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Macroeconomic and financial stability issues raised by a global influenza pandemic

Introduction

The World Health Organisation (WHO) has stated that "the world is now closer to another influenza pandemic than at any time since 1968, when the last of the previous century's three pandemics occurred."[1] If a global flu pandemic does occur, and if the virus turns out to be both easily transmitted and accompanied by a high mortality rate, the result would be a profound human tragedy. Even a milder pandemic could have a substantial impact on global economic activity, as labour supply falls and trade, travel and tourism decline sharply.

In some respects the impact on financial stability of a serious global pandemic would be similar to that of any prolonged recession. Markets and institutions would need to deal with a broad slowdown in activity, as well as uncertainty about the severity of the recession and the timing of a recovery. There is likely to be a generalised retreat from most categories of risk.

At the same time, many aspects of the situation would be unique. Intermediaries and infrastructure providers may have to deal with concerns about business continuity, for themselves and their counterparties, if absenteeism and lower productivity become widespread. "Systemic continuity" issues could also come to the fore, if users of the financial system struggle to cope with disruptions to important intermediaries, uncertainty about the resiliency of financial infrastructure and reduced liquidity for many assets.

Preparations for a possible flu pandemic by financial market participants and authorities vary widely. While uncertainty over the timing and severity of a pandemic makes it impossible to formulate detailed plans, many national authorities are preparing for possible scenarios and reviewing the continuity plans of the key institutions in their national markets. Others have taken a "wait and see" attitude.

This note reviews some of the ways in which a global influenza pandemic may affect macroeconomic and financial stability. It then identifies areas which call for planning and coordination by financial system participants and authorities.

Background

The current outbreak

The first documented cases of human infection with the H5N1 influenza virus occurred in Hong Kong in 1997, when eighteen human cases, six of them fatal, coincided with outbreaks of highly pathogenic avian influenza (HPAI) on poultry farms and in live markets. Concern about the H5N1 virus increased sharply in December 2003, when there was an outbreak at three commercial poultry farms in Korea. Human cases were reported a few weeks later in Vietnam. Through 27 February, 2006, there have been 173 confirmed human cases of H5N1-based influenza, of which 93 have been fatal. These cases have occurred in seven countries: China, Vietnam, Cambodia, Thailand, Indonesia, Turkey and Iraq. H5N1 has been detected in wild and domestic bird populations in a much broader range of countries, originally mostly in East Asia but more recently extending into Europe and Africa. All of the human cases that have occurred so far appear to have resulted from contact with infected birds.

[1] This quotation is taken from the WHO website: http://www.who.int/csr/disease/avian_influenza/phase/en/index.html.

Health experts believe that all of the elements necessary for a global pandemic are now in place except one: the evolution of the HPAI virus into a form that can be efficiently transmitted between humans. Such a virus would encounter little in the way of pre-existing immunity, given that no one alive today has encountered the H5N1 strain in the form of a seasonal flu virus or in a previous pandemic.

Previous episodes

Past experience suggests that a pandemic need not be accompanied by widespread loss of life. Global flu pandemics in 1957 and 1968 were relatively mild, with worldwide excess mortality estimated at 2 million and 1 million respectively.

The more worrying prior example is the "Spanish flu" pandemic of 1918-1919, which is estimated to have killed at least 40 million worldwide. In part the high mortality in this episode reflected the poor state of medical knowledge at the time; antibiotics and had not yet been discovered and viruses were little understood. It also appears to have been an unusually severe virus, causing a form of pneumonia that could be fatal within 48 hours. Unlike other flu viruses, which primarily affect the very young and the very old, a high proportion of victims of the "Spanish flu" were young adults.

The Sudden Acute Respiratory Syndrome (SARS) epidemic of 2003 offers another case study in the rapid spread of infectious disease. Some 8,000 people in thirty countries, mostly in East Asia, were infected over a period of five months, with a mortality rate of about 10%. Widespread public alarm led to a sharp fall in travel and tourism, and some easing in economic activity, in the countries concerned.

