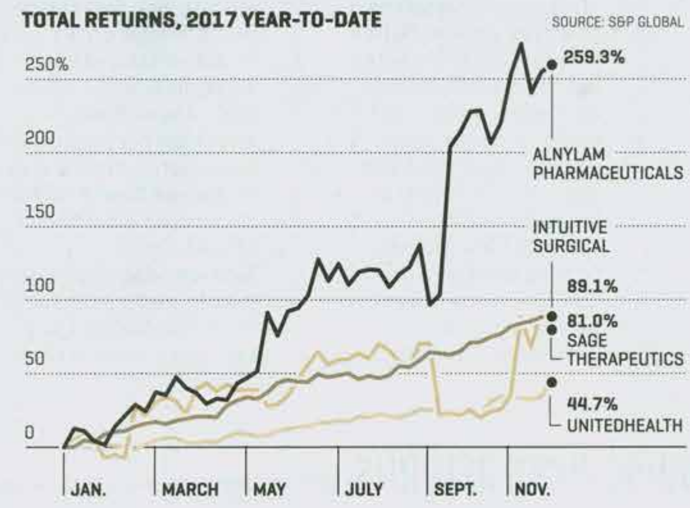
In this environment,

nimble companies developing new technologies may have an advantage over the bigger, better-known names that are trying to eke every penny out of legacy products, says Loncar. "It's a good time for smaller companies. That's where the innovation is right now."

Both Loncar and Bakri see huge opportunities for firms on the cusp of FDA approvals in spaces like gene therapy. Bakri points to **Alnylam Pharmaceuticals,** whose shares have risen an absurd 259% this year thanks to promising clinical trial results for its experimental drug patisiran, which is being tested to treat hereditary ATTR amyloidosis, a rare neurodegenerative disease. But in the long term, the company's bigger promise could be its underlying technology platform: "RNA interference," in which certain kinds of gene expressions can be "silenced" to potentially treat all kinds of genetic diseases.

Then there's **Sage Therapeutics** [up 81% on the year], which may become the first company to market with a drug for postpartum depression, called brexanolone. That condition afflicts between 10% and 20% of women who give birth in the U.S., and late-stage trials indicate it's both fast-acting and long-lasting.

Poised to Repeat Some of 2017's best-performing health care stocks are primed to do well next year too.



PICKS

ALNYLAM PHARMACEUTICALS (ALNY: $137)

SAGE THERAPEUTICS (SAGE: $93)

UNITEDHEALTH GROUP (UNH: $227)

INTUITIVE SURGICAL (ISRG: $397)

PRICES AS OF 12/01/17

INSURANCE

OBAMACARE has been on a roller coaster for nearly a decade, convincing some investors to stay far away from insurance companies in the short term.

But the overall health insurance sector encompasses private, public, and privately managed public programs across individual, small group, and large group markets—many of which have nothing to do with Obamacare. Bakri says companies like Humana are well-positioned for growth as the managed care market continues to blossom. But the best bet, he says, is titan **UnitedHealth Group:** "It's extremely diversified, it has its fingers in businesses like Medicare Advantage and managed care."

UnitedHealth Group's market value has ballooned 41% this year, and 296% over the past five, thanks in part to savvy acquisitions. But analysts who follow the company expect an average 13.5% earnings growth rate for the firm over the next five years, meaning it still has room to grow.

DEVICES

FORTUNE earlier this year launched its "Future 50," which homed in on the companies poised for explosive growth. **Intuitive Surgical,** the runaway market leader in robotic-assisted surgery, was high on the list for its rapid [and ongoing] product adoption boom. [Some 753,000 procedures were performed with its da Vinci robotic surgery devices in 2016 alone, according to the company.]

The potential that the firm's tech will be involved in an increasing number of procedure types in a growing number of countries is one reason it's been lauded by analysts and investors, including both Bakri and Morgan Stanley's David Lewis. A new generation of surgeons has embraced the technology—which allows doctors to perform surgeries without having to slice open patients, via a futuristic console that controls the da Vinci's various arms. Lewis told *Fortune* that a prominent medical conference that was skeptical of the technology just five years ago had now been taken over by young surgeons sharing their research on use of the robots.

Intuitive seems to think it has plenty of room to grow too. The company's stock had surpassed $1,100 before a three-for-one stock split took effect in October that made its shares more accessible. Analysts like Lewis expect earnings to continue their hot streak thanks to Intuitive's existing—and expanding—market clout and a business model where 71% of sales are recurring in nature [thanks in part to the firm's growing arsenal of accessories].

Fortune Crushed the Market Last Year. Here's How

OUR INVESTMENT TEAM didn't go into 2017 as raging bulls. If anything, we thought overvalued U.S. stocks might put a lid on investors' returns. But we did know that there were sectors and companies that looked very likely to outperform—no matter what the market did. One year later, the results are in: Our 23 stocks and funds returned 34%—outperforming the high-flying S&P 500 by more than 10 percentage points. Here's what worked, and why:

Consumers spent freely: A so-so year for the auto industry still delivered big gains for our best-performing pick, **Fiat Chrysler,** as low fuel prices bolstered sales of its Jeeps, pickups, and other SUVs. And a global pivot away from beer and wine and toward liquor paid off for **Pernod Ricard,** maker of Jameson whiskey and Absolut Vodka.

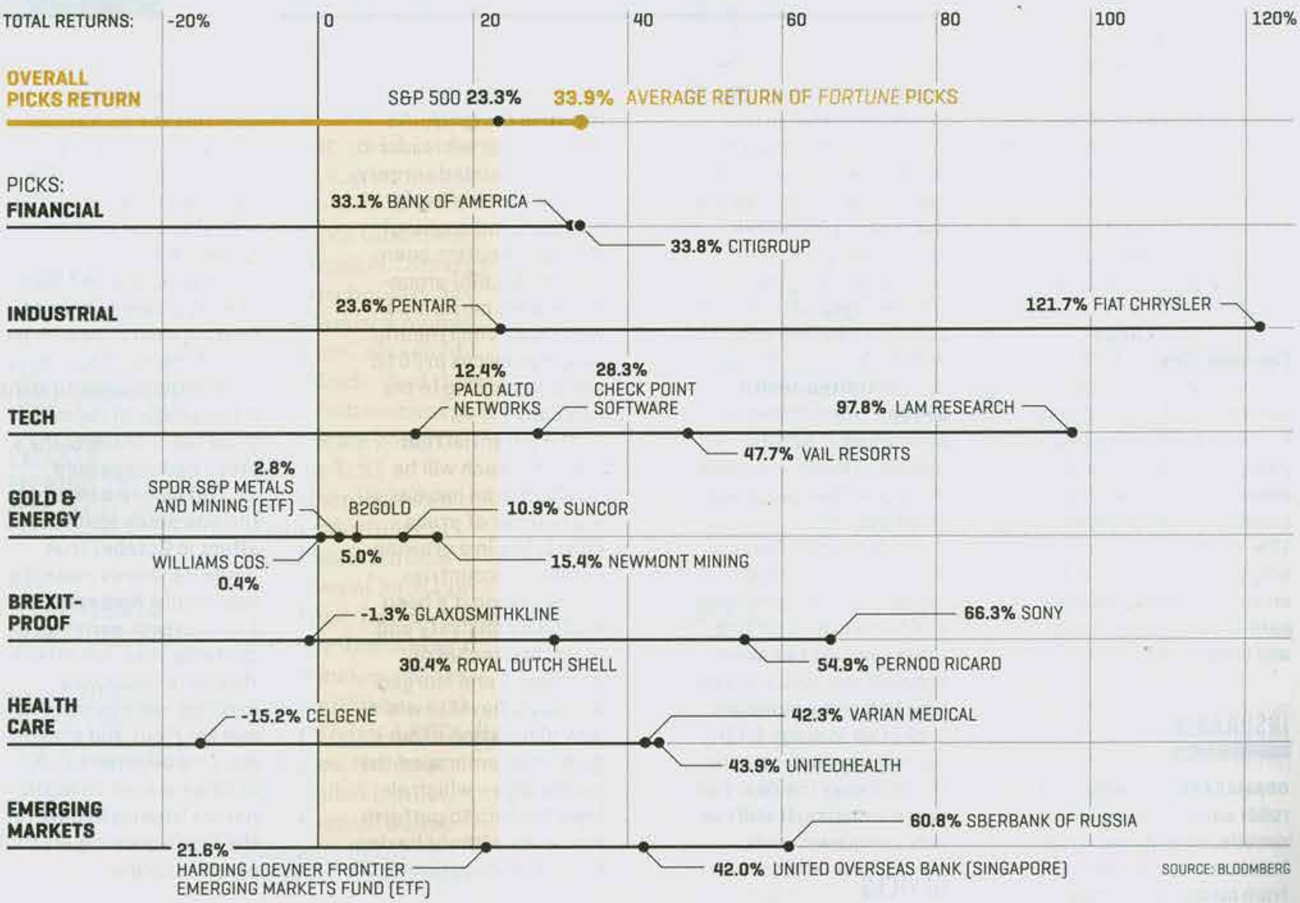
Tech was king: Tech was the top-performing sector in the S&P 500. Our best tech picks included **LAM Research,** a provider of equipment for the "flash" memory used in all kinds of devices, and **Sony,** whose PS4 game console saw a resurgence, thanks in part to its strengths in live-TV streaming.

Banks cashed in: Rising interest rates and an improving global economy meant big gains for **Citigroup** and **Bank of America** and even bigger ones for **Sberbank of Russia** and Singapore's **United Overseas Bank**.

—MATT HEIMER

2017 INVESTOR GUIDE PICKS RETURNS

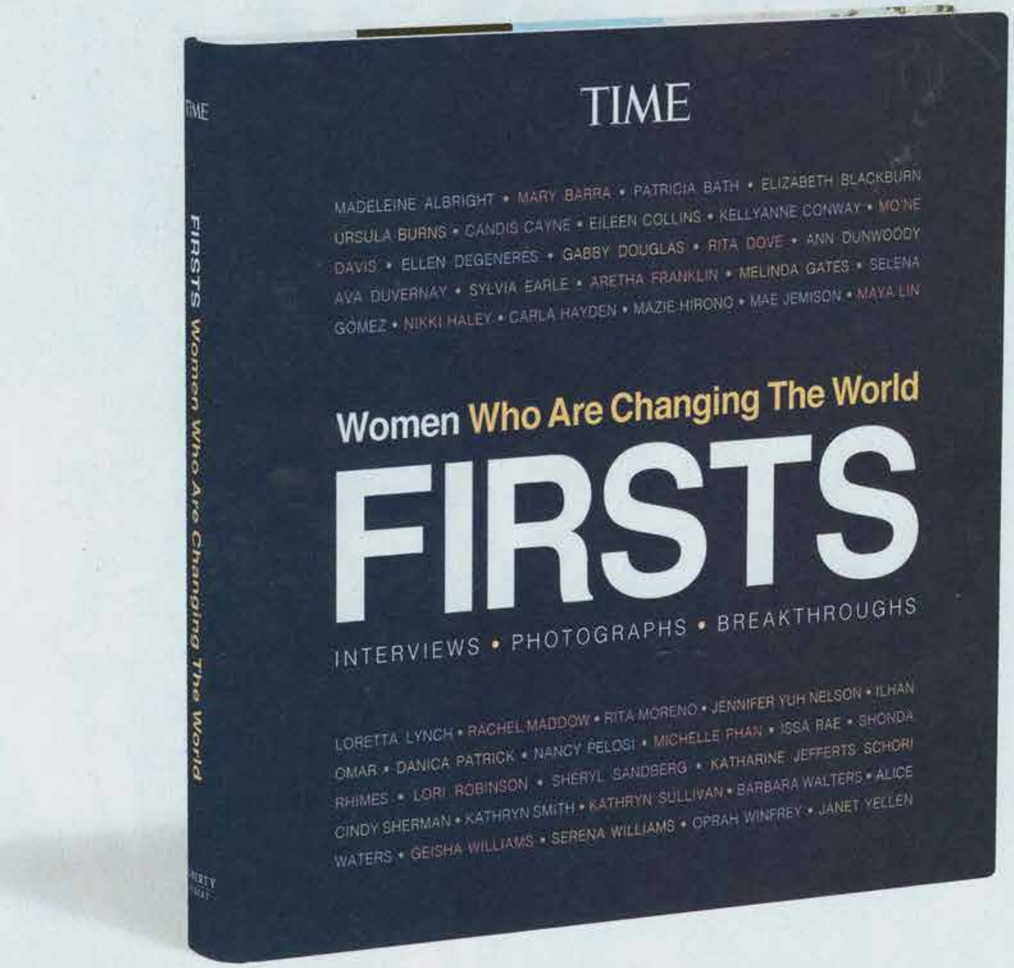
TOTAL RETURNS FROM DEC. 1, 2016, THROUGH NOV. 30, 2017



SOURCE: BLOOMBERG

"My mom always used to say, '*Inspire a generation.*'"

—Gabby Douglas, *Olympic champion gymnast*

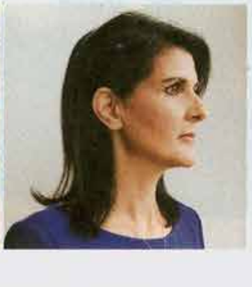


Inspiring interviews with and photographs of groundbreaking women

The companion book to the extraordinary TIME.com project includes profiles of more than 40 women who have challenged convention and are setting a new course for the world.







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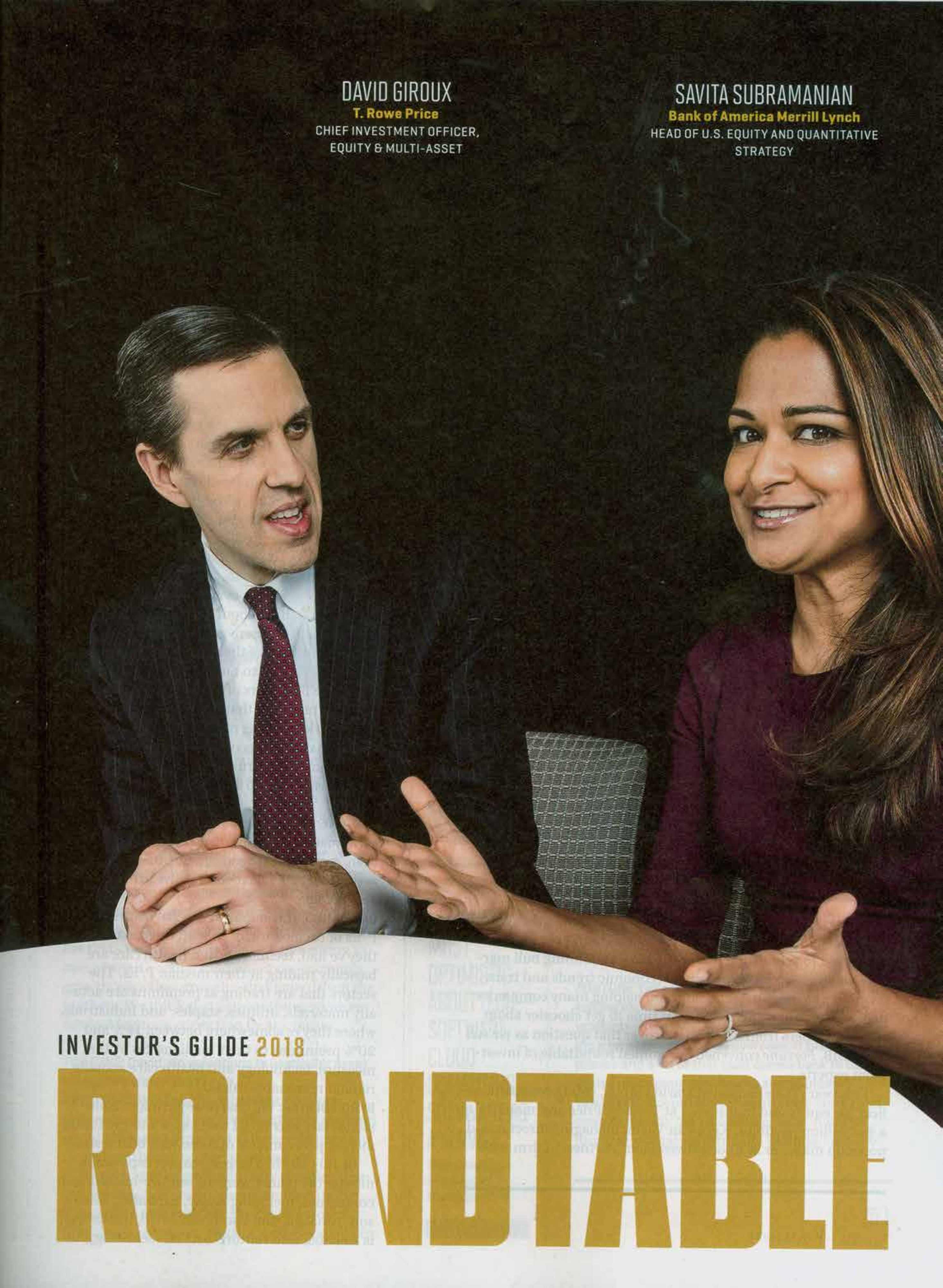
What Is the Smart Money Buying Now?

A historically long bull market has made bargains scarce. But our panel of market experts continues to see profitable opportunities ahead in stocks—powered by technology.

INTERVIEW BY MATT HEIMER
▲ PHOTOGRAPHS BY **SPENCER HEYFRON**



DAVID GIROUX
T. Rowe Price
CHIEF INVESTMENT OFFICER, EQUITY & MULTI-ASSET

SAVITA SUBRAMANIAN
Bank of America Merrill Lynch
HEAD OF U.S. EQUITY AND QUANTITATIVE STRATEGY

INVESTOR'S GUIDE 2018

ROUNDTABLE

EVERY PARTY HAS TO END SOMETIME. That's the troubling thought that's been nagging at many investors this year, even as they've continued to profit from one of the longest-running bull markets for stocks in history. Positive economic trends and transformative changes in technology are helping many companies deliver standout returns—but is it time to get choosier about sorting winners from losers? To answer that question as we roll into 2018, *Fortune* convened our annual roundtable of investment experts.

This year's panel included David Giroux, chief investment officer for equity and multi-asset at T. Rowe Price and manager of a $45 billion portfolio; Kera Van Valen, managing director and portfolio manager at Epoch Investment Partners, a firm with $49 billion under management; Byron Deeter, partner at Bessemer Venture Partners, a global VC firm with $4.5 billion under management; Dan Chung, CEO and chief investment officer of the $19 billion Fred Alger Management advisory firm; and Savita Subramanian, head of U.S. equity and quantitative strategy at Bank of America Merrill Lynch Global Research, whose wealth-management client balances total $2.7 trillion. Here, edited excerpts from their discussion.

***FORTUNE:* I'd like to ask about the very long bull run that we've had in stocks. The bull market is almost nine years old. Some Cassandras, myself included, have been worried that markets are overvalued, especially in the U.S. Is a slowdown or even a market correction looking more likely in 2018?**

SAVITA SUBRAMANIAN: It does feel sort of unsettling. By next July if the market continues to go up, we'll be in officially the longest bull market, by technical definitions, in history. And it doesn't feel good to buy equities now.

But if you think about 1999, it was a year where valuations were getting high. One sector was driving most of the returns of the S&P 500. It didn't feel great to buy equities, yet that was one of the best years of that bull market.

It also turns out that valuations are a really lousy market-timing model. If you're concerned about what happens over the next 12 months, the amount of returns that are explained by the price/earnings ratio are basically close to zero.

***FORTUNE:* You invoked 1999: One of the better performing areas of the market in the past year has been, once again, technology. But, Dan, you were saying that tech valuations, relative to history, are not that high.**

DAN CHUNG: If you look at the 20-year median P/Es of each sector, even with the run that they've had, technology and health care are basically trading at their median P/Es. The sectors that are trading at premiums are actually materials, utilities, staples, and industrials, where they're somewhere between 14% and 20% premiums to their medians. So by that measure, technology and health care actually remain reasonably valued.

BYRON DEETER: We passed some major milestones last year that I think speak to the fundamental performance of these tech businesses.

In July, the five largest market cap companies on the planet were all venture-backed tech companies, including Apple, Alphabet, Microsoft, Amazon, and Facebook. No. 6, by the way, is Alibaba, also venture-backed technology, in

China. The fundamental business performance of these companies has allowed them to pass the old guard of Berkshire, JPMorgan, and Exxon for the world's most valuable companies.

And as you think about the trends ahead—mobility, machine learning, cloud computing—a lot of these tailwind trends that are ripping through large portions of the economy are increasing and going to continue.

KERA VAN VALEN: We've also moved from a market that's been fueled by quantitative easing to one where it's actual fundamentals—earnings growth, cash flow growth—that have driven the markets. We think that can continue, so we're not looking for a correction by any means.

***FORTUNE:* David, do valuations in particular asset categories worry you?**

DAVID GIROUX: Globally, wherever you look, valuations are high and credit spreads are kind of tight. Treasury interest rates are kind of low as well, so there's no real good value.

Foreign stocks are nominally cheaper than U.S. stocks, but really when you look under the surface and take out the FANG stocks [Facebook, Amazon, Netflix, and Google], European stocks and U.S. stocks are somewhat similarly valued.

I would say the one sector that we like a lot is non-pharma health care. You're getting companies basically running at a market multiple with 1.5 to 2 times the growth rate of the market. So you think about something like the life science tool companies, like a **PerkinElmer,** or **Thermo Fisher Scientific.** They have a lot of exposure into China. And you think about what's driving China's growth rate, it's health care, food safety, water quality. These are things that all the life sciences companies sell into.

> "WE'RE DEFINITELY MOST OPTIMISTIC ABOUT TECH—SOFTWARE, CLOUD COMPUTING, SOFTWARE AS A SERVICE."
>
> **Dan Chung,** Fred Alger Management

***FORTUNE:* That is in some ways a technology play too.**

CHUNG: Right. I think in pharma and biotech, for example, you've got, oh, I don't know how many years ago the human genome was sequenced and then the development of ever faster, ever cheaper sequencing techniques. That set the base for research that is now coming out with new drugs. For example, immuno-oncology: Cancer tumors are not all the same, basically, and genetic differences can determine what cancers respond to which drugs and which do not. And it's not just cancer, of course. Cystic fibrosis [drugmaker] **Vertex** has shown pretty remarkable advances there in treating that terrible disease.

On the equipment side, we like **Illumina,** which is one of the genetic sequencing companies that provide the heavy horsepower to analyze specific genetic codes and sequences for clinical and research purposes. There are also advances that are software and automation driven. So a great company like Intuitive Surgical is using more and more automation software to allow surgery to be done with more control, less damage to healthy tissue or nerves, and less invasiveness.

***FORTUNE:* Let's talk about tax reform. We've been talking about American companies selling their products worldwide. And as we know, they're parking a lot of their earnings overseas. If tax reform passes and a lot of that cash comes back to the States, does more of it flow to shareholders?**

VAN VALEN: It's unlikely that any one-time cash change, or any tax reform per se, is going to increase capital investments because access to

funds has been quite easy in recent years. So a one-time event shouldn't change that. We would expect it potentially to materialize more through share buybacks. If there's a permanent level to the tax reform and tax reductions, then dividends could increase even without companies having to change their capital allocation policies because they would be more profitable.

DEETER: There are some real potential positives from tax policy. In terms of immigration policy, I'm a little more concerned. The data shows that 51% of companies in the tech sector with over a billion dollars in market cap were started by at least one immigrant founder. If you throttle that back, or if you start to limit immigration, there will be disastrous impact on the innovation economy.

SUBRAMANIAN: That's absolutely right. Tech is the most exposed to H-1B visas of any sector. So, yeah, that is a big risk for the tech story.

"THE FED HAS BEEN PRINTING A LOT OF MONEY. NORMALLY YOU SEE INFLATION ALONGSIDE THAT. AND WE HAVEN'T."

Savita Subramanian, Bank of America Merrill Lynch

***FORTUNE:* If that risk comes to fruition, who gains if the U.S. loses?**

SUBRAMANIAN: In stocks, you'd want to go domestic; you'd want to go for U.S. companies that hire primarily U.S. workers. I think that's ultimately inflationary and potentially stagflationary, because we're crimping off growth from overseas.

CHUNG: I think China would be in a very strong position for investors. Their Internet industry is just as strong as the U.S. They're making huge investments in the Silk Road initiative for infrastructure. And if the U.S. is really withdrawing from globalization and immigration, they are a source of capital as well for all of these projects, as well as talent.

And I would point out companies like **Tencent,** where in mobile payments they're well ahead of Western or even European standards.

GIROUX: I actually spent a lot of time in D.C. over the last year. I think you will see tax reform. I think it's a positive for the U.S. market because the average company today is at about a 27% tax rate. If that can go down to 20%, that could boost earnings for the market, 7%, 8%, 9%. The domestic companies, financials, consumer discretionary companies would probably be the winners.

So if you look at a company like a **Pfizer** that has a 34% tax rate, their earnings could potentially go up as much as a dollar a share if you had tax reform. You could look at a **Dr Pepper Snapple** with a 34% tax rate, where their earnings—it was actually trading at a discount to what it historically traded, where the earnings could go up 15%. There are a lot of high-tax-rate companies that are just not being appropriately valued for [the impact of a tax cut].

***FORTUNE:* Historically it's been argued that a big tax cut benefits smaller companies more.**

SUBRAMANIAN: It's true. Small-caps pay a higher effective tax rate. They would stand to gain a lot more from that tax cut. But within small-caps you need to be careful because the question is, How much of that tax benefit are companies going to actually retain? And what we've found is that when you have a windfall for a sector or for the market overall from a lower corporate tax rate, a lot of that benefit is actually competed away.

So for example, if you're in a commoditized industry and you and all of your competitors get a windfall in terms of a lower tax rate, maybe you pass that on to your customers through lower prices, and that marginal benefit actually gets whittled away by natural competitive forces.

FORTUNE: Could tax reform turn 2018 into a big IPO year?

DEETER: Quite possibly. We have this very bizarre market dynamic right now, which you can call the logjam of the unicorns, the unprecedented number of high-quality companies that have chosen to delay their IPOs. Eight years ago was the first time a venture-backed private tech company was valued at over a billion dollars. We have over 200 today worldwide, and well over half those are in the U.S.

And so you've got this glut of fabulous companies, high-quality companies that in prior years would have been public, and today are sitting on the doorstep with ranges from the Ubers and Airbnbs and Pinterests in the tens of billions to dozens of enterprise cloud companies that are worth well over $1 billion.

I know of several companies personally that are targeting early 2018 IPOs if the market holds up, but are waiting until late Q1 or early Q2 so that they can include their full 2017 audited financials. We just need predictability—low volatility and willing buy-side investors.

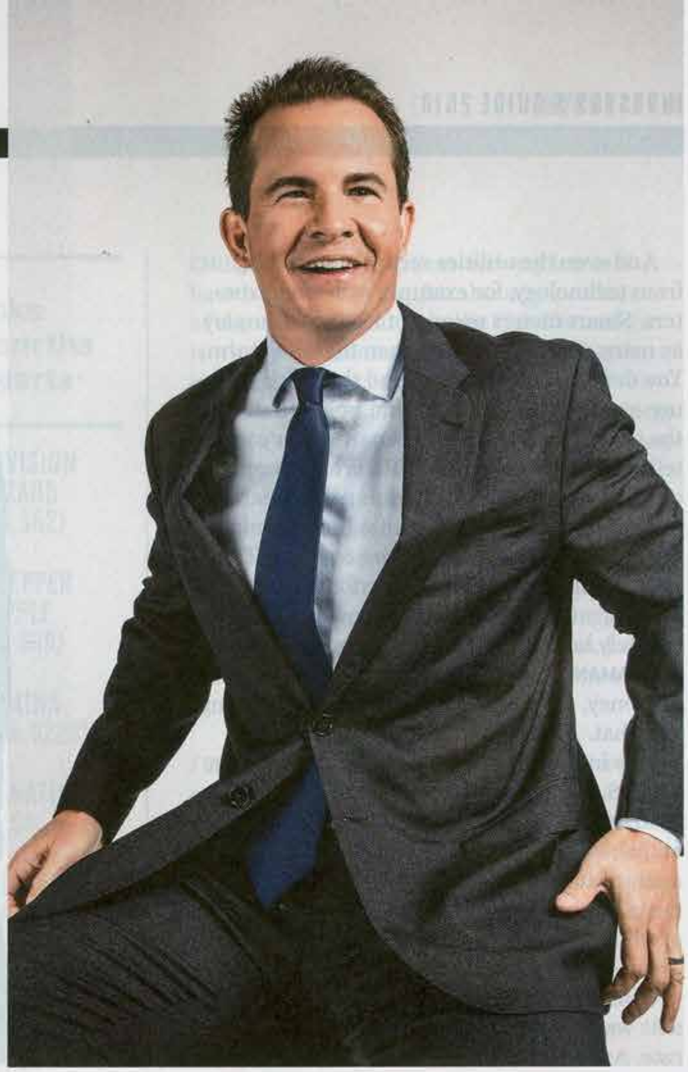
FORTUNE: What are some of the specific industries where you'll see new technology moving the needle next year?

DEETER: Automotive a few years from now will be completely transformed by the three big trends: electrification, on demand, and soon, autonomy. I don't believe kids born today in the U.S. will get their driver's licenses, and it will seem like a hobby to drive a car, much like riding a horse is, because it's irrational and unsafe.

FORTUNE: Do you think the legacy automakers can keep up?

CHUNG: They cannot keep up. They're going to play because they can be late followers, but the leaders are clearly going to be companies like **Tesla,** Google [and its parent Alphabet], Uber, and we'll see if Apple still is playing in the automotive field. And the important part, I mean, the car may say GM on it, but if they have to license the automated driving technology from somebody else, if they have to purchase better electronics from the outsource, then the value in the car might increasingly go to the technology leaders as opposed to GM.

DEETER: I would just add there's over a dozen automotive companies spending over a billion dollars each toward the combination of this autonomy and electrification wave. And so I give GM, Ford, and Daimler some credit. They've been acquisitive but also have invested internally.



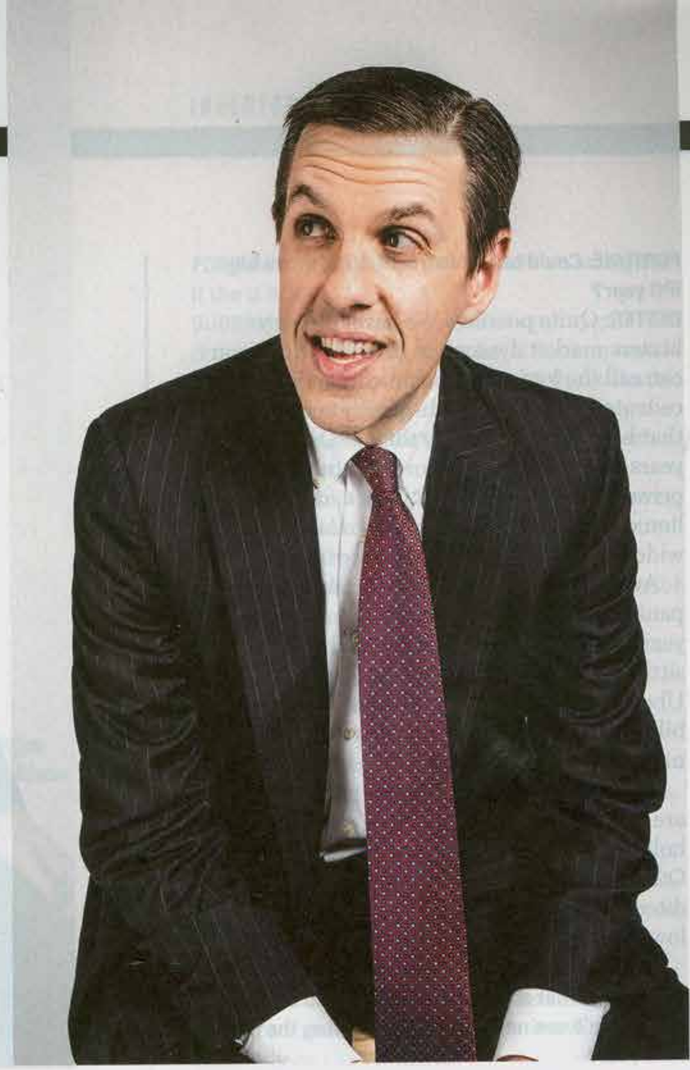
"WE HAVE THIS VERY BIZARRE MARKET DYNAMIC RIGHT NOW, WHICH YOU CAN CALL THE LOGJAM OF THE UNICORNS."

Byron Deeter, Bessemer Venture Partners

FORTUNE: Let's talk about inflation. You've had the Federal Reserve signaling that it's going to continue to tighten interest rates, and you've had some wage growth that might move the needle a little bit. How is that affecting your strategy?

VAN VALEN: We've been talking about when interest rates will rise for five years now, so it is a little bit of a relief to actually be in an environment where interest rates are rising.

That's true even for sectors like utilities, which everyone assumes will be challenged. Utilities have performed in line or better than the S&P 500 since the first interest rate hike in 2015 here in the U.S. So as long as you're focusing on the right utilities, not just high-yielding companies, but companies that actually have the cash flows and the growth to support their cash returns back to shareholders, we think that the rising interest rate environment is actually a good thing as long as it is a reflection of improvement in the economy.



And even the utilities sector is benefiting from technology, for example with smart meters. Smart meters mean not having to employ as many people to go out when there's a storm. You don't have to drive around the block to figure out where the tree fell that knocked down the power line because the smart meter can tell you this immediately. **PPL** is an example of a company currently investing in a smart-meter replacement project that is modernizing the power grid to make it more resilient. This smart-meter project does contribute to the rate base, earnings and cash flow growth, which ultimately helps drive the growth in the dividend.

SUBRAMANIAN: The Fed has been printing a lot of money, and normally you see inflation alongside that. And we haven't.

One interesting trend that we're noticing in the U.S. is this growing scarcity of labor within more manual-labor-oriented jobs. So for example, our industrials analysts, our transports analysts have been writing about the fact that these companies can't find manual labor types of workers. And the reasons are pretty unusual. There is a larger percentage of people addicted to opioids, and that's shrunk the pool of available workers. There's a higher incarceration rate. And we've also noticed that the average, you know, typically male members of society that sign up for these jobs are playing more video games.

But this scarcity is actually showing up in margins. So you're seeing homebuilders, for example, having to pay higher and higher wages to court these workers back from other activities. It is a trend that's just starting to percolate, and you are starting to see margins in those industries under some pressure.

