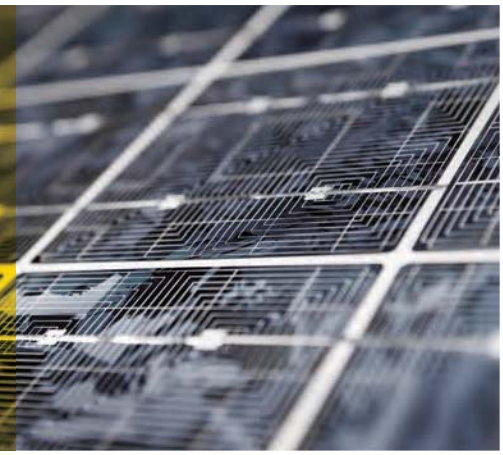


A First Perspective: The Transformational Influence of "Big Data" on the 21st Century Global Financial System

Jack Malvey, CFA,
Chief Global Markets Strategist
and Director of
BNY Mellon Center for Global
Investment and Market Intelligence

Ashish Shrowty
Managing Director
BNY Mellon Corporate Technology

Lale Akoner
Investment Analyst
BNY Mellon Center for Global
Investment and Market Intelligence

This essay defines big data, highlights its vast potential, acknowledges its limitations, sketches its transformational influence on the 21st century global financial system.

EXECUTIVE SUMMARY

Big data has arrived. The cheering din grows louder. Supporting the idea of a monumental data-stimulated change ahead in many disciplines, especially finance, information flows are rising at an exponential pace. A Google search on April 15, 2013, for big data revealed a gargantuan 2.2 billion entries, shrunk by using an advanced filter to a "paltry" 30.2 million items. Big data conferences, books, and articles proliferate. This essay defines big data, highlights its vast potential, acknowledges its limitations, sketches its transformational influence on the 21st century global financial system, mainly from an asset management perspective, and lists key capital market inquiries that might be well addressed by big data methods.[1]

INTRODUCTION: "THE ACCELERATING EVOLUTION OF THE GLOBAL FINANCIAL SYSTEM"

Green eyeshade finance perished little more than a generation ago. A small group of grizzled veterans from the Great Depression still inhabited financial institutions as recently as the late 1970s. Performing more forensic archaeology on historical measures of economic and corporate vitality, these "statistical clerks" (as security analysts used to be known) were outfitted with pencils, spreadsheets, and adding machines the size of giant dictionaries in lieu of computers. These prototype modern capital-market soldiers engaged mainly in retrospective comparative analyses rather than forecasting. To satisfy the demand for prognostications, the illusion of forecasting was created by the manufacture of modified extrapolations of the past into the future. Like the medical and pharmaceutical fields, competition atomized research to cater to sponsoring institutions to the disadvantage of perhaps more rapid coordinated progress.

1 The authors would like to thank the following for their contributions and comments to this article: Charlie Dolan, Bryan Besecker, Perry Beaumont, Chip Dickson, Aram Flores, Tom Higgins, Pete Johnson, Gary Maier, Steve Nagourney, Fati Naraghi, Kishlaya Pathak, and Dexter Senft.

BNY MELLON

The past four decades wrought prodigious change to the practice, principles, and technology of finance. Monroe calculators replaced printed bond yield tables. In turn, computers quickly superseded Monroe calculators. Bloomberg terminals and broadcast financial media introduced near real-time simultaneous dissemination of important financial market information. High-frequency trading advanced into the machine realm via APIs (Application Program Interfaces), with client servers co-located next to exchange servers to expedite processing speed. Asset management and dealer scale ballooned. Quantitative methods blossomed beyond simple statistics to sophisticated models.

The past four decades wrought prodigious change to the practice, principles, and technology of finance.

Graduate programs in financial engineering began to sprout up in the in the early 1990s. Empirical analyses surpassed qualitative, subjective techniques. Investment and planning horizons both shortened (along with the burgeoning hedge fund industry) and extended for plan sponsors, endowments, and sovereign wealth funds. Globalization, disintermediation, and derivatization recast the financial system. Regulatory oversight converged more regionally than globally and could not fully keep pace with all the new products, new markets, and new techniques of the rapidly evolving global financial system. Many of the best and brightest students elected to pursue lucrative careers in finance over manufacturing, management consulting, science, medicine, law, and other professional fields.

Despite numerous welcome advances in economics and finance in the late 20th and early 21st centuries, the forecasting prowess of these social science disciplines has not been distinguished, as evidenced by the general capital market shock that greeted the arrival of the partially predictable "Great Recession" and the extended policy uncertainties as to how to best cope with its long aftermath. Like seismologists who can calculate the probability but not the timing of earthquakes, financial market prognosticators can articulate possible stresses but usually not their timing, magnitude, or implications. These shortcomings may be addressed in the 21st century.

Under the auspices of big data, substantial aid is on the way to better decipher and navigate the intertwined financial system realms of economics, regulation, corporate finance, asset management, risk, product innovation, insurance, technology, and marketing.

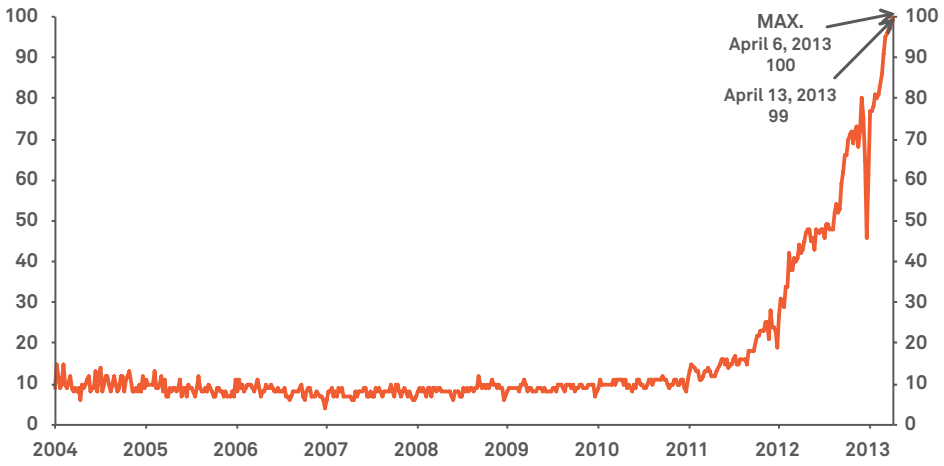
This early third millennium already has posted an impressive list of milestone scientific achievements. The human genome has been decoded (2001). Earth-like planets have been discovered in other solar systems (2007). The Higgs-Boson particle (2012) presumably has been confirmed.

And the best advances are yet to come, especially in better understanding and forecasting the path of the incredibly complex global financial system that serves the needs of more than 7 billion human beings currently populating approximately 200 nations. Under the auspices of big data, substantial aid is on the way to better decipher and navigate the intertwined financial system realms of economics, regulation, corporate finance, asset management, risk, product innovation, insurance, technology, and marketing.

As shown in Exhibit 1, world curiosity about big data has skyrocketed. Since mid-2012, big data has partially been credited with U.S. President Obama's re-election. And big data has been featured at the World Economic Forum in Davos in 2012 and the Council of Foreign Relations in 2013 as well as in such publications as *The Wall Street Journal,* the *Financial Times, The New York Times, Harvard Business Review, CFA Institute Magazine, Fortune, Foreign Affairs,* and spawned conferences around the world like "Big Data in Africa."[2] In addition to abetting actuarial methods, cosmological inquiries, meteorological predictions, unraveling quantum and criminology mysteries, aiding epidemiological studies, advancing life sciences, and expediting business logistics, these articles envision the construction of more accurate economic and business predictions as well as improved decision-making processes thanks to big data.

2 "Big Data: World Africa." Johannesburg, South Africa. October 24, 2012.

