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 Foresight

# Future of Computer Trading in Financial Markets

## Industry Workshops:

## Drivers of Change & Scenarios

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Foresight Project on The Future of Computer Trading in Financial Markets.  
The views expressed are not those of the UK Government and do not represent its policies.

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## Chapter One: Executive Summary

### 1.1 Introduction

Foresight has undertaken a two-year project to investigate how computer based trading (CBT) in financial markets might evolve over the course of the next decade<sup>1</sup>. As part of this project, and in order to understand industry perspectives on the question, the Foresight project team organised workshops in London, Singapore and New York in September 2011, inviting senior representatives from a number of leading firms.<sup>2</sup>

Participants at the workshops were asked to identify the most significant factors shaping the world today, and to identify what forces would be important drivers of change over the next few years, and used the drivers to create short scenarios. Finally, each workshop considered the implications of the drivers and scenarios for five key indicators of market quality: liquidity, stability, price efficiency and discovery, transaction costs, and potential for market abuse.

Based on the outputs of the workshop, the Foresight team, with oversight from the project's Lead Expert Group, analysed the drivers of change identified at the workshop and grouped them into six themes each representing a cluster of drivers of change that would have a high impact on the future of computer-based trading in financial markets over the next decade. From these themes, the team has prepared a set of four overarching scenarios<sup>3</sup> that will be used to test possible policy options for maximising the benefits of CBT while minimising risks and ensuring market stability.

An overview of the themes and scenarios is provided below. Chapter 2 of this report summarises the views of the workshop participants from which these themes were developed; while Chapter 3 explains how the themes were used to generate the four overarching scenarios, and gives an overview of each of them. The Annexes contain the full list of drivers of change identified during the workshops, along with the scenarios that were developed by participants on the day.

### 1.2 Drivers of Change and Scenarios

The six major groups of drivers of change identified during the workshops were: Technology; Regulation; Asset classes and returns; Demographics; Geopolitics; and Competition and business model innovation. These are described in full in Chapter 2. Examples from each of these categories are:

- *Technology* may lead to the creation of highly distributed trading platforms, on which large numbers of individuals carry out transactions. Individual handsets, possibly receiving live news and data feeds, may be used for trading; institutional trading strategies may also be influenced by communications on social networks. A new

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<sup>1</sup> see <http://www.bis.gov.uk/foresight/our-work/projects/current-projects/computer-trading>.

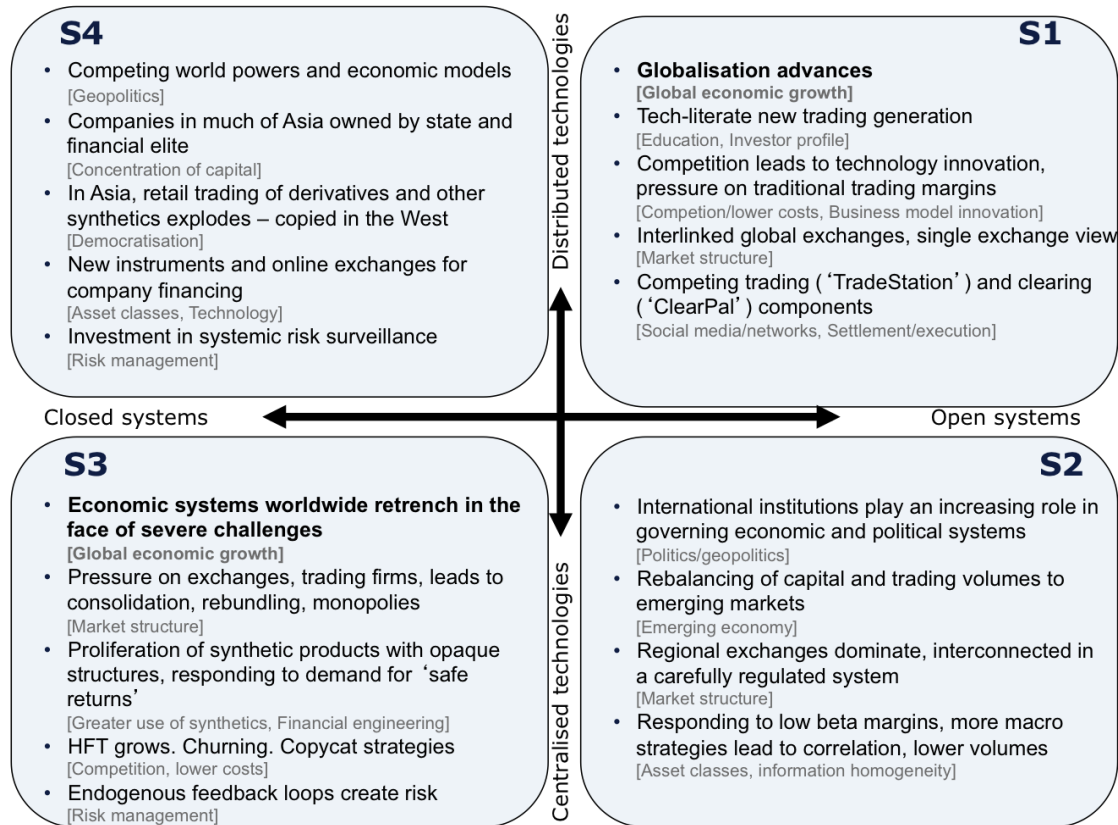
<sup>2</sup> see the Annex for a list of firms represented.