The million-dollar question is whether they will have pricing power, whether the economy gets strong enough that consumers are willing to pay the higher prices that offset the cost increase.

***FORTUNE*: Speaking of not paying higher prices, I have been dying to talk about the Amazon effect, not just on retail but on all kinds of industries where it competes.**

GIROUX: Matt, I think it's much more broad than the Amazon effect really. I've been doing this for 19 years. I've just never seen more disruption in more sectors than I do today. We've already talked a little bit about autonomous cars, what impact that could have on GM, Ford. Or think about shale oil. Shale oil is really disrupting OPEC and the energy majors.

We talk about watching blockchain, from a technology perspective, disrupting money transfers or title insurers down the road. Almost every sector out there is going through some change. And those sectors that are not, my guess is over time those companies' valuations will tend to go higher than they have historically.

CHUNG: There's definitely been a trend in the market where companies in the consumer space fare better if they are Amazon-proof or at least seem less subject to risk. A great example is the video game companies. The industry has significant franchises like **Take-Two Interactive** and **Activision Blizzard.** It's not a skill set that Amazon has.

Another example is **Live Nation,** which is in the business of live entertainment; they own Ticketmaster, and they also own venues and music festivals, which gives them unique advertising opportunities, especially with millennials. If you think about it, these are experiences

> "GLOBALLY, WHEREVER YOU LOOK, VALUATIONS ARE HIGH AND CREDIT SPREADS ARE TIGHT."
> **David Giroux,** T. Rowe Price

that people value, and they're not Amazon-able. And Whole Foods is the most dramatic counterexample, right? Amazon has moved directly into one of the most brick-and-mortar businesses that there is.

VAN VALEN: This is where the individual companies are going to have to distinguish themselves. Take suppliers like **Campbell's Soup,** for example. They had a disruption from club stores, the Costcos and the Sams of the world. You couldn't just take six cans of soup and add some plastic around it and sell it for cheaper. That obviously would hurt your margins. So companies like Campbell's have had to sit down and figure out, How do we operate within this new environment? How do we offer different packaging, different price points to make sure not only can we help the retailers survive, but also figure out how to get direct to consumers.

So it's not just the changing retail, it's also the changing consumer, and the consumer shopping differently. It's all intertwined, but there's certainly a lot of pressure on these companies to adapt and adapt quickly. An example of a company that has embraced technology and, therefore, adapted is **McDonald's.** They continue to deploy technology solutions like their global mobile app and in-store kiosks, which ultimately give people more choice on how to order and how to pay. In addition, they have begun to partner with UberEats to offer delivery.

***FORTUNE:* Recent news we've seen from oil producers like Venezuela and Saudi Arabia have involved the kinds of events that five or six years ago would have sent oil prices through the roof. Instead they've been relatively stable. Is oil in the $55-to-$65-a-barrel range the new normal?**

GIROUX: Actually I would argue that in five years oil will be dramatically lower than it is today. Today we have basically just-in-time production on shale. You can drill a new hole and actually have oil producing in three months. And as the majors have been disrupted by that, they're responding by lowering their cost to be able to bring on new production offshore at $40 to $50, where they used to need $70, $80 to get good returns.

And again, we have to talk about autonomous vehicles and electric vehicles. Long term, the demand side of the equation for energy is also at a negative. So you have more supply at lower cost as well as declining demand. If you are a long-term investor, it makes a lot of sense to be underweight energy in the next five to 10 years.

Picks From the Experts

ACTIVISION BLIZZARD (ATVI, $62)
—
DR PEPPER SNAPPLE (DPS, $89)
—
ILLUMINA (ILMN, $228)
—
LIVE NATION (LYV, $46)
—
MCDONALD'S (MCD, $170)
—
PERKINELMER (PKI, $73)
—
PFIZER (PFE, $36)
—
PPL (PPL, $37)
—
SENDGRID (SEND, $21)
—
TAKE-TWO INTERACTIVE (TTWO, $111)
—
TENCENT (TCEHY, $52)
—
THERMO FISHER (TMO, $193)
—
TWILIO (TWLO, $26)
—
VERTEX (VRTX, $144)

STOCK PRICES AS OF NOV. 29, 2017

CHUNG: Natural-gas prices are very low and have been for a while. It's also a by-product of the shale revolution in the U.S. Natural gas is what powers most of our electricity needs, right? And that combined with renewables is another important trend that will affect energy prices globally. So we also have a negative long-term view.

DEETER: Battery technology continues to see heavy investments, and a large portion of Tesla's market cap is actually Gigafactory related. The U.S. venture capital industry did lose money in solar as a result of the aggressive pricing from Chinese competitors, but the size of the market is too large to ignore long term.

***FORTUNE:* So for 2018, where do you see the greatest risk and the greatest opportunity?**

DEETER: I think the biggest risk is geopolitical, both with tax and immigration policy, which we talked about, as well as international political stability. But I think the fundamentals of the economy and the businesses within the economy are quite strong.

On the opportunity side, we've talked a lot about how tech is the largest sector of economic growth. Software within tech is the biggest driver, and cloud computing is the future of software. And so as a firm, we have disproportionately bet on cloud computing. We took **Twilio** public in 2016, and **SendGrid** just [recently]. And I think 2018 is very much a double-down year where that trend is going to accelerate even more.

***FORTUNE:* Savita, what's your thinking?**

SUBRAMANIAN: We're at the end of a 40-year period where we got used to a very low cost of capital, where leverage was essentially free and cash yielded nothing. Moving from that scenario to an environment where the Fed is tightening, that's going to be a little bit tricky, especially if you look at valuations of some of the most bond-like stocks in the S&P. There are areas of the market that typically do well in a downturn, like regulated utilities, that might not do as well in a downturn if that downturn is caused by a rate spike.

I think within the consumer discretionary sector, the Internet and catalog retailers might win, and some of the bombed out brick-and-

mortar retailers might remain bombed out and even go lower.

FORTUNE: Dan, what do you think?

CHUNG: I'm a little worried about the massive amount of money that's flowed into index, ETF, and quantitative-oriented strategies, and the chance of a computer-driven flash crash. It wouldn't necessarily be something that is very long-lasting, but could be sharp and kind of scary. You know, there are now more ETFs than there are stocks. And companies are actually their biggest buyers of their own stocks because of their strong cash flow. So there's been a real imbalance in supply-demand, and I worry about what all that quantitatively driven money will do if it tends to be herd-like.

We're definitely most optimistic about tech—software, cloud computing, software as a service. Companies generally are adapting to the digital world. They have the money. Labor is scarce. Talented technology employees are very expensive, and so it's exactly the right time when companies invest in these things to improve their efficiency and also to bring themselves into the next wave of business.

What we're the most concerned about is actually low-growth companies without a lot of pricing power. We think a lot of the consumer staple names are not in good fundamental position. They are beloved historic companies, but they are just not the brands or the products that the millennials are interested in. Our analysis on that extends into apparel and retailing as well. They're not your daughter's fashion brand.

FORTUNE: Kera, what's your thinking—greatest risk, greatest opportunity?

VAN VALEN: I'm not actually concerned that interest rates are going to spike or rise too quickly, but were that to happen, I think that wouldn't just be detrimental to the more defensive sectors, it would be detrimental to all sectors.

As far as opportunities go, we like to say tech is the new macro. If you're looking at dividend stocks, it's hard to find direct investments within the tech space. However, the influence that technology has across all sectors in terms of revenue growth and profitability is substantial. It means margins can stay at higher levels. It means cash flows can remain higher, leaving a lot more cash to continue to be returned to shareholders.

"WE THINK [GROWTH] CAN CONTINUE, SO WE'RE NOT LOOKING FOR A CORRECTION BY ANY MEANS."

Kera Van Valen, Epoch Investment Partners

FORTUNE: David, last word?

GIROUX: We've basically grown earnings on a compound rate of about 5% per year for the last five years. If you actually had tax reform in 2018, you could see earnings growth that's more like 13% to 15% potentially, depending on what the corporate rate does. I think that would be a positive for the market, sort of an acceleration in earnings growth.

In terms of negatives: If you have a three- to five-year horizon, you're starting from a point where valuations are high. I don't know if we're going to have a correction in '18, but I think it makes sense to be a little bit defensive where we are in the cycle.

FORTUNE: Thank you all so much. It's been great to have you on the panel.

BCEL—AT THE HEART OF LAOS'S ECONOMIC GROWTH

Banque Pour Le Commerce Exterieur Lao Public (BCEL) is a local bank that greatly contributes to the economic development of Laos.

Phoukhong Chanthachak
General Managing Director of BCEL

THE LAO PEOPLE'S Democratic Republic (Lao PDR) is a member of the Greater Mekong Subregion of countries and of the World Trade Organization and the ASEAN economic bloc, as well as many other international unions. The country is located in the middle of the Indochina Peninsula, with the Mekong River running from north to south demarcating most of Laos's western border.

The country has transportation routes that connect it with other Southeast Asian countries and has connecting flights with many international airlines. Lao PDR has plenty of natural resources and a unique culture, and it is a country that is developing itself in all areas. All this makes it a suitable investment destination for both domestic and international investors aiming to achieve high benefits.

Along with the country's reserves of coal, wood, and precious metals, the hydroelectric potential of the Mekong is helping turn Laos into one of the fastest-growing economies in Southeast Asia. Fueled by the expansion of its power-generation sector and the adoption of labor-intensive techniques by its manufacturing and agricultural industries, Laos has seen its GDP grow at an average of 7.8% for the past 10 years, playing a part in combating poverty and bringing the country to the attention of the global investment community.

Laos is a peaceful and safe society, and the Lao banking industry is very stable. Those are important factors that help explain why foreign investment into Laos is increasing each year. Four major state-owned commercial banks dominate the country's banking sector. Between them, they account for 44% of the country's assets, 59% of its deposits, and just over half of its loans. The largest of these is the Banque Pour Le Commerce Exterieur Lao Public (BCEL), which was established after the Lao People's Democratic Republic declared independence in 1975; it is now in the 28th year of its current incarnation as a commercial bank.

In today's rapidly globalizing economy, and particularly in the context of the country's accession to the WTO and ASEAN economic bloc, few would deny that BCEL's not-so-new role in driving Laos's economic and industrial development is even more important than its previous remit of processing the government's paychecks. The first bank to be listed on the Lao Securities Exchange, in 2010, BCEL has consistently and significantly contributed to the country's socioeconomic development by providing the funding for many of its major development projects, particularly in the fields of industry, trade, and construction.

BCEL serves its retail clients through 19 branches, 82 service units, and 16 exchange units whose agents are tasked with meeting the needs of customers. And it has arranged with more than 30 correspondent banks worldwide to help with international settlements and trade services. BCEL also leads its sector in the provision of both mobile and online banking, a surefire growth market in a country experiencing a steady growth in disposable income and the expansion of its middle class.

"We categorize both our retail and corporate customers by their needs," says general managing director Phoukhong Chanthachak, "and we frequently modify our services to make sure they meet individuals' and businesses' specific requirements. Because of this, we are confident that the services we offer are better than those of our competitors." Paying a yearly dividend is part of BCEL's strategy to give the highest benefits to its shareholders.

Although BCEL was officially reconstituted as a commercial bank in 1989, its current inexorable rise, according to Mr. Chanthachak, really began to pick up steam with its listing on the stock exchange seven years ago. The added transparency that this called for helped strengthen the trust between the bank and its customers, and it gave BCEL the financial muscle to grow its asset base and invest in the development of its IT systems.

Even though the Ministry of Finance holds a 70% stake in BCEL and the French government controls a further 10%, Mr. Chanthachak is always looking for new initiatives to make the remaining 20% that is traded on the open market attractive to new overseas investors. "We have set ourselves a target of growing deposits by 18% each year for the next two to five years," he says, "and we definitely plan to grow both assets and profits so that we can carry on paying out dividends to our shareholders."

The next step, Mr. Chanthachak says, is to develop and improve BCEL's range of products in line with international standards, and rightly so. As a member of ASEAN, Laos now belongs to a club of nations with a combined population of more than 250 million consumers, many of them potential customers. And with the government set on establishing Laos as "the battery of Southeast Asia" through its harnessing of the Mekong, inward investment into its hydropower, transmission, and distribution infrastructure is bound to be in great demand—as will the financial expertise of BCEL to service it. ●

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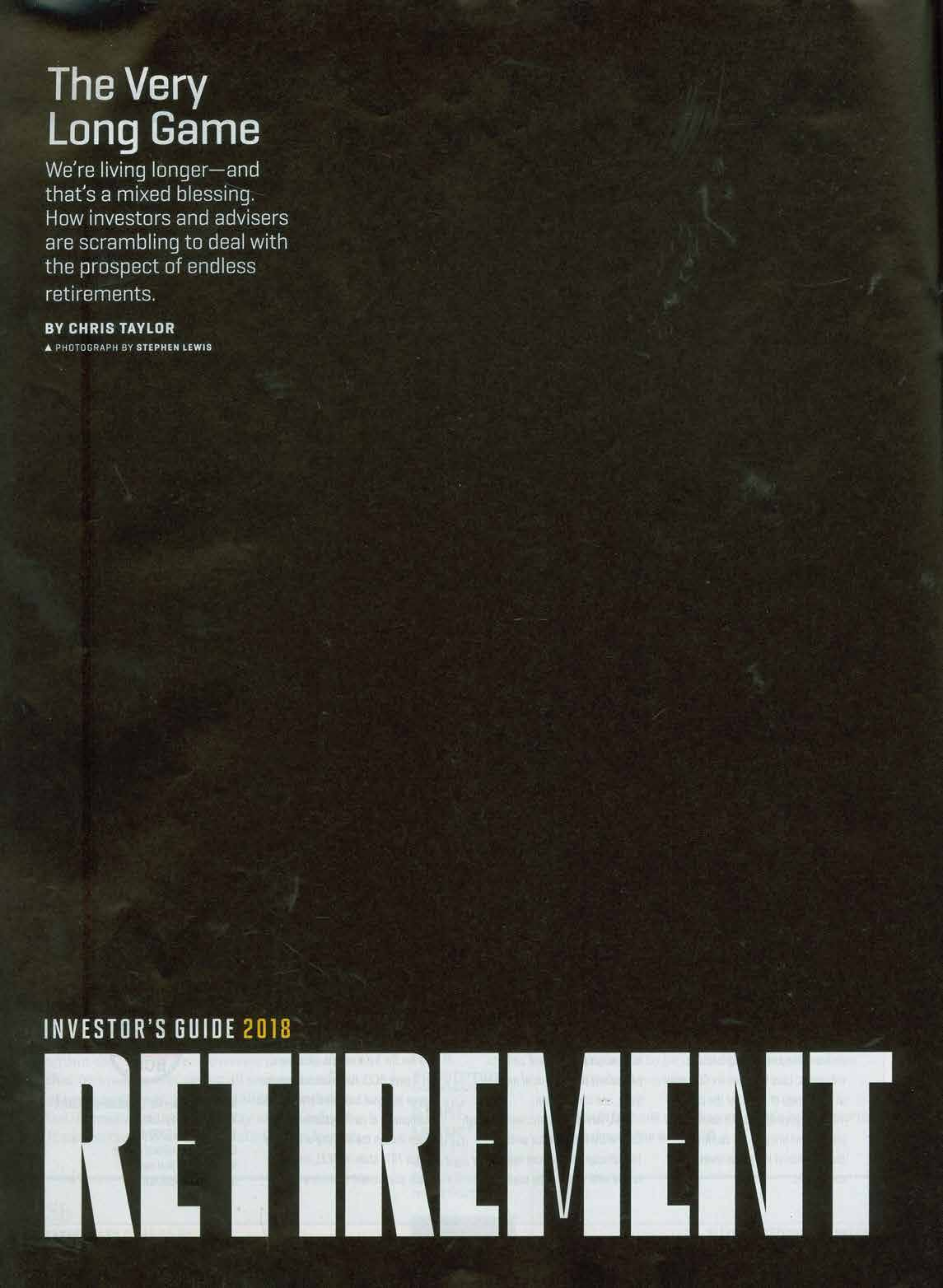


The Very Long Game

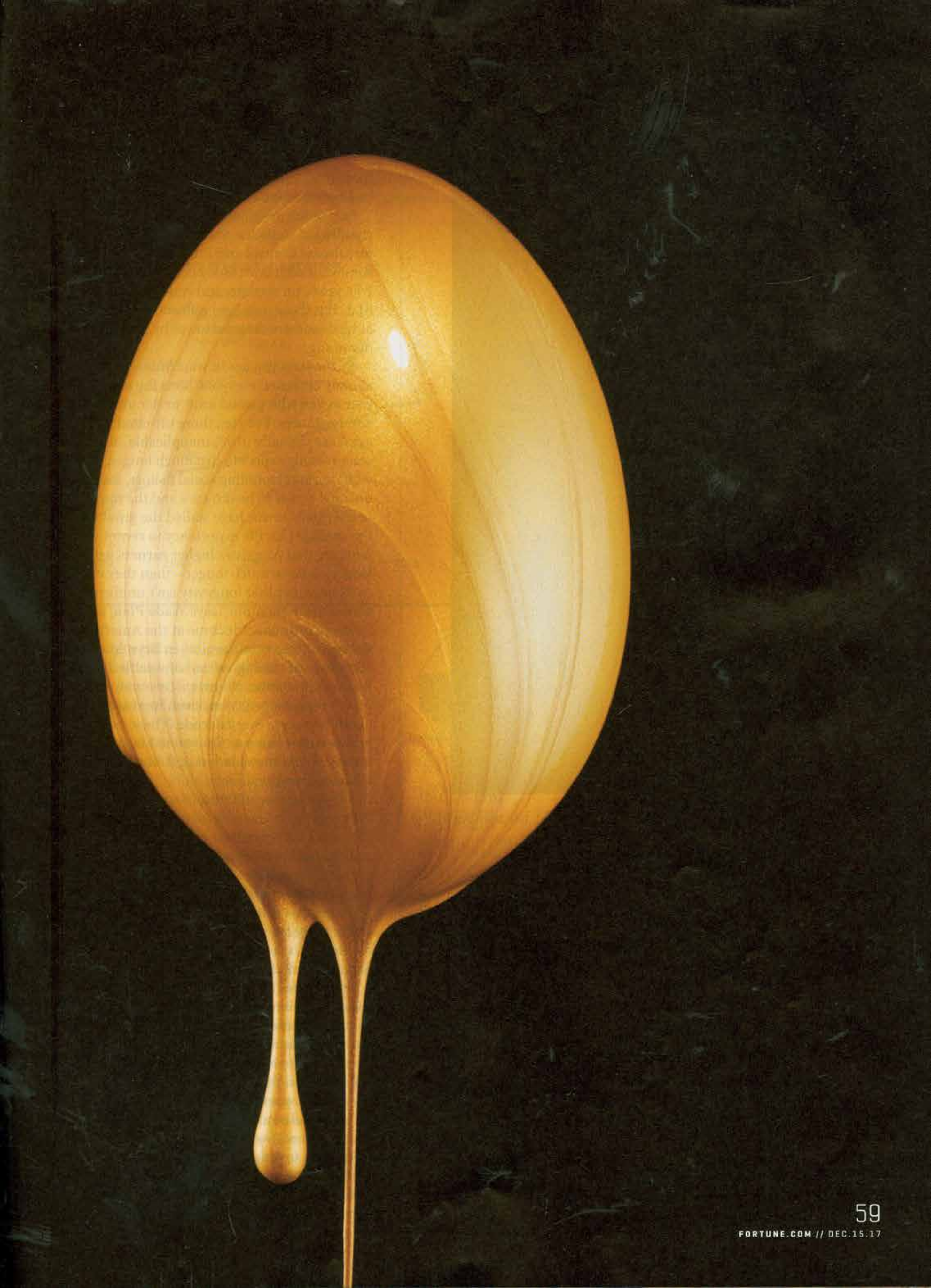
We're living longer—and that's a mixed blessing. How investors and advisers are scrambling to deal with the prospect of endless retirements.

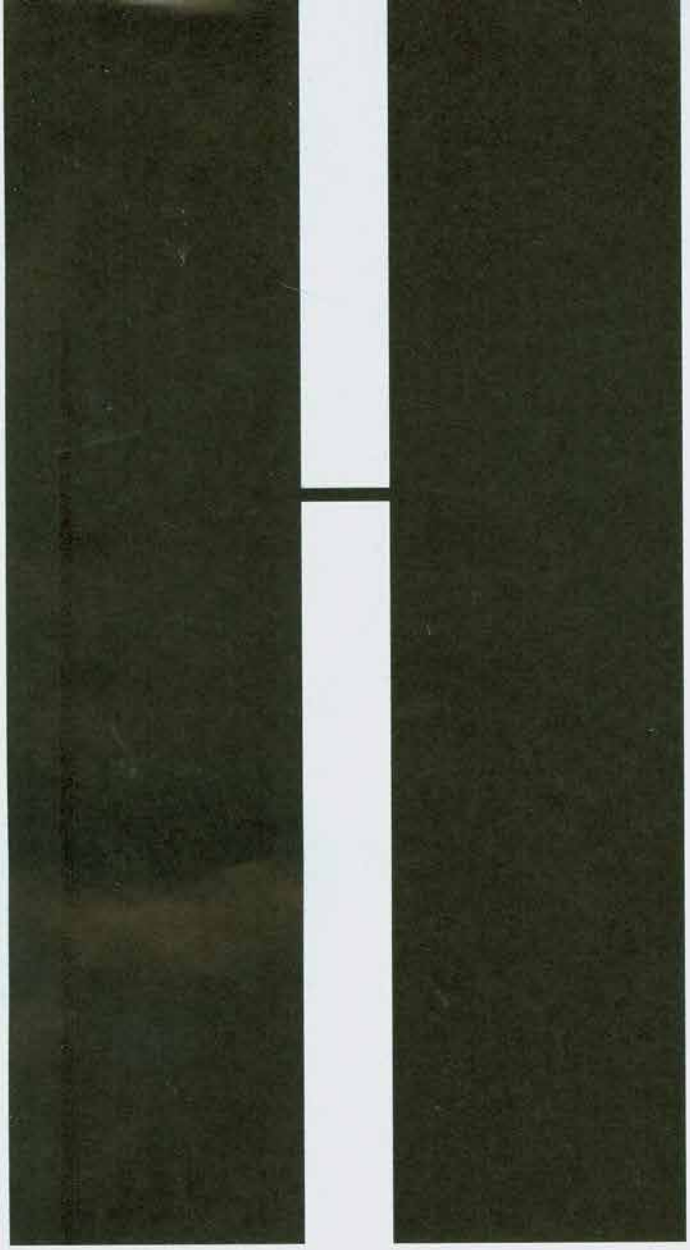
BY CHRIS TAYLOR

▲ PHOTOGRAPH BY **STEPHEN LEWIS**

INVESTOR'S GUIDE 2018

RETIREMENT





HAVE A SEAT, WON'T YOU? Maybe take a deep breath too, because we have some good news and some bad news.

At this point in your life, you almost certainly have some milepost numbers in your head that are shaping your plans for the future. Some of those numbers have dollar signs attached, of course, but just as important are the ones pegged to birthdays. Chances are you've been basing your retirement planning—the amount you're saving, where you plan to live, the lifestyle you intend to fund—on an estimate of how long you will live.

The good news: You probably underestimated.

The bad news? Same.

You're far from alone in this. In fact, 40% of retirees underestimate life expectancy of people their age by at least five years, according to a study by the Society of Actuaries. One gigantic study by the University of Michigan asked 26,000 Americans 50 and over, back in 1992, how many of them would make it to 75, and then tracked exactly how many did. As of this year, the results are in: Those who said they had a 0% chance of reaching 75? Half of them made it. And among those who said they had only a 50/50 chance, 75% did.

Part of the problem stems from a misunderstanding of statistics. Stats from the Centers for Disease Control and Prevention say that American men born today can expect to live 76.5 years, on average, and American women 81.3. But those numbers reflect life expectancy at birth and are dragged lower by people who die young.

By the time you are in your fifties, you have already outlasted everyone born the same year as you who passed away under untimely circumstances. For you, those oft-cited "averages" are virtually 100% inapplicable. You can probably expect to live much longer. And while various troubling social factors, including unequal access to health care and the impact of the opioid crisis, have stalled the growth of the average U.S. life expectancy in recent years, odds are that America's higher earners will live longer—maybe much longer—than they expect.

"Remember that longevity isn't uniform across the population," says Wade Pfau, a professor of retirement income at the American College of Financial Services in Bryn Mawr, Pa. "For those at the higher end of wealth distribution, with better education, income, and health care, longevity has been increasing by about two years every decade. Those people can expect to live three or four years longer than average." And the older you get, the more that advantage compounds.

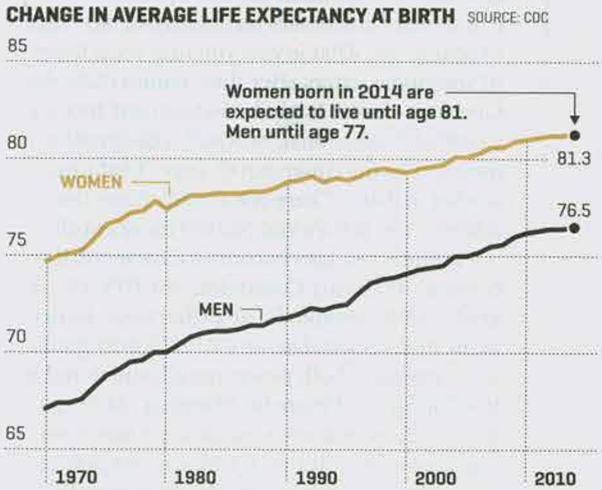
For the very wealthiest, of course, there's little financial downside to the likelihood of five or 10 more years on earth. But for most middle- and even upper-middle-income earners, the prospect of making one's savings stretch into what seems like an endless retirement is a daunting one, increasing the uncertainty around how to invest, how to pay for medical care, and whether you can leave a legacy behind for the kids or your community.

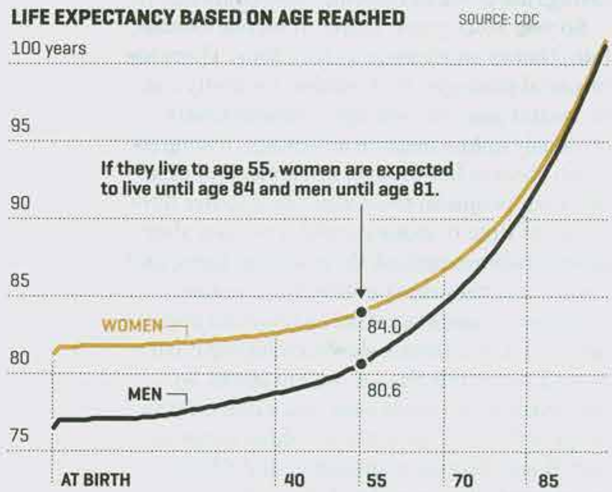
It's also daunting for the financial services industry, where a cadre of advisers and mutual fund companies are reinventing themselves to work with, and for, people who may need to finance a 30-year retirement. And at a time of political uncertainly and rising U.S. government debt, where the long-term viability of pillars of retirement-age financial security like Medicare and Social Security is increasingly in doubt, the urgency of preparing for a long post-career life becomes that much greater.

So first things first: Congratulations on those extra years. (Don't let financial challenges obscure the value of the gift of time.) But second:

OPENING SPREAD: STYLING BY JILL NICHOLS

Longer Than You Think The most widely reported statistics on life spans are based on "average life expectancy at birth." But by the time you've reached midlife, chances are you're going to live longer than that average.





Get ready to take a longer, more careful look at your retirement plans. Because if you're likely to live to 95, or 105, you may need to throw out the old playbook and draw up a new one.

THAT REEXAMINATION can create the kind of push-and-pull that Bev and W. Davis ("Dave") Hobbs are having with their financial planner. The retired couple from Eastham, Mass., both 66 years old, have done pretty well for themselves, with a classic home on Cape Cod and a successful business they just sold last year.

But when they started pulling $10,000 checks from their portfolio a little too often, their financial adviser, Jim Guarino, started pulling his hair out. After all, Bev's mom lived until 92, and her grandmother until 94, so the odds that Bev could keep on trucking into her mid-nineties are very solid indeed. (Dave, whose family history doesn't include as many old-timers, expects to live to around 82.)

With that longevity horizon, even the $1.5 million the Hobbses squirreled away from their company sale could run out if the couple spend too fast. So Guarino pulled out the charts and graphs, went over the couple's spending line by line—and begged them to reduce their monthly drawdowns to $7,800. "He explained that if we kept spending at this rate, we would run out of money by the time I was ninetysomething," Bev recalls.

> "THOSE AT THE HIGHER END OF WEALTH DISTRIBUTION, WITH BETTER EDUCATION, INCOME, AND HEALTH CARE, CAN EXPECT TO LIVE THREE OR FOUR YEARS LONGER."
> **Wade Pfau,** professor of retirement income, the American College

The Hobbses took some of Guarino's advice, like using a home-equity loan rather than savings to cover home repairs, and looking into long-term-care insurance. But they also remain dead set on pricey upcoming trips to Belize and the New Orleans jazz festival. Let's just say the debate and the adjustments are... ongoing.

Even for the most diligent savers and investors, the prospect of funding decades of retirement is daunting. It's psychologically challenging to put off satisfaction in the present for security in the future—much less decades in the future. It's human nature that we estimate our longevity based on the longevity of our parents, or grandparents. The realization that we're likely to live much longer than they did may come as both a blessing and a curse: More years means more time to travel the world, scratch off bucket-list items, or volunteer for favorite causes. What it also means: More years to pay for all that, more years for the mind and body to break down, more years to worry about becoming a financial burden on your family.

These financial anxieties of old age are particularly resonant in America. Author and London Business School professor Lynda Gratton, along with her coauthor, Andrew Scott, had a simple premise in mind for their 2016 book, *The 100-Year Life*: What is going to happen to us all, when everyone starts living to 100? "One of the most resounding comments in the U.S. was, 'My savings are going to run out,'" says Gratton.

So yes: More years, more problems. Thankfully, there's no shortage of solutions. There are financial strategies that combat longevity risk, no matter your current age. Younger savers obviously hold a massive advantage, having so much runway left to save, stockpile, and plan. But even people in their fifties and sixties have plenty of time to make portfolio tweaks, alter their timelines, rethink their savings rates, and ensure that they don't outlive their money.

Society's "longevity risk," as financial planners call it, has been a slow-developing crisis, more a rising tide than a sudden storm, so top investment minds have had some time to prepare for it. "This is not a sudden surprise," says Roger Ferguson, president and CEO of retirement-plan provider TIAA. "We annuity writers have seen this coming."

In response, financial services companies are building longevity risk more intrinsically into their products. To witness how longevity is changing the business, just look at target-date mutual funds (TDFs). The one-stop shopping cart of retirement vehicles, they are designed to put you on a comfortable "glide path" toward retirement—owning more equities when you are young, more fixed income and cash when you are older—while keeping investors from having to make potentially wealth-destroying decisions about timing the market. (The "target date" roughly corresponds to the year the hypothetical investor reaches retirement age.) At a time when many mutual funds in general have fallen out of fashion, TDFs have gobbled up the investing world, having amassed $1.07 trillion in assets at the end of October, according to research shop Morningstar, up from $116 billion at the end of 2006.

But because of longevity risk, target-date funds have changed. Many used to be "To" funds, fixing investors' asset allocation at their retirement date and staying there. Nowadays the vast majority are "Through" funds, designed to carry customers to the end of life. They keep equities fairly high and tinker with allocation for 20 or even 30 years after retirement, and they tend to own more stocks. An added bonus: That nod to longevity has made for superior returns, notes Morningstar.

The industry's personal touch is changing too. Financial planners are scrambling to get certified as retirement-income specialists who can steward customers through 20 or 30 years of retired life. That is why you may see a flurry of additional letters after their names these days. One such cluster might be Retirement Income Certified Professional, or RICP, a designation awarded by the American College. That program started in 2013: There are already more than 5,000 active RICPs and 10,000 more enrolled.

Planners can also become a Chartered Retirement Planning Counselor, or CRPC (28,600 grads, 2,000 enrolled); or a Chartered Retirement Plans Specialist, or CRPS (6,000 grads, 500 enrolled), both programs administered by the College for Financial Planning. All these designations indicate your planner has been loading up on additional training not just to get you to retirement, but also to successfully manage the many years that will follow.

Perhaps the biggest clue about what the future holds: Ask retirement experts, who are buried in longevity data all day, about how long they themselves plan to live. How about Wade Pfau, for instance, one of the industry's foremost retirement authorities? "On my spreadsheet, I have worked it out until 105."

In case you *haven't* worked it out that far, here's what you can do about it.

> "ONE OF THE CONCLUSIONS WE CAME TO, EARLY ON, WAS THAT THE TRADITIONAL NOTION OF RETIRING IN YOUR EARLY SIXTIES WAS A BAD IDEA ... 70 IS THE NEW 65."
> **Steve Vernon,** scholar, Stanford Center on Longevity

STRATEGY ONE: WORK LONGER

LET'S GET THIS ONE out of the way first: Working longer will change the math in your favor, and powerfully so. It may not be the laid-back future that many associate with the word "retirement," but just a few more years of working and saving, rather than drawing down assets, is a game changer.

That was the conclusion of the Stanford Center on Longevity, in a collaborative project with the Society of Actuaries. Researchers tested a blizzard of potential "drawdown strategies"—that is, hypothetical rates of spending in retirement, mapped against investment returns on people's savings—to analyze which had the best chance to keep up with inflation and sustain a portfolio through a long retirement.

"One of the conclusions we came to pretty early on was that the traditional notion of retiring in your early sixties was a bad idea," says Steve Vernon, a research scholar at the center.

Putting Off the Party Americans are retiring later, in some cases because they're staying healthier longer, in others because they need to save more for their nest eggs.

AVERAGE U.S. RETIREMENT AGE SOURCE: CENTER FOR RETIREMENT RESEARCH

"If you're going to last into your mid-eighties or beyond, most people don't have enough savings to generate the income needed to keep them going." So where retirement timing is concerned, Vernon says, "70 is the new 65."

In practice, many of us don't even stay on the job until 65. The average U.S. retirement age has been steadily rising, but it's still only 63, according to an analysis of Census data by the Center for Retirement Research at Boston College. That reflects both voluntary early retirement, by those who have hit their goals, and involuntary departures by those whom job losses or health concerns have pushed out the door.