Exhibit 1 – Global Web Search Curiosity about Big Data, 2004 to April 13, 2013*



*Google insight data reflects total Google searches for "Big Data". The data is normalized and scaled with 100 being set as the maximum volume that the search results have yielded in the time frame shown. All other values are relative to the max volume of searches, for example, if the value in the chart has fallen from 100 to 50, the interest has halved.

Source: BNY Mellon using data from Google.

The swift amplification of the big data din may foster doubts by some seasoned capital market veterans. After all, evanescent market fads are common. And "catchy-phraseology hype" sells in futurology. False prophets of revolution litter the prediction landscapes of economics, capital markets, and technology. Recall the excessively enthusiastic expectations for fractal market analysis in the early 1990s as well as "B2B" and "e-commerce" in the late 1990s. For example, "horror of horrors," shopping mall obsolescence was presumed by the inevitable surrender by consumers to the glories of online shopping. But in our view, the forthcoming successful application of big data methods will disappoint jaundiced cynics.

The swift amplification of the big data din may foster doubts by some seasoned capital market veterans.

The concept of big data, including the search for regular signals to better predict the future, has been around since the dawn of humanity. Effectively, big data is simply a new name for an old and universal undertaking: the acquisition and application of new information confer competitive advantage throughout the economic system and speed progress in all fields.

But in our view, the forthcoming successful application of big data methods will disappoint jaundiced cynics.

Through history, these data surges are a series of stochastic jumps rather than continuous flows. And each can be characterized by a different source of information expansion. The seafaring "Age of Discovery" in the 15th and 16th centuries was predicated on new navigation information. The accumulation of data spurred the Scientific Revolution in the 15th-17th centuries, which in turn begot the Industrial Revolution of the 18th and 19th centuries. Under the tutelage of such business luminaries as Alfred Sloan, W. Edwards Deming, and Peter Drucker, modern corporate management came to rely upon the systematic acquisition and interpretation of new information. For decades, successful firms have set out to learn as much as possible about their political environment, customers, products, costs, and competitors. And all major sports now routinely prowl for fresh data-driven guidance on legitimate performance enhancement.

Despite exponential technological advance over the past century with attendant societal benefits, information harvests, information analyses, and information-based transformation of many institutional practices in financial services still remain in an adolescent phase in the early 21st century. Historical records have

not been fully converted into computer-manipulated forms and awaiting the installation of "new measurement sensors," the "datafication" of much pertinent financial market information has not been completed. To pick one field, the complete transcription of financial market reality into interpretative computer-friendly components lies over the long horizon. New analytical and visualization methodologies await invention.

Over the long run, big data may come to be viewed as the successor to the Internet in terms of revolutionary impact.

Over the long run, big data may come to be viewed as the successor to the Internet in terms of revolutionary impact. For financial markets, this implies the creation of a whole new set of questions, and original data-supported insights (see accompanying list of potential big data inquiries), and hopefully better performance. This shift may not be uniform. For cultural, ideological, and institutional purposes, full and even partial acceptance of new methods often varies and extends over many years. (In Hicks' *Capital and Growth*, these long-term processes are called "information diffusion" and "capital transmutation.")[3]

BIG DATA DEFINED

Introduced by NASA researchers Michael Cox and David Ellsworth in 1997[4] and popularized by various technology firms, especially IBM, big data can seem elusive. Poll five sources in search of a definition and expect five different replies.

Technology frames big data by the 3 Vs: Volume, Velocity, and Variety. Simply, the quantity, speed, and diversity of information flows are expanding at a geometric rate and thereby producing data to be analyzed and possibly to be acted upon.

Technology frames big data by the 3 Vs: Volume, Velocity, and Variety. Simply, the quantity, speed, and diversity of information flows are expanding at a geometric rate and thereby producing data to be analyzed and possibly to be acted upon.

Analytically, big data can be further framed by drawing a distinction between "insight generation" and "methodology."

As applied to financial markets and depicted in Exhibit 2, big data encompasses the following four main areas:

Insight Generation

- evaluating internal organizational data in search of "unrealized information" that enhances functional effectiveness (e.g., more precise calculation of internally generated cash flows by issuers to optimize timing of external financing)
- sifting external data in pursuit of new perspectives and "competitive gold" (e.g., national and local housing demand and supply data)

Methodology

- constructing new analytics and statistics (especially correlations) to uncover and to test the meaningfulness of heretofore "unrealized internal and external information" (e.g., acquiring a better understanding of performance and return attribution in a multi-asset class portfolio through comparative portfolio/index analytics)
- information can be made beautiful (e.g., see Edward Tufte's work[5]); developing new data visualization techniques that, in conjunction with novel analytics, reveal previously unknown insights about businesses and markets (e.g., fabrication of "efficient visualization ergonomics" to scan financial market data)

3 John Hicks, *Capital and Growth* (London: Oxford University Press, 1965), p. 296.

4 Michael Cox and David Ellsworth, "Application-Controlled Demand Paging for Out-of-Core Visualization," *8th Conference on Visualization '97,* 18-24 October 1997, IEEE.

5 Edward R. Tufte, *The Visual Display of Quantitative Information* (Connecticut: Graphics Press, 2001).

Key Examples of Big Data Global Financial System Inquiries

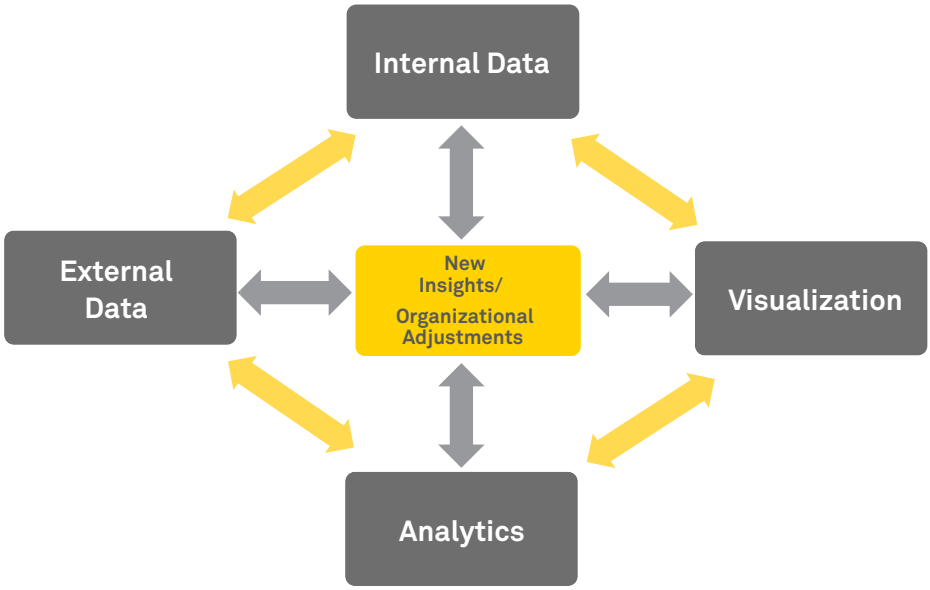
From a near-inexhaustible set of possibilities, the following representative questions might best be investigated through big data methods:

