

# Financial Markets in 2020

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## **Introduction**

At Bankers Trust, we spend a lot of time anticipating trends in the financial markets, not only those affecting short-term price movements but also those that are responsible for the long-term evolution of the system itself.

Anticipating the longer term is especially compelling today considering the speed at which the financial system is changing. Even our inherent romanticism doesn't let us forget that we are straddling the twentieth and twenty-first centuries, a period when more than ever the future seems just around the corner.

But there's the future and the future. For the purpose of this paper, let's impose a stop-loss on our observations. I like the year *2020*. For one thing, it is the year when the Jet Propulsion Laboratory predicts that Voyager will stop transmitting data back to Earth—a forecast that for some reason I find exciting. Twenty-seven years also is far enough away to allow trends to develop, yet near enough to be useful for long-range planning. And it doesn't hurt to know that *20120* stands for perfect vision. Maybe that alone will improve the odds of my being correct.

Thus this paper will focus on the period between now and the year *2020*, contemplating how the financial functions will evolve over that period and how quickly change will come.

Anyone who deals in the financial markets knows that anticipating trends is difficult at best. But he or she also realizes that not to try is tantamount to accepting the most unlikely scenario of all: no change.

So I will plunge ahead.

### **Constants and change**

Heraclitus said it best: "All is flux, nothing stays still. Nothing endures but change." That is true. Nonetheless, between now and 2020 two phenomena will remain constant. First, human nature will not change. Second, the basic financial functions, as I will define them, will not change, although how we perform these functions will change.

First for human nature. A very basic element of that nature is a hunger for security — law and order, job security, retirement security, decent and affordable health care, and **financial** security. For a variety of reasons, people have begun to feel that organizations, especially governments, designed to provide their basic security no longer can be relied on.

This societal change is having a profound impact on financial institutions' relationships with their clients and employees, who once automatically accepted an institution's promise that "We know what is best for you."

By necessity, not by preference, people are becoming more involved in creating their own security by doing their own homework and making their own decisions. "One-way broadcasting" and "command and control" styles are no longer acceptable. This pervasive sense of vulnerability is putting risk management at the top of the agenda for many people and organizations. To the degree that financial institutions can better help their clients deal with risk, the clients are very ready for change. In any event, gaining their trust will be an essential challenge for financial institutions.

In addition to the sense of individual vulnerability, two other facets of human nature will affect the pace of change: people's inherent thirst

for knowledge and their frequent aversion to change. The first is the motivator behind financial innovation and the second is the greatest barrier to it.

That barrier is deeply entrenched, as evidenced by a report from an observer at the Digital World Conference, which was held in Los Angeles in July 1993: "Given that this was a conference on digital technology for industry insiders, I saw very few laptop computer note takers; 99 percent used paper and pen. Very few had mobile telephones with them, and consequently the lines at the pay phones were lengthy."

We see that even technologists have trouble adjusting to the new environment. I have no doubts, though, that their children, steeped in today's technology, will be far less likely to be lining up for pay phones by the time they dominate the work force—well before 2020. It won't be long before the impact of the "computer games" generation is strongly felt at the policymaking level.

Countering any inertia that works against change is the human drive for knowledge. And this thirst has been whetted by rapid advances in financial theory, as exciting and as portentous as the twentieth century's major developments in physics and biology. A substantial portion of this paper will deal with those developments.

Let me emphasize, however, that this paper looks only at the future impact of *currently* available technology. It does not delve into Buck Rogers speculation about new inventions (or Star Trek, depending on your age and frame of reference). And it does not talk about couch potatoes with virtual reality helmets operating out of hermit huts. It recognizes that an ocean of new technologies is available to today's markets, but that the process toward implementation of these technologies has hardly begun.

Some may believe that the predictions in this paper are too bold, but I believe that if anything, change will be faster and more far-reaching.

