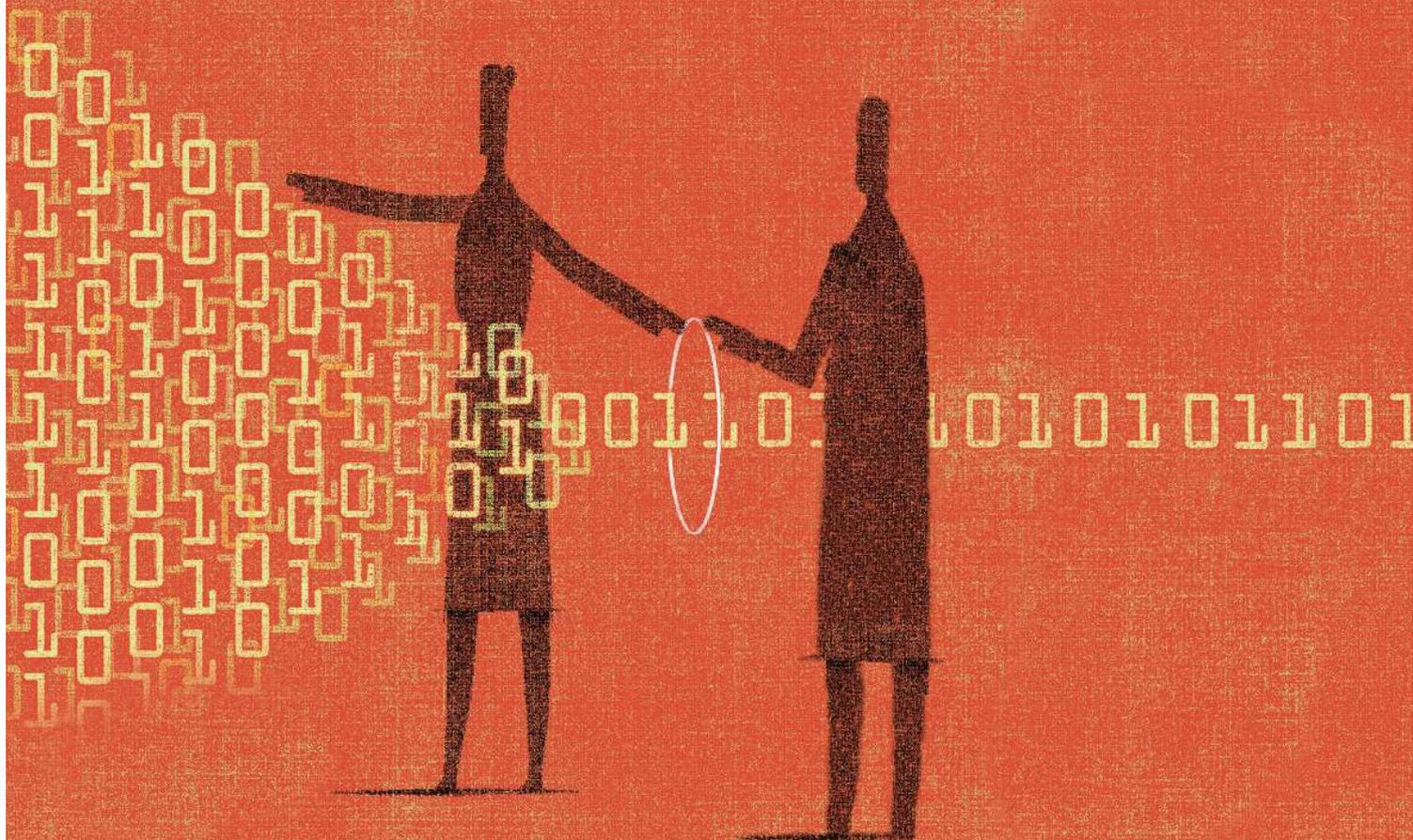


SEPTEMBER 2019

Digital innovations— pinpointing fixed income credit risks

FRANKLIN TEMPLETON THINKS™

FIXED INCOME MARKETS



In this Issue

In today's world of new technologies, it's easy to grasp how digital innovations touch our personal lives. We can order groceries with a simple voice command, leave tips with our phone, or apply for online loans without leaving our couch. Less obvious are the ways data science and digital analytics have transformed the methods some asset managers use to analyze risks and generate returns.

