

Kensho- Article #1: Kensho – King of Financial Data Analytics

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<https://digit.hbs.org/submission/kensho-king-of-financial-data-analytics/>

Kensho is refreshing financial data analytics with big data technologies.

Kensho's Value Creation

THE BUSINESS. Kensho is a market data analytics system that can find answers to more than 65 million question combinations by scanning over 90,000 customizable actions. Questions, asked in plain English, are typed into a Google-style text box. Kensho's creative approach to data analytics allows users to ask out of the box questions, such as:

- Which cement stocks go up the most when a Category 3 hurricane hits Florida? (The biggest winner? Texas Industries.)
- Which Applesupplier's share price goes up the most when the company releases a new iPad? (OmniVision, which makes the sensors in the iPad camera.)
- How does [Apple](#) typically trade before and after original product releases?
- How do the big banks trade the day after the [Federal Reserve](#)'s stress test results are released?
- Which retail stocks were the best performers from Thanksgiving through the end of the year over the last 10 years?
- When [Netflix](#) beats earnings, how do shares of [Amazon](#) historically perform the next day?

Until now, answering these types of questions required several analysts and several days. Kensho can do it in a matter of minutes, effectively acting like a quant army.

Kensho's analyzed market data can include things like:

- Earnings releases
- Economic Reports
- Stock price movement
- Moving averages
- Company product launches
- FDA drug approvals
- Stock price triggers
- Monetary policy changes
- Political events

Kensho's Value Capture

Kensho received \$15 million in a new investment round led by Goldman Sachs on November 2014. Forbes reported that the terms of the deal were not disclosed but a source said Goldman is now Kensho's largest investor. The source also said the deal placed Kensho's valuation in the 9-figure range. Kensho had previously raised a \$10 million seed round from the likes of Accel Partners, Breyer Capital, General Catalyst, Google Ventures and NEA.

As part of Kensho's strategic partnership Goldman, Kensho will implement its data-crunching software across the bank. This deal is very promising for Kensho, but time will tell how Kensho will grow and offer its product to other companies.

Kensho's Operating Model

Kensho's processes, capabilities, resources, and use of data are all dedicated to value creation. Kensho has expert engineers, UX designers, and data scientists focus on creating a product that studies unimaginable amounts of structured and structured data to determine how all types of events have historically affected the markets. Their tools include the latest big data and analytics technologies. **Kensho will empower clients to make more educated financial decisions by putting things in a historical context to focus on the macroeconomic picture.**

Kensho's goal is to allow financial professionals to make better, faster and more informed decisions with statistics. As Kensho's CEO, Daniel Nadler, stated, "Kensho is trying to bring to Wall Street what Saber Metrics (Moneyball) accomplished for baseball."

Kensho, founded in May 2013, is bringing a refreshing change to the **financial data industry**, an industry that has long been led by Bloomberg and Thomson Reuters. Kensho is democratizing financial data analytics "by giving the masses the type of complex, quantitative computer power currently used by a few top hedge funds like Bridgewater Associates, D.E. Shaw and Renaissance Technologies." And potential clients, including investment banking and fund management giants, are receptive to Kensho's offering.

Kensho- Article #2: Kensho: Warren is like Watson and Siri, for analysts, investors and traders

APRIL 6, 2015 BY **BERNARD LUNN** By Efi Pylarinou

<http://bankinnovation.net/2015/04/kensho-warren-is-like-watson-and-siri-for-analysts-investors-and-traders/>

MEMO: To all researchers and traders on the Sell and Buy side, The conventional ways of analyzing markets and generating trade ideas in all **bulge bracket** financial institutions on Wall Street, is in jeopardy. The typical mode of addressing any complex financial inquiry, usually entails a couple of days of intense spreadsheet manipulation and data collection. This is "threatened" by innovative financial technology, e.g. **Kensho**, and we suggest you all invest in re-training towards becoming masters in asking meaningful complex financial questions to an Artificial Intelligence software.

Kensho, is a Japanese word, synonymous to **Satori**. They both essentially mean Insight, a glimpse into Enlightened, Awakening which leads into further training to deepen the insight.