## **The basic financial functions**

As the existing technologies come onstream, they will affect how the basic financial functions will be performed. These functions are (1) financing, (2) risk management, (3) trading and positioning, (4) advising, and (5) transaction processing. This paper will avoid many standard financial terms of twentieth century thought. Although financial functions will be the same, they will be looked at differently in the twenty-first century. Thus we will not refer to "loans," "borrowings," or "securities," but to "claims on wealth" or "financial claims." We will avoid the term "banks" because banks, certainly as we know them, will not exist.

### ***Financing***

Financing facilitates the movement of funds from suppliers to users. Usually it starts with the identification of users and suppliers by a financial institution and ends with the creation of products to satisfy both.

Successful products created by a financial intermediary enable each party to meet its needs for timing and location of cash flows and for the amounts of money to be supplied or used. The intermediary also helps clients assess the merits of alternative products, seeking to find the least costly source of money for users and getting the best possible return for suppliers, taking into consideration their appetites for risk.

### ***Risk management***

Risk management is the process of moving clients closer to their desired risk profiles by helping them shed unwanted risks or acquire new risks that suit their portfolios. At times, this can be done simply by matching a client who wants to shed a risk with one who wants to acquire that risk. More often, it involves unbundling, transforming, and repackaging risks into bundles tailored to fit the particular needs of various clients.

### ***Trading and positioning***

Trading and positioning is the buying and selling of claims on wealth. It provides liquidity to clients so they can more easily alter their portfolios or raise cash. It also moves market prices of financial claims closer to their fair values and makes market prices more visible and reliable.

### ***Advising***

Advising is making decisions on behalf of clients or giving them information and advice that help them make better decisions for themselves.

### ***Transaction processing***

Transaction processing is the storing, safeguarding, verifying, reporting, and transferring of claims on wealth.

As noted, some of these functions are taking on new forms and are becoming more sophisticated, but they will be needed as much in **2020** as they are today.

## **Technical and market environment in 2020**

Again, technology is driving these changes. Information technology already is helping us execute these financial functions better and faster by providing improved data collection, calculation, communications, and risk control. By **2020**, those tools will be much cheaper and far more powerful. As indications of this trend: A transistor, once costing \$5, costs less than a staple today; entire reference libraries are now stored on one five-inch compact disc, and computer users have become accustomed to increasing their processing power by a factor of ten every five to seven years at no additional cost. And the progress is geometric because each **element—computation**, availability of data, communications, and algorithms—feeds on the others.

This revolution in information technology is enabling the financial world to operate on a much more complex level than before.

At times the speed and power at which computation and communications tasks can be accomplished is so much greater than in the past that it brings qualitative change, not just quantitative change. For example, the options business could not operate as it does today without high-speed computers to track its intricacies, including the monitoring of risk profiles and valuations. Computer technology has made it possible to disaggregate risk on a broad scale and redistribute it efficiently, enabling management to maintain greater risk control while giving employees more freedom to use their own judgment. In other words, information technology allows a financial organization to decentralize while improving control.

The ability to program computers to digest ever-larger amounts of information more and more quickly enables us to apply sophisticated automated logic—what we call "automated analytics"—to many problems, such as performing elemental arbitrage tasks. Eventually these programs will be embedded on computer chips, which will be able to solve progressively more complex problems—and on a global basis.

Indeed, by 2020, a true global marketplace will be established, with everyone—individuals, companies, investors, organizations, and governments—linked through telephone lines, cables, and radio-wave technology. With the touch of a button, people will have access to other individuals and vast databases around the world. Such access will be readily available through phones, interactive television, workstations, or hand-held "personal digital assistants" that combine all these functions.

Organizations will be "fully wired" so that their computers will capture incoming and internally generated data, analyze the information, and make it instantly available to any authorized person, wherever he or she may be. Armies of clerks and administrators no longer will be needed to serve as messengers, translators, reconcilers, or summarizers of information. As discussed below, this will change how firms are managed.

To further increase the system's efficiency, all financial claims (including claims on volatility) will be in book entry form, and

ownership of all these claims will be transferable instantly anywhere around the globe via 24-hour multicurrency payment systems. Settlement risk will be eliminated and with it a major bottleneck to transaction flows. This has enormous implications for releasing capital and lowering transaction costs.