These episodes followed broadly similar patterns. They first emerged in Asia, where population density is high and people often live in close proximity to poultry and other livestock. It took some time for an initial set of cases to lead to a broader epidemic, but once the number of cases started to increase it rose exponentially in a matter of weeks. The epidemics tended to occur in waves, with each wave lasting three to six months. Waves differed in terms of the age groups and geographical areas affected, since the survivors of a given wave of infections tended to have increased immunity against the virus when it returned. The virus sometimes mutated and become more severe from one wave to the next. Within these broad parameters, the different episodes showed broad variation in the timing and severity of their impact. In the US, the 1918 virus infected roughly a quarter of the population, while the mortality rate among those infected was 2.5%. SARS had a much higher mortality rate, at 9.6%, but the infection rate was very low, with the highest level of 0.026% observed in Hong Kong.

Response strategies

The effectiveness of any response to an incipient pandemic will depend on how much information authorities have about the nature of the virus, how far in advance that information becomes available (which in turn depends on whether the critical genetic mutations occur piecemeal or through a sudden shift) and how rapidly it spreads. More lead time would allow some preventative measures to be put in place, including the ramping up of vaccine and drug production. Unfortunately, the ability to plan in advance is limited, given uncertainty over such matters as the channels and speed of human-to-human transmission, the virulence of the disease, and the ease of synthesizing and manufacturing vaccines and anti-flu drugs. Some experts estimate that once a human-to-human strain emerges it could spread around the world in a matter of weeks.

With enough advance notice, widespread **vaccination** might appear to be the best preventative measure, but this approach is fraught with problems. Isolating the relevant strain can only be done once the disease has started to spread. Although the pace of research into improved production techniques has accelerated recently, synthesising and mass-producing vaccine is still a time-consuming process, subject to error and contamination. According to one estimate, mass production can only start at least six months after a pandemic strain has appeared. Furthermore,

global production capacity for vaccines has fallen in recent years, because of low profitability and litigation risks. In past episodes, vaccines have tended to be developed too late, or have been produced and distributed in insufficient quantities, to have much of an impact on the spread and severity of the pandemic.

A second approach is to treat the illness itself, through **antiviral drugs** such as oseltamivir (Tamiflu) and zanamivir (Relenza). Antibiotics would also be needed to deal with secondary bacterial infections. While national health authorities have started to stockpile antiviral drugs, production capacity is limited. One recent study suggested that some flu viruses have evolved to become resistant to oseltamivir. Certainly the mass administration of such drugs to healthy people would increase the likelihood that resistant strains will emerge. Instead, the WHO is recommending a strategy of stockpiling such drugs in order to dispatch them rapidly to an area where there are signs of an emerging pandemic.

A third approach is to **reduce opportunities for human-to-human transmission**. In previous episodes, quarantines and travel restrictions have tended to have little effect, because the infection can spread well in advance of the appearance of observable symptoms. However, localised travel restrictions may help limit the spread of the virus in the early stage of a pandemic, while temporary banning of some public gatherings and closure of schools have often helped to reduce the speed at which disease spreads. A wide range of strategies will probably be employed, especially given the likely pressure on public authorities to demonstrate a strong response to the disease threat.

For both vaccines and anti-flu drugs, cost becomes an important constraint, especially for less developed countries. The recent announcements of national and multilateral aid programs targeted at flu prevention and treatment, as well as the donations of antiviral drugs by manufacturers, are aimed at addressing these concerns. Yet wealthier countries are also likely to face shortages of needed drugs and vaccines in the event of a pandemic.

Macroeconomic impact

Any estimate of the macroeconomic costs of a flu pandemic must necessarily be very rough, given the many uncertainties surrounding the timing and severity of the pandemic and the reaction to it by authorities and the public. An important variable would be the duration of pandemic conditions. A severe global pandemic, which could include several waves, could last from 12 to 36 months. Impacts are likely to vary from one wave to the next, both geographically and in terms of morbidity and mortality.

One can nevertheless identify some of the channels through which effects may occur. For one thing, the economy may become substantially less productive. Possible supply-side effects include the following:

- The need to destroy **poultry stocks** has already caused reductions in trade and rural output in some poor and middle-income countries.
- Widespread illness will reduce **labour force participation** among those who are ill and members of their families. Healthy people may stay away from work as well, whether because of official bans on travel, because of breakdowns in public transportation networks or voluntarily from fear of infection. Telecommuting could allow a fraction (probably small) of the workforce to continue doing their jobs, assuming communications infrastructure can be maintained.
- For those who continue working, **labour productivity** may suffer, because of insufficient workplace staffing. At the same time, increased effort among those at work may help to dampen the impact of absences.