Kensho was founded in 2013, in Boston and offers a technology that revolutionizes the way financial information is processed; It speeds up the cumbersome spreadsheet crunching, from a couple of days to minutes. It uncovers relationships that can lead to trade signals (Buy/Sell). It organizes our thinking around what we don't know. It is the commercial incarnation of **Watson** in the financial space.

Typical 4 yr olds ask more than 300 questions per day. Typical 40yr olds on Wall Street, can maybe channel to their supporting research department a few inquiries per week. Kensho can offer fast visual context to thoughtful questions like:

- Which Apple supplier's share price goes up the most when the company releases a new product?
- What happens to the currencies of oil producing countries when oil trades below \$45 and the USD is strengthening?
- Which part of the yield curve is more affected 3 months before the first rate hike?

- How do pegged currencies to the USD react, when the dollar strengthens in a strong trendy fashion against most major reserve currencies?

Those privileged to the quick answers, can interpret further the results and develop trading strategies based on informed big data analytics.

Kensho's software is called **Warren**, inspired by an older, wise and patient uncle that knew all the answers (says co-founder D. Nadler). But of course, there is an immediate association with Warren Buffet. Warren is a cloud-based software that can find answers to more than 65 million question combinations in an instant, by scanning more than 90,000 sources such as economic reports, monetary policy changes, and political events and their impact on nearly every financial asset on the planet. Kensho is also in the process of building a massive unstructured geopolitical and natural world event database, which will allow processing such information and their relationship to financial events. Questions are simply typed in natural language in a simple Google-like text box.

While the partnership between Watson and Citi, has not been in the spot light; Kensho has already partnered with Goldman Sachs and CNBC, and has an impressive group of strategic investors. The FT, the Wall Street journal, Forbes magazine have already written about them. CNBC Pro offers the Kensho StatsBox that provides research and analytic insights designed to create actionable, historical context around market moving events, to its subscribers. Goldman Sachs recently led a \$15m round of financing in the company, and will roll out their platform in-house across all businesses as well as to some of its big clients. Such investment houses have typically developed their own in-house technologies and through this move, Goldman is paving the way to welcoming data scientists for the analysis of financial information.

Kensho, has been likened to a Siri-style service for investors, analysts and traders. Users are impressed by the simplicity in which the complex inquiry is inputted. Will Kensho do to financial data analytics what Google did to search?

I've signed up for CNBC Pro to check out myself the Kensho partnership in action, even though totally behind the scenes. This April is a great month to "test" whether I gain additional insights from this service. As the uncertainty of the timing of the Fed rate hike still looms, Greece is at the brink of bankruptcy, multiple geopolitical conflicts are continuing, unprecedented divergence in growth rates between economies and Emerging markets volatility are the new normal,.....guidance is very welcome. CNBC Pro services (subscription business model) include the pro news/analysis texts which are then released with a delay to the public (generated with the support of StatsBox); an exclusive tracking of a virtual portfolio of only 5 stocks per year from 5 selected managers (ranging from founders of TradeMonster, to the CEO of Ritholtz Wealth Management and an MD from TIAA-CREF); another effort to be part of the democratization of the investment culture, through a more diversified portfolio with 14 fund managers sharing their top 5 picks for the year and exposing themselves to their annual performance on another \$100k, virtual again, portfolio

Kensho- Article #3: The Robots Are Coming for Wall Street

Hundreds of financial analysts are being replaced with software. What office jobs are next?

FEB. 25, 2016; By [NATHANIEL POPPER](#) Photographs by JONNO RATTMAN

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When Daniel Nadler woke on Nov. 6, he had just enough time to pour himself a glass of orange juice and open his laptop before the Bureau of Labor Statistics released its monthly employment report at 8:30 a.m. He sat at the kitchen table in his one-bedroom apartment in Chelsea, nervously refreshing his web browser

— *Command-R, Command-R, Command-R* — as the software of his company, Kensho, scraped the data from the bureau’s website. Within two minutes, an automated Kensho analysis popped up on his screen: a brief overview, followed by 13 exhibits predicting the performance of investments based on their past response to similar employment reports.