### *"Wealth accounts"*

A key to the system will be "wealth accounts," in which companies and individuals will hold their assets and liabilities. These accounts will contain today's relatively illiquid assets such as buildings and vehicles as well as what we know today as stocks, bonds, other securities, and new types of financial claims. These accounts would also contain all forms of liabilities.

Computers will continuously keep track of these items in the wealth accounts and will constantly mark both assets and liabilities to market, making these items effectively liquid. Within an individual wealth account, the arithmetic sum of the items will be the net worth. Yesterday's income and today's wealth will always be known with a high degree of confidence.

The wealth accounts will be the focal point for financial processing and reporting. The integrity of these accounts will be validated by institutions, much the same as checking accounts or mutual funds are today. Wealth accounts will be instantly tapped via "wealth cards." For example, this will allow you to pay for your sports car by instantly drawing on part of the wealth inherent in your vacation house.

Wealth accounts will simplify the provision of credit. In the ultimate extension of today's home-equity lines, instant credit will be available to companies and individuals secured with the current value of their wealth accounts. Leverage constraints will be established by investors and perhaps central banks. Some investors will continue to extend unsecured credit on the basis of an individual's expected income stream, but this would violate this writer's strongly held view that one should never extend unsecured credit to anything that eats.

Owners of wealth accounts will use automated analytics to help

them determine their **risk/reward** appetites and suggest appropriate actions to achieve those targets. If the owner approves, the wealth account would proceed to automatically implement the program. Of course, some people will prefer the advice of a human on more complex or large transactions, for both expert judgment and psychological comfort.

Automated analytics will also provide customized investment management, making the wealth accounts far superior to today's mutual funds. In effect, individuals will have the option to manage their own mutual fund.

All seekers of financial claims will understand that to get full access to the financial markets they will be legally responsible for keeping their wealth accounts up to date. These accounts will be electronically accessible to any authorized user, directly or through computerized analytics programs. Privacy will be maintained as with today's checking accounts.

Global electronic bulletin boards will be the principal medium through which buyers and sellers will post their needs and execute transactions. Many financial claims (including what are known today as loans and securities) will bypass middlemen (commercial and investment banks) and will be bought and sold by electronic auction through these global bulletin boards, with minimal transaction costs.

Today we have only a few recognized rating agencies. In 2020 we will have hundreds — perhaps thousands — of specialized providers of news, data, and analysis that will provide interactive electronic bulletins, on demand, real-time, and tailored to each subscriber's particular notion of risk.

There will be no special need for retail financial branches because everyone will have direct access to his or her financial suppliers through interactive TV and personal digital assistants. True interstate banking will have arrived at last! Or more accurately, true "global banking" will have arrived, as every household will be a "branch."

A key feature of 2020 is that nearly everything could be tailored to

a client's needs or wishes at a reasonable price, including highly personalized service from financial companies. Firms will be selling to market segments of one.

In addition to the bulletin boards that will be open to anyone who pays a nominal fee, users and suppliers of financial claims will be networked to each other to exchange real-time data and documents (computer-to-computer), to automatically execute most day-to-day transactions, and maybe to confer via virtual reality electronic meetings. On any given deal, firms may compete not only with their natural competitors but with their nominal clients as well. In effect, supplying financial assistance will be a free-for-all. It will not be limited to those calling themselves "financial institutions" because any organization or individual will be able to reply to needs posted on the bulletin boards. That means an organization that specializes in financial matters may, at times, find itself competing directly with its clients.

Other elements of the financial world of 2020 are especially hard to predict. What form will robbery and fraud take? As we said, human nature will not change and dishonesty will be around in 2020 as it is today. Voice recognition, DNA fingerprinting, and secure **data encryption** will instantly verify transactions, preventing today's scams. But new forms of "information crime" will appear.

