Government Office for Science

Foresight

In association with RAND Europe

The Future of Computer Trading in Financial Markets:

Scenarios

June 2012

This paper has been commissioned as part of the UK Government's Foresight Project on The Future of Computer Trading in Financial Markets. The views expressed are not those of the Government and do not represent its policies.

Contents

Four Scenarios for the Future of Computer Trading in Financial Markets

1. Introduction

The four scenarios presented in this report (figure 1, and section 1.2) are based on a series of workshops held as part of the Foresight project on the Future of Computer Trading in Financial Markets. Three workshops were held in September 2011 in London, Singapore and New York, each bringing together a wide range of industry participants. In May 2012, a further workshop was held with a group of senior economists from major public and private sector institutions. The purpose of the workshops was to attempt to identify the major trends and drivers of change relevant to the financial industry that were likely to occur during the period between now and 2020 and, using a scenario process, to consider the impact of such factors on the financial markets and the role of computer trading within them.

To inform its consideration of policy options during the second phase of its project, Foresight asked RAND Europe to consolidate the material from the workshops into a single set of four scenarios. Together these should represent *challenging but plausible* alternative futures that the financial markets might face.

In carrying out this task, we have attempted to reflect the spirit as well as the specific material of the two exercises and – most importantly – to produce four contrasting scenarios of direct relevance to the Foresight project. The purpose was not to attempt to predict the future, but rather to demonstrate that several quite different futures were possible. Ideally, the formulation of policy should take these scenarios into account.

Section 1.3 of this report presents the key drivers of change identified in the exercises, along with a brief description of each.

As a starting point for the consideration of policy options, section 1.4 assesses the implications of each scenario for six important financial market criteria, based on the sessions held at the scenario workshops.

An annex to the report summarises the two independently run scenario exercises that have been combined here, and the drivers of change identified by participants in the separate exercises.