If you can keep clocking in until age 70, not only are you building up your savings instead of chipping away, but you are also enabling yourself to delay the start of Social Security. The allure of that: Every month you put it off, up to age 70, the amount you're paid in the future rises. Let's say your monthly benefit at age 66, the current "full retirement age," is $2,500. Put it off until 70, and that monthly figure becomes $3,300—a 32% raise that you'll collect for life.

There are exceptions to this rule of thumb, of course: Some married couples, for example, can collect more benefits if one opts to take Social Security earlier while the other keeps working. But for most people, says Vernon, delaying Social Security is so smart that, if you need some cash to tide you over until 70, it may be worth dipping into savings to do so. It may be counterintuitive to start drawing down your assets early, but the prospect of a higher lifetime payout later just makes too much sense.

Working longer isn't just a financial issue. Studies have demonstrated that remaining in the workforce sustains cognitive functioning, preserves social networks, and can even delay the onset of Alzheimer's. (For more about how to work later in life, on your own terms, see "How to 'Consultify' Your Retirement" at the end of this story.)

"Think about it: If you retire at 60, and you live to 100, that's a hell of a lot of time," says Gratton, the London Business School professor. It's so long, in fact, that Gratton suggests we completely jettison our traditional conception of the three-stage life—education, work, retirement. In its place, we should think about a "multistage" life in which every stage expands.

Educational breaks, like the pursuit of an additional degree, can be inserted into your working career (keeping your skills updated and helping you remain relevant to employers). Mid-career sabbaticals can act as early "retirements," allowing you to travel the world or do other things to recharge, before you return to the workforce. What all these ideas have in common: Making the most of extra years.

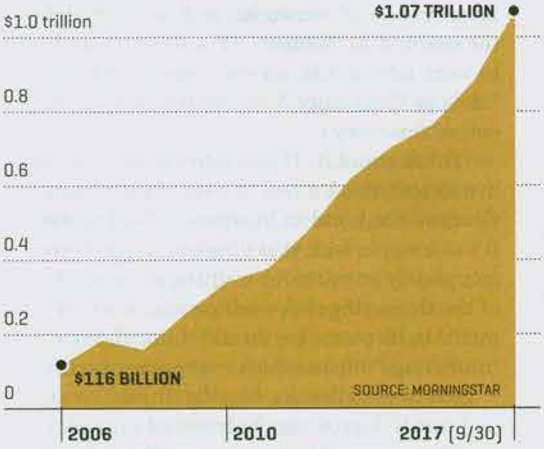
STRATEGY TWO:
UPGRADE YOUR PORTFOLIO

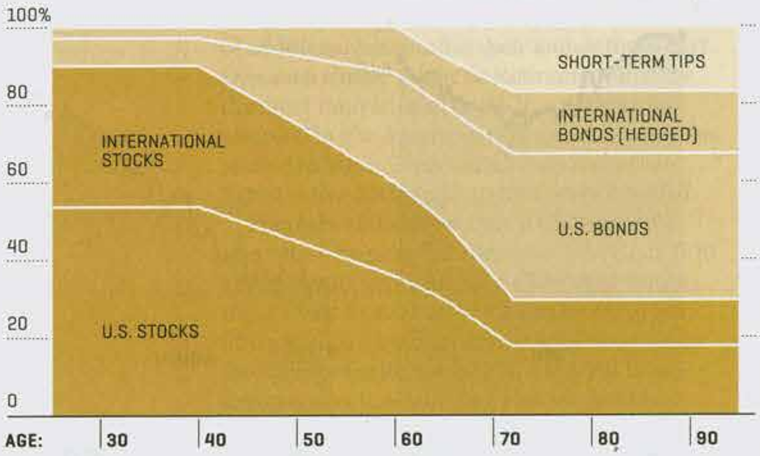
HOW SHOULD your investment approach change, in a world where you could very well live to 100?

The most conventional guideposts out there are pretty old and creaky. Take the idea that your exposure to the stock market, in percentage terms, should be 100 minus your age—so a 90-year-old might have 10% in the stock market and the rest in fixed income and cash. That may have made sense from the 1960s through the early 2000s, when annual interest rates on ultrasafe Treasury bills routinely topped 5%; it looks less smart in the low-interest-rate new economy.

Here's a better tip: Think like a target-date fund manager. Here's why. The raison d'être of these investment products is to build assets in a thoughtful way, give you increasing safety as a retirement date draws near, provide enough diversification to keep your portfolio balanced

Targeting a Longer Life Target-date funds have come to dominate American retirement portfolios. To address longer life spans, fund managers like Vanguard are changing their asset mix to include more stocks.





during market jolts, and generate returns long after you've retired. In short, these are the people digesting all the latest longevity data and coming up with the right investment recipe to make a customer's money last.

Here is the reality such managers face: Equities are the best (and likely the only) asset class primed to keep your portfolio chugging over the very long term. The S&P 500 has delivered a 9.5% annual return going back to 1928, according to a study by NYU Stern School of Business finance professor Aswath Damodaran. And with global interest rates so low, fixed income and cash alone are unlikely to enable your savings to keep up with your cost of living after retirement.

Jake Gilliam, senior portfolio strategist at Charles Schwab Investment Management, plays a role in constructing that company's expansive target-date product line. Back when the firm rolled out target-date products, he says, the funds were designed to shift gradually toward a retirement allocation of 25% equity and 75% fixed income. But in the mid-2000s, data about growing longevity helped convince the company that the "To" model wasn't going to get the job done anymore. So Schwab moved to the "Through" model, with allocations shifting even during retirement years.

The new mix: 40% equity and 60% fixed income at retirement, with the heavier dose of stocks providing more upside potential. Schwab's target-date funds do eventually reach a 25/75 split—but only after 20 full years of retirement. "We now manage assets through an expected life span of at least age 85," Gilliam says.

The change in asset percentages was only one of several noteworthy tweaks. Schwab managers meet for formal reviews every year to adjust target-date funds' underlying assets with an eye to boosting returns. In recent years they have added international equities and small-cap stocks—asset classes that come with higher volatility than sturdier blue chips, but also offer the promise of higher returns.

They've also spiced the loaf with assets like global real estate and Treasury Inflation-Protected Securities (TIPS), whose returns generally rise with inflation. The goal: to have an asset mix sufficiently diversified so that when one part of the market crashes, investors won't feel the need to go fleeing for the exits. These assets are all riskier, in the short run, than plain-vanilla bonds, but a retiree with a long-term time horizon can't afford to shun the rewards that come with those risks.

Investment giant Vanguard Group goes even heavier on equities than Schwab does, to power decades of retirement returns. Its target-date funds are composed of 50% stocks at retirement, a percentage that glides down over the next seven years to 30%, where it stays.

Its investment strategists are envisioning a 30-year time horizon beyond retirement at 65. In other words, even if you aren't picturing yourself at age 95, senior investment analyst Maria Bruno is. Bruno is part of the Vanguard strategy team putting the firm's products together. "It's good to use 30 years of retirement as a general guideline," says Bruno. "And when you are making projections, you should always err on the conservative side—maybe even going all the way to 100 or 110."

STRATEGY THREE: THE 'DRAWDOWN' SHOWDOWN

FOR MOST OF THEIR LIVES, retirement savers (and their brokers and advisers) focus on asset accumulation. But that phase is just the beginning of your retirement challenge. The other half of the equation is the drawdown: How much you will chip away, each year, at everything you have built up.

Conventional wisdom is that a 4% annual drawdown rate is the way to go—a withdrawal big enough to keep your retirement years comfortable, but not so big that you risk running out of money prematurely. To which Wade Pfau says nope. "With people living longer, the 4% rule has become a lot less safe than it used to be," he says. "I think a 3% figure provides the same amount of safety that people generally attach to the 4% rule."

To use a concrete example, if you have a million bucks socked away for retirement, drawing down $30,000 a year (in addition to any other sources like Social Security or pensions) is a conservative enough choice that you should be able to sleep at night, confident that even extreme swings in the market won't harm your ability to keep your portfolio healthy into your nineties. Take out $40,000 a year or more, Pfau argues, and statistical models suggest that you are starting to stress the long-term viability of your portfolio. (In either model, you'd adjust your annual withdrawal to keep up with inflation.)

For all but the wealthiest, this advice can sound both spartan and constraining. After all, we aren't robots, and no one has the exact same monetary needs every single year. That's why other advisers suggest another way to come at the drawdown problem: Be flexible about it.

Vanguard's Bruno prefers to think about a "floor and ceiling" approach. In her models she uses a 2.5% annual drawdown as a floor and 5% as a ceiling. The rate you choose depends on how the market performs the previous year. If the S&P 500 has a boffo year, go ahead and feel comfortable about a 5% drawdown, moving that money out of your retirement accounts and into the bank at the start of the following year. (Based on 2017's performance, it looks as though this is what you'd be doing in 2018.) If the market has had a down year, try to restrain your spending with a 2.5% rate.

Not only does this method recognize the realities of life, but it "increases the longevity of your portfolio," Bruno says. It keeps you from selling more assets when the market is lowest, giving your portfolio a few more years of life.

> "
> WITH A RETIREMENT PORTFOLIO, "YOU SHOULD ALWAYS ERR ON THE CONSERVATIVE SIDE—MAYBE EVEN GOING ALL THE WAY TO AGE 100 OR 110."
>
> **Maria Bruno,** senior investment analyst, the Vanguard Group

STRATEGY FOUR: 'LONGEVITY INSURANCE'

AS ALL OF THE ABOVE suggests, even a substantial nest egg may not be able to cover all the exigencies of a blessedly long life. That's why the idea of "longevity insurance" has become a cornerstone of preparation for a longer retirement. One form of such insurance is an annuity; another is long-term care.

The term "annuity" has taken on toxic overtones in some circles in recent years. That umbrella definition covers a wide range of relatively complicated and expensive investment products that have been associated with high-pressure sales tactics and inscrutable rules about fees and payouts. But strip away bad actors and financial engineering, and the concept makes eminent sense in an era of increasing life spans. In its simplest and least expensive form (often called a "simple income annuity"), an annuity gets you a potentially riskless stream of income: You give an insurer a lump sum, and in exchange you get a lifetime of payouts, akin to Social Security checks.

The longer you live, the more money you derive from the transaction. If you die early, the insurer gets the better of the deal—but frankly, you won't be around to regret it. Another increasingly popular product, sometimes called the deferred annuity, makes this tradeoff even starker. In return for waiting for payouts to begin—for 10 years, say, or until you turn 85—you pay much less upfront than you would for an annuity that paid you immediately.

For most retirees, devoting all your savings to this is the wrong move. But funding an annuity with a portion of your assets can help fuel a lifetime of monthly checks that—when paired with other income and investments—forms a powerful three-pronged solution. "To purchase guaranteed income for life, at a low cost, can be a very good strategy," says Vanguard's Bruno. "In conjunction with Social Security, those are two pretty big tools in your toolbox."

Long-term-care policies are essentially another kind of longevity insurance—and a vexed one for many families. Their very existence reflects the fact that Medicare, which most retirees rely on for health coverage, does not cover nursing-home care. Should you need regular assistance, either in a nursing facility or in your own home, you usually have to self-fund, either through insurance coverage or your own savings. Medicaid picks up the tab only after you've exhausted your own assets.

Nursing homes, obviously, are not cheap. The average nationwide cost for a private room is now $8,121 a month, according to a new study by insurer Genworth. But only 8% of the population is covered by private long-term-care policies, in part because the coverage itself is fairly pricey and complex. Premiums typically range from $2,500 to $6,000 a year, and insurers that provide it have been hiking those premiums in recent years, and in some cases trimming the benefits they offer, in response to unexpectedly high costs. Rules of thumb: Buy it when you're younger and healthier, to capture a lower premium rate, and run the numbers with an adviser to make sure the cost of coverage won't derail your savings.

All of these strategies require savers and investors to picture themselves at 85, at 90, at 100. That's an exercise that's counterintuitive to us, in part because, for most people at most points in human history, that kind of longevity was utterly out of reach. But we are getting to the point where that person is not just possible—he or she is becoming probable.

"Before, people used to retire at 65 and then live another 10 years and that was it," says Pfau. "Now we are living another 30 or 40 years, so it is almost like every year of work has to fund a year of retirement. That's just not feasible ... As life expectancies get so high, we have to start looking at everything differently."

HOW TO 'CONSULTIFY' YOUR RETIREMENT

Funding a longer retirement may mean working later in life. Here's how to do it on your own terms.

BY JONATHAN CHEW

BY 2011, AT AGE 53, Warren Dodge was primed for retirement. He had spent 29 years at Accenture as an information technology and change management expert, culminating in a senior partner position at the global consulting firm. Buttressed by earnings from the company's 2001 IPO, Dodge had all the financial security he needed and was ready to make way for a younger cohort. "I had run my course," he says.

But nine months after retiring—after climbing Mount Kilimanjaro, playing numerous rounds of golf, and teaching part-time at NYU—Dodge had a rethink. He talked with a life coach and realized he wasn't growing. Through a network of former colleagues, he began to find consulting projects where he worked on innovation and organizational change for both nonprofits and global companies like PepsiCo. At 59, Dodge now balances his time between being a part-time consultant for the staffing company Business Talent Group (BTG), teaching business and organizational ethics at Mercy College and NYU, and volunteering at his local church in Scarsdale, N.Y. "I hate the word 'retired,'" he reflects. "Frankly speaking, I work part-time."

> "I HATE THE WORD 'RETIRED.' FRANKLY SPEAKING, I WORK PART-TIME."
> **Warren Dodge,** former Accenture senior partner, adjunct professor at NYU

Call it the boilerplate for retirement's 2017 edition, a new iteration where gold watches and congratulatory handshakes are giving way to a desire for flexibility, growth, and, well, more work. Around one in five Americans over 65 is still working, according to the most recent U.S. jobs report, and that age group's employment-to-population ratio is at the highest level in 55 years. That fact marks a drastic departure from the model of post-work life that was gradually cemented after the Social Security Act of 1935 established 65 as the "traditional" American retirement age.

While we once glorified retirement as an earned, equable epilogue, those attitudes are changing. A longer life expectancy—and the need to keep earning money to fund those additional years—is one factor at work; another is the sense among a healthier, more affluent cadre of retirees that they have more to learn and give. "The majority of retirees are bored silly," says Ken Dychtwald, founder of think tank Age Wave. "Now it's less about retirement and more about reinvention."

Increasingly, older workers are reinventing themselves by partaking in the gig economy, where workers with considerable experience in their professions see a lot of appeal in the idea of becoming independent consultants. According to a "State of Independence" study by business services company MBO Partners, people born before 1965—in essence, baby boomers and their elders—now account for 35% of independent workers. "Those who are approaching retirement are saying, 'I'm not really retiring. I just want to leave the traditional full-time workforce and have a better work/life balance,'" says Sharon Emek, CEO, president, and cofounder of WAHVE, a contract staffing company that has 400 retired, part-time, and full-time insurance and accounting professionals who consult on projects. "To us, retired doesn't mean you're not working."

From conversations with experts and those who have made the transition, here are three pointers on how to become a consultant after retirement:

Three Steps to an Emeritus Career

How to parlay a lifetime of experience into the part-time work you want.

1. Find the channels of opportunity.

The ideal scenario for transitioning into the consulting life is to get your employer on board with retaining you. But that's trickier than it sounds—one study showed that while 80% of companies support employees working past 65, less than a third actually allow part-time work. However, the Internet hosts a plethora of platforms that will help you find the right thread to pull. Karen Fisher, 59, was contacted by BTG through LinkedIn, after a three-year break from the biopharma industry. What lured the staffing company? "I kept my profile updated and always said that if something like [part-time consulting work] came along, I'd jump on it," says Fisher, who lives in Southern California. The takeaway: Burnish your LinkedIn profile, register for part-time job-placement sites such as Catalant and TalMix, and get to know staffing companies like BTG, WAHVE, and Robert Half Management Resources that welcome experienced retirees into their fold. "The challenge to find experienced talent is becoming increasingly difficult. You need to leverage these new tools and communities so that you can be found," says Mike Lewis, chief of sales and marketing officer at YourEncore, a talent community that connects around 10,000 experts with short- and long-term projects for life sciences and consumer goods companies.

2. Stay current and connected.

In 2009 the Indianapolis-based Carole Boylan retired from her 30-year career at pharmaceutical company Eli Lilly. Over the next two years she established a standing date with her local library: For around three days a week, she would spend time reading the latest studies in her field, regulatory affairs, as well as news on the U.S. Food and Drug Administration and European Medicines Agency websites. "I imposed a self-study time to stay current; that was very important to me," says Boylan. After a two-year hiatus, Boylan now works as a part-time consultant for YourEncore and regularly meets with like-minded people to keep abreast of trends. Whether you take a short course, form a small group, or peruse the latest publications, staying work-sharp will serve you well in a consulting job, where you are expected to hit the ground running. "Consultants get parachuted into all kinds of situations," says Tim Hird, executive director of staffing firm Robert Half. "You don't have six months to prove yourself. You need to demonstrate value very quickly."

3. Be open to change.

Don Mankin spent the better part of 40 years as an author and teacher of organizational psychology. When he retired in 2006, he dived into his passion: travel writing. "I wasn't looking to make a living," says the 75-year-old. But through his first book, a guide to adventure trips for older travelers called *Riding the Hulahula to the Arctic Ocean*, and articles for his blog and magazines, Mankin parlayed that skill into consulting opportunities and speaking engagements. The lesson: If you take retirement as a chance to pursue new skills or passions, short-term opportunities could arise. "Be open to trying something different," says Dychtwald. "Try to do more of what you like, vs. what looks good to someone else." ■

An Ageless VC Gets an Act Three

As one of the nation's first venture capitalists, Alan Patricof invested early in AOL and Apple and helped build hundreds of other companies. Here's why the 82-year-old dealmaker went back to his startup roots, and what he's teaching a new generation.

BY JEFF JOHN ROBERTS

▲ PHOTOGRAPH BY **ROBYN TWOMEY**

PASSING THE TORCH: Patricof [center] with partners Ian Sigalow [left] and Dana Settle in the kitchen of Greycroft's New York offices. The younger partners are increasingly taking the lead on the VC firm's big bets.

THE LOBBY OF MANHATTAN'S Crosby Street Hotel, with its industrial chic and just-so designer furniture, is very 2017. Alan Patricof, with his loose-fitting suits and mop of gray hair, is very 1967. But on a cloudy recent morning, as the high-ceilinged room buzzes with bankers on the hunt for media deals at a conference, Patricof fits right in.

As he wends his way through the hotel restaurant, the 82-year-old exchanges warm hellos and swaps media gossip with well-heeled movers and shakers. People who don't know him notice him; people who do treat him like The Man. And after he joins me at a small table and orders tea, Patricof drops a hint about just how long he's enjoyed that status. "*New York* magazine is celebrating its 50th anniversary next week," he points out. "I'll be one of two people attending who was there when it opened."

Patricof's investment in *New York*, which helped turn a small-circulation pub into one of the most important media voices in art and politics, was one of his very first, and it showed the acumen that has made him a legend in venture capital circles. Since then he's helped build hundreds of companies, including the likes of Apple and AOL—as one of the country's first VCs and then as cofounder of Apax Partners, one of the world's biggest private equity firms.

In 2006, at age 71, he sought something both new and familiar, collaborating with a younger generation of VCs as cofounder of a new firm, Greycroft Partners. After nearly 12 years there, studded with successful investments in startups like payment platform Venmo, entertainment firm Maker Studios, and men's styling service Trunk Club, the patriarch shows few signs of slowing down. He's first into the office every morning, and he recently made his first bet on a Bitcoin company. As our interview wraps up, he's in a rush to rejoin the confab in the lobby to parlay with Cheddar, a fast-rising web TV service. "Alan in his eighties is younger than everyone I know," says Mike Lazerow, founder of Buddy Media, another of Greycroft's successful exits.

Patricof has nothing left to prove—but he and his (chronologically) younger partners are still trying to accomplish something significant. They're striving to show that a boutique VC firm can add value for investors and founders in an era of multibillion-dollar super-startups. They're demonstrating how different generations can learn from each other and help a company evolve and stay nimble. And at a time of rapid change in the venture business, the hope is that, when Patricof hangs it up, they'll prove that this famous builder of companies has constructed his own firm to flourish without him.

"IT'S TOO CORNY TO SAY IT'S A HAPPY PLACE, BUT WE BUILT A GOOD ENVIRONMENT WHERE PEOPLE LIKE TO WORK."
Alan Patricof, cofounder and managing director, Greycroft Partners

IN ITS OFFICES high above Grand Central Terminal, Greycroft's New York team begins a Monday morning ritual: speed-vetting a list of young companies that want money. Patricof is there, with other Greycroft partners, including Ellie Wheeler, 35, and Ian Sigalow, 38. David Stern, the former NBA commissioner who has a standing invitation to join the meeting, is one of the few other gray-hairs present.

Greycroft's bread and butter is early-stage companies, typically in "seed" or "Series A" rounds, meaning that most firms on today's list have a handful of employees, big dreams, and little in the way of profits. (The firm also operates two growth funds for later-stage investments.) The team gets right to it, picking apart the roster like fussy chefs shopping for just the right ingredients. After casting off a few candidates, they alight on one that gives customers a new way to order lunch online. Several in the room see promise, pointing to the firm's rapid growth and high-margin business model. But Wheeler tosses on some cold water. "This just doesn't seem like it'll change our world," she

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Patricof, at 82, is still the first to arrive at his office every morning.

says. "I might be a user but not an investor."

Next on the list is a virtual reality firm, but Patricof shoots it down because the company has been slow to produce people who can vouch for it. (A lack of references from other founders is a deal breaker for Greycroft.) But the table becomes outright enthusiastic about a startup that bills itself as the "Axios of cyber." It's a nod to Axios, a new media venture that counts Greycroft as an investor and which in mid-November raised $20 million. "This is a good thing," says Patricof. He's a fan of Axios because it offers a high-quality product whose owners hope to someday put it behind expensive paywalls: "We had companies that wanted to be the 'Airbnb of this,' and now they want to be the 'Axios of that.'" Wheeler likes the cybersecurity firm too, putting it on a list for a meeting.

So it goes as the Greycroft gang whips through dozens of companies in under an hour. For the handful that get the table's blessing, this is only the beginning. The standouts must survive scrutiny from the firm's Los Angeles partners, which also have an initial screening roster of their own. Startups that get a thumbs-up from both coasts may get invited to make a formal presentation. Then they'll run through Greycroft's "pattern-matching process," during which quants sometimes employ dark statistical arts to see if a company's team and trajectory match up with previous successful startups.

Only after this rigmarole will Greycroft open its purse and bless the startup with an investment of anywhere up to $30 million, made in federation with other VC firms. The process may sound obsessive. But in venture capital, which produces hundreds of failures and fizzle-outs for every Facebook, Greycroft needs every edge it can get before it lavishes a firm with something just as valuable as its money—a prodigious amount of attention and networking.

FEW PEOPLE HAVE A NETWORK with as many branches and nodes on it as Patricof's. By his own description, he has been a hustling dealmaker since college, when he worked his way through college by selling party favors and neckties to fraternities. The success of his *New York* investment elevated his stature and eventually led him into private equity at the helm of a firm he founded in the late 1970s, Apax Partners.

A FIVE-DECADE HIT PARADE

Alan Patricof, one of the country's first venture capitalists, has been a deft trend-spotter through a half-century of technological change. Here are some of his more notable bets.

1967
NEW YORK MAGAZINE
In a year that saw the launch of *Rolling Stone* and the musical *Hair*—Patricof invested in a pioneer of "new journalism." *New York* would go on to become one of the most important voices in American arts and politics; Patricof exited in 1977.

1979–85
APPLE AND AOL
By the late 1970s, Patricof was steering a global private equity firm, Apax Partners. But he still left his stamp on Silicon Valley as an early-stage funder. He was a second-round investor in a startup called Apple (five years before the release of the first Mac). He also bet on Steve Case's Quantum Computer Services—which soon changed its name to AOL.

2001–06
EURO-BUYOUTS
Apax becomes a force to be reckoned with in leveraged buyouts, especially in Europe. The firm lands the 2001 purchase of Yellow Pages and the 2005 buyout of Danish phone company TDC for $15.3 billion—the biggest LBO in European history at the time.

2006
HUFFINGTON POST
Patricof returns to early-stage investing with his new firm, Greycroft Partners. New media remains a passion: Patricof is part of a $5 million first round into the Huffington Post—which is bought six years later by another of his early investments, AOL, for $315 million.

2007–17
VENMO AND MORE
With the help of a new generation of protégés, Patricof's Greycroft becomes one of the leading VC firms in New York and L.A., where Silicon Valley giants cast less of a shadow. Hot payment app Venmo is one of its best-known early bets (though the firm's partners kick themselves for selling too soon). But it also scores with film company Maker Studios (sold to Disney) and meal-prep startup Plated (to Albertsons).

With funds in the billions to play with, Apax became a global force.

Patricof invested in Apple in 1979—before there was such thing as a Mac—and in a company called Quantum Computer in 1985, before Steve Case changed its name to America Online. His repertoire eventually expanded to include takeovers and leveraged buyouts, including a takeover of a Danish phone company in 2005 that was Europe's biggest LBO at the time.

But as the deals got larger, Patricof says, the satisfaction he got from them did not. Armies of lawyers got the important work done, and he was no longer spending time with inspiring young founders who built companies from scratch. "I decided to go back to how I started," he says. "I thought I'd learn from my mistakes... I wanted to go back to being small."

So he returned to what he loves, which is helping founders get a foothold. His style is remarkably hands-on. Several startup CEOs in Greycroft's portfolio recount getting calls and emails at all hours from Patricof in his excitement to share an idea. Elizabeth Rossiello, the globe-trotting founder of BitPesa, a firm that uses blockchain technology to help merchants in Africa and Asia lower their money-transfer fees, describes watching her email in-box fill with tidbits about Bitcoin that Patricof had seen in media and finance newsletters.

Rossiello also received regular installments of one of Patricof's most treasured currencies: advice about building relationships outside her own professional circles. Greycroft holds dozens of networking events every year, including annual "summits" in Los Angeles and at Patricof's own estate in East Hampton, N.Y., with speakers and guests drawn from the top ranks of tech, media, and politics. (Patricof is a prominent Democratic rainmaker, and his office is adorned with personal photos of the Clintons and Obamas, whom he knows well.)

Greycroft gets a competitive edge by being one of relatively few prominent VC firms not based in Silicon Valley, where juggernauts like Sequoia Capital and Andreessen Horowitz define the scene. In 2006, when Patricof launched Greycroft in New York, few took the city seriously as an ecosystem for tech talent. Patricof credits former mayor Michael Bloomberg with helping to change this perception and paving the way for Greycroft and a handful of other New York City firms, including the now high-profile Union Square Ventures.

"NEW YORK MIGHT NOT HAVE A TECH SCENE WITHOUT ALAN. GREYCROFT WAS WELCOMING AND GENEROUS WHEN THEY DIDN'T HAVE TO BE."

Bradley Tusk, venture capital investor

THE MOUNT RUSHMORE OF VC

VENTURE CAPITAL is today synonymous with Silicon Valley. But the industry got its start in Boston, where Georges Doriot, a Harvard professor and WWII military quartermaster, founded the country's first VC firm in 1946. Doriot is hardly the most famous, however. When *Fortune* asked VCs whom they put would on the "Mount Rushmore of Venture Capital," these four are the names that came up the most. The group includes no women—but this should change as more firms follow the lead of Greycroft and others and incorporate more women in leadership roles.

But other VCs pay similar homage to Patricof. "It's possible New York would not have a tech scene without Alan," says Bradley Tusk, a chief of staff during the Bloomberg administration who now runs his own venture firm. "Greycroft was welcoming and generous to us when they didn't have to be." Brad Feld, a prominent investor who now runs Colorado-based Foundry Group, describes Patricof as "one of the foundational members of the VC universe."

Patricof's desire to stay small has kept Greycroft focused on early-stage investments. It raises less money than many other VC firms—it currently oversees a total of just under $1.1 billion. This approach has meant that the mega-unicorns that bring VCs the most attention—giants like Uber or Airbnb—have been absent from Greycroft's stable.

The firm, like most VC operations, is reticent about publicly discussing its returns. But outside data, subsequently confirmed by Ian Sigalow, shows healthy results: According to research firm Pitchbook, the internal rate of return (IRR), a measure of performance in private companies, for Greycroft's first two funds hovered around 19.5% annually from 2015 through 2017, squarely in the midrange for VC firms but about twice the annualized return of the S&P 500 over that stretch.

Sigalow adds that the final IRR figures will be higher if and when other portfolio companies enjoy a profitable exit. "By the end of 2017, Greycroft will have generated nearly $400 million of

VINOD KHOSLA
Khosla Ventures

The Indian-born billionaire cofounded Sun Microsystems in 1982 before starting his eponymous venture fund in 2004. He's famed for his clean-energy initiatives and notorious in a different way for his legal battle to block public access to a beach near his home in Half Moon Bay, Calif.

MARC ANDREESSEN
Andreessen Horowitz

The 46-year-old Andreessen, who invented the seminal web browser Netscape, runs what's arguably today's most widely watched VC firm. The company, which insiders call a16z, uses its outsize funds to bet on tech like cyberdefense and blockchains, and maintains a high profile in the press.

TOM PERKINS
Kleiner Perkins

An engineer and laser-technology inventor, the late Perkins worked for HP before founding his iconic firm with Eugene Kleiner. He is known for enormously lucrative bets on Genentech and Google, and for a personal life that included high-stakes yacht races and a stormy marriage to author Danielle Steel.

JOHN DOERR
Kleiner Perkins

Doerr made his name as a top salesman at Intel in the 1970s before joining Kleiner Perkins. There he became an early backer of founders like Amazon's Jeff Bezos and Google's Larry Page. Doerr is also an outspoken advocate for expanding stem-cell research and fighting climate change.

FROM LEFT: KIM KULISH—CORBIS/GETTY IMAGES; DAVID PAUL MORRIS—BLOOMBERG/GETTY IMAGES [2]; COURTESY OF KPCB

realized gains for LPs [limited partners] from 30 profitable exits," he told *Fortune* by email.

Greycroft's performance, of course, encompasses many misses and a few big hits. Its greatest "exits" so far include the $800 million sale of Buddy Media, a social media management platform, to Salesforce in 2012, as well as Disney's acquisition of Maker Studios for $675 million in 2014. Greycroft notched another notable exit this September when grocery giant Albertsons bought meal-preparation startup Plated for $300 million.

There's also no shortage of lost opportunities that partners rue. "We've lost more money by not doing stuff," says Sigalow. "Not investing in a Series A in Twitter cost us a billion." Sigalow counts selling Venmo too soon as one the firm's bigger missteps. The ubiquitous payment app, which is now owned by PayPal and could easily fetch over $1 billion, earned Greycroft just $27 million when it sold in 2013 to the merchant banking service Braintree. (One consolation for Greycroft: It also held a position in Braintree, which eBay bought soon after for a reported $800 million.)

AT BALTAIRE, a swank restaurant in the Brentwood section of Los Angeles, the founders of more than a dozen startups are gathered in a private room, networking on Greycroft's dime. Over dinner and bottles of Napa Valley merlot, they swap stories about building companies. At least a third are women—an unusually high ratio in the often hyper-male VC world. The startups span a diverse range of businesses—from baby cradles to data science—and they're all getting attention from Greycroft's network of investors, lawyers, and all-around fixers. If one of the founders needs help with a sales or hiring issue, or is seeking a crucial introduction, chances are good someone at the table will be able to lend a hand.

Founding partner Dana Settle calls Greycroft's web of connections its "secret sauce." But the Baltaire dinner also testifies to Settle's own influence. A poised fortysomething who often flies to New York and back on the same day, Settle is a master networker. She earned money as a girl selling shellfish from the beaches near her home in the Pacific Northwest, and after college she sold spectrum in India for the telecom tycoon Craig McCaw. Since joining Greycroft in 2007, Settle has engineered some of the firm's most successful bets, including Maker Studios and Trunk Club, which was acquired by Nordstrom in 2014 for $350 million.

She has also influenced Patricof, her cofounder and mentor, in ways that have expanded Greycroft's horizons. Patricof says he once thought of L.A. as a "wasteland" for VC investing. When he first hired Settle, he initially insisted she move to New York. She declined, and Patricof realized it was indeed possible to build a bicoastal firm. Now Greycroft has a strong presence in two cities where big Silicon Valley firms like Sequoia and Kleiner Perkins are less well established. "Alan, Ian, and Dana have access to contacts that other firms don't," says Brian Spaly, founder of Trunk Club and clothing chain Bonobos.

IN HIS AUTOBIOGRAPHY, *Valley Boy,* the late Tom Perkins describes the venture capital landscape at the time he and partner Eugene Kleiner started their iconic, eponymous VC firm in the early 1970s. "The total pool of venture capital at the time ... has been estimated to have been much less than $100 million throughout the United States, and all the practitioners could easily be assembled into one moderately sized room."

It's an understatement to say things are different today. In 2016 alone, venture capitalists invested a near-record $69.1 *billion.* There are hundreds of VC firms in the U.S., and newer players, including foreign governments, big tech companies, and mutual funds, are jockeying to join the scene. The upshot is, it has become much harder to get an early bite of the next Facebook or Uber, especially as VC firms known for investing in later-stage startups move their money into younger companies. "All of the later-stage investors are moving earlier because they think their perch is overheated," explains Wheeler, the Greycroft partner. These same forces also pressure some founders to seek more money sooner, to prove that they're players.

In practice, these trends mean that Series A funding rounds have ballooned from $3 million or so to as much as $20 million, and that "seed" rounds that once leveled off in the hundreds of thousands now hit the millions. That creates problems for smaller firms like Greycroft, which don't command the resources that imbue a startup with star status. "There are these massive West Coast firms that want huge returns. The vast majority of other firms won't be able to compete," says Lazerow of Buddy Media.

Still, Lazerow and others familiar with Greycroft, including investors and CEOs of its portfolio companies, think the firm will hang in by being high-touch, offering connections and coaching, and a reputation as an easy-to-work-with partner. Unlike many VC firm, Greycroft doesn't insist portfolio companies assign it board seats or name it as the lead investor. The company boasts that it doesn't block acquisitions to hold out for higher prices, and it encourages partnerships among investors, in what partner Mark Terbeek calls a "federated model."

"THESE MASSIVE WEST COAST VC FIRMS WANT HUGE RETURNS. THE VAST MAJORITY OF OTHER FIRMS WON'T BE ABLE TO COMPETE."