Geography will be less of a constraint. Many employees could be geographically dispersed, such as those engaged in processing (for cost advantages), in sales and marketing (to be close to the customer), and in handling local problems that require local solutions. But the people responsible for creating products and overall strategy will still have to be in major cities. These people need the creative stimulation that is found primarily in cities, where they will thrive on face-to-face contact with people from different backgrounds and cultures and from different disciplines — artists, scientists, businesspeople and lawyers.

### **“Particle finance”**

In fact, a convergence is taking place among these disciplines as finance becomes more like science and the arts. Financial theory is becoming increasingly important and tremendously useful as **theo-**

retical advances have emerged in the last few years. These include portfolio theories, asset pricing theories, option pricing theories, and market efficiency theories.

Many of the financial world's most creative people are devoting their time to these theories and are radically improving our comprehension and management of risk. They deal with variables as straightforward as interest rates and as complex as the weather—all of which have an enormous impact on the markets.

This path-breaking work is providing a solid platform for innovation in practice as well as in theory. The rapidly growing acceptance of derivative-based financial solutions is one very important example of this.

At this point, however, the science of markets is at an extraordinarily early stage of development. We are still in a "Newtonian" era of "classical finance," in which we tend to look at financial instruments—such as stocks, bonds, and loans—in static, highly aggregated terms.

Models based on classical finance analyze risk at the level of "securities" (or options on these securities) and usually assume that the volatilities of the securities are constant over time and can be estimated with statistical averages of past price data—a stationary world where there is no progress, no structural change, no evolution. But in reality, a security's volatility is based on a highly aggregated bundle of many complex underlying risks that are unlikely to be stationary and that usually interact with one another. Classical finance also assumes that human beings are rational economic decisionmakers—an assumption that frequently appears to be violated.

Most classical finance models looking at Bankers Trust would concentrate on the "beta" of its stock—the stock's volatility relative to the market. These models would have great difficulty dealing with the multitude of underlying critical risk factors that produce beta, such as changes in financial market volatility, changes in global product, the volumes of our transaction processing, an earthquake in Japan, changes in consumer confidence in the United Kingdom, or a change

in our corporate strategy. We describe these critical factors as "financial attributes." Beta ignores them or grossly summarizes them as homogeneous packets of white noise.

Theoreticians, however, are not ignoring them. Researchers have begun to look for a theory—what we call "The Theory of Particle Finance"—that will help us better understand an asset's financial attributes.

Finding such a theory is **not** just around the corner, but we are seeing interesting signs of progress, and by 2020 a much more powerful financial discipline will be in place. We are beginning from a Newtonian view, which operates at the level of tangible objects (summarized by dimension and mass), to a perspective more in line with the nonlinear and chaotic world of quantum physics and molecular biology.

Quantum physics, which operates at the level of subatomic particles, and which may eventually bridge subatomic and astronomical events, goes much deeper than Newtonian physics—beyond objects to molecules, to atoms and to subatomic particles.

Similarly, classical biology operated at the level of the organism and was preoccupied with taxonomy and anatomy. Biology advanced by probing deeper into the cells and genes, which are much closer to the fundamental building blocks of life. This made it possible to explain some of the critical interactions among cells, organisms, and the environment.

Like quantum physics and modern biology, particle finance is beginning to look beneath beta to identify an asset's financial attributes, including the attributes' individual and collective volatility. Efforts also are being made to integrate these attributes into the desired financial claims.

This work is creating order from apparent disorder, providing building blocks that will allow the more effective packaging and management of risk in an economy whose structure is constantly changing.

The purpose of this research is to reach the most efficient balance of risk and return—getting a higher expected return on the same risk or getting the same return with lower risk.

As noted earlier, the theory of particle finance is still in its infancy—but by 2020, it will be much further advanced, aided by an explosion in computing power and financial data. We can't say which of today's early attempts to advance the theory of particle finance will work, but already the developments are intriguing.

For example:

(1) Chaos theorists are attempting to find the underlying structure and pattern—if they exist—of the apparent randomness of changes in asset values. (The "Random Walk" may not be completely random after all.)