Mind you, the goal of risk analysis isn't to avoid risks. On the contrary, generating positive returns over cash requires taking some risks. The chief job of a fixed income manager involves distinguishing which risks are more likely to pay off for investors versus those that probably won't. In this article, we examine how machine learning techniques can measure the risks of consumer and home loans—helping pinpoint credit risks we think are worth taking.

Key takeaways

- We start by reviewing a relatively new asset class: digital loans. Across the globe, consumers are accessing loans from online vendors. Using predictive algorithms—statistical modeling techniques that forecast outcomes—we can quickly analyze thousands of loans to spot ones that we believe offer better risk profiles.
- We explain why data science on its own isn't a panacea for gauging risks or constructing multi-sector fixed income strategies. Without the practical experience of managing fixed income through different market regimes, data-driven analytics in isolation can lead investment managers astray.
- Quantitative approaches may be more applicable to some fixed income sectors than others. We examine one of the world's largest fixed income markets—US residential mortgage loans—and explain how data science can be used to analyze the impact a hurricane can have on securitized mortgages containing thousands of loans.

Don't worry, machines are watching you

Algorithms written in computer code are ever-present these days, predicting our behaviors. Some forecast how we're likely to vote, while others anticipate our next purchase on websites like Amazon or Taobao in China. If you've used a credit card recently, it's a certainty that computers are analyzing all your transactions. Not necessarily to send you tailored marketing promotions, but for your protection.

Credit card companies like Visa and Mastercard use machine learning tools to stop fraudulent charges that you might otherwise be obligated to pay.

By monitoring your charges, self-improving algorithms can pinpoint suspicious patterns much faster and cheaper than humans can. Exposure to fraud is a risk many of us are glad to avoid. Mastercard even has biometric technology that can track your unique patterns of typing or scrolling to spot someone who isn't you.

Machines aren't just analyzing your spending or scrolling patterns, however. Advanced algorithms can also measure your creditworthiness—the likelihood you'll pay back a loan—often with greater predictive accuracy than rudimentary credit scores like “SCHUFA” in Germany or “FICO” in the United States. These algorithms have given

technology upstarts a leg up over traditional banks, many of whom still rely on one-dimensional credit scores. In emerging economies, these credit-scoring algorithms are a boon for millions of small businesses and consumers for whom brick-and-mortar banks are still out of reach.

A new frontier—digital loans

Consider the fact that a large portion of Latin America's population still lives without a bank account or credit cards, and largely gets by on cash. A big hurdle for cash-based entrepreneurs is that traditional banks won't issue loans without a history of verified bank transactions. That's where digitally

sophisticated companies like MercadoLibre step into the picture.

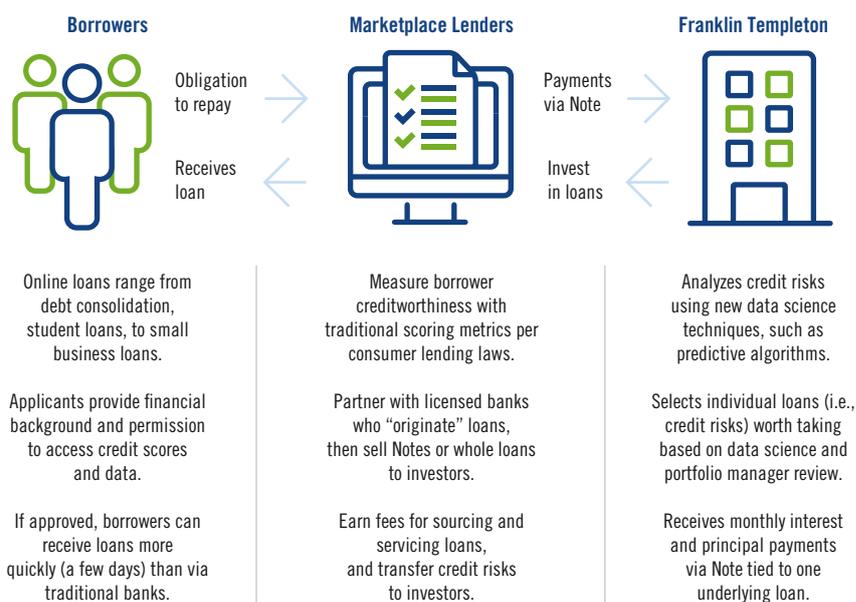
MercadoLibre operates online marketplaces, much like eBay and Amazon, that serve 249 million customers throughout Latin America.¹ By applying predictive algorithms to the vast quantities of data it collects from its online merchants and shoppers, MercadoLibre offers digital loans to consumers and budding entrepreneurs whom many local banks still largely ignore.