Mike Lazerow, founder, Buddy Media (a Greycroft investment)

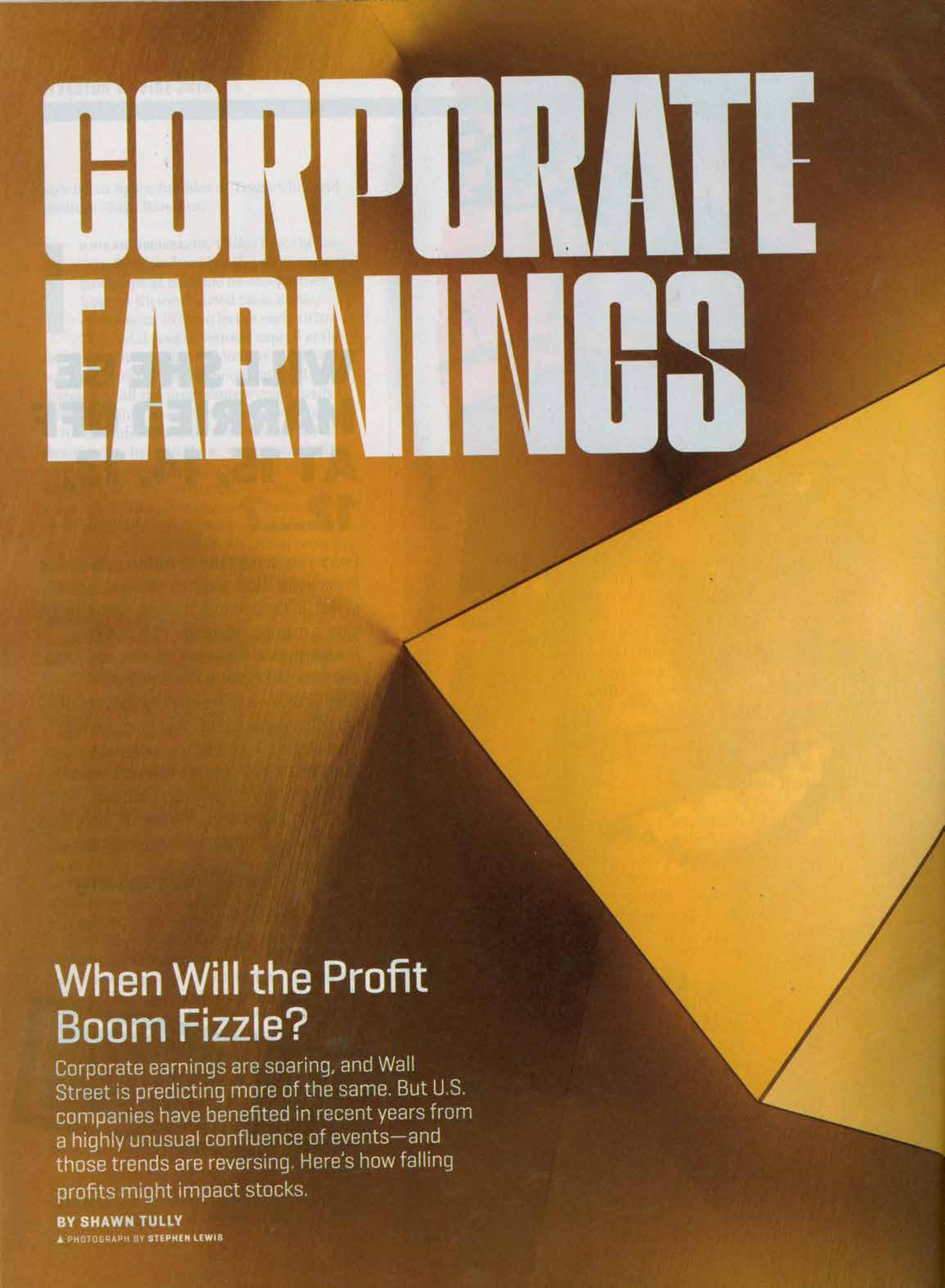
Other Greycrofters argue that being small helps the firm steer clear of some of the industry's abuses. Sigalow says giant funds can create a me-too mentality and pressure to juice results to placate impatient investors. "You have the ability to market an illiquid portfolio a thousand different ways, so it's very difficult to know if someone's doing a good job or not until the gains or losses are realized," he says. In contrast, Greycroft's straight-shooter reputation has led its limited partner investors, including the Walt Disney Co. and Cambridge Associates, to reinvest year after year.

Greycroft also strives for an inclusive, open culture that's taking on growing importance at a time when venture capital is confronting ugly undercurrents of misogyny and discrimination. The presence and influence of high-ranking women like partners Settle and Wheeler set an important tone. In interviews, female entrepreneurs and journalists spoke highly of Greycroft, and the firm has backed dozens of women founders and CEOs, including BitPesa's Rossiello and Katherine Power of Clique Media, a fashion media and e-commerce company that now approaches $100 million in revenue.

Patricof says he worked to create an environment where people are encouraged to speak their mind, and where racist or sexist attitudes have no place. "I made a point from the beginning that we don't talk about each other, and that we don't tolerate backbiting," he says. "It's too corny to say it's a happy place, but we built a good environment."

These days, Patricof leads fewer investments than his protégés, Sigalow and Settle, and he brings in smaller returns than they do. The younger partners are clearly thriving under that arrangement. Sigalow says his first experience in venture capital was at a firm where junior people didn't speak; he recalls watching bad deals where he wanted to object but could not. Patricof has set the opposite tone, encouraging the team to cultivate their own relationships and collaborate, and investors are noticing. "LPs are making a bet as much on Ian and Dana," says Ashton Newhall of Greenspring, a VC firm that is one of Greycroft's investors.

In return, Patricof gets a team that keeps him up to speed on finance and technology—helping him remain a player for as long as he chooses. Speaking from behind a desk crowded with mementos, he lays out his philosophy in simple terms: "You have to read. You have to go to conferences. You have to stay relevant." He also has to cut the interview short: He's rushing off to attend another startup's big presentation. F



CORPORATE EARNINGS

When Will the Profit Boom Fizzle?

Corporate earnings are soaring, and Wall Street is predicting more of the same. But U.S. companies have benefited in recent years from a highly unusual confluence of events—and those trends are reversing. Here's how falling profits might impact stocks.

BY SHAWN TULLY

▲ PHOTOGRAPH BY **STEPHEN LEWIS**

MILTON FRIEDMAN WASN'T BUYING the profit boom. It was late 1997, corporate earnings had surged to heights unseen in over a decade, and the Wall Street crowd was predicting years of near-double-digit gains to come. So I called the Nobel Prize–winning economist, the most celebrated monetarist of the 20th century, to get his take on whether the bull case for long-term profit growth was reasonable—or mostly bull.

The 85-year-old Friedman phoned back, collect as usual, from his office at the Hoover Institution. "Would you accept the charges from Milton?" asked the operator. I said I would, and Friedman got straight to the point. "Beware of predictions that earnings can grow faster than the economy for long periods," he warned. "When earnings are exceptionally high, they don't just keep booming." Eventually, Friedman explained, profits must move back down to their traditional share of GDP. Earnings can get only so high, Friedman said. "They can't break loose from economic gravity."

Two decades later, Friedman's warning is as timely as ever. Earnings are again in the stratosphere: Consider that in the second quarter, corporate profits in the U.S. were equal to 9.5% of GDP vs. the long-term average since 1950 of 6.6%. And Wall Street analysts are forecasting that cumulative earnings per share for the S&P 500 will jump by 11% in 2018 and another 10% in 2019, according to analytics and data provider FactSet.

Here's one problem with that projection: The S&P 500's profit *margins* are now near all-time highs. Even if they remain elevated, a questionable assumption, earnings can grow only as fast as sales. "And sales grow along with the economy," says Roger Ibbotson, professor emeritus at Yale and chief of investment firm Zebra Capital. In other words, as Friedman preached, it's the fundamentals underpinning GDP—basics such as consumer spending and capital investment—that will guide earnings growth in the years ahead. Nobody is projecting GDP growth of 11% in 2018; the consensus, including inflation, is around 4%.

It's highly uncertain, however, that profits can even manage to climb in step with GDP. That's because they're already highly elevated thanks to those super-rich margins. Put simply, U.S. companies have benefited in recent years from an unusual combination of tailwinds—including flat labor costs, super-low interest rates, and, in 2017, a falling dollar. Those factors have outraced a plodding economy, so that the share of the economic pie flowing to corporate profits has swelled while the slice going to labor has shrunk. Last year, wages and salaries were just 43% of GDP—well below the long-term average of 47%.

Those factors are starting to reverse. Labor costs are rising, interest rates are poised to trend higher, and the greenback is starting to strengthen. It all adds up to a looming squeeze on profits. What does that mean for stocks?

TO BRING THE PROFIT PICTURE into tighter focus, *Fortune* spoke to a number of market experts with strong academic credentials—all of whom are largely unswayed by the herd mentality of Wall Street. Although their outlooks varied, the differences in their forecasts were relatively narrow.

In the pessimistic camp is Rob Arnott, founder and CEO of Research Affiliates, a firm overseeing strategies for $200 billion in index funds. He says that workers are due for a raise. "Companies and shareholders have been taking a bigger and bigger share of the pie at the expense of labor," says Arnott. "That can't last. Labor's share will rise as wages and other factors normalize." He predicts that the crunch

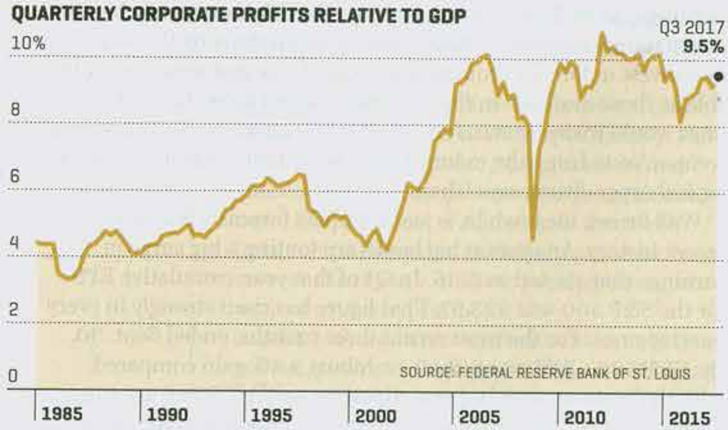
OPENING SPREAD: STYLING BY JILL NICHOLS

Scaling New Peaks

S&P 500 earnings are back near highs and now equal 9.5% of U.S. GDP, well above the long-term average of 6.6%.

S&P 500 COMPANIES' 12-MONTH EARNINGS PER SHARE

QUARTERLY CORPORATE PROFITS RELATIVE TO GDP



will slow earnings gains to at least a point below GDP growth over the next decade. That's at best 3% annual growth—or well below the Congressional Budget Office's estimate of an average of 4% nominal GDP growth over the next several years (consisting of 1.9% real increases annually, plus 2.1% inflation).

Mark Zandi, chief economist at Moody's Analytics, takes a middle position. "Earnings are peaking or have already peaked," he says. "At best, they'll track U.S. GDP going forward. And that includes a boost from the rebound in economic growth overseas." (All of our discussion on profits refers to earnings per share, or EPS, the number that really counts for investors.)

A notable optimist, relatively speaking, is Jeremy Siegel, the renowned professor of finance at the Wharton School. Siegel thinks that earnings per share can grow about half a point faster than nominal GDP—in the 5% range including inflation—chiefly because of big gains in the technology sector. "In tech today, it's all about ideas that don't require much capital, not about building $100 million plants. Margins for the tech titans can expand from here," says Siegel. Still, he dismisses Wall Street's projections as bogus. "The idea of 8% or 10% or 12% growth is ridiculous," he says. "It will not happen."

All of the experts agree, however, that the sluggish outlook could improve if Congress enacts robust tax reform. (Republicans appeared to be closing in on a bill at press time.) The potential benefits are twofold. First, a reduction in the nominal corporate rate from 35% to 20% should give companies a healthy boost in after-tax profits. Not that the average U.S. company pays the official 35% rate now: Howard Silverblatt, senior industry analyst for S&P, calculated that the average effective levy for the S&P 500 in 2016 was 24.8%. Still, dropping down to 20% will have a significant impact.

"EARNINGS ARE PEAKING OR HAVE ALREADY PEAKED. AT BEST, THEY'LL TRACK U.S. GDP GOING FORWARD."

Mark Zandi, chief economist, Moody's Analytics

It won't necessarily be America's big multinationals that gain the most under the tax plan proposed by Republicans. The GOP wants to erase their biggest shelter—deferring payments to the Treasury by leaving foreign-generated profits in overseas subsidiaries. That kind of strategy helped Alphabet, for instance, pay an effective tax rate of just 19.3% in its most recent fiscal year. Rather, the leading beneficiaries would be enterprises that do most of their business in the U.S. Grocery giant Kroger, for example, pays over 30% in federal taxes. Michael Arone, chief investment strategist at State Street Global Advisors, reckons that new legislation that drops the rate all the way to 20%, and contains other levy-lowering provisions such as immediate expensing of capital expenditure, could raise EPS for the S&P 500 by 8% in the first year. A weaker package would deliver substantially less juice, he says.

Tax reform could also provide a more long-lasting tonic to earnings. A 20% corporate rate would greatly lower the break-even point for investments in the U.S. "Corporate profits right now are great," says Urooj Khan, a professor at Columbia Business School. "But they're not translating into economic growth in the U.S. And that's because of the way the U.S. taxes foreign earnings, as well as the drag from a rate that's extremely high by international standards." Khan cites research showing that companies invest in foreign projects and acquisitions that aren't as profitable as those available in the U.S. just to avoid taxes. Lower U.S. rates would make overseas shelters far less attractive and encourage companies to bring the money home, potentially causing a surge in capital expenditure, says Khan.

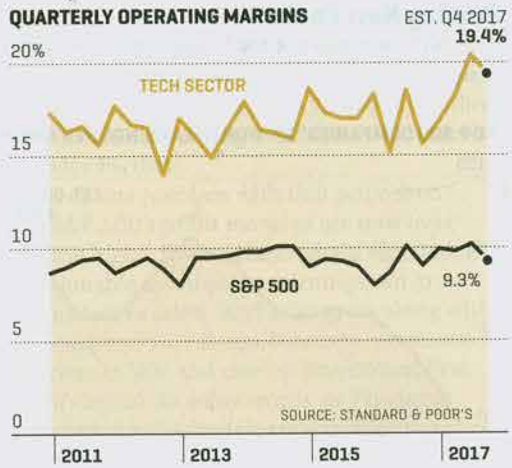
Wall Street, meanwhile, is jacking up its forecasts based on recent history. Analysts at big banks are touting a big surge in earnings that started in 2016. In Q1 of that year, cumulative EPS for the S&P 500 was $23.97. That figure has risen strongly in every quarter since. For the most recent three months, ended Sept. 30, the S&P 500's EPS was $31.50—a robust 9.8% gain compared with the same quarter last year. Boosters on Wall Street are suggesting that springboard can turn into a trampoline going forward. But digging into the S&P's numbers over a longer stretch reveals a more discouraging picture.

In real terms, EPS actually peaked three years ago, in the third quarter of 2014. The reason the S&P 500's recent performance looks so good is that earnings cratered for six quarters (stretching from that peak in late 2014 to early 2016), thanks to a collapse in oil prices that pushed earnings for energy giants deeply into the red. EPS (specifically, "as reported" GAAP earnings per share) hit bottom in Q1 of 2016 at a trailing, 12-month reading of $86. Now that we're past that period of easy year-over-year comparison, the earnings hill will get harder to climb.

The profit boom looks even more mirage-like when you examine S&P profits in raw dollars. At its high point in Q3 2014, the S&P 500 had earned $943 billion in the previous 12 months. Three years later, the comparable number was $885 billion—or 6.2% lower. "Basically, we're just back to where we were at the previous peak," says Silverblatt of S&P.

Earnings per share have managed to stay flat partly because of a massive surge in share buybacks. But that's a departure from the norm that likely won't repeat. From Q3 of 2014 to Q3 of 2016, S&P members went on a rampage of stock repurchasing. "After their stocks took a big fall, they raised repurchases to extremely high levels," says Silverblatt.

A study of the S&P 500 by Research Affiliates finds that since 2012, buybacks have modestly boosted growth in earnings per share—adding around 0.16 percentage points per year. But that period has been highly unusual, the study concluded. Over the long term, new issuance exceeds repurchases by a large margin, eroding rather than bolstering EPS. From 1988 to 2017, the S&P 500 saw average dilution of 1.2% a year. That's because many big enterprises regularly issue more stock than they buy back, using the proceeds for repurchase of new shares from newly exercised options and vested restricted stock, for M&A, and for secondary offerings. Adding to dilution are IPOs that flood the market with new shares, funding the expansion of newly public companies that snatch profits from the established incumbents.



But annualized spending on buybacks has dropped by at least 15% from its high point last year, according to Silverblatt. And investors shouldn't count on another buyback boom. Given the long-term history of new issuance exceeding buybacks, it's more likely that future EPS could actually suffer from net dilution.

S**O IF EARNINGS GROWTH** has been so anemic, why have stocks continued to soar over the past few years—with the S&P 500 rising 29% since September 2014? "It's all multiple expansion," says Silverblatt, noting that the price-to-earnings ratio for the 500 has jumped over those three-plus years from 18.9 to the current, super-rich 24.3. Let's look at the S&P as one big company. Its current annualized earnings of $107 haven't budged in three years, yet its "price" has risen from 2,018 to 2,602. Hence, investors who three years ago paid less than $19 for $1 of earnings now pay $24.30—an extra $5.30, or an almost 30% premium, for a dollar of earnings.

Much of the bullishness driving that multiple expansion derives from enthusiasm about the tech sector. And indeed, tech is the star when it comes to profit growth. From Q3 2014 to Q3 2017, the sector boosted EPS by a phenomenal 31% while S&P 500's earnings overall remained flat. The jump wasn't primarily generated by annualized revenues, which rose a modest 11% per share over that period. The engine was an explosion in margins from 15.9%

to 20.4%. By contrast, energy profits dropped over the same period by 76%, explaining in large part why EPS didn't budge overall.

The energy sector should rebound in 2018 because of the resurgence in oil prices. But it accounts for a surprisingly small portion of index earnings; Silverblatt reckons that the oil and natural-gas giants will contribute around 4% of the S&P 500's total in 2018. "The energy rebound is a nice tailwind, but it doesn't move the total much," he says. By comparison, tech is by far the dominant industry, accounting for around one-quarter of all S&P earnings. Financial services is No. 2, at approximately 18%.

The most powerful hit to profits will come from rising labor costs, which account for between two-thirds and three-quarters of all business expense. For years shareholders have garnered big returns while workers' incomes have remained flat. "Labor costs have been depressed for a long time, and that can't continue," says Zandi. "They will accelerate and cut into margins." That balance is already starting to flip. Today's 4.2% unemployment rate signals an extremely tight market for workers. The Department of Labor's Employment Cost Index calculates that total compensation rose at an annual rate of 2.51% in the third quarter of 2017. That's 1.2 percentage points higher than inflation, and far above the 1.77% increase in early 2014.

Let's step back and do a little math to see how this applies to stocks. Even if you hold on to some very bullish assumptions about the near future, the numbers argue that prices must come down. For example, let's assume that the S&P 500's P/E stays at its current elevated level. Then imagine that earnings drop from 9.5% of GDP to 8%—a figure that's still well above the historical average. In that scenario, the S&P 500 index would fall by 13%, even if economic growth meets expectations.

EARNINGS BULLS invariably cite the recent, synchronized rise in global growth as a major boon to U.S. multinationals. And they're correct. What's mostly ignored is a heavy counterweight—the meager prospects at home. The S&P 500 is highly international: Around 30% of total sales, and 40% of profits, flow from abroad. Increasingly, it's been fast-growing overseas operations supplying the juice. According to FactSet, S&P companies with more than 50% of their sales outside the U.S. raised their earnings 13.4% in Q3 of 2017 vs. the same quarter a year ago, compared with just 2.3% for those with more than half their sales in the U.S. Europe has turned from a millstone into a motor. Nike recently reported seven straight quarters of rising sales in Europe. And DowDuPont, Apple, and McDonald's all highlighted strong results in the most recent quarters from Europe, Asia, and emerging markets.

"COMPANIES AND SHAREHOLDERS HAVE BEEN TAKING A BIGGER AND BIGGER SHARE OF THE PIE AT THE EXPENSE OF LABOR. THAT CAN'T LAST."
Rob Arnott, chairman and CEO, Research Affiliates

The dollar's 9% decline this year against a basket of global currencies helped greatly. But since the end of October, the greenback has stabilized and even gained slightly against the euro. The prospect of higher U.S. rates and lower corporate taxes is likely to arrest or even reverse the dollar's decline, curbing the recent pace of overseas profits.

Still, U.S. multinationals should benefit from robust growth abroad, especially in developing markets. The Organization for Economic Cooperation and Development (OECD) projects real global GDP of 3.7% in 2018. But non-OECD countries, including China, are forecasted to grow by 4.9% in aggregate, while the OECD estimates that U.S. GDP will grow just 2.5% next year. Among the top beneficiaries of this overseas growth story should be tech titans such as Apple, Google, Facebook, and Amazon. Technology is by far the most global sector in the S&P, garnering no less than 60% of revenues from abroad. "U.S. tech companies have tremendous market power globally," says Zandi. "Google and Facebook have 60% of all ad revenue. That power will continue to grow."

Chiefly because of tech's global strength, Zandi predicts that foreign profits for the S&P 500 will grow faster than U.S. national income. But he also projects that domestic earnings will lag GDP. The bottom line: The domestic drag will offset the global boost, so that future profits will simply track the economy. Even in a tech-driven global world, it comes back to cold, hard math.

Zandi's scenario isn't exciting, but unlike the Wall Street consensus, it makes sense. In 1999, Warren Buffett wrote an influential article for *Fortune* arguing that corporate profits as a share of GDP tend to go far higher after periods where they're depressed—and drop sharply after they've been hovering at historically high levels. So whom should you believe? Today's Wall Street crowd, or Buffett and Friedman? When two such sages agree, you should think twice before following the herd in the other direction. ■

INVESTOR

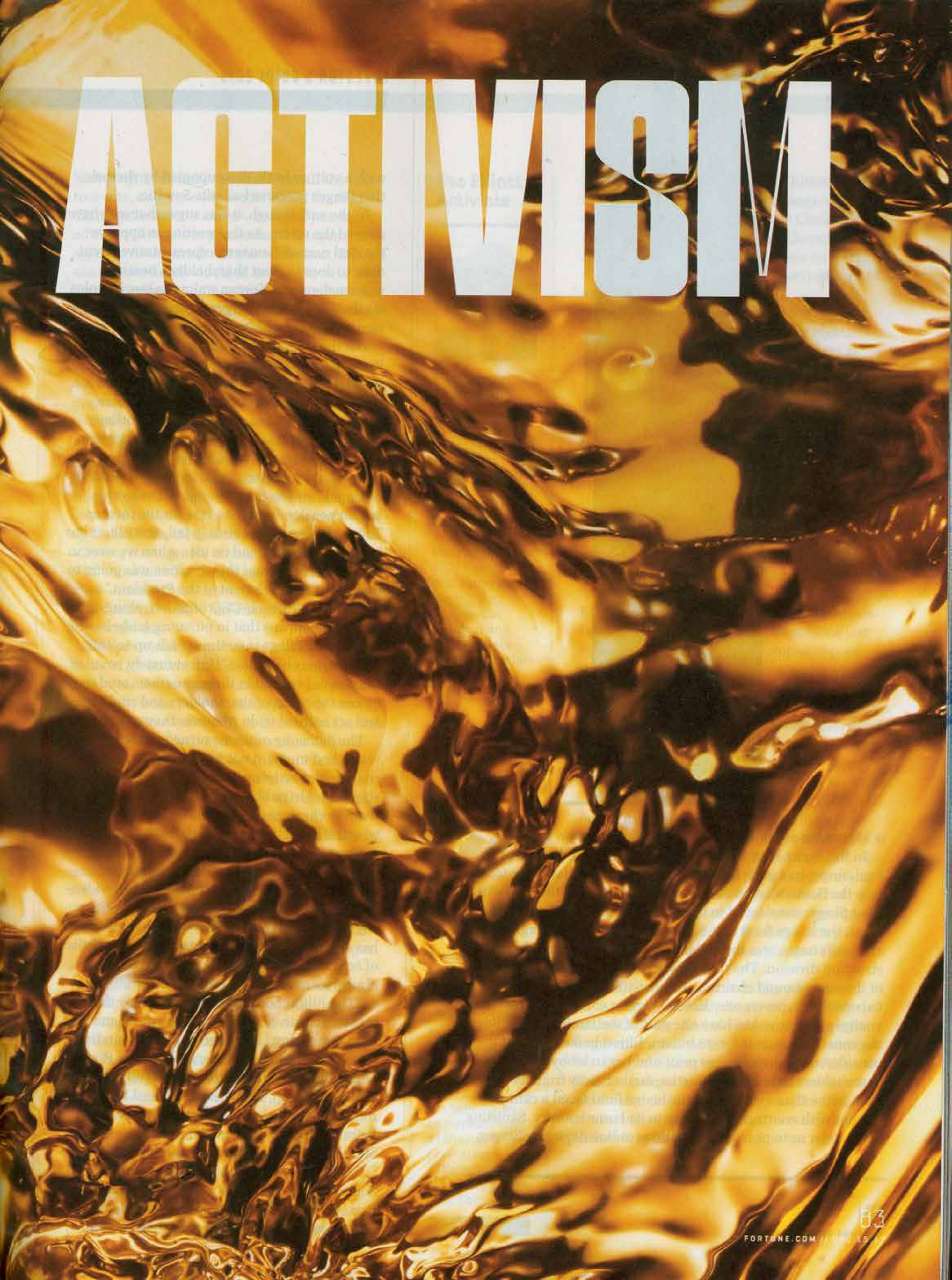
Whatever It Takes to Win

Elliott Management is the world's biggest activist hedge fund and by far the most successful. But opponents, and even some peers, say a few of its recent hardball campaigns have gone too far.

BY JEN WIECZNER

▲ PHOTOGRAPH BY **STEPHEN LEWIS**

ACTIVISM



IF NOT FOR THE WATERMELONS, Elliott might have won in Korea.

In the summer of 2015, the activist hedge fund founded by Paul Singer had gone to war in the Republic of Samsung to stop the South Korean conglomerate from going through with what Singer considered to be an unfair deal. Elliott Management, the hedge fund that Singer launched 40 years ago and still leads today, was then a large investor in Samsung's construction division. The trouble started when Jay Y. Lee, the son of the coma-bound chairman of the Samsung chaebol, started to consolidate power over Korea's biggest company. When the younger Lee moved to have one part of the family empire buy the construction unit for $8 billion, Elliott balked at what it considered an absurdly low price and began lobbying other shareholders to reject it. Investing farther away from its New York home than ever before, the hedge fund faced a canny opponent with enormous influence in its home country. Samsung went so far as to publish illustrations online depicting Singer, with a vulture beak, accompanied by rhetoric that Singer perceived as anti-Semitic.

In the end, though, it was sugar that may have swayed the voters. As the meeting to approve the deal neared, Samsung representatives went door to door to meet shareholders, bearing watermelons and Korean walnut cakes, in a plea for their votes. The merger passed. Elliott, in a rare surrender, sold its shares a few weeks later.

But the story doesn't end there. As South Korean authorities unraveled a corruption scandal that toppled the country's President earlier this year, the trail traced back to Samsung. In August, Lee was convicted of bribery. To ensure Elliott's defeat, Samsung had given a $830,000 dressage horse to the daughter of a key political influencer, who in turn cajoled the National Pension Service—one of the world's largest pension funds—to vote for the merger. Today, the Samsung heir is in jail, and Elliott has been vindicated. "I had no idea when we were in the midst of this, that this situation was going to lead to the impeachment of the President," says Jonathan Pollock, co-CEO of Elliott, alongside Singer. It happens that in pursuing misbehaving companies, Elliott sometimes ends up sniffing out nefarious behavior: "Unfortunately, some of the people involved in these situations tend to ignore the rights of shareholders and creditors, and act entitled to do whatever they want."

The Samsung outcome turned out to be a watershed moment not just for Elliott, but for shareholder activism. Activists use their ownership stakes in public companies to pressure them to change in order to boost returns—whether by restructuring their businesses, shaking up management, or even putting themselves up for sale. Such shareholder agitation has become more common in recent years as a widening pool of global investors seek a competitive edge. And in that world, the 40-year-old Elliott has emerged as both the largest and most active of activist hedge funds, and one that almost always seems to get its way.

"The Elliott book of deals is probably the most instructive, and it's also one of the most far, far reaching," says Marty Lipton, founding partner of the law firm Wachtell Lipton Rosen & Katz and inventor of the poison-pill corporate defense strategy, who has lately faced Elliott more frequently and on more fronts than ever before. "They've been enormously successful, and they are a major factor in activism today."

In the past five years, Elliott has launched activist campaigns at more than 50 companies—19 this year alone—in at least a dozen countries. During that span, the battle with

Samsung is the only one that went all the way to a vote, and the only one in which the firm didn't get what it wanted—a sign of just how effective Elliott is at pressuring management to agree to its demands. At the same time, Elliott's assets have nearly doubled to roughly $39 billion, including $5 billion it raised in a 23-hour span in May, making it more than twice the size of the second-biggest activist hedge fund, Dan Loeb's Third Point.

That war chest, along with Elliott's 400-person staff, has rendered the firm virtually impossible for adversaries—from industry titans to nation states—to beat in a fight. Warren Buffett learned that the hard way this summer, when Elliott used its financial might to successfully block Berkshire Hathaway's bid for energy company Oncor, by buying up company debt and pledging to exercise its creditor veto right. And Elliott has lately sought to clone its winning strategy: It's on track to launch about 50% more activist campaigns this year than in 2016—nearly three times as many as any other major activist fund—including, in October, two in a single day.

Elliott's winning ways are in stark contrast to many of its activist peers, whose recent attempts to take on *Fortune* 500 companies have failed miserably, from Bill Ackman's landslide loss in a proxy contest with ADP, to Greenlight Capital founder David Einhorn's strikeout at General Motors earlier this year. Even Trian Partners' Nelson Peltz, who narrowly won a blockbuster proxy campaign with P&G this fall, is still feuding with that company to accept him onto its board. And Elliott, whose 13.4% annual rate of return over its four-decade history is unmatched among hedge funds, has also outperformed at a time when that asset class has woefully lagged the market. The firm's flagship fund, Elliott Associates, has returned more than 9.7% annualized over the past five years, compared with just 4.7% for hedge funds overall.

As Elliott ramps up its activism to an unprecedented scale, it is also accumulating a growing body count of deposed executives—not to mention ousted heads of state—who dared fight it. Just last year, Elliott finally prevailed in a 15-year battle to force Argentina to repay its bonds—a saga in which the hedge fund at one point seized an Argentine navy tall ship with the sailors still on it. A few months after Elliott finally collected its $2.4 billion windfall, Argentina indicted its former President, Cristina Fernández de Kirchner, who had led her country into default in 2014 rather than pay Elliott what it owed (a decision that had also cost her party reelection). "Elliott's the only one that has effected regime change in two different sovereign countries," says Chris Cernich, managing director of Strategic Governance Advisors, who counsels executives on proxy contests. "They were successful at being right, and very publicly right."

IN THEIR CONVICTION that they're right, however, Elliott has become adept at wielding pressure on its opponents in ways their foes say can cross ethical boundaries. Through interviews with more than 40 people who have dealt with the hedge fund—including bankers, advisers, board members of various companies, and current and former employees of the firm—*Fortune* has learned previously unreported details that reveal just how far Elliott will go to win.

To many observers, Elliott appeared vindicated yet again this spring, when a soccer ball showed up at Paul Singer's door. In January, the hedge fund had publicly called for the ouster of Klaus Kleinfeld, the CEO of aerospace manufacturer Arconic, which split from Alcoa last year. Elliott objected to the company's poor stock returns during his tenure, along with his generous compensation. Arconic refused to fire the CEO, and the stage was set for a proxy fight.

Four months later, Kleinfeld responded in the form of that soccer ball, sent by courier directly to Singer's office, across town from Arconic's New York headquarters. He enclosed a letter on his personal stationery, in which he sardonically alluded to some "lastingly legendary" partying Singer had supposedly done while attending the 2006 World Cup in Berlin. In a postscript, Kleinfeld insinuated that the hedge fund manager's alleged debauchery had included wearing Native American headgear and warbling "Singin' in the Rain" in a public fountain. He pledged to send Singer a feathered headdress next.

By Elliott's telling, it was the corporate equivalent of a bloody finger in a box. "We do understand Dr. Kleinfeld to be making veiled suggestions that he might intimidate or extort Mr. Singer," Elliott's general counsel, Richard Zabel, wrote to Arconic's board. Less than a week later, Arconic's board gave Kleinfeld no choice but to resign. Elliott, it seemed, had lucked into its desired outcome out of the blue,

The Elliott Activists

Paul Singer
Founder and co-CEO, 73

Singer, a lawyer by training and a prominent GOP donor, founded Elliott in 1977. He seldom takes part in negotiations with the companies Elliott targets and eschews joining their boards, but his clout and strategic acumen are crucial to the firm's activism.

Jesse Cohn
Senior portfolio manager, head of U.S. equity activism, 37

A self-described computer-camp geek, Cohn joined Elliott in 2004. His successful campaigns for buyouts of small tech firms helped persuade his colleagues to put activism at the center of their strategy. "The process really works," he tells *Fortune*.

FROM TOP: MISHA FRIEDMAN—BLOOMBERG/GETTY IMAGES; COURTESY OF ELLIOTT MANAGEMENT by way of its opponent's unforced error.

Behind the scenes, however, the hedge fund had been waging a sort of Cold War with Kleinfeld and Arconic, engaging in covert espionage ranging across the Eastern seaboard and all the way to Europe, *Fortune* has learned.

For Kleinfeld, it started when a pair of people who identified themselves as private investigators showed up at the door of his next-door neighbor in New York's Westchester County about a year ago, inquiring about "loud parties" at his house. As Elliott ramped up its pressure on Arconic, friends and colleagues of Kleinfeld, along with board members of Arconic, reported more suspicious run-ins: Others who live near the CEO were followed to a local restaurant by strangers who then approached the couple; they claimed to be considering investing with Kleinfeld, but first had a few questions. The German-born executive declined to speak with *Fortune,* but five people familiar with the events confirmed this account. They all believed Elliott to be behind it: "We thought they crossed the line," one of the people says.