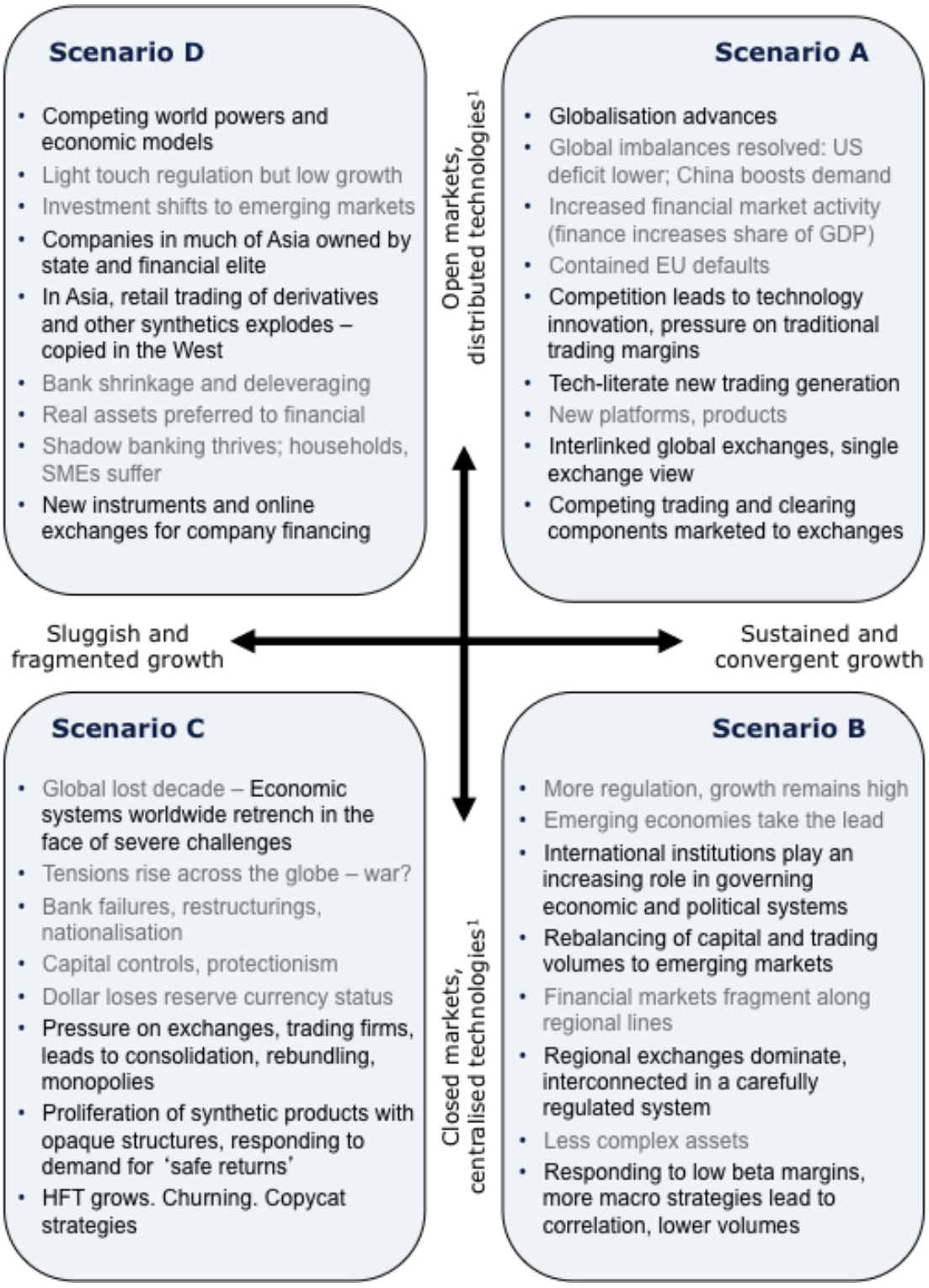

Figure 1 – Combined scenario characteristics

[1] On the vertical axis, 'centralised technologies' refers to systems and software developed for and deployed at large institutions (exchanges, major banks and trading firms); 'distributed technologies' refers to applications aimed primarily at the retail customer.

2. Scenarios

Scenario A – Back to the 1980s

Global imbalances begin to be resolved as the savings and investments imbalance between East and West reduces. Globalisation makes steady progress; growth returns to the developed world and picks up again in the emerging economies.

The Japanese economy develops (modest) surpluses, US deficits stabilise, Europe survives a series of 'corrective' defaults without major disruption and China's growth is stabilised by the emergence of healthy levels of domestic demand.

Financial markets account for an increasing proportion of GDP, although equities lose market share to derivatives and other synthetic products. Increasing amounts of investment and trading activity are accounted for by hedge funds, in part to avoid barriers and regulations. New asset classes emerge, such as water futures and country insurance bonds.

Novel platforms and financial services are also developed: for example, software providers sell competing trading and clearing components to exchanges and also offer retail versions of their products, such as algorithmic trading on mobile handsets. Retail investment volumes increase strongly.

The interconnection of global exchanges continues, offering a single view of multiple exchanges and opening the way to a 'financial grid' system.

The market for trading intermediaries attracts new entrants; competition leads to technology innovation and pressure on traditional trading margins.

Scenario B – Back to the 1950s

Markets have become less open, and finance is increasingly regulated around the world. Capital and trading volumes are 'rebalanced' in favour of emerging markets, which are better able to sustain growth, while Western economies remain encumbered by their debt burdens. International institutions play an increasing role in governing economic and political systems, offering a greater voice to the new economies. The Washington consensus of lightly regulated financial markets and capital flows has passed.

Financial markets are reconfigured along regional lines, and investment is biased towards domestic markets. Governments use regulation to capitalise on – and protect – local advantages. Globalisation declines, but does not disappear altogether; trade has reached a plateau; some regional trading blocs (such as the EU) remain effective. Trade deals tend to be bilateral rather than multilateral, and more in the interest of the new economies.

The UK rediscovers the macroeconomic policy stance of the post-war years, when higher levels of financial market regulation coexisted with annual growth rates of 5% or more. Such growth rates prove out of reach in the 2010s though, as debt is paid down.

Protectionist government intervention means financial resources are not allocated efficiently; there is more 'strategic' allocation and less short-term profit maximisation. Price discovery is distorted; risk is not efficiently priced. Savings in the emerging countries are reinvested there; the West has to bid over the odds to attract investment capital. Political support for free trade and open markets weakens in the West, leading to a gradual departure of entrepreneurial talent.

