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ValueInvestor INSIGHT

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By the Numbers

The proliferation of data and our enhanced ability to process it should be top-of-mind phenomena for all investors. They certainly are for Arjun Jayaraman, who describes how he fuses his quant-based approach with a human touch.

INVESTOR INSIGHT

Arjun Jayaraman
Causeway Capital Management

On judgement: "To exploit a market anomaly in the future there must be a dependable reason why it exists. Understanding that often requires human judgement."

Editor's Note: *It's comforting to a degree that Arjun Jayaraman, the head of the quantitative research group at Causeway Capital Management, sees a world where human judgement is removed entirely from the investment process only in the far-distant future. "You'll hear people describe machine learning as just a small step away from artificial intelligence, when the computer is learning everything it needs and adjusting strategy and execution entirely on its own," he says. "That could very well be in the future, but now I'd put it more in the realm of science fiction."*

Jayaraman, who holds a Ph.D. in Financial Economics from New York University, is focused on using the increased availability of data and ever-increasing computer processing power to improve Causeway's fundamental and quantitative investing efforts. He's also the lead manager for the firm's $7 billion (assets) emerging-markets strategy, whose main product, the Causeway Emerging Markets Fund, has earned over the past ten years a net annualized 4.8%, vs. 4.1% for the MSCI Emerging Markets Index. We spoke recently with Jayaraman from his office in Los Angeles about his approach to quantitative investing and some of the lessons he's learned as a pioneer in the field.

Forgive the basic level of the question, but can you start out by explaining your mandate as the head of quantitative research?

Arjun Jayaraman: We have two broad areas of focus. We manage quant-focused funds where the execution of the strategy is much more model-dependent than for a fundamentally managed fund. There's still a great deal of human intervention around the factors used to identify undervalued stocks and the weightings attached to those factors, but the stock selection and portfolio management are more numbers-driven and systematic. We hope that takes subjectivity that can cause problems out of the process.

We also support our fundamentally focused funds with quantitative tools. At the front end we provide quantitative screens and on the back end we provide a multi-factor risk model.

In terms of data research, what are some examples of things you're doing?

AJ: One area of research into big-data sources is focused on analyzing sentiment from social-media data, specifically Twitter. We understand there is quite a lot of "noise" in tweets, but when aggregated we believe they can represent a timely poll of popular opinion. We haven't found it helpful yet with respect to individual stocks, but one promising application of the analysis of that kind of data is around elections, referendums and other cases where popular opinion can determine the outcome. If that outcome is important in some way to informing portfolio decisions, that can be useful information.

Our first foray into predicting election results using Twitter data was during India's 2019 parliamentary election. India is the fourth-largest market in the MSCI Emerging Markets Index and our emerging-markets fund was over-weighted to the index. Our thesis was that if Prime Minister Narendra Modi's Bharatiya Janata Party (BJP) maintained its slim majority in India's Parliament, that was a positive for the economy and would result in continued market-friendly legislation. That had been the case during Modi's administration so far, during which the Indian equity market had outperformed the index.

The 2019 election was held over six weeks between April 11th and May 19th, and public-opinion polls raised considerable doubt that the parliamentary majority would be sustained. To develop a Twitter-based sentiment measure, we began by retrieving all tweets that included certain keywords related to the election and political parties. We then filtered out tweets of non-Indian users and media outlets (both non-voters), tweets from recently created accounts (users with agendas), tweets from accounts with few followers ("zombie" users), tweets with too many hashtags (attention seekers), and tweets from users who tweet excessively (likely bots). We then hired a group of Indian nationals to go through 10,000 tweets and, using their

local knowledge, to classify them depending on which candidate/party the tweet supported. We used this sample to "train" a machine-learning model that sorted future tweets. Even after filtering, the model processed over one million tweets in March and April alone from over 320,000 users. The results of this analysis actually showed much more consistent and overwhelming support for Modi's coalition than public-opinion polls were suggesting.

Along with other factors in our quantitative model, this analysis helped give us confidence to remain overweight India in our EM strategy as the election drew near. As it turns out, the BJP-led alliance won in a landslide victory. Since the election, we've continued to monitor Twitter feeds to gauge the potential for surprises in other high-profile elections. We're also investigating ways to apply Twitter analysis to other types of political events, such as Brazilian pension reform, as well as sentiment around consumer products.

As an example of how human judgement still comes in, you decided going in that the continuation of Modi's coalition would be a positive for the economy and market. Are you still comfortable with that?

AJ: You're right that there is subjectivity involved in concluding his approach is the more business-friendly. While the economy has slowed, in part due to reforms of his that have negatively impacted short-term growth, we do believe his initiatives overall will benefit business activity and the market over the long term.

Tell us about your effort to glean information from mobile-app usage data in China.