Nadler couldn’t have double-checked all this analysis if he wanted to. It was based on thousands of numbers drawn from dozens of databases. He just wanted to make sure that Kensho had pulled the right number — the overall growth in American payrolls — from the employment report. It was the least he could do, given that within minutes, at 8:35 a.m., Kensho’s analysis would be made available to employees at Goldman Sachs.

In addition to being a customer, Goldman is also Kensho’s largest investor. Nadler, who is 32, spent the rest of the morning checking in with some of the bank’s most regular Kensho users — a top executive on the options-and-derivatives-trading desks, a fund manager — then took an Uber down for a lunch meeting at Goldman’s glass tower just off the West Side Highway in Manhattan. While almost everyone in the building dresses in neatly pressed work attire, Nadler rarely deviates from his standard outfit: Louis Vuitton leather sandals and a casual but well-cut T-shirt and pants, both by the designer Alexander Wang. Nadler owns 10 sets of these. His austere aesthetic is informed by the summer vacations he spent in Japan while pursuing a doctoral degree in economics from Harvard, mostly visiting temples and meditating. (“Kensho” is the Japanese term for one of the first states of awareness in the Zen Buddhist progression.) He also wrote a volume of poetry — imagined ancient love poems — that Farrar Straus & Giroux will publish later this year.

I met with Nadler later that day in his own office, across the street from the Goldman building, on the 45th floor of 1 World Trade Center. His dozen or so employees shared a large room decked out in typical start-up style, including an aquarium and large speakers playing electronic music. Nadler has an office off to the side with little more than a large desk, made out of reclaimed telephone poles, and a large upholstered leather chair with matching ottoman. After closing the door, Nadler, who has curly dark hair and pale skin, sat on the ottoman, folded his bare feet under him and told me about the day’s feedback from Goldman. This included some tips on what they wanted in the next report, and a good dose of amazement at Kensho’s speed. “People always tell me, ‘I used to spend two out of five days a week doing this sort of thing,’ or ‘I used to have a guy whose job it was to do nothing other than this one thing,’ ” Nadler said.

This might sound like bragging. But Nadler was primarily recounting those reactions as a way of explaining his concern about the impact that start-ups like his are likely to have on the financial industry. Within a decade, he said, between a third and a half of the current employees in finance will lose their jobs to Kensho and other automation software. It began with the lower-paid clerks, many of whom became unnecessary when stock tickers and trading tickets went electronic. It has moved on to research and analysis, as software like Kensho has become capable of parsing enormous data sets far more quickly and reliably than humans ever could. The next “tranche,” as Nadler puts it, will come from the employees who deal with clients: Soon, sophisticated interfaces will mean that clients no longer feel they need or even want to work through a human being.

‘We are creating a very small number of high-paying jobs in return for destroying a very large number of fairly high-paying jobs, and the net-net to society, absent some sort of policy intervention . . . is a net loss.’

“I’m assuming that the majority of those people over a five-to-10-year horizon are not going to be replaced by other people,” he said, getting into the flow of his thoughts, which, for Nadler, meant closing his eyes and

gesticulating as though he were preaching or playing the piano. “In 10 years Goldman Sachs will be significantly smaller by head count than it is today.”

Goldman executives are reluctant to discuss the plight of their displaced financial analysts. Several managers I spoke to insisted that Kensho has not yet caused any layoffs, nor is it likely to soon. Nadler had warned me that I would hear something like that. “When you start talking about automating jobs,” he said, “everybody all of a sudden gets really quiet.”

Goldman employees who lose their jobs to machines are not likely to evoke much pity. But it is exactly Goldman’s privileged status that makes the threat to its workers so interesting. If jobs can be displaced at Goldman, they can probably be displaced even more quickly at other, less sophisticated companies, within the financial industry as well as without.

In late 2013, two Oxford academics [released a paper claiming](#) that 47 percent of current American jobs are at “high risk” of being automated within the next 20 years. The findings provoked lots of worried news reports about robots stealing jobs. The study looked at 702 occupations, using data from the Department of Labor, and assigned a probability of automation to each one, according to nine variables. The conclusions made it clear that this was no longer just the familiar (and ongoing) story of robots replacing factory and warehouse employees. Now software is increasingly doing the work that has been the province of educated people sitting in desk chairs. The vulnerability of these jobs is due, in large part, to the easy availability and rapidly declining price of computing power, as well as the rise of “machine learning” software, like Kensho, that gathers and assimilates new information on its own.