Institutional investment outweighs retail investment; interest rates do not equalise on a global basis. Large regional exchanges dominate; smaller firms and platforms are perceived as risky after well-publicised failures. Stock exchanges regulation privileges consumer protection. There are more manufacturing jobs and the financial services industry accounts for a smaller proportion of GDP.

The financial world sees a return to less exotic products and services, epitomised by the return of the building society model. There is more interest in risk sharing than aggressive (financial) gain seeking. Continued HFT use leads to reduced trading margins for institutions, while macro strategies lead to correlation, reducing activity levels.

Scenario C – Retrenchment and global tensions

The collapse of the euro and ensuing depression leads to the reintroduction of capital controls in Europe; banks are nationalised amid a resurgence of protectionism. Economic systems worldwide retrench in the face of severe challenges.

The strengthening US dollar loses its reserve currency role as the US attempts to improve its current account deficits by devaluation (rather than reform of fiscal policy and savings-investment imbalances), triggering inflation and increasing the perceived riskiness of both US sovereign debt and other dollar-denominated assets. The resulting confusion and the lack of an alternative 'risk-free' reference asset, lead to violent and unpredictable price fluctuations.

Globally, there are persistent increases in deficits and a Japanese-style lost decade lies ahead. The West reacts by blaming others and turning protectionist. There are bank failures, restructurings and nationalisations.

The loss of equilibrating global trades and the resulting restrictions on free movement of assets and entry exacerbate inequality within and among nations. This is extended by the failure of markets properly to price claims in different dates and states.

Populist politicians and parties come to the fore on a wave of discontent. 'Arab spring' turns 'Arab winter'; developed and emerging nations blame each other for their growing economic troubles; China and India fight for access to the remaining world markets. These tensions are set to escalate dangerously.

Exchanges are hit by falling volumes as people lose confidence in markets and seek liquidity. Several major trading firms fail. This leads to concentration; 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', spreading liquidity risk around the banking system.

Structured products are used to offer ‘safe’ returns to the retail market. ‘Alpha’ trading strategies – which aim to achieve returns that beat a relevant benchmark – require taking on increasing increasing principal risk. HFT grows, as returns are desperately sought. Churning and copycat strategies are adopted, and multiple feedback loops increase the likelihood of a catastrophic financial event.

Scenario D – Geopolitical and economic competition

Regulation on the whole remains ‘light touch’, but growth still falters. As stagnation persists, however, some nations opt for greater regulation and restrict access to their financial markets. World powers have entered a phase of geopolitical and economic competition.

Western economies stagnate; quantitative easing has become less effective. Even China sees GDP growth fall, but the ‘Asian model’ of a state-dominated economy remains in the ascendant. Companies in much of Asia are owned by the state and financial elite – share ownership does not converge with patterns in the West. The euro, sterling and yen lose value, and the US dollar shows signs of weakness. More trade is carried out in renminbi.

The US deleverages, in part by renegotiating or defaulting on debts. Underemployment has lowered productivity growth, while differing skill levels exacerbate wage inequality. Rising inequality has increased political fragmentation and extremism.

In countries that persist with light-touch regulation and open markets, banks and some other financial institutions have shrunk. This is partly a consequence of competition, but also to do with deleveraging. The flight of capital to emerging – and liberalising – markets prolongs the stagnation of the developed economies.

Investors have become desperate for yield. ‘Buy and hold’ strategies and pension funds underperform. As a result, capital flows from the US to China, Latin America and other emerging markets, and from traditional financial assets to ‘real’ investments; some markets struggle to handle these shifts and episodes of illiquidity occur.

The shadow-banking sector does well, but households and small firms struggle for access to capital. New instruments and online exchanges are created for company financing, as traditional capital-raising falters.

Seeking new sources of revenue in a stagnant trading environment, firms in the West offer trading apps to their customers, having seen them take off among Asian retail investors. Retail trading of derivatives and other synthetics grows strongly, though many see this as a betting culture taking hold in the absence of reliable yields from traditional investments.

Problems considered less urgent, such as the environment, take a back seat to short-term economic policy. Domestic and international political tensions are stoked by migration, continued economic malaise and growing differences in economic performance.