The most unnerving incident was when one of Kleinfeld's daughters, a student at Harvard Business School, was approached on campus by someone who asked to "friend" her on Facebook; the person also spoke to her friends, fishing for information about her family. While lawyers and advisers say it's common to hire investigators to do opposition research in the context of a proxy campaign, executives' kids—of any age—are typically considered off-limits.

Elliott does not seem to share those qualms: On at least three occasions, according to both court testimony and the accounts of seven people who spoke with *Fortune,* children of people facing the hedge fund's attack have been pulled into the fray in some way, in an apparent bid to gain either information on or leverage against their parents. In an instance involving Norbert Essing, an Arconic PR consultant in Germany, neighbors of his children in London received visits from people asking about drug abuse by them or their father. This happened shortly after Elliott publicly blamed Essing for helping or encouraging Kleinfeld to write his soccer ball letter. (Essing denies the accusation.)

Elliott, which offered limited access to two of its executives for this article, declined to comment on the use of private investigators in its activist campaigns; a person close to the firm denies that information from or about anyone's kids was part of the scope of its Arconic research effort. But in the insular world of activist hedge funds, Elliott appears to have a reputation for particularly hardball tactics, several sources say. Distaste for this no-holds-barred approach even led one prominent activist, Jeff Ubben, the CEO of hedge fund ValueAct, to stick up for Kleinfeld during a panel discussion on activism at the Milken Institute conference in May.

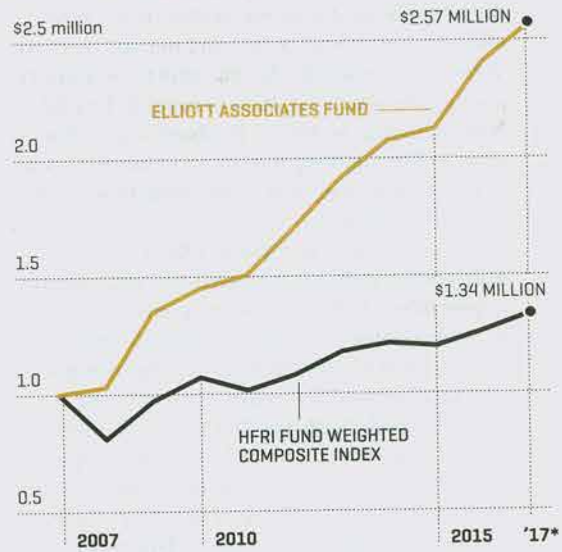
Still, dirt-digging and other aggressive tactics, while controversial, have the benefit of exerting power beyond what money can buy. And they shed light on just what distinguishes Elliott from its less successful peers. "To do activism really, really well, you have to be not only smart and persistent, but you have to be willing," says David Rosewater, who advises companies as the global head of Morgan Stanley's shareholder activism and corporate defense group, and who has previously represented Elliott as an attorney. "Not everybody is willing to be the bad guy."

ELLIOTT MANAGEMENT was founded in 1977 by Paul Elliott Singer, a lawyer by training who found he could use the court system to great gain as an investor in bankruptcy situations and arbitrage. Conservative in almost every sense of the word, the billionaire Singer, now 73, insists on

Boardroom Wins That Pay Off

Elliott Management has launched more activist campaigns than any other major hedge fund in recent years—and has category-beating returns to show for it.

HYPOTHETICAL GROWTH OF $1 MILLION INVESTED IN ELLIOTT ASSOCIATES FUND



SOURCES: PUBLIC-PENSION PLAN FILINGS, HFR INC. *YTD THROUGH 9/30

CAMPAIGN ACTIVITY BY LEADING ACTIVISTS AS OF SEPTEMBER 30, 2017

* AS OF DEC. 5, 2017 SOURCES: LAZARD; ACTIVIST INSIGHT; FACTSET; BLOOMBERG; PUBLIC FILINGS

hedging all his investments to reduce the risk of loss, and prizes "manual efforts"—in other words, old-fashioned elbow grease—as the defining characteristic of his investment style.

A powerful GOP donor who split with his party by funding the "Never Trump" movement—and by supporting same-sex marriage—Singer is also obsessed about his own and his employees' physical safety, according to those who know him well. Elliott largely bans staff from social media; with few exceptions, employees cannot post pictures of themselves online—not even an official headshot—making them virtual ghosts in the digital age. The precaution is meant to protect them from anyone who might hold a grudge against the firm. "Paul has always been paranoid about security," says one Elliott investor, who asked not to be identified for fear of offending Singer. In an extreme extension of that philosophy, Singer has even hedged his Manhattan headquarters, maintaining a backup version of the five-floor offices in New Jersey, just in case.

In the 1980s and '90s, Elliott applied its acumen primarily to distressed debt and other more esoteric securities where relatively few Wall Street investors ventured. But the modern history of Elliott's activism begins in 2004 with the arrival of Jesse Cohn. Now 37, Cohn is Elliott's enfant terrible; a car fanatic and triathlete from Long Island who can talk so quickly it sometimes seems like he's on fast-forward.

> "ELLIOTT IS SINGLE-HANDEDLY MAKING THE PUBLIC MARKETS LESS ATTRACTIVE TO COMPANIES."
>
> **Jeff Ubben,** activist investor and CEO of hedge fund ValueAct

A self-described computer-camp geek, Cohn spent two years as an M&A banker at Morgan Stanley before joining Elliott. That's where he started writing letters to small tech companies, urging them to put themselves up for auction to garner big gains for their shareholders.

Cohn's fanboy-meets-dealmaker affect earned him a reputation as a bit of a whippersnapper. In 2010, in a letter to the board of Novell, he boasted of earning one of the company's IT certifications when he was 14—a charming bit of common ground that shared the pages with a hostile bid to buy the firm. The brash move worked—Novell was sold to private equity—and Cohn's formula impressed his bosses enough that they promoted him to head all of its U.S. equity activism. Cohn's campaigns have resulted in the takeouts or buyouts of more than a dozen companies, including BMC Software, Informatica, LifeLock and, biggest of all, EMC, which Dell acquired for $67 billion in 2015. "I don't know if anyone has any more experience than he does prosecuting activist campaigns," says Chris Young, head of contested situations at Credit Suisse, who has known Cohn since the latter started at Elliott.

While Singer eschews sitting on corporate boards, Cohn sits on four, and has become so integral to the firm that some of Elliott's investors mistakenly believe Cohn is Singer's nephew. While Singer seldom appears in public (he declined to be interviewed for this article) and rarely takes part in negotiations with companies the firm targets, Cohn is often on the front lines. "Paul is the final decision maker on lots of these issues, but Jesse is the guy, and everyone in the activist community knows who he is," says Marc Weingarten, a partner and cochair of the shareholder activism group at law firm Schulte Roth & Zabel who has represented Elliott.

In private, people sitting across the table from Cohn have seen another side of him, that of a maestro in the art of applying strategic pressure. That aspect of him bubbled into public view with Compuware, the Detroit-based business software maker that eventually sold to private equity firm Thoma Bravo for $2.4 billion in 2014 as a result of Elliott's campaign.

In September 2013, a delegation from the Compuware board flew to New York to meet with Elliott about its demands for the company. Cohn opened the meeting by casually flipping through a six-inch-thick manila folder of purportedly embarrassing information on his guests, which included former GM CEO Fritz Henderson. Bill Grabe, an advisory director at private equity firm General Atlantic who sat on Compuware's board at the time, would later testify in arbitration proceedings that Cohn unabashedly brought Henderson's daughter into the conversation. "And you know, you have a daughter that's doing this and whatnot," Grabe recalled Cohn saying, paraphrasing the young fund manager. "You're dealing with somebody whose tactics it is to intimidate, to splinter, to do everything they can to be disruptive," Grabe testified. In the same case, then–Compuware CEO Bob Paul testified that in a follow-up phone call, Cohn dropped a "veiled threat" that he knew Paul kept an Aston Martin in his garage, saying, "By the way, love that English car you're driving."

These encounters, first disclosed during a wrongful termination dispute with Compuware cofounder Peter Karmanos Jr., have provided ammunition for Karmanos's current suit in Michigan state court, accusing Elliott of "blackmailing" the directors into selling the company. "Elliott is taking advantage of the situation," Karmanos tells *Fortune*, "and then when they wanted to push it a little harder, they bend the rules." Karmanos started Compuware in 1973 with a few hundred dollars in tax refund checks. He had already announced his retirement from the board when Elliott launched its campaign, but was fired as a consultant a few months later for saying publicly that he "would tell the hedge fund to go fuck themselves"—comments he says he does not regret. "It's hard to watch it just get torn apart by those jerks in New York," he says.

A person who was in the room when Cohn brought out the dossiers says the ploy had no influence on the board's decisions, though it was unmistakably a threat to release damaging information. "There was no question as to what the intent was of that folder," the person says. The directors had come to the meeting prepared, after their counterparts at rival BMC, which Elliott had come after a year earlier, warned them of similar tactics. That effort included a disturbing phone call to a BMC director's daughter, the Compuware directors say.

Elliott declined to comment. But a person close to the firm says the shtick was designed "to be sort of funny, but sort of brutal," a kind of shame game cataloging the board's conflicts of interest, and conveying that the jig was up. The intel itself implicated the director, not his daughter, even if she was the source of it, the person adds: "We draw the line there. His daughter doesn't sit on the board."

Still, such maneuvers are concerning to investors like ValueAct's Ubben, who worry that Elliott may undermine the ability of other activists to work with companies in good faith, whether by its indifference to the human toll of its campaigns or because of its apparent affinity for knocking companies out of existence. "Our form of activism could not be more different than Elliott," Ubben tells *Fortune*. Ubben's hedge fund's behind-closed-doors campaign at Microsoft, now going on five years, is credited with expediting the tech giant's turnaround under CEO Satya Nadella. "Elliott is single-handedly making the public markets less attractive to companies," Ubben says, "and we see it in the shrinking number of public companies and the growth in private ownership."

WHILE COHN was in the trenches with Compuware, a sea change was taking hold inside Elliott. Elliott's top brass saw Cohn's strategy as an obvious extension of the firm's bread-and-butter, labor-intensive investing, and five years ago they kicked it into high gear.

Elliott's Fallen Foes

Cristina Fernández de Kirchner
Former President, Argentina

Argentina fought with Elliott for years over payments on some sovereign bonds. But Kirchner's refusal to pay the debt helped push the nation into default, leading to her party's electoral defeat and, more recently, her indictment for corruption.

Jay Y. Lee
Former vice chairman, Samsung Group

Lee, the de facto head of the South Korean conglomerate, was convicted and jailed for bribery in August. Samsung had given an $830,000 horse to the child of a key political influencer, in a bid to secure a vote against Elliott in a proxy fight.

© FROM TOP: JOHN THYS—AFP/GETTY IMAGES; SEONGJOON CHO—BLOOMBERG/GETTY IMAGES

Elliott had a generation of young managers eager to do what Cohn had done in their respective industries, from energy to metals and mining. Jonathan Pollock, who had practiced closed-end fund arbitrage in Europe and Asia, had returned to New York a few years earlier, and now fused the principles upon which Singer had built the firm into an equity strategy that could travel across Elliott and the globe.

The first big test was Hess. With a market cap of about $25 billion at the time, the family-run oil and gas empire was the largest company Elliott had ever gone after, and it occupied a nostalgic place in American culture thanks to the novelty toy trucks it released each year at Christmastime. Hess never saw Elliott coming. Elliott owned only 4% of Hess's stock—not enough to necessitate an activist warning-shot 13D filing with the SEC—in January 2013 when the fund went public with a proxy campaign to replace five of the board's directors. Elliott alleged that Hess was paying execs some of the highest compensation packages in the industry, while stock returns were near the bottom. It was "a sneak attack," recalls Thomas Kean, the former Republican governor of New Jersey and one of the Hess directors in Elliott's crosshairs.

Hess had an aura of impenetrability as one of America's last dynastic corporations. But the hedge fund nominated an unimpeachable lineup of new directors (including former CEOs of BP and American Express), none of whom worked for Elliott, forcing shareholders to evaluate its arguments on merit. The Hess board "looked like the junior varsity B team when you compared them to the Elliott slate," Cernich says. Elliott, Kean claims, told some institutional shareholders that failing to support its candidates would be tantamount to neglecting their fiduciary duty—an allegation with potential legal consequences.

On the eve of the proxy vote at the May 2013 annual meeting, representatives of Elliott and Hess holed up counting incoming votes in the Four Seasons hotel in Houston. It was only around 10 p.m., when the outcome was still too close to call, that the two sides came together, working through the night on a settlement: At 6:30 a.m., Hess announced that it would add three of Elliott's nominees to its board. Kean, after 23 years of service, relinquished his seat. "By taking that on, they showed that they could move up the weight class to take on bigger companies, and that's that," Kean says. The Hess family's defeat also reverberated beyond Elliott, says a banker who advises companies on facing activists: "Once that broke, I think everybody was like, party on."

Inside Elliott, the mounting victories catalyzed the activist impulse. In October 2015, the hedge fund took on its first retail company with Cabela's, which eventually sold itself to Bass Pro Shops. For Cohn, the moment of enlightenment came with American Capital. Elliott had originally invested in the obscure financial stock as part of an arbitrage trade, but when a colleague saw that the company was laying groundwork to shield itself from activist investors, he went across the hall to Cohn for the first time.

Running the company through Elliott's activism checklist—Is the company undervalued? Can it be fixed? Can you convince other shareholders of the need for change?—Cohn brought the idea of a campaign to Pollock and Singer, who immediately signed off. In mid-November 2015, Elliott sent a public letter to American Capital while simultaneously revealing an 8.4% stake; the company caved just nine days later, announcing it was beginning a sale process. It was the quickest turnaround of any of Elliott's public campaigns. (Ares Capital acquired the firm six months later for $3.4 billion.) "It showed that the process really works," says Cohn. "And it's scalable. That's part of what I think we've proven—we're not just a group of tech people doing just tech trades; we're a team that's able to take what we've built and do it over a long period of time, and roll it out to other industries and geographies, too."

Still, Cohn wasn't quite satisfied with the machine he'd helped build. From his earliest days at Elliott, he'd harbored a dream that he'd frequently express over dinners with colleagues and advisers. For as many times as he'd pushed companies onto the block, as many sales as he'd secured, there was something missing: Jesse Cohn wanted to buy companies himself.

TO HEAR COHN TELL IT, he'd fallen in love. The time and effort Elliott put in to researching companies before launching campaigns often imbued the activists with an intimate knowledge of, and deep appreciation for, their targets. With EMC, for example, Elliott had spent months getting to know the data storage company, interviewing some 700 of its customers before launching a campaign urging

Klaus Kleinfeld
Former CEO, Arconic

He lost his temper during a proxy battle with Elliott and lost his job after sending an angry letter to Singer.

Ton Büchner
Former CEO, AkzoNobel

Pushing the Dutch paint-maker to merge with PPG Industries, Elliott sued to oust its chairman. That didn't work, but in July, Büchner quit for "health reasons."

Mark Templeton
Former CEO, Citrix Systems

Jesse Cohn wrote to Citrix in June 2015 calling for "fundamental change" at the enterprise tech firm. Templeton resigned when Citrix put Cohn on its board.

© FROM TOP: ROB KIM—GETTY IMAGES FOR YAHOO FINANCE; JASPER JUINEN—BLOOMBERG/GETTY IMAGES; MUNSHI AHMED—BLOOMBERG/GETTY IMAGES it to pursue M&A opportunities. But when computing giant Dell, with financing from its private equity owner Silver Lake, bought EMC, Elliott was shut out of the deal. One day, Cohn hoped, Elliott would be big enough to afford whales of its own.

Cohn's dream finally came true this fall, when Elliott acquired cybersecurity firm Gigamon for $1.6 billion, less than six months after unveiling a position in the stock. It was the first time Elliott had taken an entire public company private by itself, a major milestone for its relatively new Silicon Valley–based private equity arm, Evergreen Coast Capital.

But in a bit of high-finance irony, Elliott's reputation for sharp elbows, Cohn realized, could be a liability in achieving these new goals. Cohn is now often sourcing leads for deals from the very bankers and lawyers who sat across from him during tough negotiations in the past. And with that adjustment, people who've worked with him say, has come a newfound sensitivity to how both he and Elliott are perceived.

At Athenahealth, for example, which Elliott targeted this spring, Cohn has been polite and even complimentary in his interactions with management, despite being a "regular drumbeat" of a presence, according to people close to the health IT company. On occasion, Cohn has been known to let a tinge of guilt creep in when he reflects on his more swashbuckling days. "Our tactics probably evolved over time," says Pollock, who is Cohn's boss. "We're looking more toward this constructive engagement approach."

That's why Elliott's attack on Arconic this year ruffled feathers inside and outside the firm. Led by 38-year-old portfolio manager Dave Miller, the campaign rhetoric packed more vitriol than any of Elliott's campaigns in recent memory. Elliott's 336-slide deck, distributed to Arconic shareholders and released publicly, depicted Kleinfeld as the Monopoly man, running away with money bags. It also alluded to Kleinfeld having personality abnormalities (a claim Arconic dismissed as an "unsubstantiated" ad hominem attack), prompting some to observe that Elliott could have a split personality of its own. "The problem is, I don't know whether I'm going to get the mensch or the schmuck," Joele Frank, of the eponymous public relations firm that has helped companies fight Elliott and other activists, commented at a panel at a Tulane law school event in March. (Miller, for his part, was promoted to head of U.S. restructuring at Elliott this spring.)

"OUR TACTICS PROBABLY EVOLVED OVER TIME. WE'RE LOOKING MORE TOWARD THIS CONSTRUCTIVE ENGAGEMENT APPROACH."

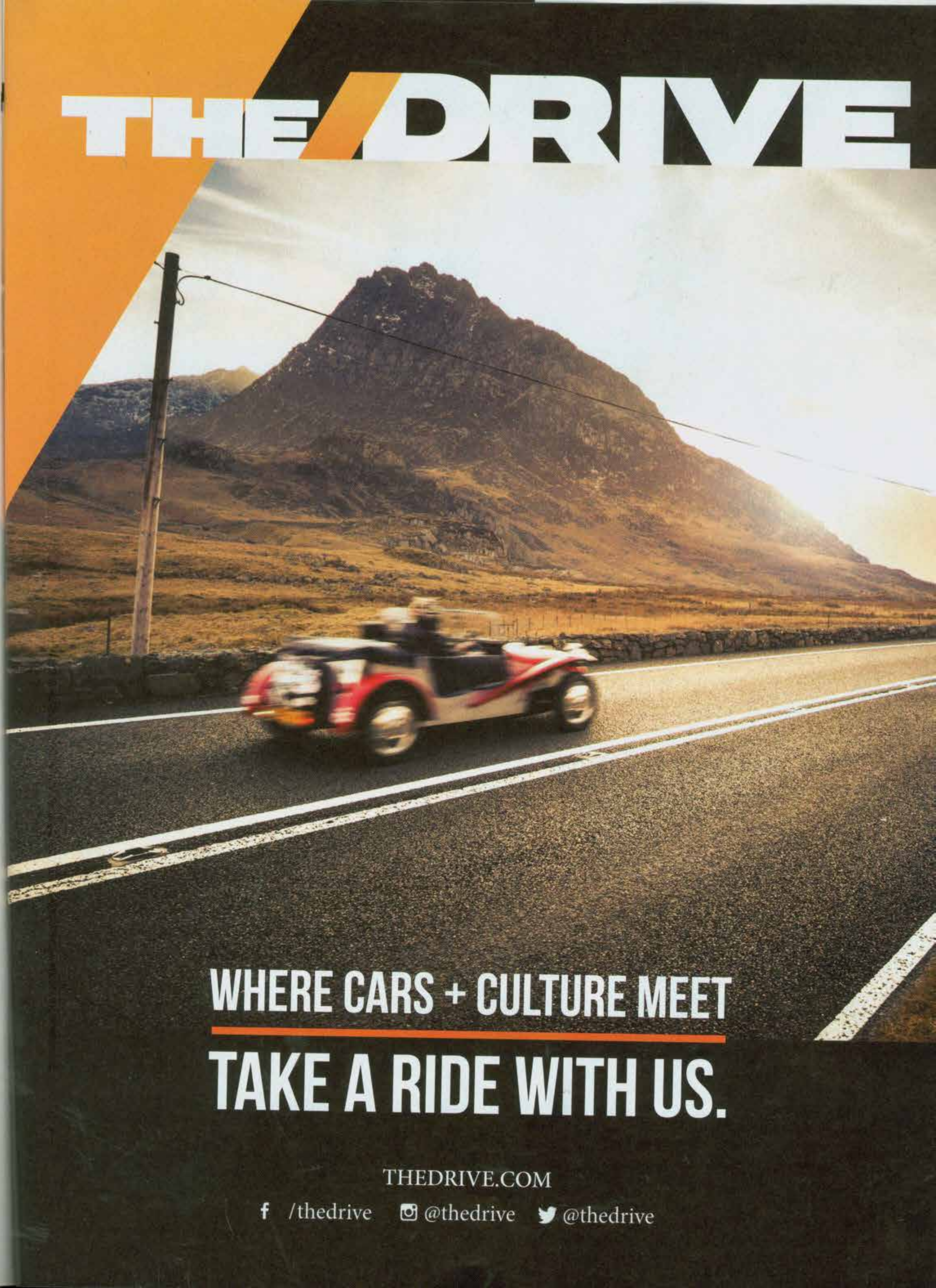
Jonathan Pollock, co-CEO, Elliott Management

The Arconic campaign also illustrated Elliott's power to deploy a seemingly bottomless amount of resources. In May, nearly a month after Kleinfeld resigned, Elliott did something no one has done before or since. Along with paper proxy-vote cards, the hedge fund mailed rechargeable video players, slightly smaller than an iPad, loaded with a four-minute attack ad—alleging Kleinfeld "has the worst track record of any CEO in the S&P 500 over his tenure"—that played automatically when investors opened the package. Sent to tens of thousands of large retail shareholders, the gimmick alone cost Elliott as much as $3 million, proxy contest advisers estimate. While Arconic disclosed it spent $58 million defending itself, it's likely the hedge fund spent nearly as much if not more in the attack, according to people who worked on the campaign. After two failed rounds of settlement talks in which Singer made a rare personal appearance, Arconic ultimately agreed to add three of Elliott's four picks to its board. "When Elliott shows up, it's a completely different ball game," says Weingarten, the Schulte lawyer. "They are relentless. They have the money, and they will spare no expense to ensure that they win."

From Elliott's perspective, the approach was warranted, given the resistance they'd encountered. Pollock notes that Arconic was one of just a handful of its campaigns, along with Hess and Samsung, where a true battle ensued. "I don't count the three or four as a success, necessarily," he says. (Adds someone close to Arconic, "We didn't decide to take them on, we just said we disagree.")

Bankers say the Arconic presentation has made the rounds in other companies' board rooms, and looms large over Elliott's subsequent campaigns, a warning of what can happen to those who resist its overtures. Whether it fits the firm's ideals or not, Elliott's ruthless legacy continues to color its endeavors. Unlike the activist firms run by Bill Ackman or Dan Loeb, the fund Paul Singer founded has raised an army of activists who can influence corporate fiefdoms everywhere. "There's some sense that there's an institution that survives the founder," says Cernich, the governance adviser, "and that it expands and multiplies the power and effectiveness of the organization."

Promises Pollock, "We'll be around for a while." Boards, beware. ■


THE DRIVE
WHERE CARS + CULTURE MEET
TAKE A RIDE WITH US.
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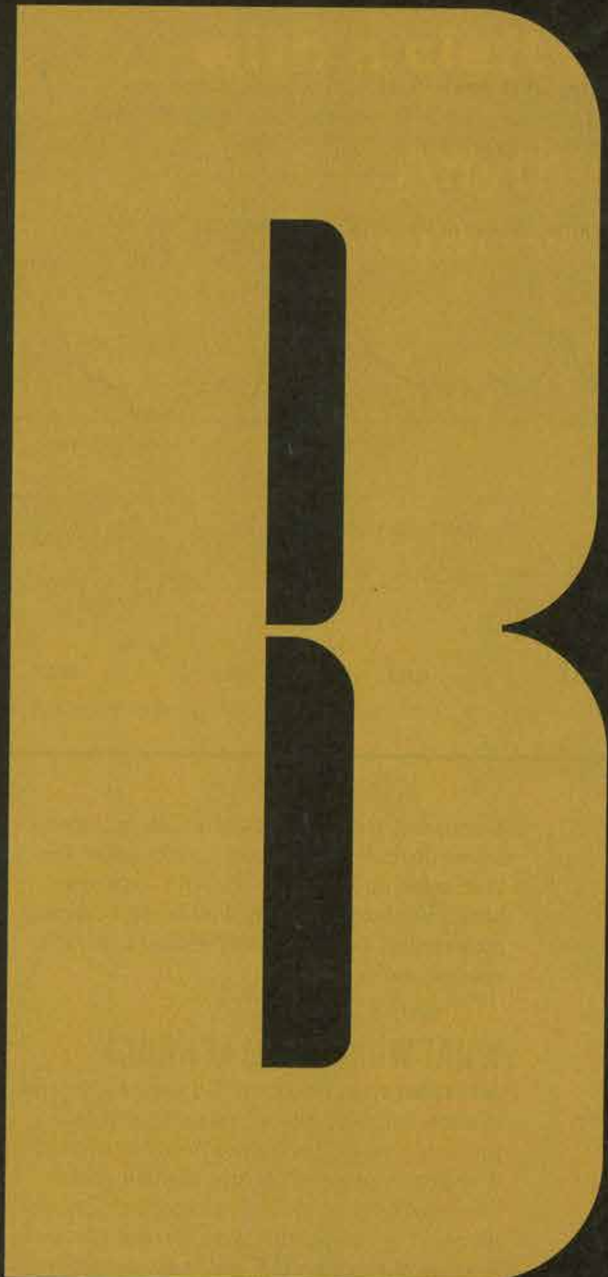
BLACKROCK ASSETS UNDER MANAGEMENT
1999
$165.0 BILLION
2005
$451.7 BILLION
2010
$3.56 TRILLION
2017 (SEPT. 30)
$5.98 TRILLION



The Planet's Biggest Investor Prepares for 2018

BY MATT HEIMER

BlackRock leads the industry with $6 trillion in assets under management—which means every move it makes has global ripple effects. Here's an **exclusive preview** of what its strategists expect from the markets next year.

▲ GRAPHIC BY NICOLAS RAPP

TO MOST MAIN STREET INVESTORS, BlackRock is basically invisible. Then again, so are Wi-Fi and oxygen. The New York–based financial giant is deeply woven into the fabric of global investing: It's the world's biggest asset manager, overseeing about $6 trillion in client money as of the end of November. That's a sum bigger than the GDP of every country on earth except the U.S. and China, and it means BlackRock's investment decisions create ripples that roll through every major global market.

BlackRock's best-known products don't involve much decision-making: It's also the biggest provider of passive exchange-traded funds, with $1.5 trillion invested in its iShares fund family. Still, BlackRock's institutional stock and bond holdings, most of which are actively managed, are considerably larger than its ETF portfolio, and the choices the company's 135 investment teams make about where to deploy that money affect and influence countless other investors.

To give *Fortune* readers a preview of what the firm expects from global markets in 2018, BlackRock's senior strategists shared their outlook with us in advance of its mid-December publication. Highlights follow from our conversations with the team; for more from BlackRock's report, visit Fortune.com.

WELCOME BACK, INFLATION

ONE OF BLACKROCK'S main themes for 2018: Globally, inflation will most likely be back to stay. That's a good thing, because we're not talking about Gerald Ford–era, runaway price increases but rather the steady inflation of around 2% a year that the Federal Reserve and macroeconomists associate with healthy growth. For the first time in nearly a decade, "instead of worrying about 'What if growth stalls?,' you're seeing real inflation coming through," says Richard Turnill, BlackRock's global chief investment strategist.

In the U.S., wage pressure is on the rise after years of ultralow unemployment. But Turnill says China is now the bigger factor globally, as it cuts production capacity in its huge state-owned heavy industries and focuses on stoking consumer spending by its own middle class. "Historically China's been a deflationary force," he notes. "Now it's starting to become an inflationary force."

Rising inflation generally makes economists happy; it makes bond owners a bit queasy, since the value of most bonds declines as interest rates rise. A faster than expected spike could mean sharp drops in the prices of longer-duration bonds and riskier corporate junk bonds. BlackRock's team is neutral or underweight on most classes of bonds for 2018, advising clients not to load up on them. Jeffrey Rosenberg, chief fixed-income strategist, says that investors who want the income associated with bonds should focus on floating-rate loan funds and Treasury Inflation-Protected Securities (TIPS). The payouts from those assets rise as interest rates rise, he explains, "and if bond prices are going down, TIPS bond prices are going to go down less."

SLOWER BUT STEADY IN STOCKS

THE S&P 500 WAS UP 19% for the year through November—and other global indexes set a pace that would be equally tough to match. BlackRock's analysts think it's likely that global economic growth will keep stocks rising, but not at the same hyperkinetic pace. In the U.S., the firm estimates that tax reform (assuming it passes) could raise GDP by 0.5% but doesn't expect it to fuel enormous market gains. (That's an opinion shared by *Fortune* editor-at-large Shawn Tully; see his analysis in "When Will the Profit Boom Fizzle?")

Still, some U.S. sectors should have big years. Kate Moore, chief equity strategist, expects another strong showing for technology stocks, as more companies take advantage of a healthy economy to upgrade or overhaul the tech that drives their businesses. She's also bullish on financials, particularly U.S. large-cap banks. "There are a lot of tailwinds and drivers for them in 2018," she tells *Fortune*, including rising interest rates (which tend to boost bank profits), and a looser regulatory climate thanks to a Dodd-Frank–allergic Trump administration. U.S. banks are also poised to hike their dividends sharply next year, Moore points out, making them more attractive if and when stock price gains begin to slow.

Turnill thinks stocks in some foreign markets may outpace U.S. equities. Earnings in many emerging markets are on the rise, and central banks in Europe and Japan are expected to keep interest rates low in order to juice their own economies. He's particularly bullish on Japan, where he thinks the Nikkei, up 16% so far this year, could do even better in 2018. Japanese businesses "are delivering double-digit earnings growth, and it's sustainable," Turnill says. "It's not one and done."

Looking Overseas BlackRock strategists expect strong performance from stocks in emerging markets, where earnings growth is on the rebound.

CUMULATIVE CHANGE IN MARKETS' EPS SINCE 2011

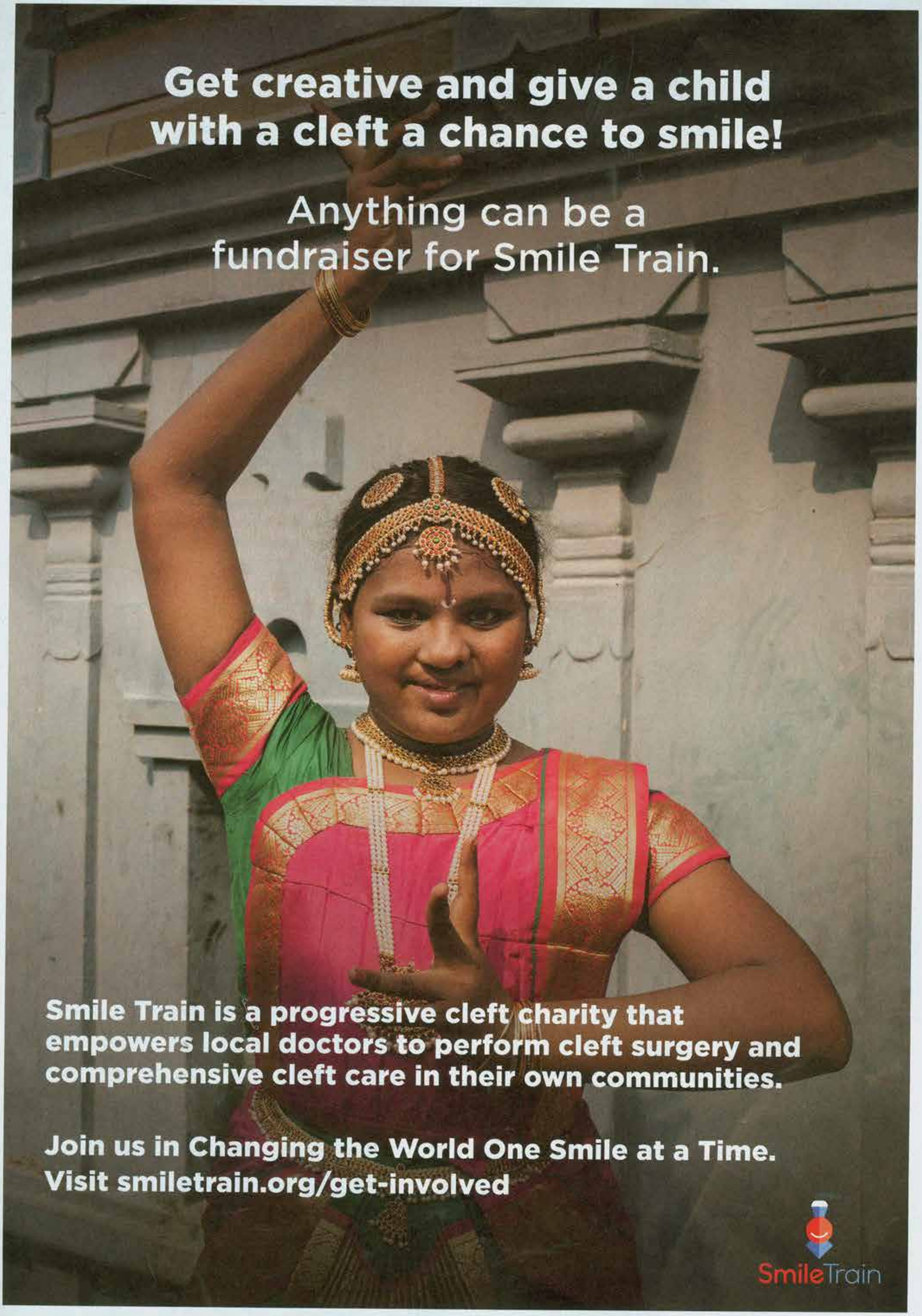
SOURCES: BLACKROCK INVESTMENT INSTITUTE; THOMSON REUTERS

> "INSTEAD OF WORRYING ABOUT 'WHAT IF GROWTH STALLS?,' YOU'RE SEEING REAL INFLATION COMING THROUGH."
>
> **Richard Turnill,** global chief investment strategist, BlackRock

WHAT WORRIES BLACKROCK

JUST ABOUT EVERY ECONOMIST believes the Federal Reserve will raise interest rates three or four times next year. The Fed has pretty much said it's going to do just that. And normally, that foreknowledge would have already led U.S. stock investors to tap the brakes a little. But BlackRock estimates that U.S. stocks are currently priced as though investors are expecting only one or two hikes next year. "The danger is that the Fed actually does what it says it's going to do," says Turnill: If that happens, it could mean short-term pain for both stock and bond investors, although prices most likely wouldn't plunge into bear market territory.