Digital loans are also widespread in China. Ant Financial—the financial technology division of China’s retailing giant Alibaba—has itself issued US\$95 billion in consumer loans, largely by using big data and algorithms to measure consumer creditworthiness.² A shopper browsing large-screen TVs in Shanghai, for example, can apply for a loan simply by scanning their phone at a retail register. Within minutes, Ant Financial calculates their credit score from data in the cloud. If approved, the shopper can leave with a new TV despite never having had a bank account or credit card.

In developed economies like the United States and United Kingdom, digital loans have grown rapidly over the past decade, partly in response to the financial crisis of 2007–2008. If traditional banks were reluctant to extend credit after the financial crisis, digital lenders were already primed to step in and pick up the slack. Zopa, which has the distinction of being the first online peer-to-peer lending service, was launched in 2005 in the United Kingdom. In the United States, Prosper was founded in 2006 and LendingClub, which began as a Facebook application, launched in mid-2007. The US Treasury expects annual digital loan originations in the United States could reach US\$90 billion by 2020.³

CONNECTING SMALL-SCALE BORROWERS WITH LARGE-SCALE INSTITUTIONAL INVESTORS

Exhibit 1: Overview of marketplace lending



Source: Franklin Templeton, for illustrative purposes only.

For borrowers, the key attraction of a company like LendingClub is the simplified, online application process and near-instant loan decision generated by algorithms in the cloud. We like LendingClub for two reasons: First, it generates a large quantity of digital loans—in 2018, LendingClub originated US\$10.9 billion of loans.⁴ Second, asset managers can pick and choose the loans they think offer the best risk and return profile based on their own credit analysis. By building a portfolio of digital loans one-by-one—the average LendingClub loan size is US\$16,671—an asset manager can bypass some of the fees and constraints that come with pre-packaged securitized loans.⁵ However, for loans of this size, institutional asset managers need to utilize machines to analyze credit risks.

The role that we and marketplace lenders, like Prosper and SoFi, play in this digital loan process is illustrated in Exhibit 1. After sourcing and vetting borrowers through their websites, many marketplace lenders turn to banks

which are licensed to “originate” the loans. They then sell the loans to investors like Franklin Templeton in the form of a “Note,” or in whole loan form. In the case of the former, the Note directs payments to institutional buyers based on the performance of the underlying loan. By purchasing these Notes, we agree to take on the borrower’s credit risk in exchange for interest and final principal payments.

So, how do we analyze the risk of borrower defaults across thousands of small consumer loans? Not with a large pool of human credit analysts, but by using a proprietary algorithm utilizing hundreds of factors sourced from data in the cloud.

A case study—seeing the forest for the trees

Using large data sets in the cloud, we’ve coded a type of algorithm that uses a random decision forest to go far beyond rudimentary credit scores, like FICO, which analyzes metrics like loan payment history, total debt and types of

credit. Combing thousands of social and economic variables (e.g., a borrower's geographic region) across millions of observations, this proprietary algorithm forecasts likely defaults and expected returns with more granularity and speed than human analysts can process.

Individually, each data point may not have much predictive power—they are quite weak signals. It's by combining seemingly unrelated signals that our algorithm can see the forest from the trees—measuring a borrower's credit-worthiness more accurately than FICO scores can, as shown below in Exhibit 2. In this example, the random decision forest algorithm and its extensions determined a borrower from Ohio seeking a loan to consolidate their debt offered a better credit profile compared with a California borrower with a higher FICO score.

The promise and pitfalls of data science

Given our data-abundant world, we know data science and machine learning tools can help us make smarter investment choices. However, we don't think algorithms by themselves

are a panacea for generating strong risk-adjusted returns. That's particularly true for the fixed income markets we operate in. Purely quantitative bond strategies have had limited success compared with some factor-based equity approaches that pick stocks based on metrics like momentum or value.