3. Key drivers of change

The nine major groups of drivers of change identified during the workshops were: Regulation; Demographics; Global economic cycles; Geopolitics; Technological progress; Loss/change of riskless assets; Changing asset classes and returns; Competition and business model innovation; Changes in (dis)intermediation. Regulation and demographics were highlighted by both the industry and the economists' workshops.

All of these drivers contribute to the scenarios, albeit in different combinations and with different weights and likely outcomes. Running the industry and economist's exercises independently provided different perspectives on how the important drivers of change would be manifested, which we have tried to reflect in the four resulting scenarios. For example, discussion of the function of the 'riskless' asset, and the risk of losing it, was extensive at the economists' workshop; while the industry workshops focused more on the possible evolution of asset classes, reflecting changes in the origin and nature of demand and supply-side innovation.

A summary description of the drivers of change from the two exercises is provided below; the separate outputs of the industry and economists' sessions can be found in the annex.

1. *Regulation*: Regulation will have an important and uncertain influence on financial markets, as both a driver and a consequence of financial market changes. As a driver, it may change the allocation of investment across assets and exchanges and across institutions and investment models or strategies. Future regulation could be more or less coercive, informed by big data analytics, sophisticated models, heavy- or light-touch. There could be fragmentation at the global level, possibly linked to resurgent protectionism. 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.

2. *Demographics*: The expansion of the middle classes in emerging economies is an important driver of change: the desire to build wealth and to finance education, health and pensions will influence demand for investments. 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. What was highly uncertain was the impact these changes would have on the demand for different classes of assets and the demand for institutional vs. retail investment services.

3. *Global economic cycles*: The economic cycle appears to have been perturbed by the nature of the current recession. The dynamics of growth, employment, savings, trade, leverage, etc. may return to previous cyclical behaviour or may instead follow a new pattern (prolonged recession, chaotic behaviour). Linked to this, global imbalances may persist or resolve. These factors will affect the demands placed on financial markets in terms of volume, asset classes and acceptable levels of risk and return. Global macroeconomic dynamics may also affect the process of globalisation and the relative importance of financial and 'real' markets.

4. *Geopolitics*: Growth rates over the next decade will powerfully influence the shape of future markets. A strong world economy will allow technological experimentation and

new connections among geopolitical regions and groupings. A faltering economy, let alone one in a tailspin, would be likely to lead to national retrenchment.

5. *Technological progress* 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 topology of either highly dispersed exchanges or of interlinked international exchanges could take shape.

6. *Loss/change of riskless asset*: The current global asset 'ecosystem' uses the return to riskless assets as a reference point for pricing risky assets. With sovereign debt now perceived to carry risk, this point of reference may be on the point of disappearing. The behaviour of financial markets without a commonly recognised riskless asset is uncertain, and it is not clear whether a new common reference point will emerge. A connected issue is the link between sovereign debt and national currencies, and the role of the dollar as the global reserve currency.

7. *Changing asset classes*: Products focusing on levels of risk exposure rather than dividends may become more prominent; investment may shift from listed equity or derivatives towards synthetic products and spread-betting. These may focus on the state-dependent pattern or returns 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.

8. *Competition*: over and above technological changes, *innovation* in business models will shape competitive dynamics. Features analogous to Amazon's 'other products you may like' button may be introduced into institutional trading products. Market shares and returns will be driven by content, financial products and costs. Firms may unbundle services to generate more commissions or rebundle them to enhance investor lock-in. Exchanges are already making more money by proposing value-added components; they could increasingly focus on content-driven models.

9. *Changes in (dis)intermediation*: Technological and financial market changes are altering both the size and role of intermediaries. The pace, direction and implications of these changes will depend on whether such entities can operate across borders, the depth of funding they influence and their impact on specific assets or investors. These developments are linked to CBT/HFT via the arbitrage role of intermediaries – which may be implemented via CBT – by the continuum of CBT from algorithmic trading to HFT and by the degree to which the implications of CBT are different for the price trading and asset management functions of intermediaries.

4. Implications of the scenarios

This section summarises the implications of the scenarios for six thematic criteria:

- Liquidity – the ability to buy or sell an asset without greatly affecting its price. The more liquid the market, the smaller the price impact of sales or purchases.

- Financial market stability – the lack of extreme movements in asset prices over short time periods. This does not preclude extreme movements in response to information shocks, which should be almost instantaneous. Such movements should not, however, lead to further destabilising movements.