According to the Oxford paper and subsequent research, employment prospects vary significantly by industry. In health care, for example, where human interaction is vital, automation threatens fewer jobs than it does in the labor market as a whole. Taxi and truck drivers, though, face a bleak future given recent advances in self-driving cars. Among better-compensated professions, the Oxford researchers took into account software that can analyze and sort legal documents, doing the work that even well-paid lawyers often spend hours on. Journalists face start-ups like Automated Insights, which is already writing up summaries of basketball games. Finance stood out in particular: Because of the degree to which the industry is built on processing information — the stuff of digitization — the research suggested that it has more jobs at high risk of automation than any skilled industry, about 54 percent.

The Oxford study received plenty of criticism — understandably, given the patina of exactness that it tried to apply to a speculative exercise. Nevertheless, the financial industry is taking automation very seriously, both as an opportunity and as a threat. It is one thing to make a few analysts redundant, but automation could put whole business models in peril. Investments in what is known as fintech, or financial technology, tripled between 2013 and 2014 to \$12.2 billion, and start-ups are now taking aim at nearly every line of financial business. Decisions about loans are now being made by software that can take into account a variety of finely parsed data about a borrower, rather than just a credit score and a background check. So-called robo-advisers create personalized investment portfolios, obviating the need for stockbrokers and financial advisers. Nearly every Wall Street firm has put out research reports on the tens of billions of dollars of revenue that might be lost to these upstarts in the coming years. Banks are trying to fend off the newcomers by making their own investments in start-ups like Kensho, which has raised more than \$25 million so far.

The skilled industries that form the bedrock of New York City’s economy have so far largely avoided this sort of transformation, because the work of financial analysts, publishers and designers hasn’t been easy to automate. But to look at a company like Kensho, and the sort of conversation it generates across the financial industry, is to see the degree to which these trends are now confronting industries that used to be thought

exempt from this sort of disruption. Last fall, Antony Jenkins, who was dismissed a few months earlier as chief executive of Barclays, the giant British bank, gave a speech in which he said a coming series of “Uber moments” would hit the financial industry.

“I predict that the number of branches and people employed in the financial-services sector may decline by as much as 50 percent,” Jenkins told the audience. “Even in a less-harsh scenario, I expect a decline of at least 20 percent.” This process could, in at least some cases, help do away with some of the expensive bloat in the financial system, providing more transparent services with fewer hidden fees. It could also be seen as a satisfying blow against the titans of an industry that only recently almost crashed the world economy. But so far the burden of job losses is stopping just short of the executive suites, even as the gains in efficiency are worsening already troubling levels of income inequality.

Some of the venture capitalists backing Kensho have told Nadler that he would be wise to stop talking about the potential job losses at the same banks he is trying to secure as customers. Nadler has told them that he needs to carry on, partly to maintain his intellectual integrity. He often connects his discussion of jobs to his political fund-raising on behalf of candidates who call for a more robust social-safety net. But he also says that his awareness of what his business is both creating and taking away sets him apart as an entrepreneur: It’s his “edge” in a business that is all about competing to predict the future more accurately.

Kensho’s main customers at Goldman so far have been the salespeople who work on the bank’s high-ceiling trading floors. In recent months, they have used the software to respond to incoming phone calls from investors who buy and sell energy stocks and commodities, wondering how they should position their portfolios in response to, for instance, flare-ups in the Syrian civil war. In the old days, the salespeople could draw on their own knowledge of recent events and how markets responded, with all the limitations of human memory. For a particularly valuable client, the sales representative might have called a research analyst within Goldman to run a more complete study, digging up old news events and looking at how markets responded in each case. The problem with this approach was that by the time the results came back, the original trading opportunity was often gone.

Now a sales representative can simply click an icon and access the Kensho interface, which consists of a simple black search bar. Nadler walked me through the process on his own laptop. Type in the word “Syria,” and several groups of events related to Syria’s civil war appear, in much the same way that Google recommends queries based on past searches. Here, among the top event groups, are “Advances Against ISIS,” which includes 25 past events, and “Major ISIS Advances and Brutal Atrocities,” with 105 events.