(2) Researchers are building neural networks that mimic certain complex properties of the human brain. When harnessed to massive computing power, it is hoped that these neural networks will find meaningful patterns in the "noise" of financial attributes and, learning from experience, will strip away some of the apparent randomness of financial events.

(3) "Fuzzy logic" is a mathematical way of drawing definite conclusions from approximate, vague, or subjective inputs. Because it attempts to embody certain kinds of human perception and **decision-making** skills, it may help us understand complex interactive systems that involve human intervention (like financial markets).

(4) Combinations of these **and/or** other new methods may produce the answer. For example, information gleaned from the neural networks might be used to define "fuzzy" relationships in the system and then to write "fuzzy" rules to control the processes or to predict the systems' behavior in new situations.

The 2020 technology environment promises much greater market efficiency through better information and lower transaction costs. However, as particle finance uncovers myriad risk variables, now

existing but "invisible," it also uncovers the inefficiencies associated with these variables. Also, the constants of human nature will still produce financial fads and bouts of irrational market euphoria and gloom (although we can hope that better information will dampen their intensity). The ideal of a perfectly efficient market will not be achieved by 2020, if ever.

Particle finance and more powerful technology will substantially reduce the amount of unwanted risk borne by individuals, institutions, and the system as a whole. We will find better ways to quantify, price, and manage today's familiar risks. We will also uncover, quantify, price, and manage risks that exist today but are hidden from view. The net benefits will be great—even granting that new and unforeseen risks could be created by this environment.

### **Applying particle finance**

Meanwhile, progress is being made at the front lines as well as in the labs. Pioneers in the derivatives business are successfully identifying, extracting, and pricing some of the more fundamental risks that drive asset values, such as interest rates, currency values, and commodity prices. Even though today these early applications look crude and primitive, they have already created a new and powerful process for solving important and practical financial problems. These range from limiting an airline's exposure to fuel price increases to helping a company hedge the value of a pending acquisition.

And important new applications are already on the runway: credit derivatives and insurance derivatives, for example.

Long before 2020, credit risks will be disaggregated into discrete attributes that will be readily traded, unbundled, and rebundled. Intermediaries will manage a large book of diversified long and short positions in credit attributes. They will make markets in credit risk attributes and in bundles of attributes customized to suit the particular needs of their clients.

Such tailored products will permit each business to price and manage credit risk arising from its activities in a way that is best for

that business. Perhaps even residual credit risks left after this process will be covered by a third-party insurance policy.

As the discipline of particle finance evolves, the primary job of financial institutions will be to help clients put theory to practical use. Just as today's man on the street does not practice particle physics, he will not practice particle finance in 2020.

It may often be done for him or her through automated analytics. For example, particle finance and automated analytics would provide much better asset allocation advice than is available today—allocating positions across many financial attributes rather than just picking the stock-bond mix.

The more advanced automated analytics programs will be like today's sophisticated computer chess programs, which can beat most players, but not all. As a result of competition from automated analytics, experts will be challenged to move on to higher and higher levels of wisdom and creativity.

However, the financial professional who prices the risk attributes will continue to use a combination of automated analytics and judgment. He or she will be responsible for the validation of the logic and historical data used in the automated analytics. In addition, forecasts of prospective market conditions will continue to play a critical role in pricing risk attributes, especially where prospective events are influenced by nonlinear relationships or structural changes that are not evident in past data or experience. We would expect a combination of chaos theory, fuzzy logic, and other tools to assist with predictive problems.

While advances in financial theory and technology will give talented people more powerful tools to apply their human creativity, they will not be replaced with robots. The CAT scan did not replace skilled neurologists—it gave them a tool that allowed them to apply their judgment with more precision and power.

In addition, highly skilled and creative specialists will continue to be needed to define and solve problems that are particularly complex

and unique. These financial specialists will be the highest practitioners of particle finance, combining a creative grasp of financial possibilities with a psychoanalyst-like ability to help clients understand the true nature of their preferences for risk and return.

### **The role of central banks**

The role of central banks will change as financial markets change. Two basic functions of central banks will be to protect us from systemic risk and to keep inflation in check.