- Volatility – variability of an asset's price over time.

- Price efficiency and price discovery – pricing is efficient when an asset's price reflects the true underlying value of an asset, and is a consequence of the speed and accuracy with which prices reflect all available information; discovery refers to the market process whereby new information is incorporated into asset prices.

- Transactions costs – the costs traders incur to buy or sell an asset.

- Market integrity – the extent to which markets are immune to manipulation. This is a consequence of *inter alia* market transparency, the ability of traders, regulators and other stakeholders to see market information. It includes post-trade transparency – the ability to see trade prices and quantities, and pre-trade transparency – the ability to see quotes.

These are discussed for each scenario and summarised in Table 1.

Under scenario A the outcomes for the six are positive, in line with mainstream economic theory. Liquidity is good, financial stability increases, volatility declines, prices efficiently incorporate all knowledge and risks, transaction costs are low and markets effectively self-regulate against opportunistic or predatory behaviour.

Scenario B entails compartmentalisation, asset simplification and financial restrictions, especially of international flows. This generally reduces liquidity, but increases financial stability and lowers overall volatility. Markets will not price properly for risk, which will harm price efficiency and discovery and increase the volatility of real returns to specific assets. Unit transaction costs will increase. Market integrity will decline but market insiders and those who circumvent the markets will do well.

Scenario C also sees widespread use of capital controls and a strong 'home bias.' In contrast to Scenario B, however, it also has limited or no growth. In consequence, although liquidity is down, increases in financial stability cannot be taken for granted, because low growth threatens the existence of a riskless asset. On the other hand, short of catastrophe, low growth depresses volatility and assets prices alike. Transaction costs are up. The pervasiveness of inefficient barriers to economic activities produces corruption and other threats to market integrity.

Under scenario D, openness without strong global growth exacerbates unstable global financial flows. Liquidity is unreliable, financial stability is threatened by a series of speculative bubbles and crashes, and volatility increases. The unstable flight of capital through a fragmented financial system indicates effective price discovery and low transactions costs. The zero-sum nature of this scenario makes the threats to market integrity even worse than in Scenario C.

	Scenario A	Scenario B	Scenario C	Scenario D
Growth Markets	High Open	High Closed	Low/none Closed	Low/none Open
Liquidity	High	Low	Low	Low
Financial stability	Up	Up	Up (no riskless asset)	Down (bubbles)
Volatility	Low	Low (high real return volatility)	Low, eventually	High (or low: capital shifting)
Price efficiency, price discovery	Very good (strong form)	Falling (risk not properly priced)	Falling	
Transaction costs	Low	High (market barriers)	High (market barriers)	
Market integrity	High	Low (insiders and bypassers do well)	Low (corruption)	Very low

Table 1 – Thematic implications of the scenarios

Annex – combining the two scenarios exercises

Scenarios

The scenarios developed from the industry workshops are summarised in figure 2 below; those from the economists' workshop in figure 3. Producing a single set of scenarios from these two independently generated sets was not an easy task, as the results of each workshop exercise were based on different perceptions of the key factors that would influence the shape of the financial markets (see tables 2 and 3 below), accounted for by participants' expertise in different industries and disciplines, as well as the necessary exercise of judgement about which trends would be most important in the future. The choice of scenario axes was also different in each case, and although at first it seemed that the 'open systems' axis from the industry workshops would map onto the 'open markets' axis from the economists workshop, when the detail of the scenarios was examined, it was discovered that this simple translation did not work.