<sup>3</sup> see The Scenarios approach in the Annex for an explanation of the scenario method.

topology of either highly dispersed exchanges or of interlinked international exchanges could take shape.

- The demand for *regulation* will tend to have an inverse relationship with levels of trust in the market. If there are several flash crashes in a row, trust will collapse. We may see future watershed events that could completely change the course of regulation, potentially driving towards a more paternalistic or even protectionist climate.
- *Asset classes*: Products focusing on levels of risk exposure rather than dividends may become more prominent. There may be an evolution of products away from listed equity or derivatives, to synthetic products and spread-betting. These may focus on exposure rather than ownership, and are likely to include more 'exotic' instruments. Computer-based trading (CBT) may lead to the creation of new financial instruments for asset classes that are not currently directly traded using HFT or algorithmic tools.
- *Demographics*: There will be a significant expansion of the middle classes in the emerging economies. The desire to build wealth and to finance education, health and pensions will create demand for investments, including new product classes. In the West, baby boomers will drive investment shifts, for example in the demand for retail rather than mutual funds, or fixed income rather than equities.
- *Geopolitics*: Growth rates over the next decade will have a determining effect on the shape of future markets. A strong world economy will allow experimentation in technology and new connections between geopolitical regions and groupings. A faltering economy, let alone one in a tailspin, would be likely to lead to national retrenchment.
- *Competition: Innovation* will be in business models, not technology. Features analogous to Amazon's 'other products you may like' button may be introduced into institutions. Competition will be around content, financial products and costs. Firms may de-bundle services to generate more commission. Exchanges are already making more money by proposing value-added components; they could focus on more content-driven models.

The scenarios (see below and Chapter 3) present four alternative future contexts for CBT in financial markets, determined by two of these drivers of change themes analysed in Chapter 2 playing out in opposing directions. On one axis, the *geopolitical* situation is either 'open' or 'closed'; while on the other, new *technologies* are developed and implemented in either a centralised or distributed way.



## 1.3 Conclusions

While there was agreement on the way several issues would develop, many factors and drivers of change were considered to be uncertain, and some were given more attention at one of the country workshops than at the others.

For example, at the opening workshop in London, particular attention was given to the role social media would play in informing investment decisions and enabling new trading strategies and tools. In Singapore, the role of synthetic products emerged as a strong theme; while in New York opportunities for business model innovation were explored in greater depth than elsewhere.