"The No. 1 one risk we're focused on," says Turnill, "is trade." Ongoing talks on the North American Free Trade Agreement (NAFTA) and looming elections (both for Mexico's presidency and U.S. congressional midterms) could elevate the simmering tension between the U.S. and its neighbors into open conflict. That could pour cold water on global growth—and make trouble everywhere that BlackRock invests.


Get creative and give a child with a cleft a chance to smile!
Anything can be a fundraiser for Smile Train.
Smile Train is a progressive cleft charity that empowers local doctors to perform cleft surgery and comprehensive cleft care in their own communities.
Join us in Changing the World One Smile at a Time.
Visit smiletrain.org/get-involved
SmileTrain

How Schwab Beat Back the Robots

You might expect a 46-year-old brokerage to be first in line to get disrupted by the new forces remaking the industry. But Charles Schwab has stayed ahead of the digital wave—by joining in. CEO WALT BETTINGER talked to *Fortune* about his remarkable run at the helm, the future of finance, and what Americans get wrong about investing.

INTERVIEW BY
ADAM LASHINSKY

Walt Bettinger, Charles Schwab CEO, is bulking up its A.I. and other digital offerings.

CHARLES SCHWAB, the discount brokerage, went public 30 years ago and has since ridden repeated waves of financial cycles and a thorough reordering of the personal finance industry. Its CEO, **Walt Bettinger,** calls the modern Schwab a "no-tradeoffs firm": a low-cost brokerage that has high-touch service, with a human-plus-machine "robo-advisory" offering, and inexpensive passive investments including ETFs (exchange-traded funds). Bettinger, who still labors under the watchful eye of executive chairman Charles Schwab, has strong views on Schwab's money-back guarantee, the firm's pricing strategy, and how the renegade-turned-incumbent uses artificial intelligence. (Spoiler alert: to aid customer service, not to beat the market.) If he has a regret, it's that American savers still lack the necessary financial literacy to secure their futures. We sat down with Bettinger this fall. Below, an edited transcript.

What is Schwab's overarching approach to financial services on behalf of clients?

Our core strategy is around creating a no-tradeoffs type of firm. Whether it's offering pricing on commodity products like index mutual funds and ETFs that is as low or in many cases lower than anyone else in the industry, yet combined with hundreds of branches around the country. Two years ago J.D. Power ranked us No. 1 in *full service* for brokerage. Who would have thought 40 years ago Charles Schwab would be No. 1 in full-service brokerage?

In each of your major business lines you have more narrowly focused competitors. Why is your comprehensiveness superior?

The main businesses we're in are all complementary. We're not building widgets and then marketing investments. They all leverage the same infrastructure. One of our greatest advantages is our scale. At $3.2 trillion in assets, we operate the firm on 17 basis points of cost.

Our nearest publicly traded competitor, TD Ameritrade, is about 10 basis points above that. And the wealth-management divisions of traditional full-service firms, Bank of America and Morgan Stanley, are about three times that. That's why we're growing so much faster, because we're leaving more money in the pocket of the client.

Charles Schwab
After setting up shop in San Francisco in 1971, Schwab built his namesake company into an investing behemoth, pioneering the discount brokerage concept in the U.S.

You speak about challenging the status quo. What do you mean by that?

Let's play a word association game. I tell you that you want the lowest cost index fund, who do you say?

Vanguard.

Okay, but that's not right. Our index funds are as low or lower. Here's another. I say you want the absolute premier service and advice in the industry. This time I'm not going to have you say a name because whatever name you say, we [add more assets each] year than that firm. This is challenging the status quo. When you work in an industry you're going to have more knowledge about how the sausage is made than the person who buys the sausage. The internal expense rate of an ETF is the same no matter how much you buy. So why is it that when it comes to index mutual funds, if you go with $500 you will pay the biggest names in the industry four and five times what you would pay for that index fund if you bought $5 million? It's an example of taking advantage of knowing how the sausage is made to extract more from the client.

We looked at that and made the decision earlier this year to eliminate all the share classes on our index mutual funds [in other words: to charge the same price no matter the volume purchased].

This must have been a painful decision.

In 2017 we've given up just under $400 million in annualized revenue via price reductions to clients. And we did just under $2.2 billion of revenue last quarter. So this year alone we'll give up somewhere between 4% to 5% of our gross revenue in terms of delivering a better value to the consumer.

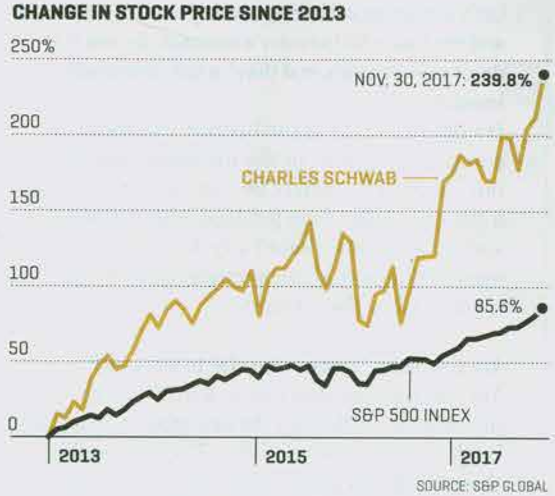
Why give up easy money?

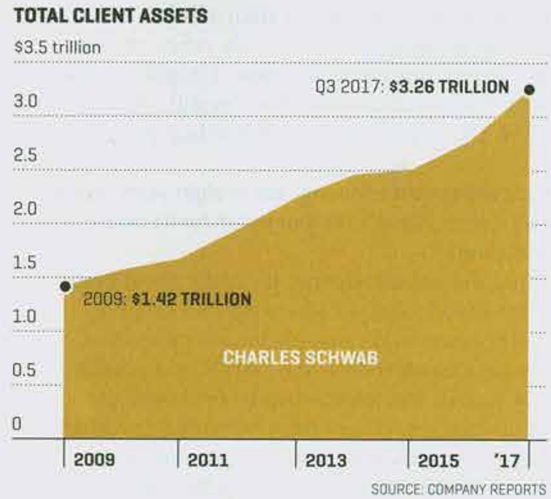
We have a long-term time horizon, which means we're looking to continue to build our scale. This causes consternation on Wall Street, but there's nothing I would like more than to see the 27 or 28 basis points that we take from clients in revenue today and go down to 24 or 22. We'll keep lowering our cost because that's going to continue to grow our overall top line, because more consumers will want to do business with us. And it'll continue to improve our profitability because we'll use technology to become more and more efficient.

How do you think about investing in technology?

When you're responsible for custody of

PREVIOUS SPREAD: STUART ISETT—FORTUNE GLOBAL FORUM, 2015; SCHWAB: DANIEL ACKER—BLOOMBERG/GETTY IMAGES





$3.2 trillion, technology has to be at the forefront of virtually everything you do. And not just for efficiency, but also for minimization of errors and processing, for protecting clients' information, security of their personal information and their assets. Then you have to back it all up with a guarantee. If you're unhappy with any experience you have at Schwab, we'll give you your money back. Commission, fee, even your advisory fee if you're using us for advisory services and you're unhappy with the advisory services we provide. We give you your money back.

That's a nice human touch. But aren't the robots going to take over eventually, particularly at giving advice?
Digital advice is a credible product. People will put money into a digital advisory solution. Our clients are putting in about a billion dollars net every month into [what we call] Intelligent Portfolios. But it is just a product. What our clients tell us is that to have a real relationship, it's going to be more than just technology. That's why from the moment we introduced Intelligent Portfolios we said the product is going to have 24/7/365 access to speak with live licensed professionals. We never believed that the notion of people staying with a plan during difficult times in the market was a given.

How are you using artificial intelligence?
Artificial intelligence is utilized much more for service experiences. We have a saying at Schwab that we use our data to serve, not to sell. That's the greatest opportunity for artificial intelligence. I'll give a very simple example: You call up one of our call centers, and you have a concentrated position in XYZ stock because you worked there for 35 years. Our computers can listen to that call, interpret what you are saying, and reach right back out to you with an option strategy that gives you some downside protection in the event that that individual stock runs into problems.

"WHEN YOU'RE RESPONSIBLE FOR CUSTODY OF $3.2 TRILLION, TECHNOLOGY HAS TO BE AT THE FOREFRONT OF VIRTUALLY EVERYTHING YOU DO."

And your contention is that the computer is a better listener than a person?
How can you listen to tens of thousands of phone calls every day in real time and be able to rapidly offer a strategy? You were simply just expressing an issue to us and now we can come back and give you a potential solution that would make sense for you.

Did you design or buy that?
There are components of it that you buy, but the overall concept and approach are things that we built ourselves. That's where I see intelligence creating value. Anyone telling me that they've got the latest and greatest way to time the market, beat the market, outperform the market, I say, Come on, people have been selling us those stories for a hundred years.

But aren't you like a pharmacy that also sells cigarettes? Stock pickers can't beat the market, yet you still sell individuals stocks.
If I have a grocery store and I think a certain

brand of ketchup is better than another brand, I'm not going to just completely refuse to give the second one any shelf space. I might not put it on the end of my aisle, but I'm still going to allow you to pick the kind of ketchup you want.

Let's shift to the economy. We're eight years into a bull market. What's the game plan for its inevitable end?

From a client standpoint, it's really about planning. It's about asset allocation and keeping your costs low. We don't believe it's possible for people at scale to beat the market and predict the market and know when to get in and out of the market. Where most individual investors get in trouble is when the market goes down and they can't stand the pain so they leave. Then they either don't get back in or they wait until the market's turned and gone way up and then get back in. That's what really crushes individual investors.

Now from a firm standpoint, our business model is designed with natural hedge. When the market is going up as it has been of late, we generate more revenue from our advisory fees. When the market goes down, clients tend to move money out of the market, despite our best recommendations, into cash. And we can make money on the [moving back to] cash side.

But that didn't stop 2008 to 2009 from being an incredibly painful and disruptive time for Schwab, right?

ZIRP, the time of "zero interest rate policies," was incredibly painful for us because interest rates went so low and clients moved to cash in record numbers. In order to ensure that they weren't getting a zero yield or a negative yield on their money funds, we waived all our fees. That's the one environment that is very difficult for us, although we still maintained profitability throughout the entire time. In those three years, after the financial crisis we grew our assets by $530 billion. Merrill Lynch, Morgan Stanley, E*Trade, Ameritrade added together grew by about $320 billion. So you're also preparing for down times in the way you run your firm in good times. It's why our balance sheet is 70% U.S. Treasuries and government-backed paper today. Because we don't want to take credit risk. Our clients know that in tough times we're a safe port.

"THERE IS SO MUCH WE CAN DO AROUND FINANCIAL EDUCATION FROM A SOCIETAL STANDPOINT THAT I THINK WOULD HAVE A TREMENDOUS IMPACT."

Let's end on an existential note. For all of Schwab's and the financial industry's success, people still don't save enough, and they're still financially insecure.

It's probably one of the biggest and most complex questions in the investing industry. In our capitalistic society owners are rewarded to a greater extent than lenders. And yet, we as a society have not created a system that encourages the masses of our population to be an owner rather than a lender.

Are you using "lender" to refer to workers?

Yes. People who don't save, aren't able to save, or whatever little they do save goes into a passbook or a CD or something. They're lending their wealth to people who are owners. We as a society haven't done a good job of educating people on the opportunity differences between the two approaches. And we have an enormous issue that just has to do with teaching people about finance.

I think we would all agree, at least all of us who work in this industry, that these should be required programs in school. When I was in school I had home economics. I learned how to make a vest, and I learned how to cook macaroni and cheese. Now the vest part I'm not so sure about, but the macaroni and cheese benefited me in college. Still, I would have probably been better off to understand, How does a credit card work? How does compound interest work? Why is it not a great thing to have to pay someone 19% interest because I spent more than I had? There is so much we can do around financial education from a societal standpoint that I think would have a tremendous impact. But we haven't yet been able to get that on a broad scale through our academic institutions.

But what can Schwab do?

We can try to make it part of our corporate strategy, the education going on in schools, in workplaces, things we do in the Boys & Girls Clubs of America, which we're a national sponsor of. Ideally you want an ever-shrinking percentage of the population who can't come up with money needed to live. It's very difficult from a corporate standpoint to change where society is unless we start at the beginning. And start with people at a younger age.

BY RYAN BRADLEY

CLOSING AMER

CA'S IDEA GAP

WE'RE LIVING IN A GOLDEN ERA OF TECH BREAKTHROUGHS, BUT OUR INNOVATIONS AREN'T DOING AS MUCH AS THEY USED TO TO BOOST ECONOMIC GROWTH. HERE'S WHY WE'RE GETTING LESS BANG FOR OUR R&D BUCK—AND WHAT WE CAN DO TO FIX IT.

▲ ILLUSTRATION BY **SÉBASTIEN THIBAULT**

I

IT'S POSSIBLE, without squinting, to gauge the past decade as one of unprecedented technological growth. It ushered in not only the smartphone, but with it a cornucopia of apps for every imaginable want, need, or obsession. It was a decade in which Uber became a noun, a verb, and an analogy too—as in, the "Uber of X." In these same 10 years, virtual reality headsets and drones joined the litany of everyday playthings; millennial friendships were saved by Venmo; and a completely stateless digital currency became an investor darling, even if most of Bitcoin's fans still don't quite grasp how it works. Genetic editing became extraordinarily accessible thanks to a tool named Crispr, and A.I. went from mastering Go to becoming the "self" in self-driving cars. There's now an entire economy based on the mobile connectedness that's built on the devices in our pockets. In 2007, most of these innovations didn't exist.

So given all that, it would seem absurd to suggest that innovation is somehow less potent than it once was—that, somehow, all those new ideas we're generating are offering less bang for the buck. But that is precisely what one group of economists have concluded. And it's worth assessing their argument for a number of reasons, because it has enormous implications for businesses, investors, and society as a whole.

Over the past decade, even as innovation has soared, growth in overall productivity as well as economic output has slowed. Both remain at anemic levels even after recent upticks, hovering at annual rates between 1% and 2% since the Great Recession, whereas historical averages are closer to 5% GDP growth and 3% productivity rates. Plus, year by year, income inequality has widened. The economic benefits of the business world's new ideas do not seem to be so widely shared. The new ideas that were meant to transform the way we live aren't unleashing the kinds of broad economic benefits that actually make life better for most people.

Put another way: There's a gap between the ambitions of our innovations and the scale of their impact. Understanding the causes of that gap could help us close it—and, in turn, convert more of business's big ideas into the kind of broadly shared prosperity we've been pining for.

IDEAS THAT WERE MEANT TO TRANSFORM THE WAY WE LIVE AREN'T UNLEASHING THE ECONOMIC BENEFITS THAT ACTUALLY MAKE LIFE BETTER.

WE HAVE BEEN in a period of remarkable, near-exponential growth since the beginning of the industrial age. Economists have explained this growth as the result, in part, of a more or less constant number of researchers and scientists diligently doing what researchers and scientists do. That constant, economists held, was supposed to be capable of producing a steady stream of new ideas that would, in turn, generate economic expansion. So long as the number of researchers and scientists is held in a relative constant, so is the potential for very strong growth.

But lately, cracks have begun appearing in this economic theory. This summer, a group of economics professors and graduate students at MIT and Stanford took a closer look at the link between research spending and economic growth. The title of their working paper, published by the National Bureau of Economic Research, got right to the point: "Are Ideas Getting Harder to Find?" Reading the paper, one quickly learns that, yes, ideas are getting harder to find, and a lot more expensive too.

The best example of the old theory—that constant research leads to exponential growth—is Moore's law, which holds that processing power on a computer chip doubles approximately every two years. This has pretty much been the case for more than 40 years, as happily evidenced by our mobile phones, which hold more sheer computing power than many buildings full of 1970s computers.

The problem, however, is that the research that has driven such a tremendous change hasn't been a constant at all. In fact, as the "Ideas" paper's authors found, the cost of such research efforts requires 78 times the funding today in inflation-adjusted dollars as it did when Nixon was President. The computers may be much

AMERICA'S BIG IDEAS IN WAITING

Crispr-Cas9, a gene-editing system.

An Airbus staffer views a cockpit with VR.

Amazon's A.I.-powered Echo Dot.

CRISPR

EARLIER THIS YEAR, researchers in Oregon changed the DNA of human embryos. Using Crispr, the breakthrough genome-editing technology that acts like a sort of molecular scissors, the scientists repaired a genetic mutation—a heritable heart condition—in the embryonic DNA. That once-unthinkable, almost God-like feat is just one of a number of stunning Crispr experiments that in recent years have taken the scientific world by storm.

The rapidly evolving technology—actually self-guided bacterial proteins—allows scientists to snip and edit problematic DNA with relative quickness and speed, an ability that holds tantalizing promise for treating (or even curing) genetic disease and mutation, whether it be in humans, plants, or animals. Think drought-resistant crops and children free of their parents' hereditary diseases. There are still plenty of kinks to work out, but scientists have already used Crispr to, among other things, restore hearing in mice, create low-fat pigs, and delay the browning of mushrooms.

VIRTUAL REALITY

IT MAY SEEM like virtual reality is a nifty, if still somewhat clunky, technology for video enthusiasts and gamers—albeit with tangential benefits for online shopping, chatting, and entertainment. But leisure isn't all those headsets are going to be good for. VR and its cousin augmented reality are also changing and bettering the way we perform at work.

The practical applications for immersive, virtual experience are myriad—from speeding and enriching product development (engineers and manufacturers can preview and tinker virtually) to training medical students and sharpening the skills of surgeons (who can practice before tricky procedures). Athletes use it to prep for big games; real estate professionals use it to show homes and spaces; and journalists and entertainers use it to enhance their content. Corporations from Airbus to Ford to Marriott to Carnival (the cruise line) have all found uses.

After all, experience is the best teacher, and increasingly—often because of VR—you don't have to depend on the real world to get it.

ARTIFICIAL INTELLIGENCE

AFTER DECADES fantasizing—and fretting—about the rise of artificial intelligence, the revolution (if not the singularity) finally seems nigh. From voice-activated assistants like the Amazon Echo to self-driving cars, machines are swiftly getting smarter, thanks to relatively recent breakthroughs in "deep learning." Deep learning enables software—fed with ever-accumulating reams of data (that gets processed with ever-increasing computer power)—to recognize patterns and perform complex tasks much more quickly and reliably than humans ever could.

That means machines may be better suited to the time-consuming activities we humans do imperfectly—like picking stocks, diagnosing disease, detecting fraud, and identifying drug targets. In some cases, machines will make us more productive in the jobs we have; in others, they'll make us obsolete. The stakes in this race are so high that Russian President Vladimir Putin has framed the matter as a modern-day space race: Whoever leads in A.I., he told a group of students earlier this year, will rule the world. —ERIKA FRY

LEFT TO RIGHT: MOLEKUUL—SCIENCE PHOTO LIBRARY/GETTY IMAGES; KYODO NEWS VIA GETTY IMAGES; COURTESY OF AMAZON smaller, but now it's the people driving their advances that fill many, many buildings.

This trend isn't limited to the tech sector. The study's authors also looked at agriculture, specifically the yields of corn, soybean, cotton, and wheat. They compared the annual yields with funding for research into improving crop productivity. Spending increased, and so did yields, but not in the way you might expect. While the average yield doubled between 1960 and 2015, the annual inflation-adjusted investment in research to improve those yields increased at least threefold. In some cases—for certain crops, over certain years—the research investment increased by a factor of 25. Agricultural businesses seem to be spending more and more on R&D, all while getting less and less out of it.

It's the same story in other fields too. The Stanford and MIT economists also looked at productivity in medical research—specifically in cancer. They found declines in productivity across the board. Even as more papers were published and more clinical trials mounted, the growth in the rate of lives saved per 100,000 people has continued to slow. While individual moments of progress bring astonishment and relief (as we've seen to some extent in cancer immunotherapy), on the whole more effort is yielding less impact. We need to publish even more papers, spend even more on clinical trials, if we hope to keep up the pace of lifesaving treatments we were developing decades ago.

Sure, increases in research spending tend to pay off in the short term for individual companies. A *Fortune* study of the S&P 500 showed that of the 155 that reported increased levels of R&D spending between 2007 and 2017, more than two-thirds—108 companies in all—had stock returns that beat the index's. But generating stock market outperformance isn't the same thing as having a broad, positive impact on the economy as a whole. Across all publicly traded companies, the "Ideas" paper's authors found that to produce the same rate of growth our economy experienced 30 years ago, companies would need to spend 15 times as much on R&D. The bottom line: Big ideas—the ones that truly drive economic growth or a change in the standard of living—are harder than ever to find because they're more costly than ever before.

Why is that so? One reason that such innovations are increasingly difficult to come by is because, as knowledge advances, the base of fundamental knowledge grows. Just to be proficient in many fields of science or industry today requires an investment in education or training that is significantly higher than it was a generation ago.

THE TALENT BASE ONLY GROWS (MAKING IDEAS CHEAPER) IF WE MAKE A POINT OF CULTIVATING AND SUPPORTING TALENT.

Another factor is the cost of pure research. Yes, that's growing too. Equipment has generally become more expensive and, relatedly, exclusive. Fewer people have access to it. And just as we've moved from single computers to supercomputers, we've moved from a culture of individual researchers making breakthroughs to one of massive teams of highly educated and compensated experts attempting to solve far more complicated problems. We're way past the low-hanging fruit, trying to build the tools and systems that will get us to the tippy-top of the tree.

THE "IDEAS" PAPER, and others like it, might make it sound as though we're staring down the barrel at the end of innovation. Do not despair. It is entirely possible, even likely, that we're simply approaching the end of boom times in particular fields, the tops of certain already well-trimmed trees. From the discovery of computers to the rise of IT and the Internet, we have the undercurrent of Moore's law, churning away. Now, that current is slowing down—but others could someday lend their velocity to a growing economy.

"It's not true that because we've hit a hard place, we've reached peak ideas," says Michael Webb, a Ph.D. candidate in economics at Stanford and one of the study's authors. "A good way to think of it, perhaps, is like prospecting for oil. Within a given oilfield, you get most of the oil out, and it becomes really expensive to get the rest. We've been pumping out the oil from IT for a very long time now, but there's a whole new oilfield out there we haven't found yet."

One such field, Webb suggests, is genomics, which is experiencing a flourishing of new applications thanks to the gene-editing tool known as Crispr (see sidebar). We're still in the very early, exploratory days of what may become the medical and economic equivalent of a rich oilfield of cheap and abundant ideas that pay off in reduced medical costs and longer productive life spans. The same goes for virtual reality, which has been around for longer, and

LESS FRUIT, MORE LABOR

American productivity growth soared during the Industrial Revolution. But today's information technology revolution has taken more resources and so far produced fewer economic gains.

GROWTH AND RESEARCH EFFORT

SOURCES: STANFORD UNIVERSITY; MIT; NBER

may end up being the media of choice in the future—driving explosive growth.

Which brings up a secondary but no less important point: There are plenty of current technologies that won't look cost-effective unless and until they really do become transformative—at which point, in hindsight, they will appear to be relative bargains. The Internet was a geeky academics' hobby until the mid-1990s. Today it's an economic pillar.

Nearly every economist I spoke to pointed to artificial intelligence as an especially likely avenue of ideas that could catalyze enormous leaps in growth and productivity. A.I. is also a great example of how expensive new ideas can be: The computing power required is enormous, the expertise tremendous, and the jobs incredibly well-paying (and thus costly for employers).

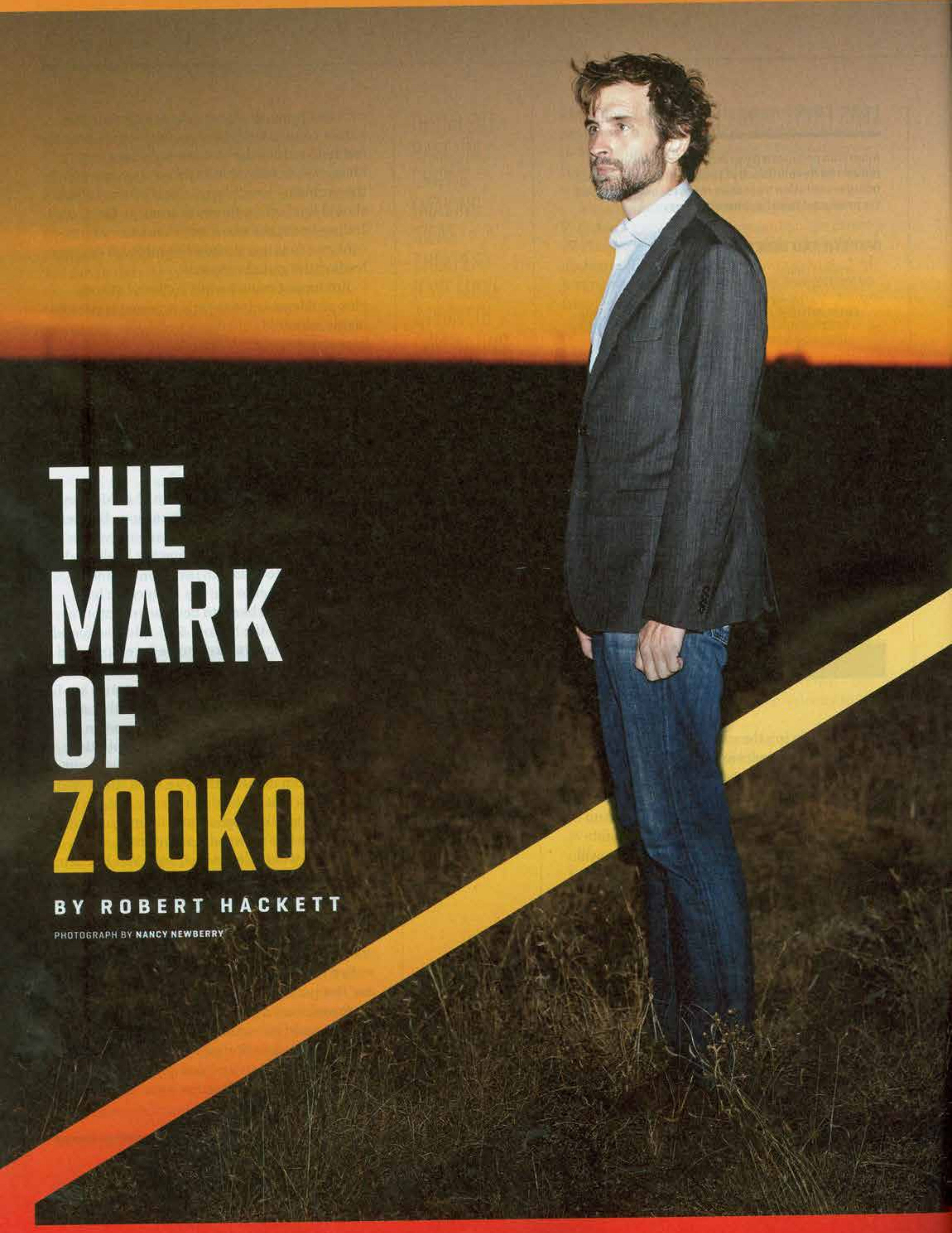
Benjamin Jones, an economist at Northwestern who studies entrepreneurship and has a forthcoming paper on A.I., says that, in perhaps a counterintuitive way, population growth can help reduce the cost of generating new ideas. "We're fully able to throw more people at the problem," he explains. Costs of employment should level off, in theory at least, as China and India—by far the two most populous nations—continue to integrate into the research engines feeding the global economy.

But having more people to throw at complex problems helps us only if more people are highly educated. In other words: The talent base grows (making ideas cheaper) only if we make a point of cultivating and supporting talent. As the evolutionary biologist Stephen Jay Gould once put it, "I am, somehow, less interested in the weight and convolutions of Einstein's brain than in the near certainty that people of equal talent have lived and died in cotton fields and sweatshops."

John Van Reenen, an economist at MIT and another of the "Ideas" paper's authors, has performed studies that look at talent cultivation in the U.S. by trying to determine the likelihood of someone becoming an inventor. He found that those born into the top 1% income level were 10 times as likely to become inventors as those born into the bottom 50%. He also found that men were more likely to be inventors, and minorities less likely.

Van Reenen's research nicely illustrates a problem of opportunity. If we believe that a smart kid from anywhere could become an inventor—a belief that is integral to both the economy and the story we tell ourselves about the American dream—then we need to support the policies that make that possible. "Many kids don't even get the opportunity to imagine what it would be like to become an inventor, what that job is, what it looks like," says Van Reenen. "A huge part of this is education, exposure, allowing someone to dream of better possibilities for themselves."

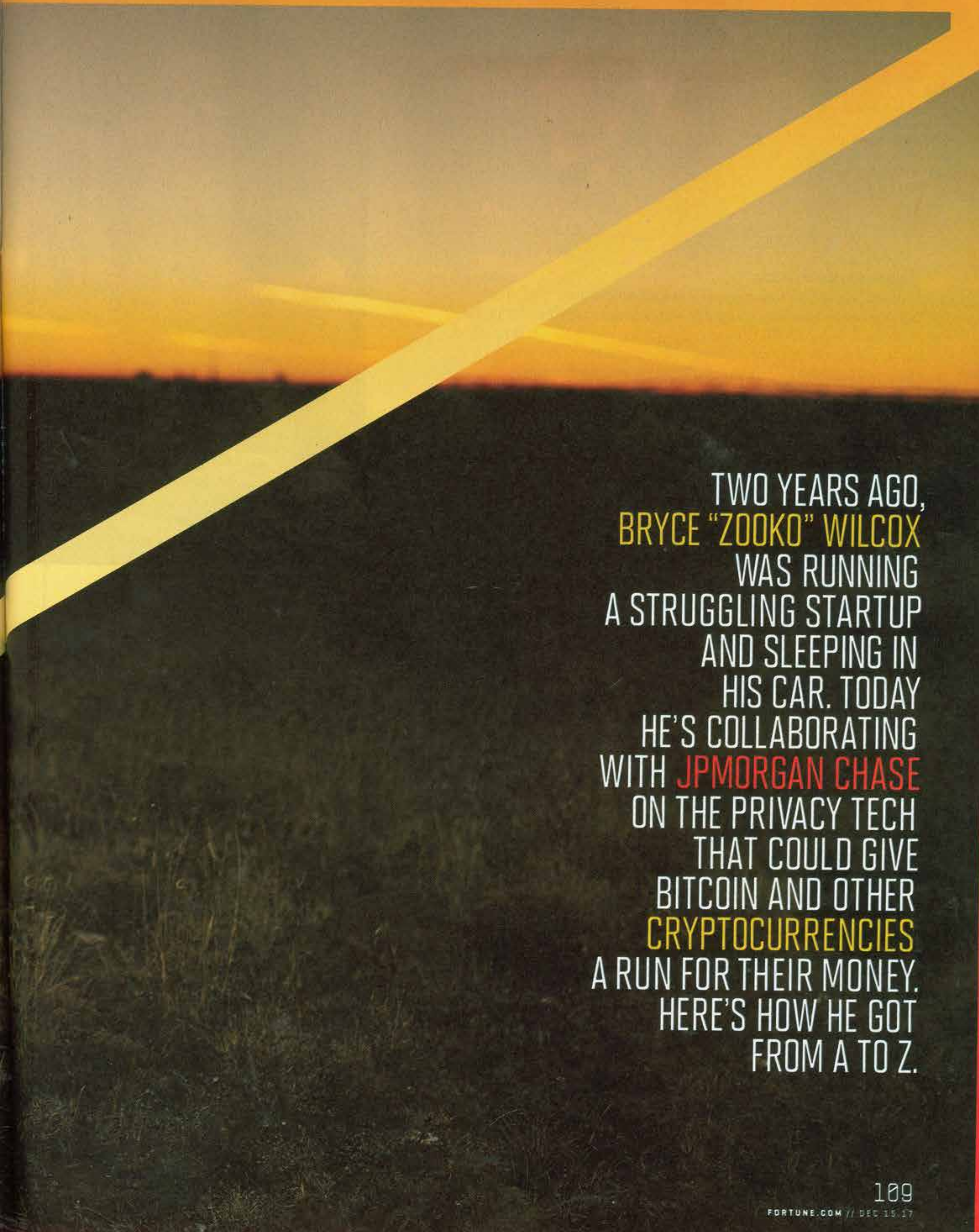
Van Reenen realizes that his solution might not seem as sexy as erecting a steel and glass-walled building filled with brilliant researchers. But policy-based solutions as simple as improved funding to underfunded public schools could be a much cheaper solution to closing the innovation gap than other, more complex fixes. In an increasingly knowledge-fueled economy, Van Reenen says, "This is the low-hanging fruit." ■



THE MARK OF ZOOKO

BY ROBERT HACKETT

PHOTOGRAPH BY NANCY NEWBERRY



TWO YEARS AGO, BRYCE "ZOOKO" WILCOX WAS RUNNING A STRUGGLING STARTUP AND SLEEPING IN HIS CAR. TODAY HE'S COLLABORATING WITH JPMORGAN CHASE ON THE PRIVACY TECH THAT COULD GIVE BITCOIN AND OTHER CRYPTOCURRENCIES A RUN FOR THEIR MONEY. HERE'S HOW HE GOT FROM A TO Z.

1

VRRRZZEEEEEERRRZZZZZZZZZZ.

Bryce "Zooko" Wilcox stands by as his brother, Josh "Za," slices into his Lenovo desktop computer with an angle grinder. The metal on metal looses a dazzling cascade of sparks, which flicker through the harsh rays of the car headlamps trained on the scene taking place in a backyard in Longmont, Colo. A fire glows nearby.

"Can I try whacking it now?" Zooko asks from underneath the wide brim of a wizard's hat.

Za obliges. Like Gandalf wielding a makeshift staff, Zooko unleashes the force of a sledgehammer upon the CPU tower. *THWUANCK*. "It's kind of smoking, so I don't want to touch it," Zooko says, before picking up the mangled mess with his bare hands. Fragments fall to the gravel below. He pins the battered husk down with his foot and prods its innards with a crowbar.