AJ: Given the increasing importance of the Internet cohort in China in our portfolio and the emerging-markets benchmark, we're always trying to improve our tools for analyzing this group of stocks, which includes large holdings like Tencent [HK: 700] and Alibaba [BABA]. We came across a very interesting dataset from a company that designs smartphone apps and can track data across all the apps used by phones on which its apps are installed. While that may be pushing the envelope when it comes to privacy in the U.S., in China it's all O.K., so we can get real-time access to data on app usage from the company's 1.3-billion installed user base.

This particular data source allows us to link specific app usage to its corporate owner – including data on market penetration, daily average users and the frequency and time spent on the app – from which we can then try to extrapolate its financial performance. To test the efficacy of the metrics, at each month-end we formed a long portfolio by taking the top quintile of stocks sorted by each metric's month-over-month percentage growth and formed a short portfolio with the bottom quintile. Rebalancing the portfolios monthly, we back-tested the cumulative returns for a three-year period from 2016 to 2019.

While we recognize the data series is short, we found this type of data had significant information content related to financial performance and stock-price returns. To check that, we discussed the results at length with our fundamental information-technology analysts, who gave credence to such information providing a causal link. Starting last year we added these mobile-app usage statistics as a factor in our assessment of relevant Internet-related stocks.

Describe the stock selection and portfolio-management aspects of what you do.

AJ: We analyze our investment universe through four groups of factors, based on inputs related to value, to growth, to momentum and to the relevant macroeconomic environment. Our value factors are things like P/E multiples, EV/EBITDA mul-

Processing Power

Computers do the heavy lifting for the Causeway Emerging Markets Fund managed by Arjun Jayaraman. Selected on a variable combination of value, growth, momentum and macroeconomic "factors," here are the fund's top holdings based on their portfolio weight relative to a benchmark MSCI index.

Company	Ticker	Industry	Share Price @ 2/26/20	52 Week Low	52 Week High	Active Weight	Rationale
China Construction Bank	939:HK	Banking	6.32	5.55	7.21	1.9%	Valuation
Samsung Electronics	005930:KS	Consumer Electronics/Semiconductors	56,500	40,850	62,800	1.9%	Valuation, Earnings Growth
Lukoil	LKOD:LI	Oil & Gas	95.46	74.64	110.10	1.5%	Momentum, Earnings Growth
Investimentos Itau	ITSA4:BZ	Banking	12.07	11.02	14.38	1.5%	Macro, Momentum
JBS	JBSS3:BZ	Food	23.51	12.80	34.25	1.3%	Valuation, Earnings Growth
Tencent	700:HK	Interactive Media & Services	399.60	312.20	420.00	1.1%	Earnings Growth, Sector
Ping An Insurance	2318:HK	Insurance	88.20	80.40	101.00	1.1%	Valuation
Anhui Conch Cement	914:HK	Construction Materials	55.50	41.30	61.10	1.1%	Valuation, Earnings Growth
Sberbank	SBER:LI	Banking	15.31	12.10	17.59	1.1%	Momentum, Currency
Gazprom	OGZD:LI	Oil & Gas	6.83	4.47	8.50	1.0%	Valuation, Momentum

Source: Causeway Capital Management, as of January 31, 2020

Notes: (1) Share prices in local market currency, except for Lukoil, Sberbank and Gazprom, which are listed in US$; (2) Active Weight = Portfolio weight – MSCI Emerging Markets Index weight

tiples and price to book value. Our growth factors are more related to upgrades and downgrades in consensus estimates, but also include alternative data like the app-usage information I described. Momentum looks primarily at six- and 12-month share-price momentum, adjusted for risk. Finally, in the emerging-markets fund, we look at macroeconomic factors primarily by country, including data on things like GDP growth, current-account surplus and the slope of the yield curve.

Within each factor bucket, we use multivariate regression and other techniques to weight the factors optimally based on historical experience. Across the factor groups, we use a contextual-weighting scheme based on whether a stock exhibits more value or growth characteristics and based on long-term historical returns. For example, each stock is weighted 25% on the macroeconomic factors, but for a "value" stock like Gazprom [Moscow: GAZP] the remaining 75% weighting would be split roughly two-thirds based on value factors and one-third based on growth and momentum. For a growth stock like Alibaba, again, 25% would be macroeconomic, but two-thirds of the remainder would be based on the growth factors and one-third on value.

The output of the model is a ranking based on the relative attractiveness of each stock based on expected return relative to the entire universe. From there we'll collaborate with our fundamental analysts to review the quantitative output to try to identify and address any special issues – such as recent corporate actions or management changes – which are difficult to detect quantitatively. Another recent example of what might get flagged is something like an increasing concern over non-performing loans at Chinese banks. These banks look very cheap based on our models, but our bank analyst suggests that we be more cautious on credit quality and only consider higher-quality names.

How does your model ranking turn into a portfolio of stocks?

AJ: We use a mathematical optimizer tool to build portfolios, using our extensive risk model as well as a number of constraints based on target number of positions, position sizing, sector and country exposures, and variance at the stock level to the benchmark weight. The result is a portfolio of roughly 135 stocks whose position sizing – given the constraints applied – reflects the risk-adjusted return potential of each holding.

