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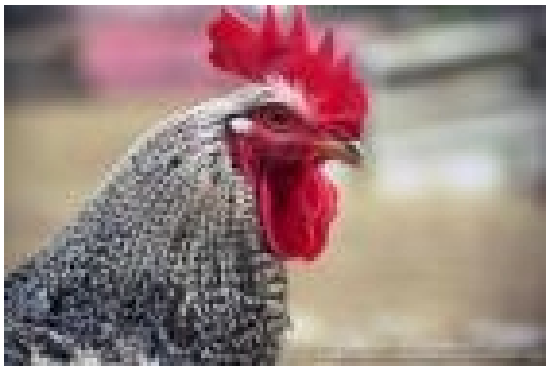

The financial effects of a bird flu triggered pandemic

The World Health Organisation predicts that another flu pandemic is just a matter of time. A particular worry is a pandemic based on a variant of the H5N1 bird flu virus that has become endemic in poultry across Asia. Recent outbreaks of bird flu have occurred in Turkey, Europe, Africa and India. So far at least 83 people have died[1] from the H5N1 virus as people have become infected from contact with diseased chickens.

There is no evidence yet that the H5N1 virus has passed from human to human. But the 1918 Spanish flu pandemic — the worst the planet has seen — infected between 10 to 40 per cent of the population and around 3 per cent of those died. The 1918 Spanish flu was caused by a H1N1 bird flu virus that mutated so it could spread easily among people. If the H5N1 virus mutated to repeat anything like the 1918 pandemic severe consequences would follow for the world's population and economies.

In this issue of *Economic Scenarios* we examine two scenarios of a human pandemic stemming from a bird flu virus. One scenario is a moderate pandemic akin to the experience with the 1957 Asian flu — a H2N2 virus. The other scenario is a severe one, akin to the 1918 Spanish flu experience. The difficult part in such an analysis is specifying the necessary shocks to represent these historical scenarios to simulate their economic effects. Therefore, it is necessary to first look at the economic effects of a pandemic.

Key points

- **Even a moderate flu pandemic could see world real GDP fall by 2.1 per cent in 2006.**
- **A severe pandemic would plunge the world into recession and knock over 5 per cent off global real GDP in 2006.**
- **Asian economies would be hit hardest with Hong Kong faring the worst.**
- **Japan is hit hard due to its high integration with East Asian economies.**
- **Equity prices will not fall dramatically over the full year, if the pandemic is a short-lived one.**
- **The US dollar will likely appreciate against all other currencies.**
- **The yield curve is likely to steepen.**

Economic effects

A pandemic can be expected to influence economies through several channels. On the supply side, the mortality and illness effects on people and the labor force are obvious enough. Research shows illness — which leads to absenteeism, schools closing and so on — is an important effect[2] so both the rate of sickness and fatalities need to be estimated. Illness will affect both supply and demand as consumers change spending levels and

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[1] World Health Organisation http://www.who.int/csr/disease/avian_influenza/country/cases_table_2006_01_25/en/. Accessed 9 February 2006 12.03 p.m.
[2] Killbourne K.D. 2004, 'Influenza pandemics: can we prepare for the unpredictable?' *Viral Immunol*, 17(3), pp. 350-357.

Using these scenarios

Nobody can foretell the future. If they could, they wouldn't tell you about it. These scenarios are not predictions or forecasts. To make profitable investments from this information you also need to decide how likely the events portrayed here are, and what is already priced in the markets. The value of this material is in the insights it offers into the economic effects of various possible events.

1 Version of the model used

The framework used is APG-Cubed model (Version 63A) and subscribers will be familiar with its features. The key points for the scenarios here for the analytical results besides the standard 'adding up' conditions (someone's surplus has to be mirrored in someone else's deficit) are that:

- agents are forward-looking and form expectations about the future;
- goods and financial markets are formally linked and integrated;
- authorities follow a modified Henderson-McKibbin-Taylor monetary policy rule that targets output and inflation (and exchange rates in East Asian economies);
- adjustment costs and 'sticky' labor markets are built into the model so that resource reallocation does not occur smoothly

Additional features of this version are the split out of the United Kingdom and India. Further explanation and to see a full description of the model, either follow the links on this website or directly access www.msgpl.com.au

patterns and as the costs of business rise due to absenteeism and the necessity for people to work from home. An example of the latter is the news report that the world's third biggest bank, HSBC, has drawn up plans to cope without half of its staff in a worse-case scenario of a pandemic triggered by bird flu.[3] The bank was preparing for staff to work from home via video links and teleconference facilities and clean offices once an hour — all extra costs.