Za's wife, Jessica, enters the firelight. She begins clobbering computer chips with a hammer, just as the stereo switches to "Still," the gangsta-funk Geto Boys track made famous in the printer-whupping scene from the 1999 film *Office Space*. Under her buffets, the circuitry explodes into shrapnel. The brothers grin.

Tonight's carnage marks the conclusion of an event Zooko calls The Ceremony. With barbecue, whisky, and heaps of entropy, Zooko and his crew are celebrating the completion of an elaborate computation meant to spawn a new, more private digital currency. They call it Zcash.

The project involved six people with an assortment of machines distributed across multiple continents. Each member of the group, several of whom were operating under aliases, contributed shards, or fractions, of an unfathomably big number that will serve as the basis for what is essentially a secret, special cryptographic key. The end result of the clandestine crew's efforts is a set of numeric parameters that will underpin a data-scrambling scheme capable of concocting a virtual currency with confidentiality at its core.

The work is spread out geographically to ensure that no malicious actor can sabotage the process or obtain the component parts. Traces of the computers' leftover math—Zooko calls it "toxic waste"—may reside in memory; if salvaged, the material could grant someone the power to counterfeit infinite sums of virtual money.

Powering down just one of the computers should be enough to wipe part of the key's recipe from the face of the earth. But in such a high-stakes scenario, one can never be too sure. Thus the total annihilation of The Ceremony.

Zooko tosses the electronic wreckage into the fire pit as Za sprays bursts of lighter fluid onto the crackling conflagration. Plumes erupt in response. The blaze reeks of melted plastic—literal toxic waste.

"And this, children, is why on Oct. 23 we have fireworks," Zooko declares to unseen future generations with mock self-importance. His compatriots stand tall. To this observer, watching the festivities on video almost a year later, the entire act seems absurd. But the pyrotechnics will help ensure that Zooko and his troupe can responsibly bring into being the germ of a new digitized tender, Zcash, one that represents the best hope yet for imbuing the realm of cryptocurrency with an element it is sorely lacking: privacy.

Within a year of that fateful evening in October 2016, the market capitalization of Zcash will swell to just under $1 billion, making it a top 20 cryptocurrency. It will be added to Ethereum, the decentralized computing network that, alongside Bitcoin, is spurring an exuberant $350 billion boom in crypto coins. And Zcash's fundamental technology, hatched in the cool shadow of the Rockies, will be adopted by the U.S.'s biggest bank, JPMorgan Chase.

Despite the record-breaking values of Bitcoin and its ilk, most digital currencies have failings that make them problematic as a mainstream medium of exchange. For instance, the transactions are essentially public and easy to track, offering you, the consumer, less privacy than

▲ PHOTOGRAPHS BY **MORGAN PECK**

Left: Bryce "Zooko" Wilcox inspects a computer chip. Right: Josh "Za" Wilcox wields an angle grinder to destroy a computer used to generate parameters for Zcash.

your credit card. Zcash aims to change that. If, one day, businesses and people come to rely on cryptocurrencies, they may have Zooko and his band of ravagers to thank for laying the foundations to make that possible.

2

CRITICS WERE SPLIT in the years following Bitcoin's arrival in 2009. Its peer-to-peer system for verifying transactions, called the blockchain, allowed people to securely and electronically exchange money without having to rely on third parties like banks. To supporters, Bitcoin promised to be a sort of anonymous, transnational digital currency that eschewed the inefficiencies of today's monetary system. To critics, it was a lawless thought experiment run amok. It didn't help that most people associated the invention with the black market. From 2011, Bitcoin was best known for its association with the dark-web bazaar called Silk Road, where unscrupulous folks used it to buy or sell drugs and other contraband under the guise of pseudonyms—the only basic protection Bitcoin afforded. They were in for a rude awakening.

"Criminals thought it was something that could never be traced back to them," says Kathryn Haun, a former federal prosecutor who now serves on the board of Coinbase, the highest privately valued digital currency startup. "People weren't thinking ahead."

The truth is that Bitcoin is radically transparent, a major strength and weakness. Think of the blockchain, the central accounting innovation at the heart of the system, as a giant billboard broadcasting everyone's holdings and financial activity at all times. The whole point is to display a public record of transactions. Anyone with some rudimentary computer skills and a familiarity with the technology can inspect the digital ledger to see who traded what with whom. The transparency helps ensure the integrity of the system. Without it, people could potentially lie about what they spent, recycling the same money in different places—a would-be disaster.

But the lack of privacy for Bitcoin and just about every other cryptocurrency is not only a problem for crooks, it's also a major barrier to adoption for regular people and businesses. There are countless transactions you might wish to keep out of the public eye: your paycheck, a surprise anniversary gift, a visit to the doctor. Bitcoin effectively exposes all of that. The same is even truer for corporations. No executive in his or her right mind would conduct business in a way that exposes trade secrets, like the amounts paid to suppliers or partners. Most cryptocurrency payments make complying with the Health Insurance Portability and Accountability Act

(HIPAA) and other data-privacy regulations nigh impossible, ruling out key industries. For many, these deficiencies are nonstarters.

"Bitcoin is the least private financial system ever invented," says Matthew Green, a cryptographer and professor at Johns Hopkins University.

Green spent the first years of Bitcoin's existence trying to find flaws in its code. Once he considered the premise sound, he focused on figuring out how to add privacy to the system. His motivations arose not from a desire to aid and abet baddies but rather from a compulsion to create safeguards for everyday users. So he and two graduate students, Ian Miers and Christina Garman, devised Zerocoin, a protocol that could obscure the parties to a transaction using encryption while maintaining the auditability of the shared ledger with a set of advanced mathematical techniques called "zero knowledge proofs." These nifty concepts, developed at MIT in the 1980s, allow people to prove a statement true without revealing any other details about the item in question. The technology miraculously ensures everyone stays honest even as it blinds data.

"This is not some scam to help criminals do their job," Green says. "It's technology we need."

Green and his team hoped to contribute their invention to the Bitcoin blockchain because of what they deemed its benefits. But the core developers of Bitcoin weren't interested. It was too new, would slow down the network, and make computations more expensive. Green and his students needed a different game plan.

At a San Jose Bitcoin conference in 2013, the Zerocoin researchers encountered another academic team, from the Technion Institute in Israel, that would prove a perfect match. Led by cryptographer Eli Ben-Sasson, these counterparts discovered a way to make zero knowledge proofs much more efficient. Ben-Sasson dubbed the invention "zk-SNARKs." The two teams joined forces and created a new protocol called Zerocash that was 98% more efficient than its forerunner.

Emin Gün Sirer, a computer scientist at Cornell University, recounts some of the cynical reactions he initially heard about the project. Colleagues said it would be used for money laundering, drugs, and other illicit activities, he says—the same criticisms lobbed at Bitcoin when it debuted. The sentiment didn't last long. The naysayers have come to appreciate, Sirer says, that "even mainstream systems need this level of privacy guarantees."

Vitalik Buterin grasped the significance immediately. Prior to creating Ethereum, Buterin covered the San Jose Bitcoin conference as a correspondent for *Bitcoin Magazine*, a publication he cofounded. The wunderkind programmer interviewed Ben-Sasson about his breakthroughs, and it left an indelible impression. "Personally, I think zk-SNARKs are a hugely important, absolutely game-changing technology," Buterin tells *Fortune*. "They are the single most under-hyped thing in cryptography right now."

Again, Bitcoin's core developers took a pass on the technology. So Green and his colleagues agreed to create a digital coin of their own that wove in zk-SNARKs. But they needed a leader with business experience to commercialize the currency. They found those traits in an unlikely man—a cypherpunk, part-coder, part-activist, who boasts of holding a world record for the most failed attempts at building a business around peer-to-peer, decentralized file sharing. They found Zooko Wilcox.

3

ZOOKO WILCOX WANTS TO SHOW ME where he once slept. On a crisp fall day in downtown Boulder, we roll down the street in his beat-up 1989 Volvo station wagon, its interior decorated with peanut shells and casually discarded coffee mugs. He is wearing a faded black T-shirt with a threadbare collar that reads, cheekily, across the chest: "I am Satoshi Nakamoto," a reference to the elusive, still unknown, pseudonymous creator of Bitcoin. His thick russet thatches exist in a state of perpetual tousle, as though magnetized by the invisible energy of some faraway Tesla coil.

He pulls into a garage off Pearl Street, the town's main thoroughfare. "This is the parking lot I used to sleep in," he says as he descends to the lower level. "This is something I have not previously talked about, really, because it's kind of shameful and embarrassing and weird."

In the summer of 2015, Wilcox had sunk most of his money in a decentralized file storage company he founded called Least Authority. He was going through a divorce with his then-wife, Amber O'Hearn. Wilcox, now 43, wanted to stay in Boulder so he could drive his kids to school. So he would enter the garage around 11 p.m., after the guard had gone home, and pull into a space on the rooftop, where he would recline his seat and rest.

A year earlier Matthew Green, the Johns Hopkins University cryptographer, had approached Wilcox about helming the Zerocoin Electric Coin Company. Wilcox declined. He felt its prospective coin, Zcash, would be a niche product and a plaything for bad actors. He later reversed his opinion once he determined the core technology would be useful to businesses and ordinary consumers.

In 2015, Wilcox scrounged together the money to fly to California with Green and pitch potential investors on the new project. It was a frustrating exercise. Wilcox's suitcase was stolen from the car after he left the airport, forcing him to spend what little he had on a new suit from Men's Wearhouse. And during the first meeting with an investor at Kleiner Perkins, the storied venture capital firm, the host showed up 10 minutes late, declared that he had to leave 10 minutes early, and radiated uninterest throughout. "The closest thing you could say is that we were laughed out of the room," Green says.

Despite the slow start, the team managed to cobble together $720,000 in seed funding from angel investors including Naval Ravikant, CEO and founder of the startup network AngelList, and investment firms such as Pantera Capital and Shanghai's Fenbushi Capital. A year later they bagged another $2 million. Zcash was in action.

That Wilcox would wind up spearheading a cryptocurrency seems, in retrospect, inevitable. In 1996, as a computer science student at the University of Colorado at Boulder, Wilcox took a leave of absence to work as a junior coder at DigiCash, the world's first e-money startup, founded by pioneering cryptographer David Chaum. Wilcox would dream up ways to make the firm's product, dubbed "cyberbucks," more decentralized. None were feasible.

The notion haunted him. After DigiCash flamed out, Wilcox explored the concept as an employee of the file-sharing startup Mojo Nation and later as a developer of Tahoe-LAFS, a decentralized cloud-storage service like Amazon S3, sans Amazon.

"I had struggled for more than 10 years to try to make a decentralized currency, and I couldn't make it work," Wilcox recalls. "In large part, I was waiting for Satoshi," the Bitcoin creator.

In January 2009, Wilcox became perhaps the first person ever to blog about Bitcoin in a post titled "Decentralized Money" on his personal blog, Zooko's Hack Log. Satoshi Nakamoto returned the favor several weeks later, linking to Wilcox's write-up in an addendum to a preliminary release of the Bitcoin software on Bitcoin.org, the newly created project's home page. Wilcox was one of only three people to receive an honorable mention in the "related links" section. (The others were Nick Szabo, inventor of "bit gold," and Wei Dai, creator of "b-money.")

If Wilcox was waiting for Nakamoto, then perhaps the reverse can be said for the enigmatic inventor. In an August 2010 thread on a forum discussing ways to improve the privacy of Bitcoin, one commenter under the alias "Insti" proposed zero knowledge proofs as one potential approach, though the author worried that they might be "theoretically impossible."

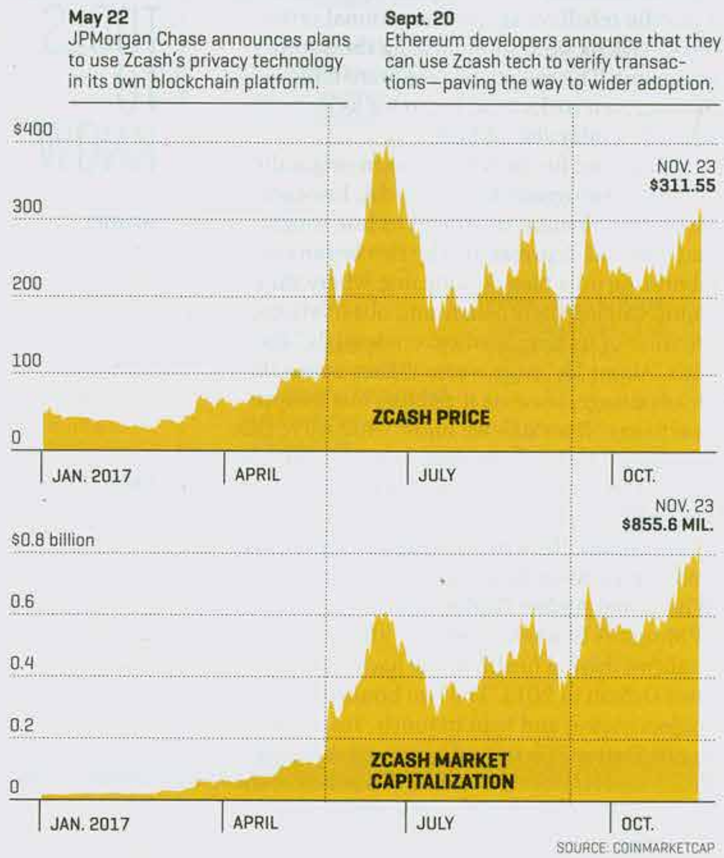
Nakamoto mulled the idea. "This is a very interesting topic," the inventor replied. "If a solution was found, a much better, easier, more convenient implementation of Bitcoin would be possible."

"Still thinking this idea through ..."

Four months later, Nakamoto would vanish from the web, never to post a public note again.

CASHING IN ON AN OPPORTUNITY

The slow and steady rise of Zcash as a different kind of digital currency—one that attracted the biggest bank in America.



4

AT HIS MODEST HOME IN THE BOULDER SUBURBS, Wilcox defends his unconventional eating habits over a grilled steak and a glass of 12-year-old Lagavulin Scotch. He is a proponent of the fringe dietary movement known as carnivory, in which participants consume only meat. (Yes, he cheats sometimes and adds milk to coffee or tomato to a burger—or in this case, whisky to a tumbler.) He's discussing a recent *Vice* story that took the trend to task. Wilcox, unsurprisingly, has a bone to pick.

"Just like Bitcoin is a puerile rebellion against monetary orthodoxy, so too is carnivory a puerile rebellion against nutritional orthodoxy," Wilcox says, summarizing the author's argument. The rickety black square table in his dining room rocks from leg to leg as he saws through a juicy slab of beef.

Wilcox and his ex-wife O'Hearn originally fell into a ketogenic diet—high fat, low carb—as an experimental treatment to lose weight and stave off depression. The two began collaborating on a blog, ketotic.org, where they would catalog their beliefs and observations. "Neither of us have medical credentials," the site's "About Us" page warns. "This is actually an advantage, because it reduces our temptation to say 'Trust us—we know what we're talking about!' Instead, we show you the evidence that led us to our beliefs, so you can judge for yourself."

Amazingly, the writings helped spark a relationship between Zcash and JPMorgan Chase. Wilcox met Amber Baldet, who now leads JPMorgan's blockchain efforts, after she gave a talk on mental health at the hacker conference Defcon in 2013. The two bonded over the subject matter and kept in touch. Years later, in 2016, after Wilcox had begun working on Zcash and Baldet on business blockchains, the two discussed a possible partnership.

The pair's long-standing mutual respect "got everyone on the same page," Baldet tells *Fortune*.

It was the start of an unlikely collaboration between a lifelong cypherpunk and a titan of Wall Street. Quorum, JPMorgan's Ethereum-inspired payments platform for businesses, now uses the zk-SNARKs commercialized by Zcash to mask the money moving around on its permissioned, enterprise blockchain. This shield, which is called the Zero Knowledge Settlement Layer, or ZSL, keeps details related to the last step of a payment private. Without this piece in place, competitors could potentially glean information about deals, front-run trades, and throw markets out of whack.

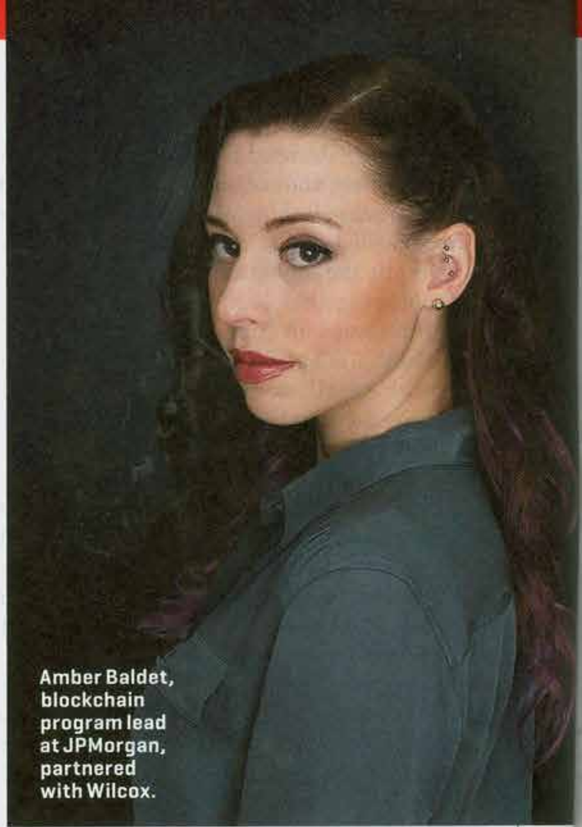
"We have a fiduciary and regulatory obligation to keep customer data private," Baldet says. "While they're a novel approach," she says of zk-SNARKs, "they solve privacy in a very elegant, universal way."

Patrick Mylund Nielsen, the lead blockchain engineer at JPMorgan, believes Zcash's zero knowledge proof–based technology holds more promise for privacy than any other single approach he's seen. Wilcox's involvement sealed the deal. "A lot of crypto engineers know Zooko as someone who only backs things he really believes in," Mylund Nielsen says.

JPMorgan isn't the only bank actively exploring this technology. Dutch financial giant ING recently released a piece of software under an open-source license that uses zero knowledge proofs as its basis. The tool allows people to prove that some figure exists between a range of numbers, such as a salary between \$70,000 and \$100,000 or a point between two geographic coordinates, without revealing the exact sum or location. "We believe the application for all this is huge," says Mariana Gomez de la Villa, ING's blockchain program manager.

At the conclusion of our meal, Wilcox ferries our dishes into the kitchen. He recounts the tale of Vilhjalmur Stefansson, an early 20th-century Arctic explorer and one of the earliest advocates of an all-meat lifestyle. Later in life, when it looked like the regimen might actually catch on, Stefansson is said to have remarked to his wife with a tinge of sorrow, "I shall have to find myself a new heresy."

Now that carnivory and cryptocurrencies are gaining traction among a growing group of peo-



Amber Baldet, blockchain program lead at JPMorgan, partnered with Wilcox.

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FIVE CRYPTO PRIVACY TOOLS TO KNOW

MONERO
A virtual currency that uses "ring signatures," which make it hard to pinpoint the origin of a transaction among a group.

DASH
A cryptocoin that offers "private send," a feature that minces payments across its network's so-called masternodes.

TOR
A browser that routes Internet traffic through encrypted relays, shielding one's IP address and geographic location.

BITCOIN MIXERS
Services that divide transactions into smaller denominations and scramble their routes.

PEDERSEN COMMITMENTS
Techniques that mask transaction amounts with "hashes," the outputs of certain one-way cryptographic functions.

ple, Wilcox jokes that he might have to do the same. "I haven't had time to think about what my next unpopular opinion will be," he says.

5

AS PROMISING AS ZCASH IS, it is far from perfect. Its sluggishness in processing private transactions, its inability to perform well on mobile devices, and the novelty of its math hold it back from its full potential—though many of these issues are likely to be addressed in coming upgrades and with further testing. What's more, the currency's strange origin story, with only six founding formulators, leaves something to be desired.

That's why a new Ceremony is underway. In the next iteration, virtually anyone can participate in the computational process that forges a new batch of zk-SNARKs. The only requirements are some computing power and a bit of bespoke randomness in the code—like an excerpt from a book or indiscriminate keyboard mashing. The goal: a new set of secure, cryptographic parameters for the next generation of the technology. "I actually think, personally, that this Ceremony is bigger news than Zcash itself," says Nathan Wilcox, a Zcash project manager and brother to Zooko and Za. He adds that it could establish a reproducible process for people interested in using zk-SNARKs.

Even novices can chip in. On Nov. 18 I joined as the ninth Ceremony participant from the comfort of my living room in Brooklyn. Others took stronger security precautions: computing their numeric shards while hurtling underground on a Hong Kong subway, within a granite-walled farmhouse outside London, or inside a cardboard box lined with aluminum foil.

Soon even this pageantry may be unnecessary. Zcash researchers intend to obviate the need for a Ceremony entirely. Ben-Sasson, an architect of zk-SNARKs, is at work on a souped-up version of the tech that will require no multiparty setup phase—no computational baton-passing, no bonfires. He calls them "zk-STARKs," where the "t" stands for "trust" and "transparency." Or, as Zooko Wilcox prefers, "toxic waste–free."

As Zcash evolves, Wilcox intends to step aside. Already the new Ceremony is moving forward without him. He's happy about it. The Zcash Foundation, an alternate governing body for the project and what it says is the first-ever cryptocurrency-related 501(c) nonprofit in the U.S., is expected to assume more responsibilities over time. Next year the organization plans to host a "constitutional convention," Wilcox says, where it will discuss how to gradually transition power to the community.

Zcash is one of the first commercially successful applications for zero knowledge proofs, "but there are more applications coming as scientists get more familiar with it," Wilcox says. Right now when we shop, bank, or do anything online, we generate data that belongs to the companies that run the websites and the pipelines; in Wilcox's vision, that data will belong to us. And the tech behind Zcash is all open source, meaning it's free to modify and redistribute. The approach has long been a hallmark of Wilcox's work.

"When I'm on my deathbed, I want to be able to say I took every opportunity present to me to improve the world for the good of all," Wilcox says. "We were never going to have a monopoly on the math." ■

ASK THE CRYPTOGRAPHERS

The math at the heart of Zcash is new and complex. So how, exactly, do "zero knowledge proofs" work? Computer scientists and cryptographers involved in the Zcash project do their best to explain in layman's terms.

MATT GREEN, ZCASH FOUNDING SCIENTIST AND JOHNS HOPKINS PROFESSOR: Zero knowledge proofs are this kind of foggy, beautiful, magical thing invented in the 1980s by cryptographers at MIT.

IAN MIERS, ZCASH FOUNDING SCIENTIST AND CORNELL TECH POSTDOC: Explaining zero knowledge proofs to people is an exercise in demonstrating their existence. Because by the end of the talk you have convinced people that you know what a zero knowledge proof is, and by the end they will have no idea whatsoever.

ELI BEN-SASSON, ZCASH FOUNDING SCIENTIST AND ZK-SNARKS CO-INVENTOR: It's like a magical restaurant bill where the items are blanked out but the restaurant can't cheat you, even if you can't see the individual sums.

ANDREW MILLER, ZCASH ADVISER AND UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN PROFESSOR: If you're familiar with how digital signatures work in Bitcoin, it's easy to understand. A digital signature is already a kind of zero knowledge proof. You're proving you know your secret key. You're using your knowledge of a secret key to bind your identity to a transaction you want to authorize. It's secure because no one who doesn't know your private key is able to fool someone.

PETER TODD, BITCOIN CORE DEVELOPER AND ZCASH SKEPTIC: zk-SNARKs are a very sophisticated mathematical technique, but you've got to remember how novel this math is. It would not surprise me and many other cryptographers if, in the future, that math got broken, making the entire system no longer secure.

The Opening Ceremonies of the 30th ASEAN Summit last April at the Philippine International Convention Center

Philippines as Chair of ASEAN 2017:

Civil Servants, Migrant Workers, and the Youth Highlighted in Country's Yearlong Chairmanship

The Philippines has successfully highlighted the role of civil servants, championed the rights of the migrant workers, and gave significance to the aspirations of the youth in its year-long chairmanship of ASEAN 2017.

The role of civil servants

In April 2017, the Heads of State/Government of ASEAN Member States signed the ASEAN Declaration on the Role of Civil Service as A Catalyst for Achieving the ASEAN Community Vision 2025.

"The Declaration, which supports the first thematic priority of a people-oriented, people-centered ASEAN under the Philippine Chairmanship of ASEAN 2017, places premium on the role of the civil service as a driver of national and regional development towards the achievement of ASEAN goals and aspirations for a politically cohesive, economically integrated, and socially responsible Community," noted Philippine Civil Service Commission Chairperson Alicia dela Rosa-Bala.

This Declaration highlighted the importance of civil service in nurturing an ASEAN that is peaceful, secure, progressive, and unified. It elevated into regional and international significance civil servants who, amidst change in political landscapes and leadership, remain to be the backbone of governance.

The rights of migrant workers

It was 10 years in the making. From its inception in 2007, the ASEAN Consensus on the Protection and Promotion of the Rights of Migrant Workers was finally signed by the ASEAN Leaders on 14 November 2017, a capstone event of the 31st ASEAN Summit.

"The ASEAN Consensus on the Protection and Promotion of the Rights of Migrant Workers is a landmark document that reflects our promise to strengthen social protection, access to justice, humane and fair treatment, and access to health services of our region's migrant workers," noted the Philippine President and Chair of the 31st ASEAN Summit Rodrigo Roa Duterte at the signing ceremony of the said document.

The ASEAN Consensus stipulates fundamental rights of migrant workers and members of their families, specific rights of migrant workers, and obligations and commitments of ASEAN Member States. The document puts enormous emphasis on safeguarding the rights of hundreds of thousands of migrant workers in the region and prohibits certain practices like confiscation of passports and excessive recruitment fees.

As the region evolves into a more integrated market that encourages movement of labor, this document will prove vital in creating an ASEAN that cares for the needs and welfare of vulnerable individuals.

The aspirations of the ASEAN youth

The youth of ASEAN are poised to contribute to the further expansion of the region in trade and economic influence.

But in order for every ASEAN citizen to be able to identify with the one ASEAN identity, and for progress in the region to be shared by all, especially the marginalized and vulnerable, it is essential that the voice of the ASEAN youth—and their needs and aspirations are addressed and heard.

"As one of the highlights of the 31st Summit, the adoption of the declaration provides a springboard for initiatives on youth development in the region anchored on the domains and indicators reflected in the ASEAN YDI," announced the Philippines' National Youth Commission Chairperson Cariza Seguerra on the ASEAN Leaders' Declaration on the Adoption of the ASEAN Youth Development Index.

Seguerra noted that this move recognizes the significant role of the youth in realizing the ASEAN Vision 2025. It is the first ASEAN instrumentality of its kind, and helps create a participatory environment for the segment of ASEAN that will herald its vision for the future.

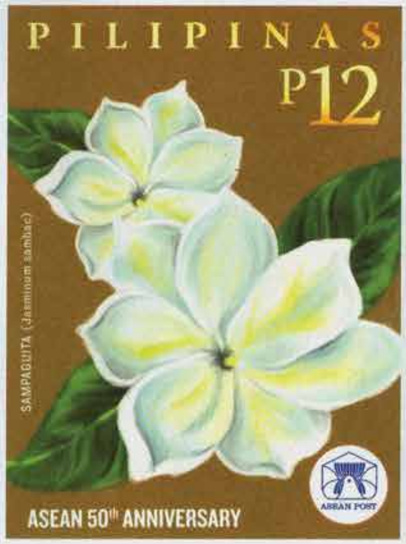
COMMEMORATIVE ITEMS: ASEAN 2017

Philippine Chairmanship Commemorative stamp

The Philippine government in partnership with the Philippine Postal Corporation launched a commemorative stamp which features this year's theme "Partnering for Change, Engaging the World". The stamp was designed using the ASEAN colors which was first seen during the Launching of the Philippines' Chairmanship of ASEAN 2017 last January.

ASEAN Commemorative Coin

The Commemorative Coin was launched last January by President Rodrigo Roa Duterte and Bangko Sentral ng Pilipinas Governor Amando M. Tetangco Jr. The observe side of the cpin contains 10 stars which represent the 10 Member States of ASEAN. On the edge is the theme "Partnering for Change, Engaging the World."ASEAN's emblem appears at the center along with images of the sun and dove symbolizing prosperity and peace; while the Filipino ancient alphabet 'baybayin' mint mark of the BSP mint is located at the bottom.

ASEAN 50 Commemorative Stamp

To commemorate the 50th Anniversary of ASEAN, the ASEANPost, which is a digital media organization, pridefully releases an omnibus joint stamp that highlights the 10 ASEAN member-states' national flower. The stamps primarily emblematize peace, friendship, and solidarity among ASEAN Members. Each member-state is accountable for their stamp's design, layout, printing and production. The commemorative stamps are now available at the Post Shop, Central Office, Manila and area post offices nationwide.

ASEAN Lantern

Measuring more than 20 ft in diameter, the giant ASEAN lantern was illuminated by president Rodrigo Duterte on 08 August on the grounds of the Cultural Center of the Philippines. In line with this event, 76 Local Government Units switched on 57 lanterns simultaneously throughout the country. The lantern illustrates the significant national symbols of the Philippines. It contains the ASEAN emblem cropped at the center, circumscribed by the Anahaw leaf and the Sampaguita flower along with the Mindanao Vinta. The symbolical lantern was produced in the lantern capital of the Philippines, San Fernando Pampanga under the supreme craftmanship of Quiman Trading.

Five Founding Fathers' Painting

To commemorate the 50th Founding Anniversary of ASEAN, a painting that was done by Filipino artist Peter Paul Blanco was unmasked. The painting depicts the signing moment of the ASEAN Declaration by the Founding Fathers of ASEAN on August 8, 1967 in Bangkok, Thailand.

ASEAN 50
PHILIPPINES 2017
PARTNERING FOR CHANGE, ENGAGING THE WORLD

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SILICON VALLEY IS BETTING BIG THAT TECHNOLOGY CAN SOLVE ONE OF THE FOOD INDUSTRY'S EXISTENTIAL PROBLEMS—HOW TO MAKE MEAT WITHOUT ANIMALS. NOW CONSUMERS JUST NEED TO BE PERSUADED TO EAT IT.

BY BETH KOWITT

A technician pours heme—what Impossible Foods considers the essence of meat—at the company's lab in Redwood City, Calif. At right, the startup's plant-based meat patties.

▲ PHOTOGRAPHS BY **SPENCER LOWELL**

WHERE'S THE BEEF?

IN AUGUST ONE OF SILICON VALLEY'S hottest startups closed a $17 million round of funding. The Series A had attracted some of the biggest names in tech. "I got closed out because of Richard Branson and Bill Gates," bemoaned Jody Rasch, the managing trustee of an angel fund that wasn't able to buy in. Venture capital firm DFJ—which has backed the likes of Tesla and SpaceX—led the round, with one of its then-partners calling the nascent company's work an "enormous technological shift."

The cutting-edge product the startup was trying to develop? Meat—the food whose more than $200 billion in U.S. sales has come to be the defining element of the Western diet. But what made this company's work so revolutionary was not what it was trying to make so much as how it was attempting to do it. Memphis Meats, the brainchild that had the startup-investor class salivating, was aiming to remove animals from the process of meat production altogether.

It's the type of world-saving vision that has oft captured the imagination of Silicon Valley—the kind of entrenched problem that technologists believe *only* technology can solve: feeding a fast-growing, protein-hungry global population in a way that doesn't blow up the planet. Conjuring up meat without livestock—whose emissions are responsible for 14.5% of global greenhouse gases—is core to that effort. Just listen to how the progenitor of Googleyness itself describes the prospect of animal-free meat: "It has the capability to transform how we view our world," Google cofounder Sergey Brin has said. "I like to look at technology opportunities where the technology seems like it's on the cusp of viability, and if it succeeds there, it can be really transformative."

Indeed, in the eyes of many Silicon Valley engineers, meatmaking is a process that's so inefficient it's ripe for disruption. Animals, it seems, are lousy tools for converting matter into muscle tissue. Cows require a whopping 26 pounds of feed for every one pound of edible meat produced. In a culture obsessed with high performance, that is maddeningly wasteful.

So why not take them out of the equation? That's precisely what Memphis Meats and a cohort of other startups are trying to do. Memphis represents one possible path called cellular agriculture, in which scientists are trying to grow what has become known as "cultured" or "clean" meat from animal cells. Others are trying to make plants taste like meat. The goal here is not to create your vegan cousin's Boca Burger of yore, but instead a veggie patty that a hard-core carnivore wouldn't be ashamed to bring to a neighborhood barbecue. (In principle, anyway.) Companies in this camp include Beyond Meat and its rival Impossible Foods—which has raised an eye-popping $275 million from the likes of Gates and Khosla Ventures. These more convincing plant burgers can already be found in the meat aisle of mainstream grocery stores like Kroger and are on the menus of restaurants ranging from famed chef David Chang's Momofuku Nishi to TGI Fridays starting in January.

Both cellular ag and plant-based meat companies have the same goal—but their paths to get there couldn't be more different. The plant-burger boosters don't believe cultured meat will ever be able to scale; Memphis Meats and its brethren counter that plants—no matter what you do to them—will always taste like plants. But both groups share the same ultimate vision: to create the post-animal economy—a world free of consumer sacrifice, guilt, and compromise.

As a sign of the market's potential, alternative meat producers point to the explosive growth plant-based milk has made in the dairy aisle, now capturing almost 10% of U.S. retail sales by volume. "I want to be able to say you don't have to make a choice in what you're eating," Memphis CEO and cofounder Uma Valeti says, "but you can make a choice on the process of how it goes to the table."

Hoping to make that choice easier, the new agripreneurs are tackling semantics first—redefining what "meat" means. Beyond Meat CEO Ethan Brown says he'd like to get people to think about meat "in terms of its composition" rather than its origin. The reframing isn't just an epistemological one, but also a scientific one, reducing meat to its molecules.

That won't be an easy sell, and the movement has its detractors—some of whom seem miffed by the notion that anyone would try to mess with Mother Nature. "They want to make up their own dictionary version of what meat is, and these are people who do not eat meat," says Suzanne Strassburger, whose family has been in the meat business for more than 150 years. "The real question is, are they feeding people or are they feeding egos."

The $2,400 Meatball

GROWING CELLS IN PETRI DISHES sounds like the stuff of science fiction, but the basic elements of the science are actually decades old. It's essentially the same process used in medicine to cultivate human cells and tissues. Memphis Meats' Valeti started thinking about growing meat when he was training as a cardiologist at the Mayo Clinic. Later, at his own practice in the Twin Cities, he began injecting stem cells into patients' hearts to regrow muscle after a heart attack.