The London workshop raised the question of education, both in terms of the specialised training required to keep a traditional centre supplied with qualified individuals, and the basic financial awareness citizens needed in order to have an informed understanding of the role of the financial system. Singapore debated geopolitical shifts, and how globally interlinked or unified market structures, financial products and regulations might become. It also considered possible changes in the ‘retail mindset’ of Asian customers of financial services, and the impact that the growing middle classes would have on the structure of markets. In New York, attention was paid to the new asset classes that might be created as investors’ demands changed and technology squeezed out the arbitrage opportunities in existing products while enabling the creation of new synthetic products.

At the end of each of the country workshops, the scenarios developed by participants during the workshop (provided in the Annex) were used to identify some of possible implications of

the drivers of change and scenarios for CBT in financial markets. Some conclusions common to several scenarios stand out:

- A world with a proliferation of participants, high peer-to-peer interaction, and open markets would be likely to lead to high efficiency and low transaction costs.
- If a new cohort of retail investors from emerging economies generates high volumes of low-value transactions, this will raise liquidity significantly.
- Such a world would foster competition, but could be open to market abuse.
- A world of restricted channels and cautious regulation would be safer, but would almost certainly have low liquidity.
- In a highly technological world, only dynamic regulation – anticipatory and rapidly adapting – is likely to be effective.
- A highly regulated but low proliferation world, such as experienced in some emerging markets today, would imply both lower liquidity and higher transaction costs.

## Chapter Two: Drivers of Change in Computer-Based Trading in the Financial Markets

### 2.1 Technology

Cheaper, faster and more powerful technology (hardware and software) will be an important factor in the development of CBT, though its role may be more as an enabler rather than a primary driver. Aside from trading, technology has an important role in risk management and surveillance.

Younger generations are increasingly at ease managing information across multiple channels, and will not be challenged by the proliferation of products and trading platforms. (S1)

New technology will inevitably mean new sources of risk. (L5) The complexity associated with the introduction of new technology may generate instability; feedback loops can exacerbate risk, and accentuate the impact of human or technological error. (S1) Moreover, most investment tends to go into front office technology: in the back office, counterparties often only look at risk the day after a trade is executed, which can reduce the opportunity for timely intervention to stabilise a situation. (L13)

Risk may be less about the nanosecond speed of transactions and more about risk in the clearing and settlement system. (NY1) There may be moves towards or T-Zero trading (originally developed in Russia in the 1990s), where settlement of a trade occurs on the same day as the trade is made, rather than 3 to 14 days after, as has traditionally been the case.

Pension funds may adopt execution algorithms on their own, which would lead to major changes in market structure.

Quantum computing might enhance the potential for dispersed hubs and social networks.

If systems are built where orders and execution take place on the same chip, what can be called co-location, then issues of latency disappear: there would be no advantage to being physically closer to an exchange. (L8)

Trading tools will improve thanks to advances in database structures, cloud computing, and the ability to incorporate unstructured data such as Twitter feeds. However, the rate of technological change, certainly around trading speed, is not the key factor. Technology's most significant impact is likely to be through enabling business model innovation, including the creation of new products.

Hardware acceleration means that a single company can effectively bring a market to its knees. "Throttling" will be increasingly necessary to block actions such as denial of service attacks (where massive quantities of non-marketable orders are sent and then cancelled). Surveillance for such events exists, and certain systems have the ability to set a limit on the

number of orders to prevent malicious attacks, though exchanges are reluctant to introduce such measures as they may have a negative impact on their business. (NY3)

Technological advances may make computer-based algorithmic trading available to retail investors, who will seek access to new markets, with an “anytime, anywhere” approach to trading. (L6) Technology may enable the retail investor to enjoy market access comparable to institutional traders (NY1); while comparison sites could reduce information asymmetry between retail and professional investors. (L6) With more places to trade, private entities can become cost efficient implementers of trades. (NY10)

Social networks could have a major influence on trading. (L1) Intra-day liquidity may be boosted by people trading on news-flow (L6). Demand for traditional financial advice may fall as people rely on their trusted networks, and funds may take social media trends into account when allocating their assets. The quality of this new source of data will, however, be hard to establish, and the risk of fraud high. (L1) Will peer-to-peer (P2P) trading reduce the demand for institutional stock exchanges?