Kensho’s software is constantly tweaking and broadening these suggested search terms, all with little human intervention. In some ways, this is the most sophisticated part of the program. In the past, a trader or analyst would have to search Wikipedia or a news database using whatever keywords came to mind. Kensho’s search engine automatically categorizes events according to abstract features. It has figured out, for instance, that ISIS’s seizure of Palmyra and France’s first airstrike in Syria were both escalations in the civil war there but also that in one of those cases, ISIS was the aggressor while in the other case, it was on the defense. The software also looks for new and unexpected relationships between events and asset prices, allowing it to recommend searches that a user might not have considered. For this feature, Nadler said, he hired one of the machine-learning whizzes who worked on Google’s megacatalog of the world’s libraries.

Back on the trading desk, after picking out one group of events — the 27 incidents of “Escalations in the Syrian civil war,” say — a sales trader can pick from a series of drop-down menus that narrow the search to a specific time period and a specific set of investments. The broadest set includes the world’s 40 or so major assets, including German stocks, the Australian dollar and a few varieties of crude oil. They can then click on

the green Generate Study button, and a few minutes later they'll have a new page full of charts. Nadler clicked to demonstrate. The top chart showed that the prices of natural gas and crude oil have underperformed in the weeks after past escalations in the war, while Asian stocks and the United States and Canadian dollar pair has outperformed. Scrolling down, we could also see how each event in Syria played out and begin to structure an optimal set of trades based on that history.

Nadler closed his laptop. The whole process had taken just a few minutes. Generating a similar query without automation, he said, "would have taken days, probably 40 man-hours, from people who were making an average of \$350,000 to \$500,000 a year."

This is all quite something for a company that was first dreamed up less than three years ago. In 2013, while in graduate school, Nadler was working as a visiting scholar at the Federal Reserve Bank in Boston. At the time, the Greek elections and instability across Europe were buffeting the financial markets. When Nadler asked how he could find out what impact similar events had on financial markets, he learned that neither the regulators nor the bankers had any good method for doing so beyond digging up old news clips. In his free time, Nadler began talking with a former Google programmer he befriended at a student club for Japan enthusiasts. Nadler was supposed to be finishing up his doctoral dissertation on the influence of politics on the 2008 financial crisis. Instead, within weeks, he had put together a small team and received early funding for his idea from Google's venture-capital arm. They later received investments from many other sources, including the C.I.A.'s venture-capital arm, according to Forbes.

'When you start talking about automating jobs, everybody all of a sudden gets really quiet.'

Kensho's main office is still in Cambridge, Mass., two floors above an old barbershop, with windows looking out onto Harvard Yard. The 30 or so employees in the large main room look like the kind of bright-eyed kids who in years past might have gone to work for Goldman Sachs. Here, though, they work at standup desks, wear jeans and enjoy the benefits of a Zen room, with pillows and tatami mats for meditation, as well as a game room with chessboards and a poker table.

I visited the Cambridge office in December, shortly before Christmas. When I arrived, most of the employees were doing their Secret Santa gift exchange; their laughter frequently trickled back to the conference room where I sat with Nadler and a few of his top deputies. Curious to know how much they all talked about the larger implications of their work, I asked the deputies how quickly the topic of automation and job loss had come up in their relationship with Nadler.

"Pretty much the second sentence," said Matt Taylor, the chief technology officer, who, at 38, is one of the senior citizens of the company.

"This was Day 1," said Martin Camacho, Kensho's 20-year-old chief architect, who entered Harvard as a freshman when he was 15.

Camacho remembered going home one night to Nadler's apartment during their first summer working on Kensho. They watched the science-fiction film "Oblivion," about a world populated by alien-generated human clones, and stayed up talking about the socioeconomic implications of the story. More recently, Nadler invited his engineering team to a dinner at one of Cambridge's nicest restaurants, Henrietta's Table, for a group conversation about the more distant implications of automation. Nadler said he anticipated some form of strong artificial intelligence, whereby computers in the far future would be smart enough to anticipate our needs and usher in an era of abundance. For the next few decades, though, he predicted a more complicated time — an interregnum in which the computers are not as smart as people but smart enough to do many of the tasks that make us money.