1. Which geopolitical risks are most likely and what will be their impact on global financial markets? Can a reliable early-warning risk system be devised?
2. How will the global economic system and related global financial system evolve over the course of the early-to-middle 21st century? Can the speed of the "Grand Convergence" of emerging market (EM) to advanced economy (AE) status be calculated? Which continents, nations, industries, and issuers will fare best? How will currencies, commodities, equities, yield curves, public debt burdens, and exchanges be affected?
3. Do trends in social media amplify prediction prowess? Will big data enable a whole new generation of more precise real-time measures, models, and visualizations of macroeconomic (especially growth, inflation, trade), industry, corporate, and market performance, risk, and volatility? Can and will risk be decomposed into finer segments? Can technological progress and human capital development be better measured?
4. Will new information lead to timelier and more astute application of economic policies as well as to the invention of new policymaking tools? Can knotty political-economic problems like the appropriate role government in markets be better sorted out? What will the effects be on public and private sector operating and financial methods? What will be the effects on asset management?
5. Are directional changes in social media trends and country, asset class, sector, and issuer capital flows leading, lagging, or coincident performance indicators? What will be found in correlations of capital flow movements with volatility, total return, debt ratings? Will calculations and comparative analyses of security turnover ratios by country, asset class, sector, and issuer serve as a liquidity proxy and possible early warning indicator?
6. Would analyses of broader macro classifications (e.g., North vs. South, Latam vs. Africa, AE vs. EM, population growing vs. population shrinking, large vs. medium vs. small economies, positive trade balance vs. negative trade balance) generate new investment strategies?
7. Are there regular "timing effects" (elections, auctions, M&A, IPOs, credit supply, key data releases, time-of-day, day-of-the week, monthly, quarterly, year-end, seasonal) for global and local markets as well as by asset class?
8. Do markets behave differently during global triple-witching hours versus a triple-witching hour in just one local market? Are prepayments of amortizing assets globally synchronized? What are the cash flow and spread implications? Can the global delta of all publicly-traded options on an index like the S&P 500, Nikkei 225, and Euro Stoxx 500 be calculated? What are the market implications of delta's ±0.5?
9. On a real-time basis, how much debt is outstanding in all forms (short term, long term, public, private)? What are the global, regional, national debt service burdens?
10. Can regular and random "event effects" (management change, economic leadership change, central bank policy change, ratings changes, earnings surprises, M&A, etc.) be anticipated and incorporated into investment strategies?
11. How effective are more recent instruments like ETFs and constraints such as sustainable and responsible investing (SRI)? Can big data spawn new generations of financial products?
12. How do big data methods and their presumed universal adoption by competitors alter the practice of corporate finance and asset management? In the end, does asset management bifurcate into short-term indexing and long-term active thematic styles?

From a near-inexhaustible set of possibilities, the following representative questions might best be investigated through big data methods.

How do big data methods and their presumed universal adoption by competitors alter the practice of corporate finance and asset management?

Exhibit 2 – Big Data Revolution



Big data will come to be viewed as a key factor of production, if not the most important factor, in many industries. World economic growth likely will be quicker. In turn, the resulting implications for global capital markets are vast.

Presumably thanks to the guidance derived from new types of big data analyses and rejecting the "techno-pessimist thesis" of slowing advanced economy productivity in the early 21st century, resource use will become more efficient especially through the greater transparency fostered by such capabilities as dynamic real-time pricing. The location and intensity of goods and services production may be altered. New, higher-value, data-dependent products await introduction. Indeed, big data will come to be viewed as a key factor of production, if not the most important factor, in many industries. World economic growth likely will be quicker. In turn, the resulting implications for global capital markets are vast. Infrastructure construction, international capital flows, foreign exchange values, asset allocation, issuer selection, product innovation, and perhaps most important, economic and financial policies will hinge partially on the results of new big data methods.

THE GENESIS OF BIG DATA

Technology connectivity and new information are exploding. The printing press doubled medieval European knowledge over a 50-year period. A 50-fold knowledge increase now occurs about every 10 years.[6] Assuming a world population of 10 billion in 2100 per the U.N.[7] and a continued doubling of global information every two years,[8] this implies at least a 2 to the 44th power increase in stored information over the remainder of the 21st century. This may sound unfathomable, but just imagine the recording of every e-mail, photo, video, Tweet, phone call, personal medical history, nearly every significant detail of an individual's "life-logging," and organization's existence. And most meaningful bits of every legitimate commercial transaction also will be added to the global information set. This monumental data bulge will bear new costs. For example, the accessibility and accuracy of such information may be problematic and require "purification costs" and subscription fees.

6 Daniel Franklin and John Andrews, Megachange: *The World in 2050 (The Economist)* (London: Profile Books, 2012).

7 U.N. World Population Prospects: 2010 Revision.

8 Rick Smolan and Jennifer Erwitt, *The Human Face of Big Data* (Sausalito, California: Against All Odds Productions, 2012).

This information comes in two forms: structured data like familiar economic time series such as real GDP and a far greater volume of unstructured data like social media commentary on pertinent economic and market topics.[9] Through time, some unstructured data will be converted into structured data. But the ratio of unstructured to structured data will remain high given the greater volume and velocity of unstructured data creation.

Individuals and large organizations may be overwhelmed by this rising information torrent. Recipients easily can spend much of their time in absorbing redundant and irrelevant data. This impedes the ability to search for new, more valuable discoveries and to engage in solution-seeking analyses. For example in capital markets, several dozen interpretations of the monthly U.S. employment report are probably unnecessary.

Big data alone is not modern analytical alchemy. For instance, information without objectives can be near meaningless. The number of ants on a sidewalk in Omaha, Nebraska, on July 19, 2025, likely has no significance beyond or even within entomology. The number of large versus small ships passing through the Panama Canal on this same July 19 versus the previous day could signal a possible shift in global trade flows.

Big data alone is not modern analytical alchemy. For instance, information without objectives can be near meaningless.

WHY NOW?

Why the sudden buzz about big data when fact/information-based decision-making has been a best practice and management mantra for a very long time? In our view, the acceleration of the big data phenomenon over 2011-2013 reflects:

- migration of social interactions to the web and adoption of smaller-form, mobile factor computing like Tablets, Smartphones, and Ultrabooks. As a result, society is becoming more comfortable with online presence/lives leading to behavioral e-trails that can be mined/analyzed
- introduction of Cloud architecture[10]: availability of large number of processors as well as network and storage capacity that can flex with changing workloads. This "just-in-time" capability leads to new possibilities for enterprises large and small
- massively parallel computing frameworks running on the Cloud architecture (e.g., Apache Hadoop) enable meaningful information extraction from extremely large datasets
- open source movement: community-driven free software tools used in information extraction, analysis, and dissemination that are on par or better than commercially available tools. Examples include Linux, Apache Hadoop, HBase, Mahout, and R. According to one estimate, the cost of developing these software tools currently exceeds $300 million and is growing[11]
- greater availability of small, cheap, low-power sensors and networks allows the collection of vast amounts of previously uncollectable data
- visible success of Amazon's and Netflix's Recommendation Engines and Google's advertising business has proven the value of extreme data analysis

Greater availability of small, cheap, low-power sensors and networks allows the collection of vast amounts of previously uncollectable data.

9 Structured data refers to data that is comprised of an organized collection of components, in which a relationship exists among the components of the collection. With unstructured data, no relationship exists among the components other than they belong to the same collection. See Nell Dale and Chip Weems, *Turbo Pascal* (London: Jones and Bartlett Publishers, 1995).

10 Amazon EC2, Google AppEngine, Microsoft Azure are examples of such publicly available Clouds.

11 Ohloh.

The abundance of data in a variety of domains has also re-energized the scientific community. The return of denser neural networks, recent advancements in "deep" learning, semi-supervised learning, and significant progress in semantic technologies are harbingers of fascinating and accelerating developments in making machines smarter. Going further out, futurologist Ray Kurzweil has famously predicted "singularity" by 2029 when machine and human intelligence become equal.

With the ascent of macroeconomics, increasing influence of central banks, and development of aggregate international economic and financial statistics, policymakers were able to devote their energies to more systemic issues.

A "TRANSFORMATIONAL GROWTH"[12] ERA FOR THE GLOBAL FINANCIAL SYSTEM

Barter markets accompanied the rise of modern humanity more than 50 millennia ago. Financial markets arose concurrently with civilization some 50 centuries past. As shown in Exhibit 3, many of the objectives of modern financial markets were pioneered prior to the 20th century. With the ascent of macroeconomics, increasing influence of central banks, and development of aggregate international economic and financial statistics, policymakers were able to devote their energies to more systemic issues like economic stimulus, development, and risk mitigation.