The development of technology and processing power could lead to decentralisation in the market. This may be accompanied by a move from mutual asset management by institutions to individual asset management, including from mobile devices. (L9) Retail trading platforms already offer high-end “build your own algorithm” packages. Retail investors with access to professional levels of technology and information would change the market in ways that are hard to predict. The impact of a proliferation of day-traders could be significant (already today, with limited access to CBT and HFT tools, individual traders affect the market through “spoofing”. (NY5)) The gap between the retail “punter” and the professional risk-taker will, however, remain wide. (S5)

Whether trading remains centralised at a few major exchanges or becomes more distributed has implications for security. The current model of a centralised hub means hackers or terrorists need only break into a small number of IT systems; on a centralised exchange, a few minutes’ data outage could be calamitous. A dispersed model could be more robust in this regard. (L14) The clearing landscape may be simplified – less expensive, and more open – accompanied by a shift from OTC trading to listed order books. Competing settlement systems might emerge for retail investors, on the PayPal model. (L13)

The democratisation of information and analytical/algorithmic power could lead to greater correlation in the performance of investments. Investors may then be less willing to pay for beta and focus instead on idea creation, which could lead to alpha drivers taking more principal risk. (NY5)

## 2.2 Regulation

The aim of regulation is important, and uncertain. It could seek to identify the build-up of systemic risk through surveillance of day-to-day trading and volatility, or take a longer-term view. It might instead focus on accountability, perhaps in response to public pressure. (S3) In a downturn or recession, there tends to be greater incursion of politics into the regulatory sphere.



Regulators are now addressing bigger risks: macro-economic risks, the build-up of systemic risks within markets, not just financial market risks. Since technology is changing so rapidly, regulation will always tend to lag behind.

The question is not whether we will have more or less regulation, but how enlightened the regulation will be. A principles-based approach may allow market practitioners to implement and comply with regulation more efficiently.

The demand for regulation will tend to have an inverse relationship with levels of trust in the market. If there are several flash crashes in a row, trust will collapse. (L4) We may see future watershed events that could completely change the course of regulation, potentially driving towards a more paternalistic or even protectionist climate. (NY1)

Regulation can reduce the opportunity for positive change. For example, new trading platforms may have the technology to execute trades more quickly than incumbent exchanges, but be prevented from doing so by regulation; minimum resting times may discourage market makers from placing quotes since by reducing their ability to react to market conditions. (L2)

Markets need to be seen as transparent, and participants have to restore trust to reduce public antipathy towards them. There is a feedback loop between political institutions, social factors, and financial markets.

The Flash Crash of 2010 dented public confidence in CBT, and has affected the political mood. (S12) At the same time, CBT enables greater transparency, and may therefore reduce the need for regulation. (NY10)

How might social attitudes change towards other areas of the markets, such as commodity trading? What social or geopolitical pressures could trigger a political or regulatory reaction? (S12)

### 2.3 Asset classes and returns

Will there be a move towards a relatively small number of very wealthy investors alongside institutions, or will capital be distributed more broadly and evenly? There are forces pushing in each direction. (S8) Institutional pools of money are so large that computer trading is being used to “drip-feed” small orders into the market, to avoid flooding it with large orders. (S14)

The level of global liquidity has increased enormously over the past 15 years since the failure of the Long-Term Capital Management fund. Markets have to be very efficient to absorb this increase in liquidity. There are more investors but there is also greater product diversity. (S15) Computer trading could move to new commodities, such as water. L7 Global warming, oil reserves, the development of water products could change the type of markets that open up to computer trading and products. (NY15)

What will happen if an ageing population insists on safer investments in a quickly changing, uncertain world? There will be rewards for firms or individuals able to satisfy those needs, yet the economic – and competitive – stress that those obligations create could represent a strong downward pull on the competitiveness of many established Western companies.