We believe data science enhances our fixed income investment process, but it doesn't replace the need for qualitative skills and the judgment of seasoned portfolio managers, fundamental research analysts and sector specialists. In our view, unaccompanied algorithms can have difficulty separating meaningful signals from noise. In some situations, they can point to false conclusions based on spurious correlations.

Consider the recent yield curve hysteria. Albeit a non-algorithmic indicator, it's gotten a lot of attention in the financial press. Some insist an inverted yield curve is a foolproof predictor of a recession. We don't see it that way. We've examined the strength of the underlying economic data and based on our judgment, determined the yield curve is

simply signaling a dovish US Federal Reserve and some panic in the markets.

In the end, we think predictive signals (algorithmic or otherwise) require specialized judgment that's grounded in specific fixed income sectors, and an appreciation for shifting macro regimes. Machine learning is certainly a powerful ally, but it needs to be complemented by human experience.

Analyzing over a million home loans rapidly

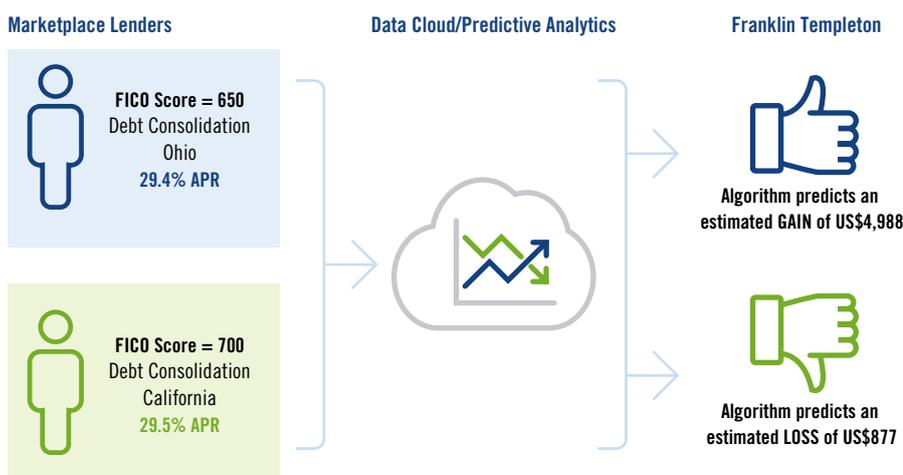
Data science has broader applications beyond digital consumer loans. It's also central, for example, to US agency mortgage-backed securities (MBS)—one of the world's largest and most liquid fixed income markets after US Treasuries.

One quality global investors find attractive about Agency MBS is that the underlying home loans are backed by Fannie Mae and Freddie Mac—two US government-sponsored enterprises (GSEs). They effectively absorb the credit risks if underlying homeowners default on their loans. In the wake of the 2008 financial crisis, the US government decided to transfer some MBS credit risks away from US taxpayers and into capital markets through credit risk transfer (CRT) securities. From their inception in 2013 through the end of 2018, CRTs have transferred credit risks on approximately US\$2.8 trillion in single-family loans to institutional investors and away from the agencies themselves.⁶

Similar to unsecured digital loans, CRT investors receive a Note that delivers monthly payments, and principal can shrink if borrowers default on their loans. Unlike digital loans, however, CRTs are tied to mortgage pools that can contain 100,000 individual

BEYOND A SINGLE FICO SCORE

Exhibit 2: Translating many data points into an investment element



It takes three skills to tango

When asked to categorize the human skills that feed into a quantitative process that's guided by fundamental analysis, we see three skill sets as shown in Exhibit 3:

- 1) engineered data in the cloud,
- 2) tailoring algorithms to solve distinct puzzles, and
- 3) qualitative insights across multiple fixed income sectors.

INTEGRATING SKILLS FOR FIXED INCOME DECISION MAKING

Exhibit 3: The intersection of science, data and expertise



1. Big data engineered in the cloud

The investment process starts with large sets of data stored in the cloud. This requires an engineering mindset that's quite different from bottom-up corporate credit analysis or understanding macro-economic cycles. By knocking down data silos, engineers can provide smoother access and movement between data so programmers can blend data for downstream analytics. Given the large quantity of information, big data processing tools are necessary to upload information (the size easily dwarfs the capacity of programs like Microsoft Excel®) along with machine learning techniques to fill in the gaps. Data that isn't properly organized and curated is far less useful.