One constraint is that you restrict individual position sizes to plus or minus 2% of their weight in your benchmark. Why?

AJ: We want to limit idiosyncratic risk. We're not big believers in a quant strategy in taking make-or-break types of positions. That's particularly the case for emerging markets, where frauds are more prevalent, economies are potentially more volatile and companies are potentially less established. We want to benefit from active stock-picking without taking what we believe is undue risk at the individual stock level.

How actively do you trade?

AJ: We typically rebalance about once a month, but if something has had a big move up or down we'll look at that in the interim to determine if we should take any action earlier. The rebalancing often isn't particularly dramatic – portfolio turnover for the emerging-markets fund is in the 40-50% annual range.

Where is your model finding particular opportunity today?

AJ: The best indicator of that would be our active weight on a stock, which is the positive variance between our position size and the stock's weight in the benchmark. If you look at our current top-ten active weights [*see table, p. 22*], it's a fairly eclectic mix. Three of the stocks – Gazprom, Lukoil [Moscow: LKOH] and Sberbank [Moscow: SBER] – are in Russia, which despite the geopolitical issues is scoring well from a macroeconomic perspective. Two are in Brazil – Investimentos Itau [Sao Paolo: ISA4] and JBS [Sao Paolo: JBSS3] – which has shown some fairly good equity-market momentum after the election of Jair Bolsonaro as President in the latter part of 2018. In China we hold good-sized growth-oriented positions like Alibaba and Tencent, but our higher active weights are in more value-oriented names like China Construction Bank [Hong Kong: 939], Ping An Insurance [Hong Kong: 2318] and Anhui Conch Cement [Hong Kong: 914].

One of your department's recent reports said, "Contrary to popular opinion, the explosion of data has made the role of human judgment more important than ever." Why so?

AJ: There are a variety of reasons. Most big-data sources are largely unstructured, so it takes much more effort and judgement to format and "clean" the data for analysis by removing sources of bias and outliers. With advanced computational techniques such as machine learning, they can uncover patterns in historical data, but they are less effective at identifying the rationale for those patterns. To exploit a market anomaly consistently in the future, there must be a dependable reason – usually risk-based, behavioral-based or structurally-based – why it exists. Without understanding the reasons, which often requires human judgement, you can end up giving credence to spurious and counter-intuitive historical data relationships.

We firmly believe that using new and different data and the improved means for processing it will be increasingly important for all active investors. But human judgement and investment intuition is still very much required to use all of that effectively. The day when that isn't the case is still a very long ways off.

Your judgement results in your weighting value-based factors more highly in your EM strategy. Has market behavior in recent years caused you to question that?

AJ: While ours is not a pure value strategy, if you look at the characteristics of our

portfolio it looks much more value than growth. Our portfolio is cheaper than the benchmark on forward P/E. It's cheaper than the benchmark on price to book value. Returns on equity are higher. The dividend yield is higher. So it hasn't helped us that value-based strategies have had a tough time of it relative to growth and/or momentum strategies.

We always discuss the relevance and appropriateness of our model factor weightings. But we're looking at long data series, and we don't think it's smart to load up on growth factors just because they've done very well over several years. You'd be increasing your exposure to something that's had a ten-year bull run. That's something from a common-sense perspective we don't want to do. VII

To determine if the Causeway Emerging Markets Fund is an appropriate investment for you, carefully consider the Fund's investment objectives, risk factors, charges and expenses before investing. Please read the summary or full prospectus carefully before you invest or send money. To obtain additional information including charges, expenses, investment objectives, or risk factors, or to open an account, call 1.866.947.7000, or visit us online at www.causewayfunds.com.

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As of 12/31/ 2019, the Causeway Emerging Market Fund Investor Class had a total return of 16.39% for 1 year, 3.94% for 5 years, and 4.51% for 10 years. The Fund's gross expense ratio is 1.41%. *The performance date quoted represents past performance. Past performance is no guarantee of future results. The investment return and principal value of an investment will fluctuate so that an investor's shares, when redeemed, may be worth more or less than their original cost and current performance may be lower or higher than the performance quoted. For performance data current to the most recent month end, please call 1.866.947.7000*

As of January 1, 2020, the top ten holdings of the Causeway Emerging Market Fund were Tencent Holdings Ltd.- 5.66%, Alibaba Group Holding – ADR- 5.64%, Samsung Electronics Co., Ltd.- 5.48%, Taiwan Semiconductor Manufacturing Co., Ltd. – ADR- 4.70%, China Construction Bank Corp.- 3.32%, Ping An Insurance Group Co Of- 2.12%, Lukoil – ADR- 1.99%, Investimentos Itau- 1.94%, Gazprom PJSC – ADR- 1.92%, and Sberbank – ADR- 1.81%. Holding are subject to change. Holdings are subject to risk.