Camacho was less pessimistic than his boss. When computer-assisted math proofs were invented a few years back, he said, it didn't lead to any decline in the number of math-research jobs. "I think there will be plenty for everyone to do," Taylor said, agreeing.

When I raised the topic of automation with executives at Goldman and beyond, I often heard a similarly optimistic belief that all the new software will free up employees in the financial industry to do other, more valuable things; that it would also create new types of jobs that don't exist right now. Several executives I spoke with argued that when A.T.M.s were widely deployed, you didn't suddenly see bank branches disappearing.

This is a common criticism of the Oxford report on automation: Even if 47 percent of all current jobs end up being automated, that does not mean that 47 percent of the working population will not have jobs, as many newspaper articles on the report concluded. Cars once displaced lots of coachmen and stable boys but created many more new jobs laying out highways and attending service stations. Nowadays, software that provides financial advice has automated the work of some stockbrokers, but it is also expanding the number of people getting financial advice and the demand for cheap investment products.

The lead author on the Oxford paper, Carl Benedikt Frey, told me that he was aware that new technologies created jobs even as they destroyed them. But, Frey was quick to add, just because the total number of jobs stays the same doesn't mean there are no disruptions along the way. The automation of textile work may not have driven up the national unemployment rate, but vast swathes of the American South suffered all the same. When it comes to those A.T.M.s, there has, in fact, been a recent steady decline in both the number of bank branches and the number of bank tellers, even as the number of low-paid workers in remote call centers has grown.

This points to a disconcerting possibility: Perhaps this time the machines really *are* reducing overall employment levels. In a recent survey of futurists and technologists, the Pew Research Institute found that about half foresee a future in which jobs continue to disappear at a faster rate than they are created.

Martin Chavez, a boisterous, bearded man who runs all of Goldman's technological operations, is unrestrained in his enthusiasm for Kensho. "This thing that we would have done in a very bespoke, almost artisanal way is now something that Kensho has industrialized," he told me.

Chavez said Kensho itself was unlikely to displace many employees. The software, he said, was doing something that was previously so time-consuming that it was seldom attempted. (Some users also told me that there were still significant limitations on the sort of events the software could search.) But whatever the impact of Kensho, Chavez's larger efforts to digitize more of Goldman's operations are already changing the number and the type of employees at the firm. Over the last few years, the number of campus recruits coming to Goldman from science-and-technology majors has gone up 5 percent each year, while the total head count has barely budged. (Goldman is one of the few companies on Wall Street at which the total number of employees hasn't dropped significantly.) "I'm pretty sure there are going to be new jobs 10 or 20 years from now that none of us could even imagine today," Chavez said.

Stock trading, one of the earliest areas to go electronic, provides an interesting precedent for how automation can play out in an institution like Goldman. On the company's trading desks, stocks are now bought and sold by computers instead of people. Chavez says that the advent of computerized trading over the last two decades has reduced the number of Goldman employees who buy and sell American stocks the old-fashioned way — over the phone — to four from around 600, but the change in the number of traders tells only part of the story. Some of the traditional traders were replaced by programmers who design and monitor the new

trading algorithms. Beyond that, there are now new jobs in the data centers where the high-speed trading takes place.

Goldman doesn't provide numbers on any of this. But Paul Chou, who worked on Goldman's electronic-trading desks from 2006 to 2010, told me that he would guess that the company probably needed one programmer for every 10 of the old-school traders who lost their jobs. In one sign of the shrinking work force, Goldman moved the last trader out of one of its four Manhattan trading floors last year.

The progression of Goldman's stock-trading operations also illustrates that automation is not an on-off switch. When Chou first joined Goldman, after graduating from M.I.T., part of his job involved logging onto dozens of trading systems and checking on what the algorithms were spitting out to make sure they weren't making any mistakes before the trades were executed. Chou sat near a woman who had been doing phone-based trading for years. She helped Chou and his young colleagues learn what to look for in a good trade. Over time, though, the programs proved themselves more error-proof than the humans. The woman left Goldman. And then Chou himself created a new program that logged into all the trading systems and pulled everything into a single screen. When he first got it going, he remembers his boss, a programmer himself, turning to Chou and saying, "I don't even know why I show up to work anymore."