2. Tailoring algorithms

Once the data is properly organized, scrubbed and accessible, data scientists work alongside portfolio managers to code programs to answer specific questions across different sectors. For example, working with a dataset of single-family residential mortgages, a data scientist might use a regression algorithm to calculate future home prices. If a manager simply wants to know if future prices will fall above or below

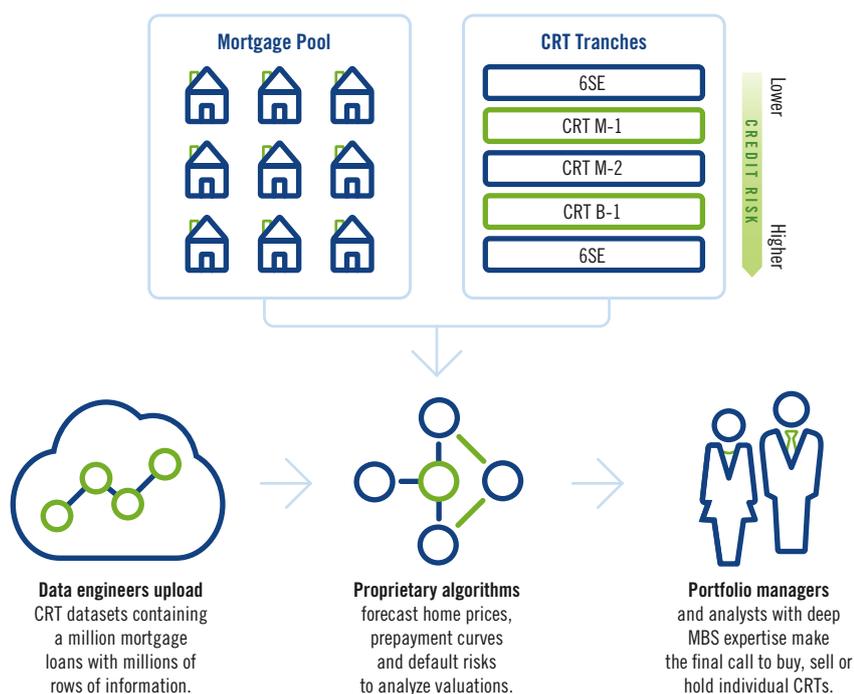
an average expected price, a classification algorithm could make better sense. Understanding coding and the taxonomy of machine learning algorithms is critical to pulling useful insights out of data.

3. Qualitative insights across sectors

With help from engineers and data scientists, portfolio managers have more time to spend on the things they like doing best—making qualitative decisions based on years of investing experience in a particular sector. Programs that take over repetitive tasks like building intricate cash flow models free up time for analysts to tackle problems computers can't solve. For example, is a new data-driven insight telling us something new that needs further exploration, or is it simply a red herring? It takes human intuition and the judgment of an experienced portfolio manager to make that call. At the end of the day, sound investment decisions still require practical human experience. With data science, these decisions simply have more horsepower.

ANALYZING OVER A MILLION HOME LOANS WITH DATA SCIENCE

Exhibit 4: Overview of Credit Risk Transfer (CRT) process



Source: Franklin Templeton, for illustrative purposes only.

loans, as illustrated in Exhibit 4 above. CRT investors must accept the combined risks of the entire pool, or none at all.

Analyzing credit risks across a large pool of mortgage loans is better suited to machines than human credit analysts. For starters, a speedy analysis is important since CRTs trade over-the-counter—a buyer may have a day, or even just one hour, to evaluate the risks before another buyer makes an offer. Data engineers regularly upload CRT datasets containing over a million mortgage loans with millions of rows of information. Then, proprietary algorithms can analyze a range of factors at the individual loan level in minutes instead of days, including

expected home price appreciations, and prepayment and default risks as well as pricing and valuation.

A case study—measuring natural disasters

When it comes to home loans, natural disasters like earthquakes and hurricanes deserve special scrutiny, because the average homeowner insurance doesn't cover these catastrophic events. Depending on a hurricane's landfall location and the intensity of the storm, for example, CRT investors can see dramatic spikes in delinquencies and defaults. It's worthwhile reviewing how we've analyzed these catastrophic risks in the past.