The mechanisms by which central banks will deal with inflation in the world of 2020 are not clear. One method might be the use of margin requirements to control the amount of *crédit* extended against wealth accounts. Clearly, capital controls and fixed exchange rates will be relics of an earlier age.

Another mission will be to avoid systemic collapse. We emphasize that this is *not* the same as dampening market volatility. Nor will regulators have to concern themselves with the fate of individual institutions, ending government-sponsored bailouts. Examiners will monitor the risk attributes of individual institutions to judge whether and how they contribute to the risk attributes of the system as a whole. (Everything else is random noise that cancels out at the portfolio level).

Central bankers will focus on the prospective behavior of the system as well as current values of key targets. They will operate in the alphabet of financial risk as many advanced professionals do *today*—"delta" risk, the change in the values of instruments that are derived from the values of other instruments; "gamma" risk, the impact of highly nonlinear price changes on the behavior of the portfolio; "vega" risk, the change in the behavior of the portfolio arising from changes in the implied volatilities of the underlying instruments; and "theta" risk, the change in the behavior of the portfolio arising from the passage of time.

To effectively operate in this environment, central bankers will have to thoroughly understand and use the new computer and **communica-**

tions technology. Human nature being constant, they will also need to understand the psychology of crowd behavior and its prospective impact on financial market stability.

Thus central banks will have tools to prevent systemic collapse in the world portfolio similar to the tools that financial institutions will use to manage the corporate systemic risk in their portfolios. These tools will include real-time data and automated analytics.

Insuring against systemic risk will require a globally coordinated effort, which could well be the biggest challenge to the central banks. Will governments be able to put aside their parochial nationalistic agendas?

### **A few implications for financial institutions arising from particle finance in 2020**

Particle finance presents a cornucopia of new business opportunities for financial institutions. Myriad risks, perhaps inexhaustible risks, are yet to be uncovered, described in "probability of occurrence" terms and then rebundled to satisfy client needs. There will always be a need for new disciplines and technologies to measure and deal with these risk attributes. In addition, all of these attributes and bundled products must be stored, safeguarded, verified, reported, and transferred.

Financial professionals will constantly be re-educating themselves. We, for example, are creating a "Bankers Trust University," where our people will be encouraged to spend many of their working hours.

Obviously, in the era of the theory of particle finance, financial organizations will look very different from the way they do today and will require a new type of manager.

With >virtually no layers of management, financial organizations will attract an array of highly skilled and creative experts, including a wide array of people from science and mathematics.

Senior management will be like conductors of orchestras guiding their "artists" and "scientists" through example and influence rather

than by "command and control." One of the important jobs of top managers will be to get their technical experts and managers to play in the same key. They are temperamentally different from one another, but as finance, science, and the arts continue to gradually merge, the scientist, artist, and manager will become more alike. The leaders' most important functions will be to inspire by articulating a clear vision of the organization's values, strategies, and objectives and to know enough about the business to be the risk manager of risk managers.

Superior judgment will always be essential and will continue to be valued highly since it will not be embedded on silicon. Depth of talent will be critical to success, so recruiting and retaining people will remain management's most important job. Technology will never replace the subtlety of the human mind. People will be the most important factor in 2020, just as they are now. We must learn how to grow wise leaders from the ranks of specialists, a difficult task.

## **Conclusion**

These concepts will not flourish unless society blesses them. A social critic may say they are nothing more than a financial engineering exercise designed to enrich a few at the expense of many—a zero-sum game.

Not true. For as risk management becomes ever more precise and customized, the amount of risk that we all have to bear will be greatly reduced, lowering the need for financial capital. This will have a tremendous social value because financial capital that had been required to cushion these risks will be available elsewhere in society to produce more wealth to address society's needs. In addition, this will liberate human capital by the greater leveraging of talent.

And these concepts will not flourish unless our clients bless them. As valuable as macro capital generation may be, it is not enough. On a micro basis, individuals and organizations must see value for themselves; clients must buy the service. Their trust must be earned by delivery of objective diagnostic help and solutions of value to them. We shall earn it.