- **Distribution networks** may be less reliable. This would be a particular problem for firms that rely on "just-in-time" inventory management, but, if the pandemic is pervasive enough, disruptions to supply chains could affect much of the economy.

There may also be a sharp fall in aggregate demand:

- **External trade and travel** could fall precipitously, hurting tourism, export-dependent sectors and those which require imported inputs. Reduced travel will hinder business activity. Travel and tourism now make up about 4% of global GDP, with a much higher share in some countries. Restrictions on transport, and perhaps tighter controls on imported goods at ports, could act as *de facto* barriers to international trade.
- Fear of infection may reduce spending on **activities involving public contact**, including restaurants, cinema, use of public transportation, and non-essential retail trade.
- Falling demand, reduced international trade, and increased uncertainty are likely to cause a decline in **business investment**.

There may be some countervailing demand effects as spending switches from external to domestic suppliers and between different components of spending. For example, there will of course be sharply increased **spending on medical products and services**. The amount will depend on the spread and severity of disease, as well as decisions about pre-stockpiling of vaccines and medication. If a severe pandemic overwhelms the existing capacity of hospitals (both hospital beds and equipment), the cost of increasing capacity at short notice will be very high. The US Centres for Disease Control has estimated direct US medical costs of $166 billion (1.3% of GDP) for a "medium-level epidemic", not including the cost of vaccines.

The experience of SARS suggests that the **psychological impact** of a pandemic could produce economic consequences even more severe than the medical impact. As noted above, while the disease had a high mortality rate, the infection rate and the total number of cases were quite low. Nevertheless, sharp declines in travel and tourism briefly brought growth to a standstill in some countries. A study by Oxford Economic Forecasting estimated the total cost of the epidemic in East Asia at 0.6% of GDP for the 2nd quarter of 2003, or about $18 billion.

A flu pandemic might be expected to have a greater impact on countries with **lower income levels**, because of poor sanitary conditions and less effective public health systems. Countries where HIV/AIDS is already widespread may be especially vulnerable. At the same time, poorer countries tend to be less exposed to the rest of the world through tourism and trade (though this is not always the case), so authorities might be more able to respond to local outbreaks in advance of the pandemic reaching the broad population or spreading to other countries.

Even a pandemic with relatively high rates of morbidity or mortality may turn out to have a limited or negligible impact on growth. The 1918 pandemic, for example, made little dent in measured economic statistics, perhaps because, while a large number of people were infected, the symptoms of the disease only affected any given individual for a few days. However, against this it has been argued that today's world economy rests on more extensive and intricate supply networks than did that of 1918.

Despite the many uncertain parameters, there have been a number of attempts to gauge the potential short-term GDP impact of a flu pandemic.

- The World Bank (2005) has estimated that a flu pandemic could cost 2% of one year's global GDP, or $800 billion. They derive this figure by extrapolating the SARS experience in East Asia geographically (to the global level) and in time (from one quarter to four).
- The US Congressional Budget Office (2005) estimates that a pandemic could cost 1.5% of US annual GDP under a moderate scenario, and 5% under a severe scenario. This figure is

derived by aggregating the estimated impact of a pandemic on various sectors of the economy.

- The Asian Development Bank (ADB)[2] estimates that Asian GDP growth in 2006 could be 2.4 percentage points lower than their baseline estimate (which is 7.1%) under a moderate scenario and 6.5 percentage points lower under a severe scenario. The corresponding dollar losses of GDP would be $99 billion and $283 billion respectively. They arrive at these estimates by entering assumptions about demand- and supply-side effects into an economic forecasting model. In both scenarios, they assume the pandemic lasts about a year. The key difference between their two scenarios is the psychological impact of the pandemic on consumption and labour supply, with these contracting for two quarters under the mild scenario and four under the more severe one.
- Citigroup[3] estimates the impact of a 2-3% decline in the labour force (through flu deaths) on GDP in a number of countries using a global macro model, and finds that GDP falls by between 0.5% and 3% in most cases.
- McKibbin and Sidorenko (2006) use a multi-sector, multi-country model to examine the impact of four pandemic scenarios. Unlike most other efforts, which focus entirely on the real side, McKibbin and Sidorenko also attempt to incorporate the impact of higher market risk premia on aggregate demand and capital flows. Losses to global GDP run from 0.8% under a "mild" scenario based on the 1968 pandemic, to 12.6% under an "ultra" scenario where mortality is even worse than the 1918-1919 experience.