The trouble is getting the economics to work for a hamburger, not a human heart. Memphis Meats created a cultured meatball that costs about $2,400 a pound to produce, and that was notable progress. The cost last year was $18,000 a pound—down from the more than $300,000 spent on the first cultured burger made in 2013 by Dutch scientist Mark Post.

Beyond Meat CEO Ethan Brown at the company's research facility in El Segundo, Calif.

Pat Brown, CEO and founder of plant-based meat company Impossible Foods, wants to end the use of animals in food production by 2035.

The biggest hurdle to lowering the cost is the cellular medium, the stuff the cells feed on. Mike Selden, CEO of Finless Foods, told me that this substrate contributed 99% of the cost of growing the company's first fish croquettes (price tag: $19,000 per pound). A critical part of the standard medium that works across animal cell types is fetal bovine serum (FBS), which is extracted from the heart of a calf fetus when its mother is pregnant at slaughter. One does not have to be an animal rights activist to see why this is not an acceptable option for the industry. As a result, much of the R&D focus right now is on finding an alternative. Selden says Finless has cut its FBS use down by half by reproducing the essential components of the serum through fermentation (see the sidebar on page 123), and Memphis says it has come up with an FBS-free medium but won't reveal what it's using instead because it's proprietary.

But even if scientists forswear FBS, cultured meat may not be wholly acceptable to one group of potential customers—vegans—because the animal can never be completely removed from the process. Cultured meat producers still have to source the first set of cells from an animal—even if it's just a small biopsy that doesn't require slaughter.

FERMENTING THE FUTURE OF FOOD

A group of cellular ag startups in the Bay Area is using this process to make everything from milk to egg whites to gelatin.

IN 2015 NICK OUZOUNOV and Alexander Lorestani applied to the San Francisco-based biotech accelerator IndieBio. The two Princeton Ph.D.s had an idea for a way to engineer a microbe that could build vast amounts of protein designed for specific functions. They envisioned that it could have biopharma applications, such as being used to produce insulin.

But Ryan Bethencourt, who cofounded the accelerator, instead encouraged them to focus on using the protein for a product in the food space. "Insulin was an old play. There are other people who can make insulin," Bethencourt explains. "You have to be transformative." The groundbreaking idea that they went with? Animal-free gelatin, which in its regular form is derived from collagen—a material that is typically made from the bones, skin, and tissues of cows and pigs. The reaction from Bethencourt, who is himself a vegan: "Brilliant."

Biotech was once a tool reserved for pharmaceutical giants making high-value goods—just like insulin. But there's a shift that's taken place as biotech's associated costs, such as DNA sequencing, have plummeted. The biofuel bust has helped further reshuffle the economics of the industry. All of a sudden bioreactors and other equipment have become available for cheap. The result is that biotech is no longer reserved just for producing high-priced medicine but could start to make sense for commodity products like food.

Ouzounov and Lorestani ended up cofounding Geltor, one of a handful of Bay Area startups using a biotech process called fermentation to make animal products. The transformative part is they don't need the animals to do it. Fellow IndieBio-backed startups Clara Foods and Perfect Day are using the method to make egg whites and milk, respectively. They use cells as part of their production method but there are no cells in the end result—what's called an acellular product. [In contrast, startups Memphis Meats and MosaMeat are working on cellular products, in which the end result contains the cells themselves.]

One obvious tell that you are visiting a startup working on this form of cellular agriculture is the yeasty smell that hits you as you walk into one of their labs. Yeast are like little factories, explains Clara CEO Arturo Elizondo. They can be programmed to make essentially anything and are critical to fermentation. In these labs scientists genetically modify yeast or bacteria and feed them sugars to produce a protein that's molecularly identical to collagen [in the case of gelatin] or casein and whey [for cheese]. At the end of the process that protein is purified out of the mixture. The end result is made using genetic engineering, but is not considered a genetically modified organism since scientists remove the altered yeast. Will consumers be freaked out by the process? "The natural way of making gelatin is much more disturbing," says Ouzounov.

Post, however, says he's not trying to turn vegetarians and vegans into cultured meat consumers anyway. In fact, he believes, it would be counterproductive. "Eating a plant-based diet is always going to be more efficient," says the 60-year-old entrepreneur.

Then why not forget the cell-culture route and try to make better burgers from the likes of peas and carrots? "We've seen plant-based products for 40 years," he says, "but they are basically still substitutes that are very different from the real thing. We believe plant-based options alone are not going to make a big difference."

I never got to taste a meat product made from cellular agriculture—very few people ever have—because none are on the market. For one thing, there are significant regulatory challenges to getting them to grocery store shelves, and it's unclear how a manufacturer seeking approval would even proceed in this uncharted area of science. The FDA oversees products made through fermentation—a key process used in the biotech sector—but the USDA is responsible for regulating meat quality and safety. Vincent Sewalt, who works in regulatory compliance at DuPont, has said if a company started the approval process today it would take two years to get through in the very best-case scenario.

> "MOST OF THE COMPANIES ARE OVERLY OPTIMISTIC," SAYS MOSAMEAT COFOUNDER MARK POST.

© COURTESY OF PERFECT DAY

Post has been working on cultured meat since 2008, now through his company MosaMeat, and his experiences over the past nine years have made him somewhat cynical about the hurdles to scaling. The challenges of finding an alternative to FBS, bringing costs down massively, speeding up cell growth, and finding an appropriate regulatory pathway, have compounded one another. And there's another scientific roadblock too: getting the cells to adhere to a certain fixed structure—assuming, that is, the aim is to produce more than ground chuck. Want your Petri-dish animal cells to end up shaped like a porterhouse? Not so easy.

Post won't put a timeline on how long the quest to get to market will take, but during my reporting I heard people throw out dates ranging from next year to more than a decade hence. "Most of the companies are overly optimistic," Post says, ruefully. "They're very idealistic." A few sources even spoke of cultured meat in the context of space exploration; we need this technology to colonize Mars, they contend. For nearly all of these scientists, it has been hard not to get sucked into the grand notion that science can solve the world's big problems. "I wouldn't call myself an idealist," says Post, "but I'm driven by the societal impact this can have. I guess that is idealism."

There Will Be Blood

IF SCALING UP IS THE LIMITING FACTOR for cellular ag, the key challenge in making viable plant-based meat is more rudimentary: getting ingredients like sorghum to taste like sirloin. "There's no black-and-white path to creating the perfect plant-based burger," says Selden. Even if you can get a garden emulsion to look like meat, and even feel like meat in your mouth, it's a whole different animal, so to speak, to get it to taste like the real thing.

Beyond Meat's research takes place at a lab dubbed the Manhattan Beach Project, down the street from its headquarters in El Segundo, Calif. "I wanted people to understand the global significance," says CEO Ethan Brown. "We have the brightest scientists and we're going to fund them at a level that this work deserves," he adds. "This is a global problem, not a culinary choice."

Beyond Meat is taking the proteins from plant matter and resetting their bonds using heating, cooling, and pressure, so they mimic animal muscle. "Why go through all the trouble of using the animal or any organism if you don't need to," says Brown. "The animal is just taking all of that material from the plant and organizing it in a certain way."

Brown admits that his team still has a ways to go. "I'm more critical than others," he says, "and I say we're pretty far away." As a constant reminder of the work that still needs to be done, Brown has a poster hanging in his office that reads "Slightly better Tofurky"—a harsh line from a critic in 2015.

For anyone working on alternative meat, the first step is fully understanding what it is you are trying to replace—not just its taste and texture but why it makes that certain sound and changes color when it cooks, what one scientist described to me as the "theater of meat."

"We started out by basically asking how does meat do what it does—how does meat work," explains Pat Brown, CEO and founder of Impossible Foods (and no relation to plant-based-meat rival Ethan Brown). Pat Brown, a professor emeritus of biochemistry at Stanford, started by studying meat in the way a researcher would study disease. "You don't just say I want to cure this cancer," he says. "You have to understand how normal cells work." He adds, "That's the way you solve a problem in biomedical research. And really that is not the mindset in the food world at all."

> "IT'S VERY BAD MANNERS TO POISON YOUR FRIENDS, BUT YOU'RE ALLOWED TO MAKE IT TASTE BAD," SAYS IMPOSSIBLE FOODS R&D DIRECTOR CHRIS DAVIS.

Impossible's breakthrough was in discovering that meat's essence comes from heme—the iron-rich molecule in blood that carries oxygen and is responsible for the deep-red color. Heme also exists in the roots of plants like legumes that turn nitrogen into fertilizer. Brown spent a little over a year thinking, incorrectly, that he could source heme by harvesting the root nodules of soybeans. But using the dirt-covered plants would be a food safety disaster—and turning the soil to harvest them would release carbon into the atmosphere, creating the kind of negative impact on the environment Brown is trying to offset.

He again went back to his roots for an answer. Thirty years ago he engineered a bacterial strain to produce an HIV enzyme so he could study how it enables HIV to infect human cells. "That's the go-to move of a molecular biologist," he says. So several years ago he tried the same approach for producing heme. He took the plant

At its Manhattan Beach Project lab, Beyond Meat uses heating, cooling, and pressure to reset the bonds of plants so they mimic meat.

gene for the protein and inserted it into yeast, then fed the modified yeast sugars and nutrients to stimulate fermentation. In that process, most of the yeast is filtered out, leaving behind heme.

At Impossible's lab just outside San Francisco I try heme in its pure form. It was far from delicious, with a metallic quality that tastes like the aftermath of biting down hard on your lip. Its flavors lingered for a long time in my mouth and oddly reminded me of soy sauce. A team of engineers was sorting out a production problem the day I visited and their white lab coats, splattered with plant blood, made it appear like an especially horrific crime had just taken place. "This is not normal," apologizes Chris Davis, Impossible's director of R&D. Davis had been working on biofuels at a company in the same office park when he got a call from Brown five years ago. "I said you do know what I do, right?" Davis recalls telling him. Brown, says Davis, simply explained the "idea that the cow was just a technology to turn plants into something you want to eat."

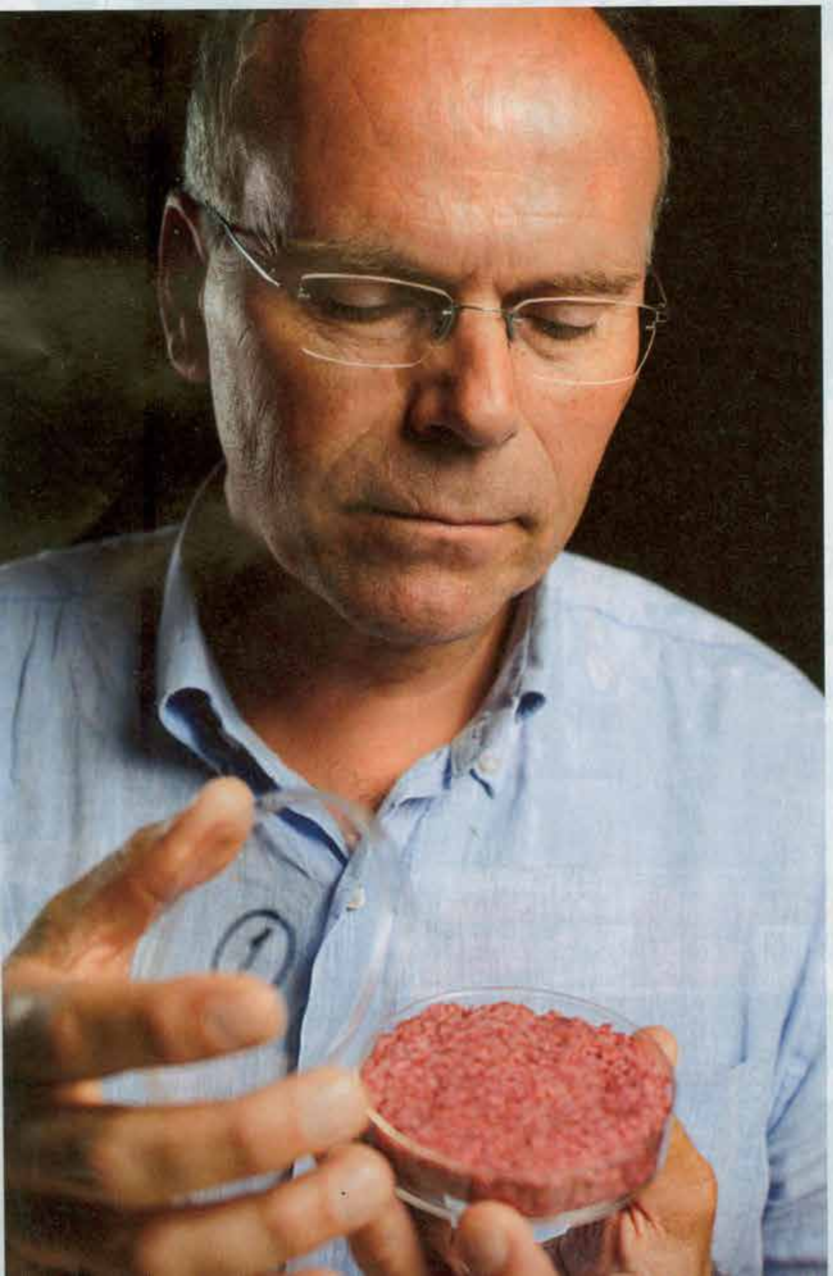
Much of the work the R&D team focuses on is developing meat flavor, a minor fraction of which we perceive by way of our tongues and the rest via aroma. No single molecule makes up the smell of meat, so Impossible's scientists are trying to identify the hundreds of compounds involved. Davis walks me by its gas chromatography mass spectrometry system, which separates out those molecules as a slab of real meat is cooking. A young researcher sits by the machine marking down notes about the varying aromas. One recent tester, for example, had identified the scents of cilantro, Cheerios, plastic, and raw potato. (Yum.)

If heme is the Impossible Burger's blood, then coconut oil is its fat. Wheat protein and potato protein gel make up the meat's "muscle"—its sinewy fiber—and then gum gel is added to make the whole concoction moldable. The R&D team constantly plays with those ingredients to adjust smell and texture. A couple of times a day the team comes around with samples for employees to taste. That can sometimes hit a snag when they come around to Brown. The startup's founder is a notoriously slow taste tester. "He's been a vegan for so long that he doesn't actually do a very good job," Davis says. "He doesn't know what meat tastes like."

Davis says the best description of the company's first successful meat analog was rancid polenta. "It was still terrible," he says. "And yet it was so much better than anything we'd made to that point." The rule of the lab, explains Davis, is that, "it's very bad manners to poison your friends, but you're allowed to make it taste bad."

In the food industry, companies traditionally don't launch a product until they think it's ready for prime time. But the likes of Impossible Foods and Beyond Meat are emulating the tech world by constantly rolling out improved versions—or in Valleyspeak, "iterations."

Every major reformulation of the Impossible Burger gets named after a bird—anhinga, blue-footed booby, condor, dodo. The updates represent Brown's ultimate goal of making



Mark Post holds the first lab-grown burger in 2013. It cost more than $300,000 to make and was backed by Google cofounder Sergey Brin.

© DAVID PARRY—REUTERS

something superior to a cow rather than something identical to one. The effort is about far more than making a great burger, says Brown. "Our mission is to develop the technology that makes animals obsolete as a food production technology," he tells me as we each chow down on an Impossible Burger—the version known internally as Oriole 2.0—at New York's sleek Saxon + Parole restaurant.

But as it turns out, there's one rather important player who has some questions about the company's technology. And that's the FDA. While Impossible Foods doesn't need the agency's approval to market its burgers in the U.S., the company voluntarily asked the regulator to confirm the designation of the protein it uses to carry heme as something "generally recognized as safe," or GRAS. But the FDA responded with some follow-up questions instead. (In November 2015, Impossible withdrew its GRAS submission but refiled this October with additional safety data.)

More troubling to some is that studies have shown that heme found in red meat facilitates the production of chemicals called N-nitroso-compounds, or NOCs, that have been shown to be carcinogenic. Davis, for his part, is not convinced by the science. "Right now there's good epidemiological data that eating meat is bad for you," he says. "That's pretty much clear. But which part of meat is causing that—the data just isn't there."

The Vegan Mafia

FOR SOME ANIMAL RIGHTS GROUPS, the alt-meat effort marks a chance to finally make some progress on their ultimate aim. Or as Paul Shapiro, vice president of policy at the Humane Society of the United States and author of the forthcoming book *Clean Meat*, sums up: "It's possible that folks in this field might end up doing more good for animals than what I've done with my life."

While the movement may have persuaded industry to free some pigs from gestation crates and hens from cages, it has so far pretty much failed in the goal many view as paramount: getting people to stop killing and consuming animals. The percentage of people who identify as vegetarians in the U.S. has remained essentially unchanged over the last three decades. If mainstream Americans won't stop eating animal flesh for ethical reasons, suggest many animal rights advocates, then perhaps they will if they're given a tastier alternative. "Rather than presenting people with tradeoffs, we should focus on making new products that are better than the status quo in every way," says Kyle Vogt.

Vogt is part of what several people jokingly refer to as the Vegan Mafia, a group of wealthy investors whose main motivation is to remove animals from the food system. Like a surprisingly large number of millennials, it seems, Vogt in part got interested in animal welfare after binge-watching a series of Netflix documentaries on the topic. But unlike many others in his age cohort, Vogt sold his self-driving-car startup Cruise to General Motors for $1 billion in 2016—and therefore has the money to do something about it. He and his wife, Tracy Vogt, who opened a farm animal sanctuary, subsequently became vegan and invested in Memphis Meats. For him it's a straightforward thought experiment: For people living 100 years from now, "what are they going to see that seems barbaric or abhorrent or just completely wrong?"

With Silicon Valley's dollars has also come impatience, say some. Post, of MosaMeat, who created the first hamburger from cultured animal cells in 2013 with backing from Google billionaire Brin, believes some of his competitors have set unrealistic timelines to market in part because that's what tech investors want to hear. "The whole Silicon Valley rhythm is imposed on this development," Post tells me. "That may not be realistic, but part of the charm and myth of Silicon Valley is that nobody cares."

Its influence can also be seen in the language of the enterprise—one that casually refers to living creatures as protein conversion technologies. In the months I spent reporting this story, I heard those kinds of descriptions regularly. It was always jarring—and at times, came across as a bit soulless.

"In most realms of human endeavor, technology is a positive thing," says Andras Forgacs, the 41-year-old cofounder and CEO of Modern Meadow, which operates on a nondescript campus in Nutley, N.J. "Food is the one realm where we're very suspicious about it." Early on, Modern Meadow decided to focus on leather materials rather than meat because that's where it thought it could have the most

Celular ag companies to know

MOSAMEAT

MosaMeat was spun out of the lab of Mark Post, a professor at Maastricht University. The Dutchman made the world's first cultured burger nearly five years ago.

© COURTESY OF MEMPHIS MEATS

MEMPHIS MEATS

Founded in 2015, Memphis this year made the first duck and chicken produced from cellular agriculture.

FINLESS FOODS

Previously operating out of biotech accelerator IndieBio, Finless is focused first on making bluefin tuna—one of the world's most high-value proteins.

SUPERMEAT

The Israeli company is working on chicken (in ground form) because it is numerically the most eaten animal in the world.

impact. Forgacs also had some concerns about how long it would take a food product to get to market as well as consumer acceptance. All food involves technology, he explains, but the most established food companies don't want to call it that—they want to call it the art of cooking. Still, "if you want to attract investors and seem like you're the revolutionary new thing, you have to robe yourself in the language of technology," he says. "That doesn't necessarily appeal to consumers."

In one of the stranger ironies, what has given real credence to the alt-meat realm is Big Food's arrival on the scene. It's an odd turn of events. When legacy packaged food companies began gobbling up natural food startups, the latter lost much of their street cred. But the opposite has happened with meat nouveau: Big Food's backing has helped validate the burgeoning industry.

The executives I spoke with at Tyson and Cargill, which have invested in Beyond Meat and Memphis Meats, respectively, laid out a future in which meat from animals, cultured meat, and plant-based meat all sit side by side in the supermarket. "To feed 9 billion people we're going to need everybody," says Sonya McCullum Roberts, president of growth ventures at Cargill. "It's not a threat to us, it's an opportunity."

Not everybody in the alt-meat crowd is willing to partner with the big guys. Pat Brown, Impossible's CEO, can't imagine how his interests could possibly align with those of a meat producer. "Let's put it this way," he says. "I don't have any illusions about what would happen if one of those companies had any measure of control over us. They would not want us to completely replace their industry in 15 years."

Says Cargill's Roberts: "I have heard some of those comments. And they hurt a little bit."

Passing the Smell Test

IN OCTOBER SOME 300 PEOPLE gather in a converted warehouse in Red Hook, Brooklyn, for the second annual New Harvest conference on cellular agriculture. As is typical of alt-meat confabs, the lunch is vegan. (And good luck finding any real milk for your coffee.)

Despite the niceties that come in an industry where everyone knows everyone else, there are still plenty of moments of discord. One clear point of angst is how candid the various startups are being with one another about the advancements of their technology. Scandal-plagued vegan mayo maker Hampton Creek had recently said it would have a cultured meat product on the market next year, and questions abound about how realistic the pronouncement really is. Not very, seems to be the consensus. ("We aim to make our first commercial sale of a clean meat product by the end of 2018," the company said in a statement.)

One can sense another underlying tension in the way companies are describing their products in the first place. The battle lines seem drawn between the joys of weird science (which the techies cherish) and those who fear consumers will run from that.

Jesse Wolff of International Flavors and Fragrances is clearly in the first camp. He kicks off day two with a presentation that includes show and smell: He instructs us to open a vial that's been placed on the back of every chair, and then take a whiff. Inside are 62 components that make up organic vegan roast chicken aroma, he says. There's a lot of science behind the flavor, he tells the crowd. (When I take the vial back to my office, most of my colleagues think it smells like Doritos.)

Two hours later, during a session called "Getting Cellular Agriculture Into the Real World," Mary Haderlein, principal of Chicago consulting firm Hyde Park Group Food Innovation, alludes to the strangeness of an additive with more than five dozen ingredients in an era when shoppers say they want simplicity. There's a big push for fewer ingredients, unprocessed foods, and clean labels, she tells the same conference-goers. "And then on the other hand we have lab meat. Those are conflicting thoughts that have to come into focus."

Embodying this issue is the debate over what to even call meat made from cellular ag. The industry has landed on "clean meat," after deciding that terms like "lab-grown meat," "in vitro meat," and "cultured meat" all have too much of an ick factor. But clean meat has its own baggage. For one thing, it has a different meaning to consumers who think of clean food as something free of artificial ingredients. "It seems like a weird term to attach to a bioengineered meat product," Haderlein tells me. But even more problematic is that clean meat suggests that the

Plant-based companies to know

BEYOND MEAT AND IMPOSSIBLE AREN'T THE ONLY COMPANIES PLAYING WITH PLANTS.

NOTCO

The startup is developing an algorithm that identifies the molecular components of plants that create certain tastes and textures so they can be used to replicate animal-based products.

NEW WAVE FOODS

Cofounded by a marine biologist, New Wave is making an algae-based shrimp alternative that it started selling through the food service industry in July.

OCEAN HUGGER FOODS

Ocean Hugger is using tomatoes as a plant-based alternative to the raw tuna used in sushi. Its proprietary process removes the flavor from the tomato and gives it a meaty texture before it's marinated in soy sauce, sugar, and sesame oil. The company launched in select Whole Foods in November.


Ad Council
I am very sensitive to lights and sounds
Jacob Sanchez
Diagnosed with autism
Sensory sensitivity is a sign of autism.
Learn the others at autismspeaks.org/signs.
AUTISM SPEAKS

Inside Impossible Foods' production facility in Oakland.

alternative—plain, old regular meat—is dirty and wrong. "The term is offensive and insensitive to farmers," says Danielle Gould, founder and CEO of Food + Tech Connect, a resource hub and community for food entrepreneurs and investors. And making potential consumers feel demonized, judged, or guilty is unlikely to be an effective marketing strategy.

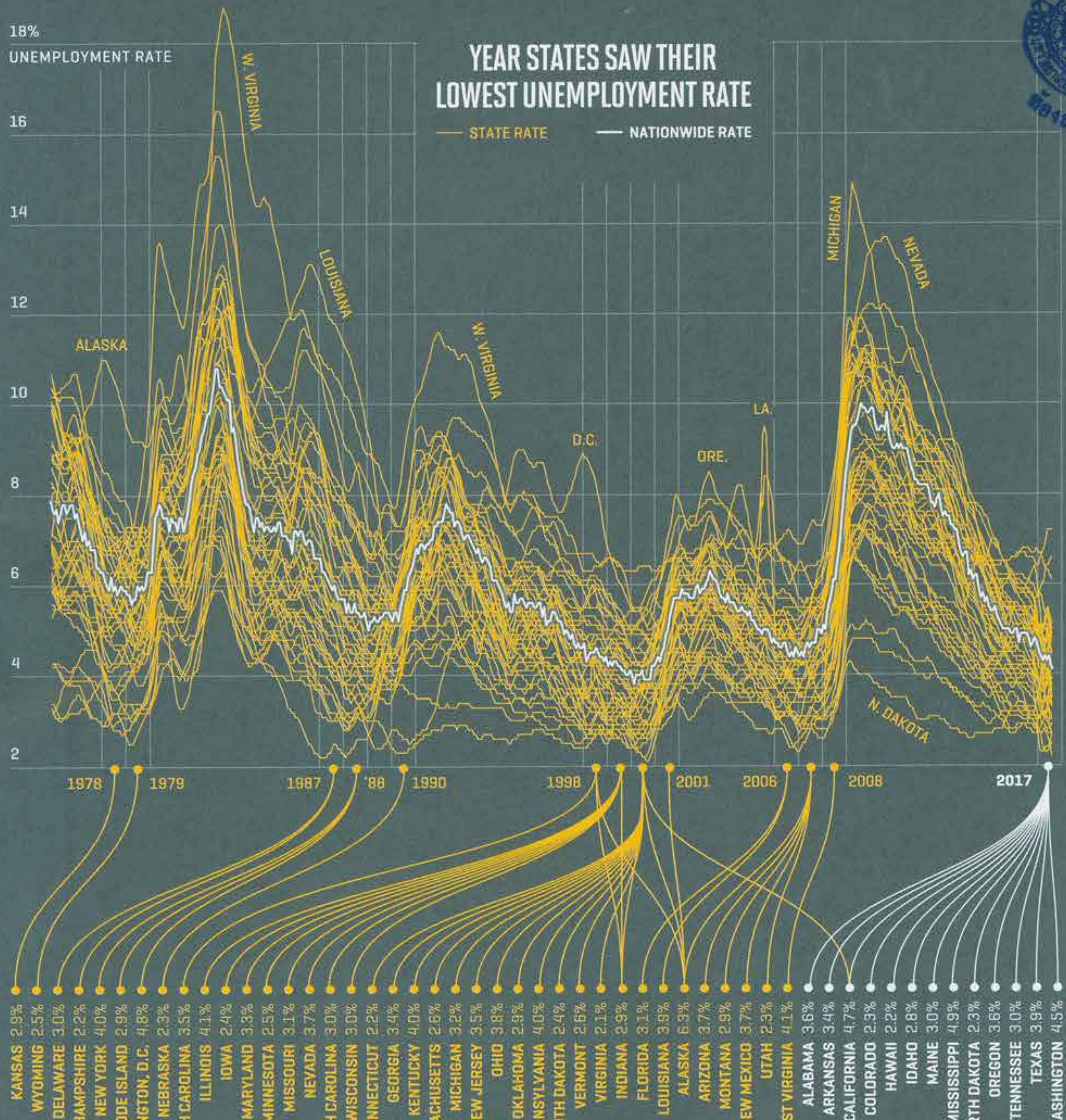
The veggie meat cohort is not immune to the tension. This summer, the University of California at Berkeley launched an alt-meat lab for students to do plant-based food research. The program was so popular it was expanded to accommodate about a dozen extra people. But the students rebelled after the first semester, disheartened by how many of the products had the same heavy formulation as processed foods. They wanted to change the current food system, not replicate it, says Ricardo San Martin, cochair for the new lab. Somehow making a burger, even one made of plants, didn't seem quite so innovative. "They were not convinced that this was the route they want to take," San Martin says. "They feel it fulfills their ethical concerns with animals, but it doesn't fulfill the kind of food they want to eat."

"THE REAL QUESTION IS, ARE THEY FEEDING PEOPLE OR ARE THEY FEEDING EGOS," ASKS A MEAT INDUSTRY VETERAN.

Over the course of reporting this story I asked pretty much everyone I talked to whether they were vegetarian or vegan. It was surprising to me how many of those engaged in this movement weren't. Post, of MosaMeat, said that he should be but that he wasn't. "There is something in us that makes it inherently difficult to take that step to a plant-based diet," he admits. "It feels like a step back. And something in me resists that." San Martin of the alt-meat lab offered that he feels horrible whenever he sees any information on the mistreatment of animals, "but when I go to the supermarket and eat ham, I don't see the connection. I just can't make it."

I felt their confusion. Most days I eat vegetarian, and I rarely eat any red meat at all. In fact, for months, as I've reported this story, I've been acutely aware of all the reasons why we probably shouldn't eat beef, chicken, or pork.

But in early November, as I was driving on the highway in Northern California, I saw an In-N-Out Burger up ahead. I pulled off the highway, and gave into the cognitive dissonance. It was the best hamburger I can remember. F



FULLY EMPLOYED

THE JOB MARKET can't get much tighter. In October the U.S. unemployment rate dropped to 4.1%—the lowest level since December 2000, when it hit 3.9%. October also marked a record-setting 85th straight month of job gains, dating back to 2010. That job creation is reaching into virtually every corner of the country. This year a remarkable 12 states have recorded their lowest unemployment rates since the Bureau of Labor Statistics began tracking state figures in 1976, and California matched its previous low. [One outlier is Alaska, with the nation's highest rate at 7.2%.] The big question: When will wages, up a weak 2.4% annually in October, finally begin to reflect the strong demand for labor? —BRIAN O'KEEFE

SOURCE: BUREAU OF LABOR STATISTICS

GRAPHIC BY NICOLAS RAPP

CNN's 'Going Green' hosted by Nicki Shields will shine a spotlight on everyday heroes championing environmental causes and conservation, like the fight against the poaching of South African rhinos in the Timbavati Private Nature Reserve.

Going Green airs November 27 to December 1, 2017.

Half-hour special airs

Sunday, December 3 at 12:30AM, 4:30AM and 3:30PM HKT
Monday, December 4 at 12:30PM HKT
Wednesday, December 6 at 12:30AM HKT

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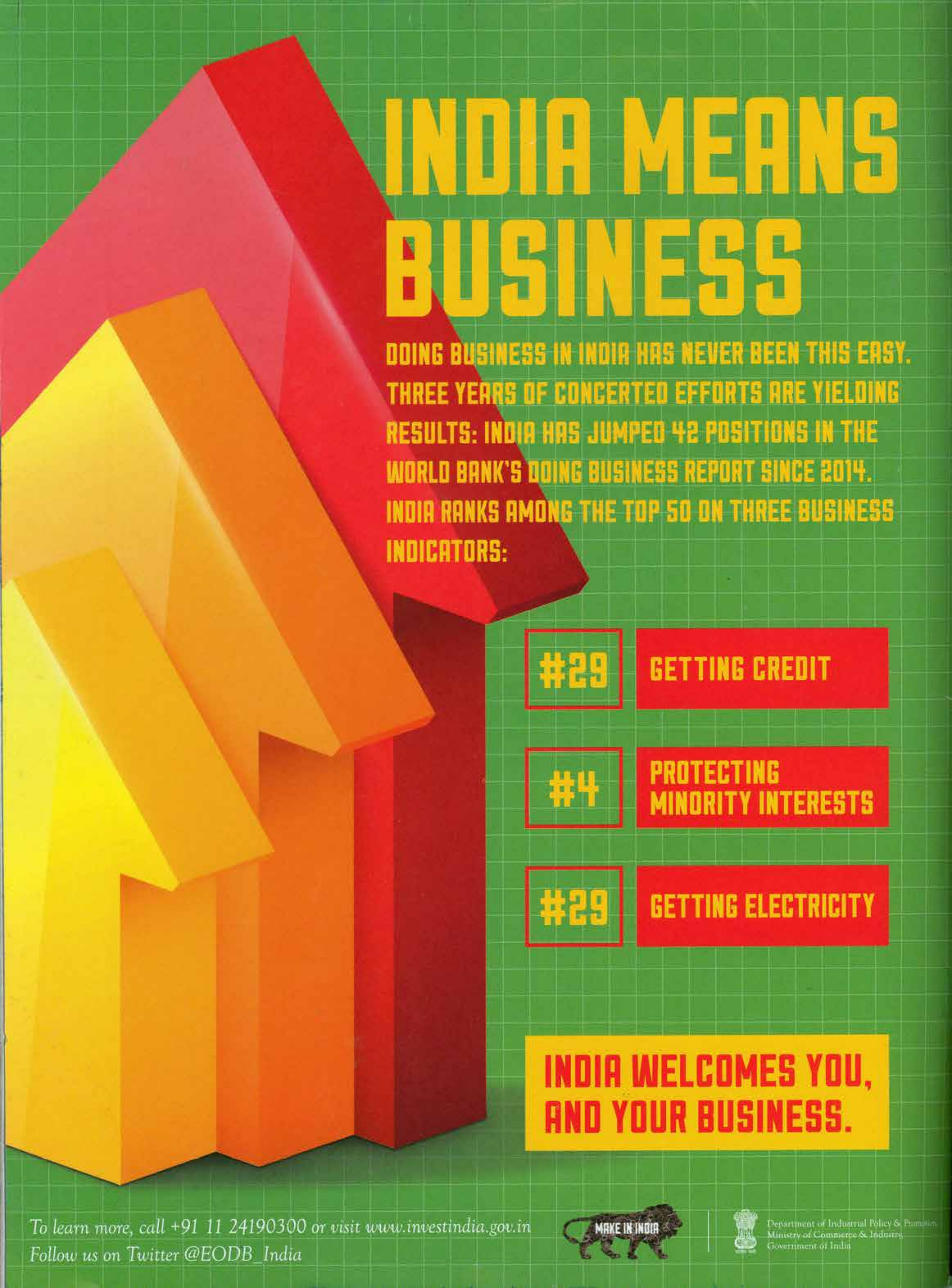
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