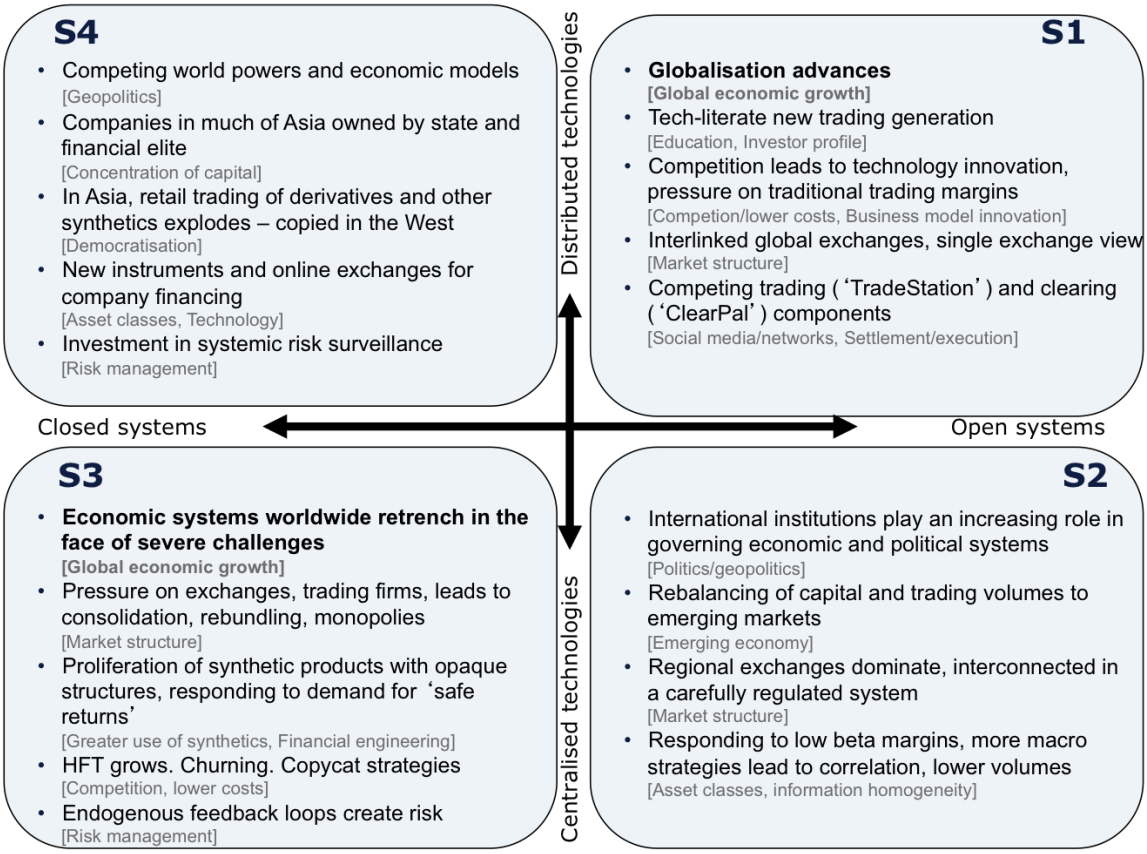

Figure 2a – Summary of main Industry workshop scenario characteristics

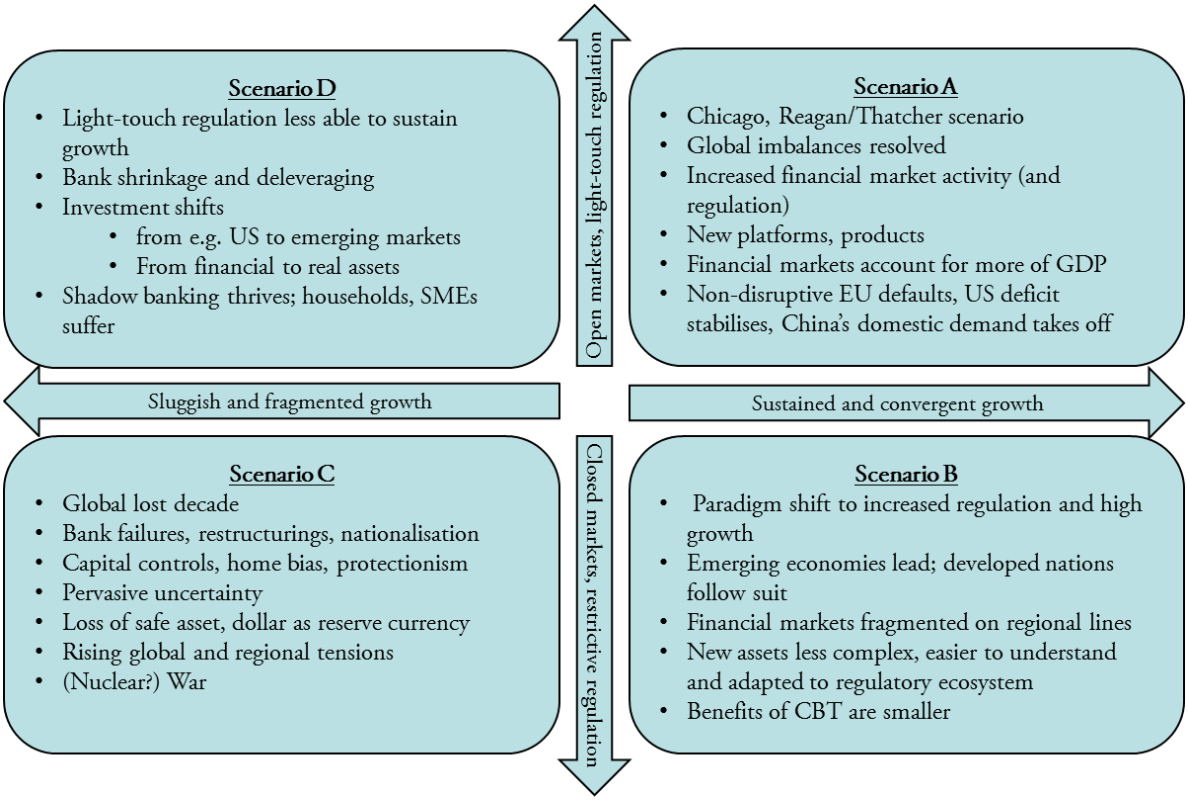

Figure 2b – Summary of main Economists workshop scenario characteristics

Drivers of change – industry workshops

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

2. 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.

3. *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.

4. *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.

5. *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.

6. *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.

Drivers of change – economists' workshop

1. *Global economic cycles*: The world's growth cycles appear to have been perturbed by the recession and its sequellae. The dynamics of growth, employment, savings trade, leverage, etc. may return to cyclical behaviour or follow some other pattern (prolonged recession, chaotic behaviour). Likewise, global imbalances may persist or resolve. This will affect the demands placed on financial markets in terms of volume, asset classes and acceptable combinations of risk and return. Global macroeconomic dynamics may also reflect and affect the progress (or regress) of globalisation and the relative economic significance of financial and 'real' markets.

2. *Loss/change of riskless asset*: The current global asset 'ecosystem' uses the return to riskless assets as a reference point in the pricing of risky assets. With the advent of (belief in) riskiness of sovereign debt, this single point of reference may have disappeared. The critical uncertainty concerned the performance and behaviour of financial markets without a commonly recognised riskless asset and whether a new riskless or other reference point would emerge. A closely connected issue is the linkage between sovereign debt and national currencies; in particular the apparent (and possibly temporary) disappearance of the dollar as a global reserve currency.