One shortcoming of most of these estimates is that they tend to ignore or downplay **network effects** – the impact of disruptions to supply chains, distribution networks, communications infrastructure and potentially the financial system. These effects would add a nonlinear component to any estimate of macroeconomic channels of pandemic impacts, in that morbidity or mortality above a certain level could cause significantly higher rates of disruption to some of these networks.

A pandemic could also have a substantial **long-term impact** on growth**,** though in this case it is even more difficult to make a precise forecast. A relatively mild scenario might have little or no impact, since production could be ramped up rapidly once the emergency had passed. If mortality rates are high, however, the effects could persist for some time. Human capital will be diminished, especially if the disease hits the working-age population disproportionately. A significant decline in the global labour force might be expected to increase returns to labour relative to other factors, thereby reducing returns to investment and slowing capital accumulation. The ADB estimates that, under their more severe scenario, GDP growth in the Asian region five years after a pandemic would be 3.6 percentage points lower than it would have been with no pandemic. Oxford Economic Forecasting estimates that global potential output would decline by 0.5-1% per annum in the long term for every 1% of the population lost to the disease.

Financial stability impact

The lack of recent experience of a flu pandemic makes it virtually impossible to quantify the possible impact on the financial system of different scenarios. Nevertheless, it is possible to identify some of the channels through which financial stability might be affected. Some of these

[2] Bloom et al (2005).

[3] Bonte-Friedheim and Hanna (2005).

effects will be similar to the strains on the financial system that might be expected from any slowdown in growth, whatever the source. Others will be particular to the conditions of a flu pandemic, such as uncertain labour supply, increased operational risks, potentially unstable infrastructure and restrictions on travel.

Channels linked to an economic slowdown

Well before the severity of a pandemic and its impact on growth are clear, financial markets are likely to start assigning **increased risk premia** to assets that are expected to be exposed to the pandemic. This would especially be the case for vulnerable regions and sectors, such as East Asian economies or firms dependent on travel and tourism. Credit spreads and other risk premia for emerging economy assets are likely to rise, particularly for countries where public health systems are considered weak and for those that are highly dependent on trade flows. Equity prices, except those for the healthcare sector, may fall sharply.[4]

A recession could also trigger many of the **vulnerabilities** that have emerged in the global economy in recent years. Thus, high levels of household indebtedness could make it harder for workers in some countries to outlast a pandemic-linked slowdown. Market volatility could rise sharply from present low levels. The direction of the impact on global imbalances is unclear, but a less certain market environment could make it harder for deficit countries to obtain adequate financing of their capital accounts, putting pressure on their exchange rates and perhaps other asset prices as well.

Channels reflecting the operational impact of a pandemic

A particularly troublesome scenario might emerge if absenteeism and increased uncertainty about operational risks harm the functioning of financial markets or financial institutions. Broadly speaking, financial system effects might stem from two sources:

- **Reduced capacity of institutions.** Absences of key personnel could reduce the operating capacity of intermediaries and infrastructure providers, and in the event of a severe pandemic may lead to disruptions to functions such as processing transactions and keeping ATM machines stocked with cash. For some institutions, such as banks, reduced capacity may be matched by reduced demand for services. Others, however, may face sharply increased workflow; for example, insurance companies are likely to face greater demands for assessing and processing claims in lines such as business interruption insurance.

- **Reduced capacity of markets**. Absenteeism in front-office and back-office staff could reduce the ability of dealers and organised exchanges to handle large order volumes. Offsetting this, there may be fewer transactions as investors scale back their activities. While the spread of technologies such as electronic trading and straight-through-processing should reduce somewhat the vulnerability of markets to the absolute number of employees, they may also leave them more vulnerable to breakdowns in the in-house functions and external infrastructural providers that support these processes.