Exhibit 3 – Capital Market Objectives

Before the 19th Century	– Capital raising: channeling savings	– Personal loans, government debt, stocks
	– Risk mitigation	– Trading mutual funds (first mutual fund in 1774 had 20-25 securities, diversification for smaller investors)
	– Income smoothing	– Annuities (Tontines)
	– Business expansion without tying up capital	– Plantation loans, antecedents of MBS, ABS
	– Liquidity creation	– Securitization, mutual funds, plantation loans
19th, 20th, 21st Centuries	– Economic stimulus (Monetary Policy and Cyclical "Fiscal Accoridion")	– Systemic Risk Analyses and Mitigation
	– Economic insurance	– Stabilization and Positive Policy Promotion via World Bank, IMF, EIB, KFW, GSEs, IADB, ADB, SWFs, Municipal tax policy
	– Economic development	– Globalization: International Division of Labor
	– Tax burden shifting	

The shock and aftermath of the Great Recession (2007-2015+) linger.

The shock and aftermath of the Great Recession (2007-2015+) linger. Political, regulatory, and economic policymakers have sought to dampen the probability of recurrence through a major upgrade of the global financial system. This multi-faceted revamp is principally directed at de-risking, deleveraging, and attempting to downsize all corners of the global financial system in order to inhibit the transmission of inevitable downward financial market fluctuations including from too-big-to-fail clearing houses to the real economy.

12 The term, "Transformational Growth," was coined by New School of Social Research economist, Edward Nell. This extension of the production possibility curve is vital for a dynamic capitalist economy.

Concurrently at approximately the midpoint of this "information age evolution," the creative reconfiguration of the world economic system seems to have accelerated in accordance with the dictates of dynamic capitalism. A static economic system eventually would implode. This reconfiguration is a highly familiar process. As far back as 1925, John Moody the founder of the rating agency that bears his name wrote, "The changes in methods of production and distribution which have been going on in this country during the past fifty years have been so comprehensive that an actual revolution in the methods of modern industrial society has been taking place right before our eyes but with few of us realizing it."[13]

The creative reconfiguration of the world economic system seems to have accelerated in accordance with the dictates of dynamic capitalism.

What will be the implications of big data revolution for global financial and economic environment? As visionary science fiction author Isaac Asimov wondered in *I, Robot,* will the future global economy be managed by super computers where, "The Earth's economy is stable, and will remain stable, because it is based upon the decisions of calculating machines [...]"; and: "The population of Earth knows that there will be no unemployment, no over-production or shortages. Waste and famine are words in history books."[14] While such perfect machines might facilitate the analysis of big data, can the fickle nature of economic decisions by humans be consistently predicted as in Asimov's psychohistory?

Asset management and the entire financial services industry are extensions of the information and knowledge businesses, operating under a continuous state of uncertainty. For example, the provision of classic bank loans, credit through debit and charge cards, personal real estate mortgage credit (FICO scores), guarantees, and manufacture and sale of credit securities demands a huge array of operating, financial, management, and issue data. As evidenced by some of the striking economic and credit market misfires since the mid-1970s, data and analytic sufficiency may be wanting in some circumstances.

Asset management and the entire financial services industry are extensions of the information and knowledge businesses.

In practice, superior information can lead to, but does not guarantee, better "evidence-based" rather than intuition-dependent decision-making by policymakers and economic agents (see Bank of England's Andy Haldane's paper, "The Dog and the Frisbee"). All techniques will be applied to anticipate the future as demonstrated by the proliferating number of independent economic, sector, and issuer research providers. The competitive pursuit of higher portfolio alpha might induce asset managers to subscribe to practically any service, perhaps even a psychic, with a record of forecasting prescience.

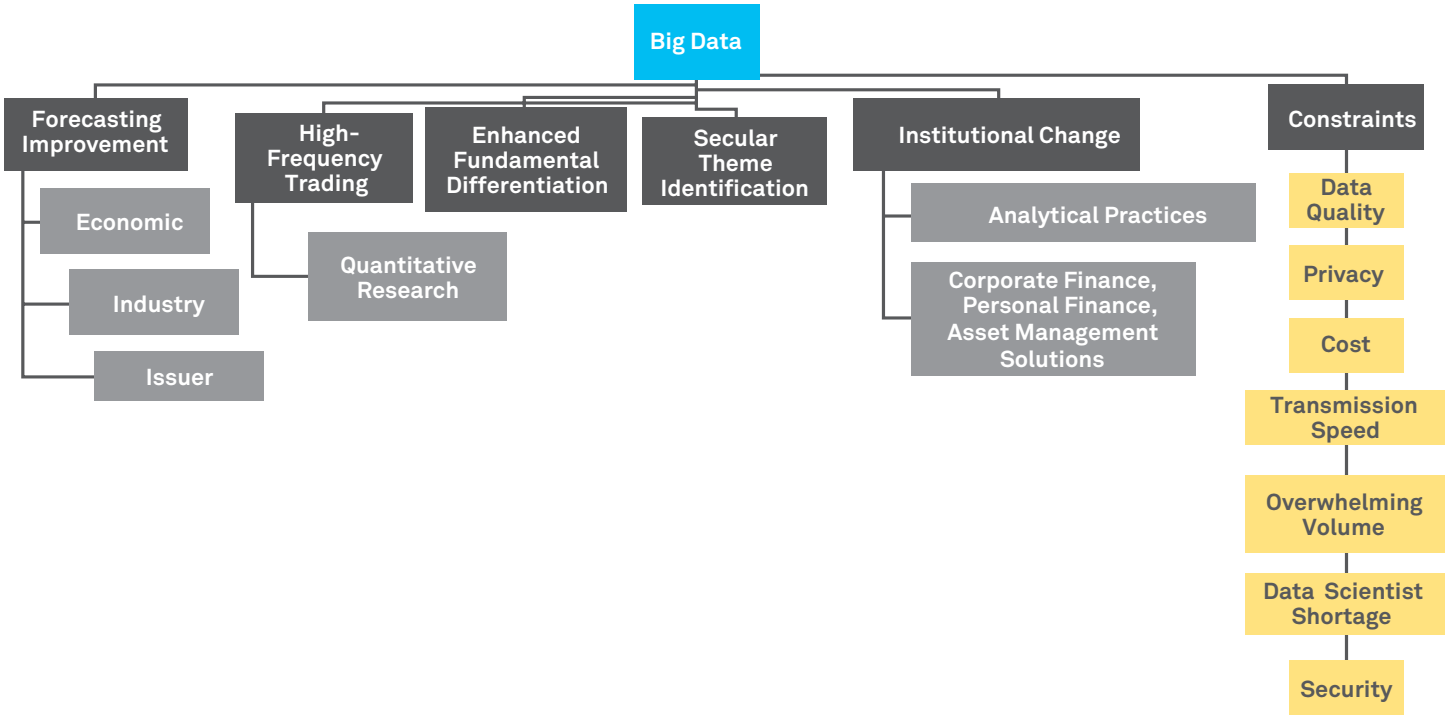
In practice, superior information can lead to, but does not guarantee, better "evidence-based" rather than intuition-dependent decision-making by policymakers and economic agents.

We believe big data will resculpt the asset management industry as portrayed in Exhibit 4. New approaches will be required in research, analytics, asset allocation, trading, and risk management. Through visualization-aided smart syntheses often in the burgeoning era of "dashboards," big data will expand the "assimilation range" of even existing information by capital market professionals. New information likely will inspire new vectors of innovation and lead to abandonment of "heuristic aphorisms," like "watch out for supply" that too often pass for analyses in the capital markets. Policymakers also will respond to this new data, which will breed a cascade of iterative feedback loops. As with any innovation, there will be constraints in the form of real-time data quality, privacy/confidentiality, transmission speed, overwhelming volumes, data scientist shortage, and security.