Prior to 2017, only a few major hurricanes (e.g., Katrina and Sandy) impacted the US housing market, with very little damage on the underlying homes within our CRT securities. That changed in 2017, when three hurricanes (Harvey, Irma and Maria) produced one of the costliest US hurricane seasons on record. Harvey alone damaged or destroyed over 200,000 homes in the Houston, Texas, metroplex.⁷

As soon as Harvey made landfall, we were able to instantly calculate potential losses of our CRT holdings, based on the home locations in our datasets. Our analytics told us the financial damage would be relatively mild. The market, however, reacted differently, with lower-rated CRT tranches selling off drastically. Confident our analytics were sound, our MBS portfolio managers took the opportunity to increase exposure to some oversold CRT tranches.

The art and science of managing bond portfolios

For digital loans, data science doesn't just offer an enhanced method of risk analysis, it also helped create a new investable asset class. Integrating new methods of data science across multi-sector portfolios potentially can enhance outcomes for our clients. But the approach still requires the judgment of portfolio managers, who can blend macro views across shifting regimes, with bottom-up insights gleaned from years of experience in specific sectors like MBS. Predictive algorithms don't offer a panacea, but in our view they are the next phase in advanced asset management.

Endnotes

1. Source: MercadoLibre FactSet consensus estimate 2018. See www.franklintempletondatasources.com for additional data provider information.
2. Source: Kwan, A. "Ant Financial Consumer Lending Reached \$95 Billion," *Bloomberg News*, 12 March 2018.
3. Source: US Department of the Treasury, "Opportunities and Challenges in Online Marketplace Lending," 10 May 2016.
4. Source: LendingClub full year financial statement for 2018.
5. Source: Porter, K. "LendingClub Personal Loans: 2019 Comprehensive Review," *Bankrate*, 7 August 2019.
6. Source: US Federal Housing Finance Agency, "Credit Risk Transfer Progress Report," Fourth quarter 2018.
7. Source: D. Hunn, M. Dempsey, and M. Zaveri. "Harvey's floods: Most homes damaged by Harvey were outside flood plain, data show," *Houston Chronicle*, 30 March 2018.

Franklin Templeton Thinks: Fixed Income Markets highlights the team's ongoing analysis of global economic trends, market cycles and bottom-up sector insights. Each quarterly issue spotlights the team's thinking on different macro forces, and particular sector views that drive our investment process.

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The Franklin Templeton Fixed Income Group

Franklin Templeton has been among the first to actively invest in many sectors of the fixed income markets as they have evolved—covering corporate credit, mortgage-based securities, asset-backed securities and municipal bonds since the 1970s, international fixed income since the 1980s and bank loans since the early 2000s. Over 170 investment professionals globally support the

portfolio managers, who oversee more than US\$169 billion in assets under management. Being part of an established investment group at Franklin Templeton gives the portfolio managers access to experts across different areas of the fixed income market, helping them to diversify opportunities and risks across multiple sectors.

Our global reach through Franklin Templeton Investments provides access to additional research, trading, and risk management resources. Portfolio managers have opportunities to exchange insights with other investment groups, and collaborate with an independent risk team that regularly examines risk analytics to help identify and address areas of excessive risk exposure within our portfolios.

WHAT ARE THE RISKS?

All investments involve risks, including possible loss of principal. Bond prices generally move in the opposite direction of interest rates. The price and yield of a MBS will be affected by interest rate movements and mortgage prepayments. During periods of declining interest rates, principal prepayments tend to increase as borrowers refinance their mortgages at lower rates; therefore MBS investors may be forced to reinvest returned principal at lower interest rates, reducing income. A MBS may be affected by borrowers that fail to make interest payments and repay principal when due. Changes in the financial strength of a MBS or in a MBS's credit rating may affect its value. Special risks are associated with foreign investing, including currency fluctuations, economic instability and political developments. Investments in emerging markets involve heightened risks related to the same factors, in addition to those associated with these markets' smaller size and lesser liquidity. Investments in fast-growing industries like the technology sector (which historically has been volatile) could result in increased price fluctuation, especially over the short term, due to the rapid pace of product change and development and changes in government regulation of companies emphasizing scientific or technological advancement.

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