(L10) There is demand for a shift from selection based on asset classes, to selection based on returns. This move will push buying into alpha and beta categories, which will alter the market. This could result in a greater “privatisation of liquidity”. (NY7)

As institutions struggle, products focusing on levels of risk exposure rather than dividends may become more prominent. There may be an evolution of products away from listed equity or derivatives, to innovative synthetic products and spread-betting. These may focus on exposure rather than ownership, and are likely to include more ‘exotic’ instruments. (S9)

Computer-based trading (CBT) may lead to the creation of new financial instruments for asset classes that are not currently directly traded using HFT or algorithmic tools. If homogeneity improved liquidity and efficiency, financial engineering could be used to make products homogeneous (as in characteristics-based trading used for ETFs). It could also, if required, make products very different. (NY9)

Commoditisation may increase in financial instruments (OTCs), in information (systems analysis), and in algorithms. There will be greater competition among intermediaries. (S11)

People could lose confidence in prices on exchanges if they are considered to have moved too far from ‘fundamental’ values. (L16) This trend may be reinforced by the impression, given by non-stop media coverage of markets, that firms’ share prices are determined by a constant stream of random external factors. (S12)

### 2.4 Demographics

The significance of an ageing population in the West and the rapid development of economies in the East, especially in China and India, cannot be ignored. The latter benefit from a larger proportion of revenue-generating workers (typically younger and without the dependencies of the aged). China will eventually experience an ageing population, but this will not have a major impact for the next ten years.

In Europe and the US, a lack of skilled graduates in science, technology, engineering and maths (STEM) poses a problem, limiting the pool of candidates for senior positions in financial services companies and technology departments. On the other hand, the ‘millennial’ generation is technology-savvy and may turn out to be more competent in STEM subjects. (L3) As well as technological awareness, general levels of education may also influence people’s understanding of financial markets and interest in trading. (NY12)

There will be a significant expansion of the middle classes in the emerging economies. The desire to build wealth and to finance education, health and pensions will create demand for investments, including new product classes. (S7) In the West, baby boomers will drive investment shifts, for example in the demand for retail rather than mutual funds, or fixed income rather than equities. (NY2)

In several Asian countries there is a traditional interest in games of risk and speculation, which may spur the growth of the retail investor market. Regulators are likely to make efforts to ensure these investors are protected. (S6)

## 2.5 Geopolitics

The next ten years may see us in an ever more volatile world. The need for free markets will be more acute, but there is a risk that greater market volatility may actually push governments to react by de-globalizing. (S4)

Growth rates over the next decade will have a determining effect on the shape of future markets. A strong world economy will allow experimentation in technology and new connections between geopolitical regions and groupings. A faltering economy, let alone one in a tailspin, would be likely to lead to national retrenchment. (NY4)

Governments and regulators risk “de-globalising” through greater market regulation and increased surveillance, greater capital controls and the use of margins to control leverage. There could be a deleveraging of the Western financial system, caused by raised capital adequacy requirements, and constraints imposed on banks, such as the separation of retail from investment operations.

China may continue to restrict capital flows, while weak growth and lack of capital in the West may drive countries to keep domestic capital onshore. (S4) Regulatory arbitrage may encourage regulatory convergence. But it will not outweigh countries’ determination to protect their interests. (L11)

If protectionism is avoided, technology could drive the emergence of networked, large regional markets with harmonised regulation and clearing mechanisms. In Asia, this trend could meet that of the internationalisation of the renminbi and greater offshore participation of pan-Asian investors. (S5)

Enabled by technology, and driven by the desire to reduce transaction costs, investors may come to view multiple exchanges as one market. This will have implications for the degree of correlation between markets. A 24/7 central order book will also have consequences for back-office and counterparty risk.