13 John Moody, *Profitable Investing* (New York, New York: B. C. Forbes Publishing Co., 1925), p. 1.

14 Isaac Asimov, *I, Robot,* (New York, New York: Bantam Dell, 1950), p. 134.

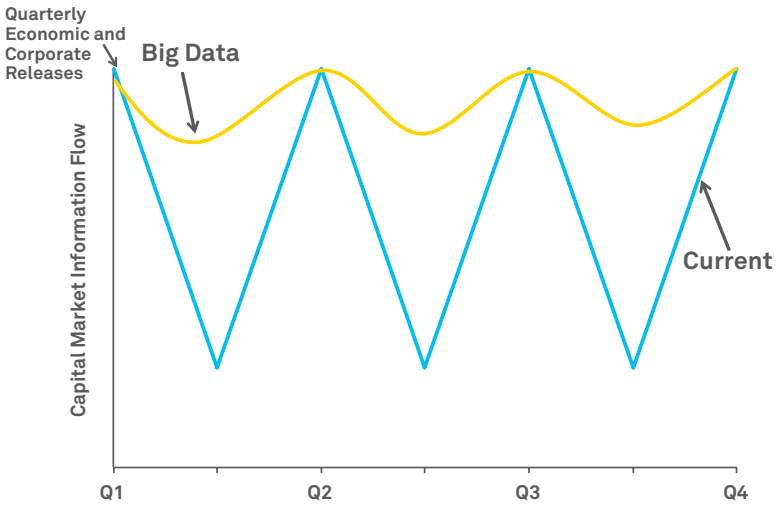
Exhibit 4 – Big Data: Potential Global Capital Market Transformation Effects



Fundamental equity and credit analyses likely will become even more granular in detail and lead to greater emphasis on issuer differentiation.

Fundamental equity and credit analyses likely will become even more granular in detail and lead to greater emphasis on issuer differentiation. With a steady stream of novel and higher quality inputs from big data, stock and bond markets may become less inclined to be as subservient to infrequent information lumps such as quarterly economic and corporate reports as shown in Exhibit 5. At the same time, the proliferation of new fundamental and tactical data points could escalate day-to-day choppiness as the markets sometimes struggle to differentiate between brief aberrations and the inception of new trends.

Exhibit 5 – Big Data: Smoother and More Granular Information Flow



Source: BNY Mellon Center for Global Investment and Market Intelligence.

Economic releases such as GDP, inflation, and industrial production may become more accurate (subject to less revision) and less surprising thanks to advance signals propagated via big data methods. Key economic announcements like housing already can be reasonably anticipated by web crawlers. Greater economic, regional, national, and industry segmentations should be possible, with the most important drivers clearly delineated and accurately measured.

Galvanized as well by next-generation analytics (especially more rigorous time series, correlation, graphical, topological, and scenario analyses) and financial modeling methods, new information implies the congregation of asset management along three- already visible routes. First, information is the lifeblood of high-frequency algorithmic trading and the foundation of longer-term quantitative portfolio strategies. Second, richer information sets should enhance fundamental differentiation for traditional managers operating on medium-term horizons. Third, the practice of secular theme identification and capitalization will be enlivened by the data-based propagation of new market-moving conceptualizations about the future. To consider two possibilities, can demographically challenged economies generate high sustained growth rates through other factors of production like human capital enhancement? Should well-entrenched investment horizon constraints be rethought as in longer horizons and reduced constraints?

Economic releases such as GDP, inflation, and industrial production may become more accurate (subject to less revision) and less surprising thanks to advance signals propagated via big data methods.

Moreover, we believe the intelligence garnered from big data techniques will have a profound influence on public and private sector users of capital markets as well as on consumers. For example, enhanced capital market knowledge will modify the operations of many organizations and especially their financial policies. In some more mature, highly competitive industries, big data promises further pricing power erosion given near-perfect price discovery and possibly lower barriers to entry. In turn, this will affect such core issuer decisions like capital spending, financial leverage, origination timing and structure selection, and dividend policy. Individual career and financial planning practices also will likely be altered in light of voluminous new information flows.

The complete market effects of this upgrade of the global financial system cannot be fully foretold in 2013. Unpredictable geopolitical events, like wars and terrorist activities, will still help govern the volatilities, correlations, and trajectories of capital market parameters. And big data alone will neither curb climate change nor speculative bursts of market optimism and pessimism, perhaps mainly driven by fluctuations in collective neurotransmitters.

The complete market effects of this upgrade of the global financial system cannot be fully foretold in 2013.

In the aftermath of the Great Recession, regulators have been keen to expand their data collection and to pursue the creation of new metrics to monitor systemic well-being. In addition to augmenting transparency and efficiency, the availability of new data sets in the public domain should aid regulatory functions. Ironically, the well-intentioned drive for enhanced regulatory oversight in the Teens may be less significant in the long run than the arrival of big data. This gush of information should lead to a reduction of systemic uncertainty and known macro-prudential and micro-prudential risk mitigation.

The well-intentioned drive for enhanced regulatory oversight in the Teens may be less significant in the long run than the arrival of big data. This gush of information should lead to a reduction of systemic uncertainty and known macro-prudential and micro-prudential risk mitigation.

But as with most technological progress, transition side effects usually become manifest. In ever more efficient markets, real alpha may become scarcer for portfolio managers. The exponential generation of new information currents will trigger an even greater demand for “model compression” into usable decision-making components. As with all financial market models dependent on information shaped by occasionally irrational human emotions, subsequent reality may diverge sharply from ex-ante predictions. And certain portfolio management methodologies, already clustering along “beta trails” in the form of indexing and ETFs at the expense of issuer differentiation, may become more common. Traditional risks, like constrained awareness of excess financial leverage, will fade in potential systemic malfeasance compared to new risks like data highways’ disruption (perhaps via cyber attacks).

The technological, analytical, and information innovations of the 20th century both transformed and preserved the core goal of the asset management profession.

So too, the innovations and challenges of the 21st century will not entirely amend the basic mission of asset management.

The technological, analytical, and information innovations of the 20th century both transformed and preserved the core goal of the asset management profession. The cardinal objective of risk-adjusted return optimization under uncertainty did not migrate; the path did. For example, the arrival of mainframe computers in the 1950s and then personal computers in the 1980s unfortunately have not repealed the vicissitudes of business cycles, sovereign and industry misfortunes, poor performances by individual issuers and less-than-perfect foresight by financial decision makers. Indeed, technology and primitive analytics arguably enabled some of the most spectacular meltdowns like the U.S. thrift crisis in the mid-to-late 1980s and Long-Term Capital Management in 1998.

So too, the innovations and challenges of the 21st century will not entirely amend the basic mission of asset management (Exhibit 6) to enhance and to preserve wealth for an assumed level of risk within a complex global capital market framework. As always in a dynamic capitalist system, business methods, in this case asset management strategies depicted in Exhibit 7, will change through time. Fast innovators fueled by big data-inspired creativity have an advantage over slow movers. Non-responders may be headed toward obsolescence. Consider the mammoth bond and equity indexes, in some ways the original big data capital market tool. Thanks to the greater ability to blend issuer fundamental information with all cash/derivative debt and equity prices, absolute and relative value issuer rankings have become more precise.

Exhibit 6 – Global Asset Management Mission: Preserve and Enhance Wealth for a Given Level of Risk

Late 20th/Early 21st Century Global Capital Market Framework	
– The Great Recession of 2007-2015 will be recalled for "systematic credit cleansing; a secular adjustment in credit risk premia and credit market methodology	– The beginning of the 21st century more conservative capital market order • Everything's ripe for re-interpretation
– Institutional aftermath: assimilation of learning lessons; long process; full adjustment by 2025 – Absolute return to relative value to absolute return	– Bright strategic outlook for the Teens – Asia-focused financial system

Global Asset Management Developments			
Low yields, paltry AE growth	Deregulation/re-regulation	Global diversification/issuer concentration	Pension fund capitalism
Aging AE demographics	Privatization/nationalization	Algorithmic/quant over fundamental value	Shorter tactical timeline
Global Grand Convergence	Derivitization/stagnation	Active vs. passive indexing & ETFs	Horizon and academic/practitioner dissonance
EM mainstreaming	Securitization pause/ resurgence	Index customization (self indices)	Risk budgeting/risk parity
GPR rise	Disintermediation/quickening in Europe/Asia	Better capitalized financial system	Quadruple A* & quadruple I† doctrine
Globalization/deceleration	Liquidity declines/ liquidity scoring	Equity market fragmentation	Global electronic bond exchange
			Big data/technology advances

Global Portfolio Strategy
Moving out risk horizon curve; portfolio concentration; minimization of pro-cyclical processes; model standardization Opportunities in IG and HY credit, EM, Frontier, real estate, and Alternative markets

* Quadruple A's: alternatives; absolute return; alpha/beta separation; all styles, geographies on choice menu;
† Quadruple I's: innovation; infrastructure; inflation-protection; insurance of risk

Source: BNY Mellon Center for Global Investment and Market Intelligence

Exhibit 7 – Snapshot of Key Asset Management Strategies in 2013; Big Data Likely Will Richen this Choice Set

Source: BNY Mellon Center for Global Investment and Market Intelligence.