Just as the nature of the impact of a flu pandemic on the economy is highly uncertain, so the specific threats to the operating capacity of markets and institutions could take a variety of forms:

- Widespread sickness in the general population could cause prolonged or rolling waves of **absences of staff**, not just those who are themselves sick, but (as noted above) those

[4] During the height of the SARS epidemic, from mid-March to the end of April 2003, the Taipei, Hong Kong and Singapore stock markets underperformed the MSCI World Index by 12%, 8%, and 3% respectively, with hotel and airline stocks especially hard hit. The Toronto stock market, however, was largely unaffected.

looking after sick relatives, those quarantined at home, those whose transport to work may be disrupted, or the "worried well". Many institutions are preparing contingency plans to cope with peak absentee rates of somewhere between 25% and 50% of staff at any one time during this period (even if their central estimate in the event of a widespread pandemic may be much lower – say 5-10%).

- A few cases of flu in a central business district could lead to **quarantining** of the entire staff of the building where a financial institution is located, accompanied by quarantining of the affected office space and equipment, for a period of several days.
- Even if a financial institution itself does not face disruptions from staff absences, **disruptions to a key counterparty, service provider or market** could create business continuity problems for the institution itself. These could involve disruption not only to financial relationships, but also to links with utilities and transportation providers.
- Firms may face sharply **changed behaviour from customers**, in ways that are difficult to predict, even as their ability to provide those services and adjust to new consumer patterns is disrupted. For instance, concern about the reliability of electronic payment systems or ATM machines could lead to increased precautionary demand for cash. Alternatively demand for cash could fall because of fear that banknotes carried germs or because of reduced retail activity. Similarly, demand patterns for short-term credit, internet banking and payment facilities are likely to shift in unpredictable ways. Sudden shifts in demand patterns could overwhelm operating capacity in a given functional area and spill over to other business functions.

Even if most financial institutions themselves are able to continue operating normally, a pandemic may introduce dynamics that disrupt the functioning of the financial system as a whole. Some of these "systemic continuity" channels might include:

- Concerns about the operating capacity of counterparties and infrastructure providers may reduce the **willingness of institutions to engage in transactions,** even if no evidence of disruption has yet emerged. These concerns may be stronger in the case of complex transactions, smaller counterparties and counterparties outside of an institution's home market.
- A broad increase in risk aversion could well involve a **flight to safe, liquid assets**. To the extent that safe assets are hoarded, the liquidity for these assets could fall, leading in turn to a further search for safety and liquidity.

Alongside these generalised channels, some financial sectors may face pandemic-related effects specific to them. For example:

- A flood of claims might strain the capacity of the global **insurance and reinsurance sectors**. Insurers are exposed to the effects of a pandemic through a number of business lines, including such risks as business interruption, health, disability, medical malpractice, workers' compensation, and life insurance. Estimates of the impact of a global flu pandemic on the insurance industry vary widely. Standard and Poor's recently suggested a mild pandemic might produce $15-20 billion in worldwide losses, while losses from a more severe event might total up to $200 billion. The Insurance Information Institute estimated that US life insurers would face an additional $31 billion in death claims under a moderate 1957/1968 scenario and $133 billion under a severe scenario, with some of these losses offset by reduced payouts on annuity policies. Ordinarily, insurers make up for severe loss events by raising premiums in the aftermath, but this option may not be available if a pandemic-induced slowdown lasts for a significant period of time. Reduced capacity in the insurance industry, in turn, could hinder the recovery from the economic effects of the pandemic.

- The impact on the balance sheets of **pension schemes** would depend critically on the demographic profile of the illness, which at this point is impossible to predict. Seasonal influenza typically affects the very young and the very old, but, as noted, the 1918 pandemic caused high mortality among young adults. Fatalities from the current, bird-transmitted form of H5N1 have been distributed evenly across the age spectrum. Relatively high mortality among the working-age population could worsen the funding deficits now faced by many defined-benefit plans. If a pandemic brings lower equity returns and lower risk-free rates, this would also worsen funding profiles.

Business continuity and contingency planning

Business continuity preparations to guard against a flu pandemic are underway in many financial institutions and financial authorities around the world. The high-level draft principles for business continuity set out recently by the Joint Forum (2005) are as relevant for a pandemic as for any other scenario.

In making more detailed preparations for a pandemic, institutions should to some extent be able to make use of existing frameworks for business continuity in their own and other organisations rather than attempt to "reinvent the wheel". However, there are also **specific features of a pandemic scenario** that differ from many of the scenarios that organisations typically consider in their business continuity planning:

- The event is likely to evolve less suddenly, and the period over which business continuity measures will need to operate will be much longer, than in the more usually considered scenarios such as natural disasters, IT or power failures or terrorist incidents.
- Disruption will be primarily to staffing rather than physical infrastructure.
- Any disruption may be over a wide geographical area, including cross-border, so plans based on shifting operations to an alternate site within the same country, or even to a site in another country, may be less effective.