Chinese markets may open up to domestic Chinese and foreign retail investors, with implications for market structure and the regulatory environment. As China develops its markets it will focus on multiple trading centres and the market infrastructure necessary to handle very large volumes. (S2) The ability to handle trading orders generated by millions of simultaneous users may turn out to be as significant a competitive advantage as the speed of trading. (L9)

Overall, it is unclear if transformed market structure will lead to a virtual global exchange, or if the desire for choice may reduce the role of exchanges. The trading system may become more “grid”-like (as for electricity), with products and investors able to move freely among different exchanges. (S2)

Financial centres such as London and New York may be able to maintain their leading role by stressing their offer of a dependable legal system, expert staff, and absence of arbitrary state intervention. But the shift of clients and assets towards Asia will challenge this dominance. Changes in the balance of trading between retail and professional and product types may also favour one region over another. Asia may play a greater role if trading becomes more retail focused; Europe has a strong institutional bias. (L11)

## 2.6 Competition and business model innovation

Technology is changing the role of intermediaries. The NYSE 2006 automation brought an exponential increase in trading. SLOPS and FX trading growth will be hugely influenced by regulation. The potential for further disintermediation remains strong. (NY14)

Innovation will be in business models, not technology. Features analogous to Amazon's 'other products you may like' button may be introduced into institutions. Competition will be around content, financial products and costs. Firms may de-bundle services to generate more commission. Exchanges are already making more money by proposing value-added components; they could focus on more content-driven models. (NY6)

How will price discovery change, when traders can easily 'move' from one trading venue to another? And if execution algorithms proliferate, what is the outlook for brokers? They may change their role to provide value in a different way, or they may disappear.

As the range of traders increases, different traditions will establish themselves. Some Asian markets already have more sophisticated gambling algorithms than trading algorithms. What will it take for those to move around the system?

There may be an end to the bid and offer structure of the market. In electricity, for example, the structure of auctions is quickly changing. (L15)

Markets with only one 'mega-clearer' represent opportunities for the growth of CBT, because of the lowered transaction costs that are likely to arise. (NY11)

## Chapter Three: Four Scenarios for the Future of Computer Trading in Financial Markets

To inform its consideration of policy options during the second phase of the Future of Computer Trading in Financial Markets project, Foresight asked its Horizon Scanning Centre (HSC) to consolidate the drivers and scenarios exercises undertaken by participants in the three industry workshops into a single set of four scenarios. Together these should represent *challenging but plausible* alternative futures that the financial markets might face. The goal of this exercise was not to attempt to predict the future, but rather to demonstrate that several different futures were possible. Ideally, the formulation of policy should take *all of these* into account.

The scenarios highlight some common themes, but also illustrate differences, not least between views from Europe, Asia and the US.

For example, at the opening workshop in London, attention was given to the role social media would play in informing investment decisions and enabling new trading strategies and tools. In Singapore, alongside an expected focus on the differences between Asian, US and European mindsets and institutional structures, the role of synthetic products emerged as a theme; while in New York opportunities for business model innovation were explored in greater depth than elsewhere.

Participants did, however, agree on a few key drivers of change for the sector. These were: Technology; Regulation; Asset classes and returns; Demographics; Geopolitics; and Competition and business model innovation (see Chapter 2). To construct a set of four contrasting scenarios, the HSC chose two axes from the list of key drivers, on the basis that:

- They should be 'macro' factors (i.e. Geopolitics, not Globalisation of trading)
- They should be exogenous, i.e. not directly subject to UK policy influence (so not Regulation)
- There must be uncertainty regarding the outcomes associated with factors (will technology use be 'democratised', or will it be controlled by large organisations?)

The drivers that best matched these criteria were:

- **Geopolitics** (will the world remain open, or will barriers go up? **Open vs Closed**)
- **Technology** (how will it develop, how will it be used? **Centralised vs Distributed**)

These axes were used to generate the scenario framework in Figure 1 on the next page.