Financial system data can be abused in the pursuit of knowingly or inadvertently asserting false claims.

A FEW CAVEATS

"Not everything that can be counted counts, and not everything that counts can be counted." — Albert Einstein

"Data-driven predictions can succeed, and they can fail. It is when we deny our role in the process that the odds of failure rise. Before we can demand more of our data, we need to demand more of ourselves." — Nate Silver [15]

Even for enthusiastic proponents like us, the big data revolution should be viewed in a realistic light. Big data will help but will not solve all problems. The ongoing upgrade of the global financial system will be enhanced but not completely defined by big data. And shown in Exhibit 8, financial system data can be abused in the pursuit of knowingly or inadvertently asserting false claims.

15 Nate Silver, *The Signal and the Noise: Why So Many Predictions Fail-but Some Don't* (London, England: Penguin Books Ltd., 2012).

Given the subjectivity often inherent in some social science "axioms," many propositions can be convincingly argued in either the affirmative or negative. Like the best political spin meisters, selective data use, also known as "data mining," is usually a favorite technique of "predisposed pundits."

Exhibit 8 – How to Abuse Financial System Data and Make Poor Decisions

- If you torture the data, they will always confess
- Don't be selective in choosing variables for models — keep trying until you get the best fit (i.e., torture)
- Ignore survivorship bias (especially true for the U.S. capital markets)
- Extrapolate the past without understanding the past
- Pay no attention to the institutional and historical context
- Assume that valuations are mean-reverting (i.e., always buy low)
- Assume that valuations are not mean-reverting (i.e., always buy high)
- Assume that all data and analytics are 100% reliable and accurate
- Assume normal distributions and presume that standard deviation is always the best measure of risk
- Assume everyone looks at data in the same way as you

Big data surfaces an almost unending stream of questions. For example, will this increased reliance on technology and data of varying quality become a handicap as forewarned in Asimov's Robot trilogy and in "The Terminator" movies? Will data/model-based decision-making impinge entrepreneurial activity? Some of the most successful entrepreneurs and businesses triumphed despite daunting initial odds.

What are the consequences of the inevitable misinterpretation of new information patterns? In the realm of geopolitical risk, history is riddled with miscalculation-induced wars (see, for example, Niall Ferguson's *The Pity of War: Explaining World War I)*. Will other unintended costs of big data be discovered? Will human decisions be able to keep pace with rapid signals generated through the constant stream of growing data? Will first-, second-, third- or more-order feedback loops be required to recalibrate/balance complex systems? As technology makes broader and deeper decisions, where does accountability reside? The appropriate answer may vary depending upon the firm and line of business. Ultimately, a combination of a new generation of cross-trained programmers, data scientists, operating managements, financial managements, and/or someday with sentient computers will seek to optimize big data pursuits.

Ultimately, a combination of a new generation of cross-trained programmers, data scientists, operating managements, financial managements, and/or someday with sentient computers will seek to optimize big data pursuits.

CONCLUSION: "GLIMPSE OF A BRIGHTER FUTURE"

As has been the case since the Middle Ages, a more technologically diverse and consumption-driven financial system awaits. An older and densely populated world will cluster in megacities, perhaps too close to rising seas in some geographies. Real-time pricing will pertain to all markets, with the application of sophisticated statistical analysis. A globally connected marketplace with enhanced information flows will generate almost perfectly steady correlations among economic/financial variables. Financial diversification will become less efficient and encourage more portfolio concentration. Assuming political stability, frontier markets, where a Mongolia becomes the next Taiwan, may become less reliable alpha generators.

These evolutionary forces will be amplified by big data to recast institutional, organizational, and personal behaviors, and in the course of economic development, hopefully will upgrade and improve the efficacy of the global financial system in our opinion.

These evolutionary forces will be amplified by big data to recast institutional, organizational, and personal behaviors, and in the course of economic development, hopefully will upgrade and improve the efficacy of the global financial system in our opinion.

The transformational effects of big data will extend far beyond the economic and financial realms. Deep questions will be spawned about the ownership, public access, and use of vital data sets. And as long predicted and recently witnessed, big data results may kindle geopolitical risk shifts and weaken the sovereign authority of some nations.

There's so much yet to discover across all fields, especially in the sciences, economics, and capital markets. Big data will not trigger nor answer all questions and is not the Holy Grail to perpetual financial system bliss. Stewards of big data enterprises need to transition from more of a warehousing mindset to an open system that fosters a high volume of research inquiry. The main impediment to the maximization of big data methods may be limited imagination and failure to embrace consilience among multiple disciplines in framing and rewarding big data research projects.

As with any new field, the conceptualization and practices of big data will evolve rapidly in not always predictable directions. For example, the term "big data" might be unbundled into a myriad of "classification flavors" like very big data, big data, medium data, and small data based on the volume of data. The same holds for analytics: heavy analytics, medium analytics, small analytics, and little or no analytics. A similar scheme could be engineered for external data sifting and visualization. See Exhibit 9 for a hypothetical classification of big data problems in asset management.

As with any new field, the conceptualization and practices of big data will evolve rapidly in not always predictable directions.

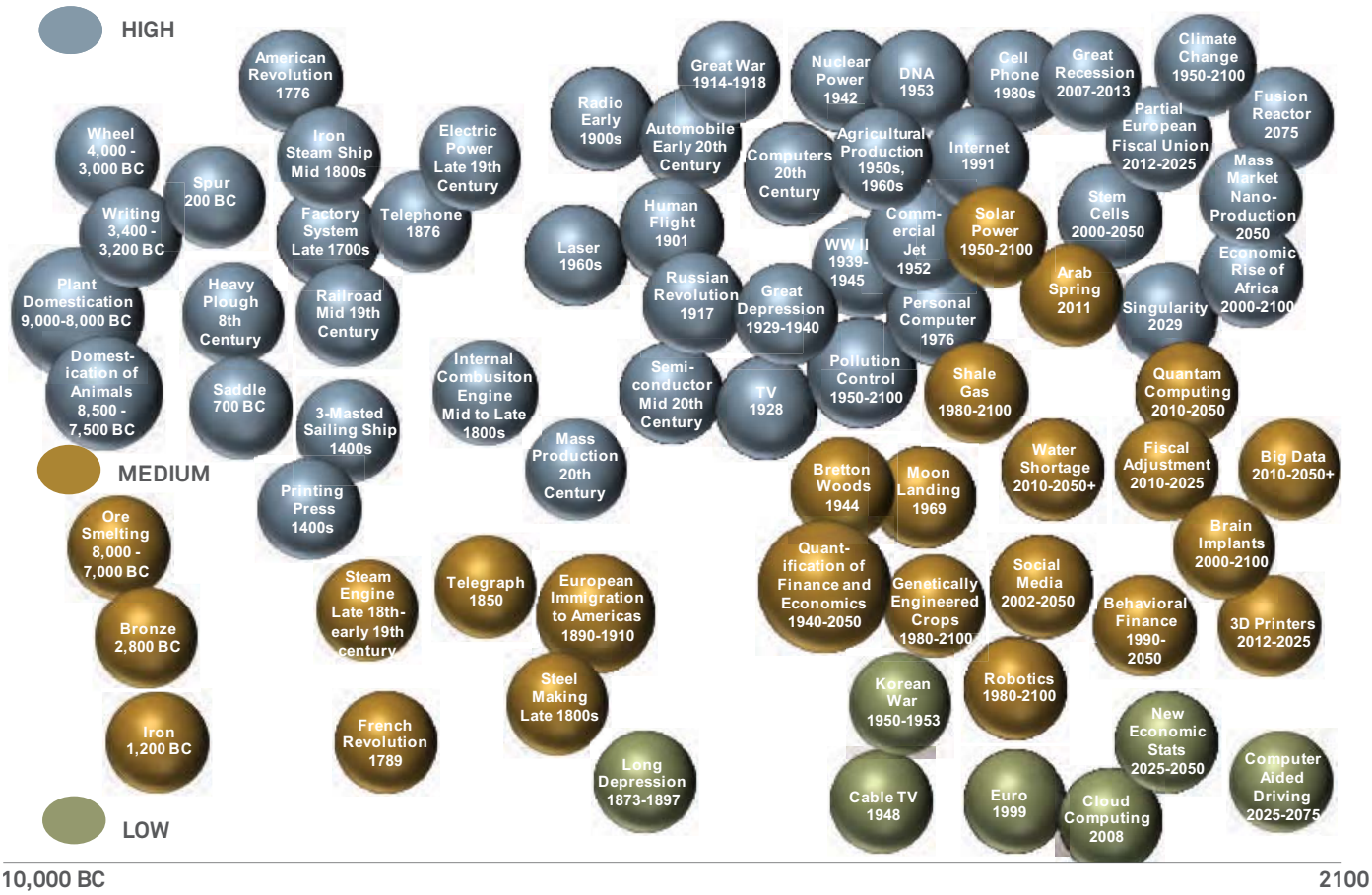
Exhibit 9 – Classification of "Big Data Problems"