Accordingly, **existing business continuity plans will need to be adapted for a pandemic scenario** in a number of ways. Compared with the typical business continuity plan that is in place at many large organisations, pandemic-oriented plans will need to include features such as the following:

- Plans will need to envisage several stages to the response, according to such factors as whether human-to-human transmission has emerged and whether cases have occurred in the organisation's local area. These defined stages could mirror national government alert levels.
- The fact that the scenario may evolve gradually may provide an opportunity for organisations to inform their employees and other organisations in advance about their business continuity plans, and to receive feedback and refine those plans. However, full knowledge of the characteristics of a pandemic will not be known in advance; more likely, planners will have to act on assumptions and plan for worse-case scenarios well before it is clear whether or not these assumptions are valid.
- Instead of a focus on achieving recovery of critical operations in the very short term (e.g. 24 hours), plans will need to be adapted to maintain operations for perhaps months in the face of sustained disruption.
- Plans may need to have a greater emphasis on succession planning for decision-making, external and internal communications channels and maintaining critical operations.

- Plans may need to focus more on the need to have back-up staff available (perhaps through cross-training for staff to be able to do multiple tasks) in addition to back-up physical locations.
- Split-team working (to reduce the risk that all the staff performing a critical task become sick or quarantined simultaneously) may play a relatively more important role, while the maintenance of unstaffed back-up sites may become less of a priority.
- Many firms are likely to implement "work from home" arrangements for relatively prolonged periods of time. This could put a strain on communications infrastructure, and expose many firms simultaneously to any operational disruption on the part of telecommunications providers.
- Plans may need to envisage shifts in the pattern of business activity in which the firm is involved. For example, as noted above there may be unpredictable shifts in customer demand for cash, credit, internet facilities or other services.
- Cross-border communication becomes even more important than before because of the global nature of the event.

While business continuity experts are aware of many of these issues, to date there appears to be great variability in the extent to which they have been incorporated in continuity plans at large public and private sector institutions.

In this uncertain environment, financial authorities face a variety of issues, both regarding their own contingency plans and regarding the need to foster appropriate planning in the private sector.

Firstly, authorities will need to ensure maintenance of **business continuity for their own critical operations**. The Joint Forum's draft principles are just as applicable to financial authorities themselves as they are to private sector financial institutions. These critical functions may include the organisation's core decision-making capacity, banknote operations, payments and settlements systems, money market operations, government financing, core operational regulatory functions and essential external and internal communications channels.

Second, authorities will want to review **business continuity planning by the financial industry participants for which they are responsible.** (Principle 7 of the draft principles addresses this point.) The responsibility for participants' business continuity plans lies with the institutions themselves, but financial authorities can help to ensure consistency and minimum standards by such means as disseminating official guidance on planning assumptions and encouraging firms to take account of potential business continuity effects on, and responses by, key financial and nonfinancial organisations with which they are connected. One means for this could be organisation or encouragement by authorities of joint simulation exercises. Some national authorities are investigating such exercises.

During the crisis itself, authorities will have a number of potential roles to play. One of these is acting as a **focal point for communication** in a variety of areas:

- Receiving information from market participants on the extent of disruption and on the business continuity measures taken that may affect other participants.
- Acting as a point of liaison between financial markets and the wider government emergency response, and perhaps also with utilities and telecommunications providers.
- Providing information to the market and to the public on the functioning of markets and systems (both financial and nonfinancial), and the measures that authorities and markets are taking.
- If necessary, facilitating coordinated market-wide decision-making by key institutions.

- Communicating with foreign authorities and market participants.

Because of this central role, **communication methods will need to be robust** to potential disruption to staffing and physical infrastructure, with multiple communication channels available. If there are disruptions to trading and communications infrastructure, ad hoc solutions may be needed in order to allow urgent transactions to take place.

As a general role, financial authorities will have a critical **coordinating role** in allowing market participants to meet these challenges. The informal agreement in the Federal Funds market in the US in the immediate aftermath of the 2001 terrorist attacks, under which all transactions were made at the rate prevailing before the attacks, offers an informative precedent in this regard.

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