3. *Impact of demographics*: Changes in demographics – especially in the age distribution – are likely to affect demand for management of assets. The group agreed that over the next decade population ageing trends are likely to continue (though as with the UK patterns of immigration may also affect national age distributions). One immediate consequence is an increase in the proportion of (potential) investors over the age of 65. What was potentially uncertain was the impact this would have on the demand for different classes of assets and the demand for institutional vs. retail investment services. The group noted that populations in different countries were ageing at different rates, and that was likely to interact with different macroeconomic trajectories.

4. *Changes in (dis)intermediation*: Technological and financial market changes are altering both the size and functions of intermediaries. The group anticipated a variety of future outcomes in terms of whether such entities could operate across borders, the depth of funding they could influence and more generally whether specific assets or investors would experience further changes in intermediation, disintermediation and other aspects of market structure. There is a link to CBT/HFT via the arbitrage role of intermediaries, the continuum from algorithmic trading to HFT, and the degree to which implications are different for price trading and asset management.

5. *Regulation*: The groups all saw regulation as an important and uncertain influence on financial markets. Regulation was recognised as both a driver and a consequence of financial market changes. As a driver, key aspects included the extent to which existing regulation or new regulation undertaken in response to the crisis might change the allocation of investment across assets and exchanges and across institutions and investment models or strategies. In terms of modality, future regulation could be more or less coercive, more or less informed by big data analytics, sophisticated models and/or 'structural' information, heavy- or light-touch, etc. At the international level, there could be costly fragmentation (possibly in conjunction with resurgent protectionism), differentiated or federated regulation reflecting 'comparative advantage' or progress towards a globally coordinated or harmonised regime.

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