	Heavy Analytics	Medium Analytics	Small Analytics	Little or No Analytics
Very Big Data	World Economic and Financial Markets Scenario Analysis			
Big Data		Multi-asset Class Return Attribution		
Medium Data			Ranking Financials of Issuers in Corporate Sectors as in Finance	
Small Data				Mapping Relative Performance of a Fund or Portfolio to an Index

Source: BNY Mellon Center for Global Investment and Market Intelligence.

The advancing utilization of big data methods in the early 21st century will be recalled as a "Very Big Plus" for the global financial system. In our opinion, the advent of the big data era will join the ranks of the other major *positive* "Great Disruptors," shown in Exhibit 10, in shaping a healthier and more prosperous future for the global financial system and its billions of dependent users.

Exhibit 10 – "The Great Disruptors"
Technological Progress and Major Political Events: 10,000 BC to 2100



Dates mainly pertain to initial proof of concept and/or practical or commercial application.
Source: BNY Mellon using sources from our bibliography (As of April 22, 2013).

BIBLIOGRAPHY

"Advertising That Works: How Big Data is Transforming the Art of Persuasion." *Harvard Business Review*, March 2013.

"Big Data Bonanza," *Financial Times,* 10 December 2012.

"Big Data: What's Your Plan?" *McKinsey Quarterly,* March 2013.

"Big Data, Big Blunders," *The Wall Street Journal*, 8 March 2013.

"Big Data, Big Impact: New Possibilities for International Development," *World Economic Forum,* 2012.

"Getting Control of Big Data," *Harvard Business Review,* October 2012.

"How Big Data is Changing the Whole Equation for Business," *The Wall Street Journal,* 8 March 2013.

"Special Report: A New Economic Model?" *Vision*, October-December 2012.

"The Year in Science," *Discover,* January/February 2013.

"The Other Earths," *Discover*, December 2012.

"The New Shape of Big Data," *The Wall Street Journal*, 8 March 2013.

Asimov, Isaac. *I, Robot*. New York, New York: Bantam Dell, 1950, p. 134.

Barton, D., and David Court. "Making Advanced Analytics Work for You." *Harvard Business Review* (October 2012).

Canton, James. *The Extreme Future: The Top Trends That Will Reshape the World in the Next 20 Years.* London: Penguin Group, 2006.

Cox, M., and David Ellsworth. "Application-Controlled Demand Paging for Out-of-Core Visualization." *8th Conference on Visualization* '97 (October 18-24, 1997).

Cukier, K. and Viktor Mayer-Schoenberger. "The Rise of Big Data: How It's Changing the Way We Think About the World. " *Foreign Affairs* (May-June 2013).

Dale, N., and Chip Weems. *Turbo Pascal*. London: Jones and Bartlett Publishers, 1995

Davenport, T., and D.J. Patil. "Data Scientist: The Sexiest Job in the 21st Century." *Harvard Business Review* (October 2012).

DeCovny, Sherree. "Next-Generation Analytics." *CFA Digest* (July/August 2012).

Ferguson, Niall. *The Pity of War: Explaining World War I*. New York, NY: The Penguin Press, 1999.

Franklin, D., and John Andrews. *Megachange: The World in 2050 (The Economist)*. London: Profile Books, 2012

Haldane, Andrew G. "The Dog and the Frisbee." Federal Reserve Bank of Kansas City. Jackson Hall, Wyoming. 31 August 2012.

Hicks, John. *Capital and Growth*. London: Oxford University Press, 1965, p. 296.

Mayer-Schonberger, V., and Kenneth Cukier. Big Data: *A Revolution That Will Transform How We Live, Work, and Think*. New York, New York: Houghton Mifflin Harcourt, 2013.

Mayer-Schonberger, V., Cukier, K., and Teresa Carlson. "The Big Issue of Big Data." Council on Foreign Relations Presentation. 5 March 2013.

McAfee, A., and Erik Brynjolfsson. "Big Data: The Management Revolution." *Harvard Business Review* (October 2012).

Moody, John. *Profitable Investing*. New York, New York: B. C. Forbes Publishing Co., 1925, p. 1.

Silver, Nate. *The Signal and the Noise: Why So Many Predictions Fail-but Some Don't.* London, England: Penguin Books Ltd., 2012.

Smolan, R., and Jennifer Erwitt. The Human Face of Big Data. Sausalito, California: Against All Odds Productions, 2012.

Steel, Emily. "Data Scientists Take Byte out of 'Mad Men'." *Financial Times* 13 December 2012: Print.

Tufte, Edward. *The Visual Display of Quantitative Information*. Connecticut: Graphics Press, 2001.

United Nations, Department of Economic and Social Affairs, Population Division. *World Population Prospects: The 2010 Revision, Highlights and Advance Tables.* New York: United Nations, 2011.

Waters, Richard. "Data Open Doors to Financial Innovation." Financial Times 14 December 2012: Print.

Waters, Richard. "Push to Exploit an Ocean of Information." Financial Times 10 December 2012: Print.

Wessel, M., and Clayton Christensen. "Surviving Disruption." *Harvard Business Review* (December 2012).

[THIS PAGE INTENTIONALLY LEFT BLANK]

BNY Mellon Investment Management is one of the world's leading investment management organizations and one of the top U.S. wealth managers, encompassing BNY Mellon's affiliated investment management firms, wealth management services and global distribution companies. BNY Mellon is the corporate brand of The Bank of New York Mellon Corporation and may also be used as a generic term to reference the Corporation as a whole or its various subsidiaries generally. • The statements and opinions expressed in this document are those of the authors as of the date of the article, are subject to change as economic and market conditions dictate, and do not necessarily represent the views of BNY Mellon, BNY Mellon Asset Management International or any of their respective affiliates. This document is of general nature, does not constitute legal, tax, accounting or other professional counsel or investment advice, is not predictive of future performance, and should not be construed as an offer to sell or a solicitation to buy any security or make an offer where otherwise unlawful. The information has been provided without taking into account the investment objective, financial situation or needs of any particular person. BNY Mellon Asset Management International Limited and its affiliates are not responsible for any subsequent investment advice given based on the information supplied.