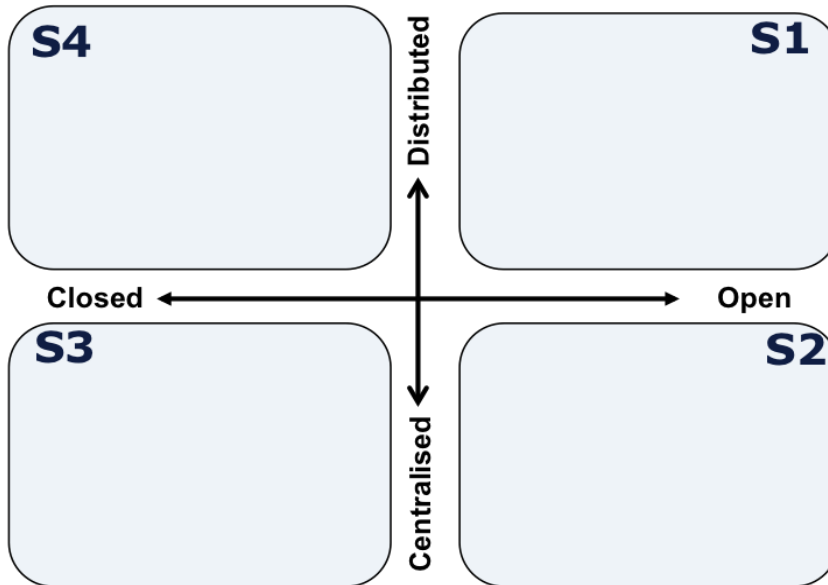


Figure 1 – Scenario framework

Having established the contrasting scenario spaces, the HSC then mapped the material generated during the workshops (during discussions of drivers of change, construction of scenarios, and consideration of implications for the sector) onto these quadrants. Descriptions of the scenarios generated in this way are summarised in Figure 2, and described in more detail below.