'I'm pretty sure there are going to be new jobs 10 or 20 years from now that none of us could even imagine today.'

The software Chou designed made it possible for him to dedicate himself to higher-level work, researching new trading strategies for the computers. This was more satisfying than all the monitoring he had been doing, but eventually it became too repetitive as well. Chou left Goldman in 2010 for Silicon Valley and now runs LedgerX, an options exchange that he founded with his wife and two others. The team he left at Goldman was smaller than it was when he arrived.

Over the course of my conversations with Nadler, he backed away from the notion that Kensho will destroy jobs at Goldman itself. But he said he had no doubt that Kensho and other financial start-ups would eliminate jobs as they expanded across the industry and that the pace of the losses would be much faster outside Goldman than inside. After the end of Goldman's period of exclusivity with Kensho last summer, Nadler signed contracts to roll out the software at JPMorgan Chase and Bank of America.

The number of jobs that these banks will support in the future will be influenced by much more than just software. Banks are currently cutting back in response to slower-than-expected economic growth and new regulations since the financial crisis. But these factors are also encouraging all the banks to look for any place where they can find a cheaper and more transparent way to do jobs that are currently being done by expensive and unreliable humans.

When I asked Chavez whether the job losses were likely to continue to outpace the gains, he reacted with what seemed like genuine uncertainty. "That is one of the most interesting questions of our time," he said.

Carl Benedikt Frey, the lead author of the 2013 study on automation, has done more recent research indicating that innovations are no longer providing as big a boost to the economy and the labor force as they did in the past. In a paper he published last year with Thor Berger, a Swedish academic, he found that in the 1980s, a large portion of the American work force was going into job categories that did not exist a decade before; IBM, in other words, was hiring. That movement, though, slowed down in the '90s and went practically to zero between 2000 and 2010. To the degree that there are new jobs, Frey's data suggests that they are often lower-paying ones that serve the wealthy elite, in roles like personal trainer or barista.

“Technology is becoming more labor-saving and less job-creating,” Frey said.

One theory for why this might be happening is that many of the recent technological advances have been in software rather than hardware. While a company like IBM or Dell needed employees to build each new computer for every new customer, software like Facebook and Kensho can be replicated endlessly, at near-zero marginal cost. When Chou came up with the software that automatically logged onto dozens of trading systems, it could essentially have been rolled out across all of Goldman’s trading desks around the world the next day. This is very different from the 1970s, when Detroit would need to retrofit its car-manufacturing plants one at a time, after the robots themselves were actually built. The difference is what convinced Chou, after his time at Goldman Sachs and in Silicon Valley, that this phase of automation would play out differently from past ones.

“We are not coming up with new jobs as fast as we are replacing them,” Chou told me.

This observation appears to be borne out by Kensho. In less than three years, Nadler’s company has expanded to serve three of the world’s largest banks and has needed only around 50 employees to do so, just enough to fill two relatively small offices. Recently, Nadler’s New York staff moved to a bigger office in 1 World Trade Center. It has more room for desks so that Kensho can expand. But most of the additional space is taken up by a kitchen, a pool table and a putting green.

The growth has made Kensho worth hundreds of millions of dollars and turned Nadler into a millionaire many times over, at least when his stake in the company is taken into account. But it’s not clear how beneficial his company will be to the American labor market as a whole. Back when I first met Nadler, for a lunch last summer, he wasn’t too proud to admit this. “The cynical answer that another tech entrepreneur would give you is that we’re creating new jobs, we’re creating technology jobs,” he told me. “We’ve created, on paper at least, more than a dozen millionaires.

“That might help people sleep better at night,” he continued, “but we are creating a very small number of high-paying jobs in return for destroying a very large number of fairly high-paying jobs, and the net-net to society, absent some sort of policy intervention or new industry that no one’s thought of yet to employ all those people, is a net loss.”

Nathaniel Popper is a financial reporter for The Times and the author of “Digital Gold: Bitcoin and the Inside Story of the Misfits and Millionaires Trying to Reinvent Money.”