Past performance is not a guide to future performance. The value of investments and the income from them is not guaranteed and can fall as well as rise due to stock market and currency movements. When you sell your investment you may get back less than you originally invested. • While the information in this document is not intended to be investment advice, it may be deemed a financial promotion in non-U.S. jurisdictions. Accordingly, where this document is used or distributed in any non-U.S. jurisdiction, the information provided is for use by professional and wholesale investors only and not for onward distribution to, or to be relied upon by, retail investors. • Products or services described in this document are provided by BNY Mellon, its subsidiaries, affiliates or related companies and may be provided in various countries by one or more of these companies where authorized and regulated as required within each jurisdiction. This document is not intended for distribution to, or use by, any person or entity in any jurisdiction or country in which such distribution or use would be contrary to local law or regulation. This document may not be distributed or used for the purpose of offers or solicitations in any jurisdiction or in any circumstances in which such offers or solicitations are unlawful or not authorized, or where there would be, by virtue of such distribution, new or additional registration requirements. Persons into whose possession this document comes are required to inform themselves about and to observe any restrictions that apply to the distribution of this document in their jurisdiction. **The investment products and services mentioned here are not insured by the FDIC (or any other state or federal agency), are not deposits of or guaranteed by any bank, and may lose value.** • This document should not be published in hard copy, electronic form, via the web or in any other medium accessible to the public, unless authorized by BNY Mellon Investment Management International Limited.

In **Australia**, this document is issued by BNY Mellon Asset Management Australia Limited (ABN 56 102 482 815, AFS License No. 227865) located at Level 6, 7 Macquarie Place, Sydney, NSW 2000. Authorized and regulated by the Australian Securities & Investments Commission. • In **Brazil**, this document is issued by BNY Mellon Serviços Financeiros DTVM S.A., Av. Presidente Wilson, 231, 11th floor, Rio de Janeiro, RJ, Brazil, CEP 20030-905. BNY Mellon Serviços Financeiros DTVM S.A. is a Financial Institution, duly authorized by the Brazilian Central Bank to provide securities distribution and by the Brazilian Securities and Exchange Commission (CVM) to provide securities portfolio managing services under Declaratory Act No. 4.620, issued on December 19, 1997. • Investment vehicles may be offered and sold in **Canada** through BNY Mellon Asset Management Canada Ltd., a Portfolio Manager, Exempt Market Dealer and Investment Fund Manager. • In **Dubai, United Arab Emirates**, this document is issued by the Dubai branch of The Bank of New York Mellon, which is regulated by the Dubai Financial Services Authority. • If this document is used or distributed in **Hong Kong**, it is issued by BNY Mellon Asset Management Hong Kong Limited, whose business address is Suites 1201-5, Level 12, Three Pacific Place, 1 Queen's Road East, Hong Kong. BNY Mellon Asset Management Hong Kong Limited is regulated by the Hong Kong Securities and Futures Commission and its registered office is at 6th floor, Alexandra House, 18 Chater Road, Central, Hong Kong. • In **Japan**, this document is issued by BNY Mellon Asset Management Japan Limited, Marunouchi Trust Tower Main Building, 1-8-3 Marunouchi Chiyoda-ku, Tokyo 100-0005, Japan. BNY Mellon Asset Management Japan Limited is a Financial Instruments Business Operator with license no 406 (Kinsho) at the Commissioner of Kanto Local Finance Bureau and is a Member of the Investment Trusts Association, Japan and Japan Securities Investment Advisers Association. • In **Korea**, this document is issued by BNY Mellon AM Korea Limited for presentation to professional investors. BNY Mellon AM Korea Limited, 29F One IFC, 10 Gukegeumyung-ro, Yeongdeungpo-gu, Seoul, 150-945, Korea. Regulated by the Financial Supervisory Service. • In **Singapore**, this document is issued by The Bank of New York Mellon, Singapore Branch for presentation to professional investors. The Bank of New York Mellon, Singapore Branch, One Temasek Avenue, #02-01 Millenia Tower, Singapore 039192. Regulated by the Monetary Authority of Singapore. In Singapore, this document is to be distributed to Institutional Investors (as defined in the Securities and Futures Act, Chapter 289 of Singapore) only. • This document is issued in the **UK** and in **mainland Europe**, by BNY Mellon Asset Management International Limited, 160 Queen Victoria Street, London EC4V 4LA. Registered in England No. 1118580. Authorized and regulated by the Financial Services Authority. • This document is issued in the **United States** by BNY Mellon Investment Management.

BNY Mellon owns over 95% of the parent holding company of The Alcentra Group, which is comprised of the following affiliated investment advisers: Alcentra, Ltd and Alcentra NY, LLC. • BNY Mellon ARX is the brand used to describe the Brazilian investment capabilities of BNY Mellon ARX Investimentos Ltda. • BNY Mellon Western FMC, Insight Investment and Meriten Investment Management do not offer services in the U.S. This presentation does not constitute an offer to sell, or a solicitation of an offer to purchase, any of the firms' services or funds to any U.S. investor, or where otherwise unlawful. • BNY Mellon Cash Investment Strategies is a division of The Dreyfus Corporation. • BNY Mellon Western Fund Management Company Limited is a joint venture between BNY Mellon (49%) and China based Western Securities Company Ltd. (51%). The firm does not offer services outside of the People's Republic of China. • BNY Mellon owns 90% of The Boston Company Asset Management, LLC and the remainder is owned by employees of the firm. • BNY Mellon owns a 19.9% minority interest in The Hamon Investment Group Pte Limited, the parent company of Blackfriars Asset Management Limited ("Blackfriars"), Hamon Asset Management Limited and Hamon Asian Advisors Limited ("HAAL"). Only Blackfriars and HAAL offer investment services in the U.S. • Services offered in the US, Canada and Australia by Pareto Investment Management Limited under the Insight Pareto brand. • The Newton Group ("Newton") is comprised of the following affiliated companies: Newton Investment Management Limited, Newton Capital Management Limited (NCM Ltd), Newton Capital Management LLC (NCM LLC), Newton International Investment Management Limited and Newton Fund Managers (C.I.) Limited. NCM LLC personnel are supervised persons of NCM Ltd and NCM LLC does not provide investment advice, all of which is conducted by NCM Ltd. Only NCM LLC and NCM Ltd offer services in the U.S. • BNY Mellon owns a 20% interest in Siguler Guff & Company, LP and certain related entities (including Siguler Guff Advisers LLC). • BNY Mellon Asset Management International Limited and any other BNY Mellon entity mentioned above are all ultimately owned by BNY Mellon, unless otherwise noted.

The Alcentra Group
BNY Mellon ARX
BNY Mellon Cash Investment Strategies
BNY Mellon Western Fund Management Company Limited
The Boston Company Asset Management, LLC
The Dreyfus Corporation
EACM Advisors LLC
Hamon Investment Group
Insight Investment
Mellon Capital Management Corporation
Meriten Investment Management
The Newton Group
Siguler Guff & Company LP
Standish Mellon Asset Management Company LLC
Urdang Capital Management, Inc.
Urdang Securities Management, Inc.
Walter Scott & Partners Limited

BNY MELLON

本情報提供資料は、BNY メロン・グループ（BNY メロンを最終親会社とするグループの総称です）の資産運用会社が提供する情報について、BNY メロン・アセット・マネジメント・ジャパン株式会社が審査の上、掲載したものです。当資料は情報の提供を目的としたもので、勧誘を目的としたものではありません。当資料は信頼できると思われる情報に基づき作成されていますが、その正確性、完全性を保証するものではありません。ここに示された意見などは、作成時点での見解であり、事前の連絡無しに変更される事もあります。

BNY メロン・アセット・マネジメント・ジャパン株式会社
BNY Mellon Asset Management Japan Limited

金融商品取引業者：関東財務局長（金商）第 406 号
〔加入協会〕一般社団法人　投資信託協会
一般社団法人　日本投資顧問業協会