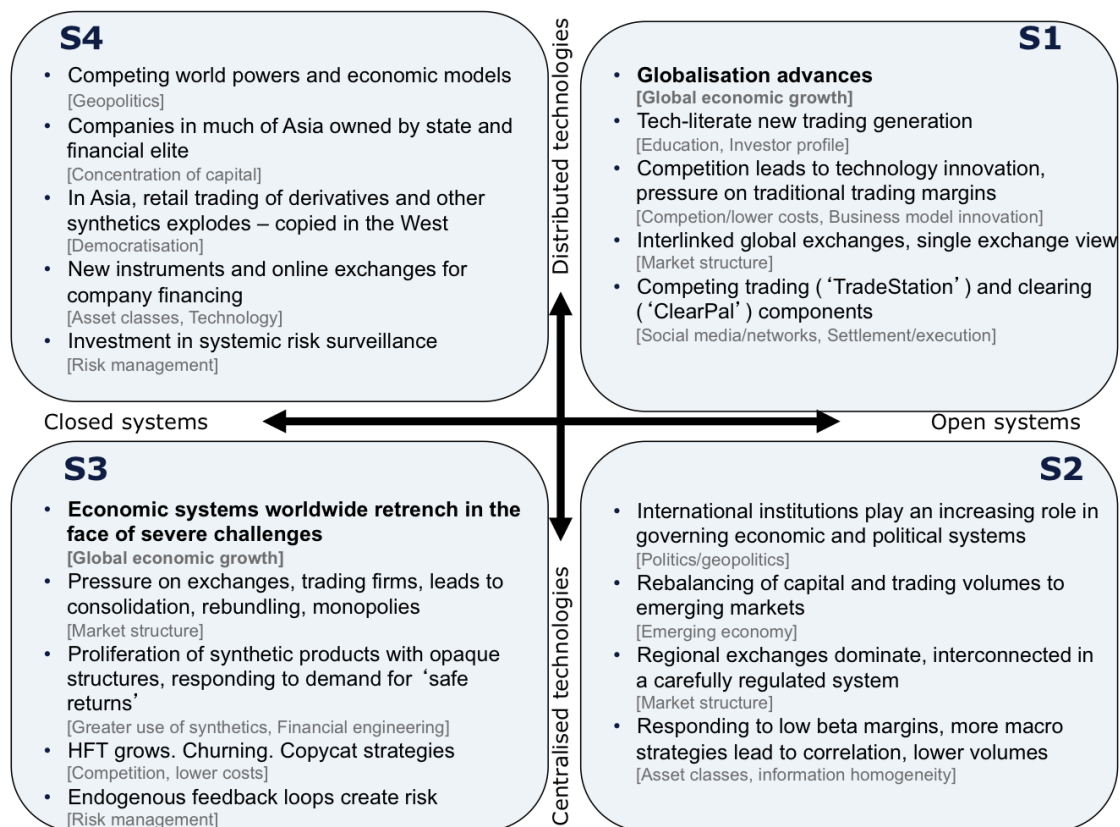


Figure 2 – Summary of main scenario features

### Scenario 1 (top-right)

- Globalisation makes steady progress; growth returns to the developed world and picks up again in the emerging economies
- Trading becomes more mainstream, particularly on mobile devices; retail volumes increase strongly
- The market for trading intermediaries attracts new entrants; competition leads to technology innovation and pressure on traditional trading margins
- New asset classes, such as water futures and country insurance bonds, are developed to satisfy the demand for new products
- Equities lose market share against derivatives and other synthetics. A lower proportion of global capital is raised through equity listings
- Global exchanges are gradually interconnected, offering a single view of multiple exchanges and opening the way to a 'financial grid' system
- Software providers offer competing trading ('TradeStation') and clearing ('ClearPal') components to exchanges
- These providers also offer retail versions of their products. Some offer algorithmic trading on a mobile handset

### Scenario 2 (bottom-right)

- The world remains open, world trade is steady; emerging economies grow strongly but Western economies are still weighed down by debt burdens
- International institutions play an increasing role in governing economic and political systems, offering a greater voice to the new economies
- Stock exchanges are regulated to encourage international trading, while protecting consumers
- Large regional exchanges dominate; smaller trading firms are perceived as risky after several well publicised failures
- Capital and trading volumes are 'rebalanced' in favour of emerging markets
- Information and data are openly accessible. Together with increased HFT and algorithmic trading, this leads to reduced margins on beta trading
- Macro strategies lead to correlation, reducing activity levels

### Scenario 3 (bottom-left)

- Economic systems worldwide retrench in the face of severe challenges
- Exchanges are hit by falling volumes as people lose confidence in markets and seek liquidity
- Several trading firms fail. This leads to consolidation; surviving firms use their dominance to control access to exchanges and 'rebundle' elements of the trading and clearing process
- Responding to demand from pension funds and the withdrawal of support from central banks, liquidity provision is increasingly privatised through 'liquidity transfers', distributing liquidity risk around the banking system
- Structured products are used to offer 'safe' returns to the retail market
- Alpha strategies require taking on increasing principal risk (alpha/beta 'fracturing')
- HFT grows, as returns are desperately sought. Churning and copycat strategies increase risk

- Multiple endogenous feedback loops increase the likelihood of another catastrophic financial event

### Scenario 4 (top-left)

- World powers have entered a phase of geopolitical and economic competition
- The 'Asian model' of a state-dominated economy is in the ascendant
- Western economies stagnate; quantitative easing is becoming less effective
- Currencies including the Euro, Sterling and Yen lose value, and the US Dollar shows signs of weakness. More trade is carried out in Renminbi
- Companies in much of Asia are owned by state and financial elite – share ownership does not converge with patterns in the West
- Retail trading of derivatives and other synthetics grows strongly. Trading 'apps' become popular across Asia
- Seeking new sources of revenue in a stagnant trading environment, trading firms in the West offer apps to their customers, with some success. Some trade directly off live news feeds
- 'Buy and hold' strategies and pension funds underperform
- New instruments and online exchanges are created for company financing, as traditional capital-raising falters
- Investment in systemic risk surveillance



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