On the demand side, a pandemic will cause consumption to change. Tourism, for example, would be hard hit due to people unwilling to travel let alone new quarantine arrangements imposed by officials as was the case with the SARS outbreak.[4] The effect on demand would therefore contain both exogenous effects as preferences and policies changed and endogenous effects as incomes fell and relative prices changed. The exogenous effects would be most apparent in the services sector where person to person contact is greatest.

The supply and demand effects would therefore vary across countries on several counts. More densely populated countries would be more at risk from person to person infections and those economies with large service sectors reliant on industries such as travel and tourism would be harder hit relative to others. Countries with better health systems and resources to tackle a pandemic would fare better than others.

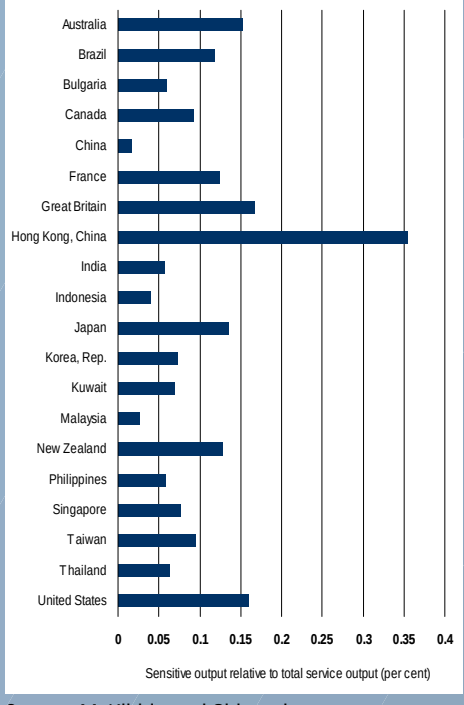
Of course, investors would know that countries would fare differently and would build in an extra risk premium for the most vulnerable countries, compounding the other economic effects. These changing risk premia would change financial flows, drive exchange rates and affect interest rates and equity prices in addition to the direct output and income effects.

So a valid scenario of a pandemic has to incorporate labor market effects (mortality and illness), extra business cost effects, demand shocks and changing country risk premia. These effects will differ across countries in ways that are related to geographical characteristics such as population density, the ability of government health systems to cope, and the size of the service sector in the economy.

The task is to take a pandemic scenario and then impose a series of shocks on a global model that can incorporate all of the above effects. A dynamic global economywide model is required to analyse these effects since a spending slowdown, say, has to go somewhere, in this case extra savings. Those extra savings, in turn, drive changes in financial flows and interest rates in addition to any induced effects from changes in production and country risk premia. The dynamic global economywide model used here is the APG-Cubed model (see box 1 for details).

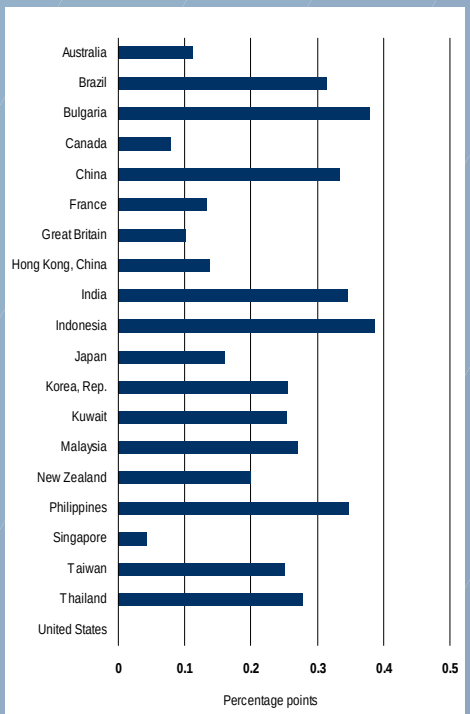
[3] BBC News, 'HSBC sees bird flu hitting staff', www.news.bbc.co.uk. Accessed 10 February 2006, 9.06 am.
[4] *Economic Scenarios.com*, 'The SARS outbreak: how bad could it get', Issue 5, May 2003 and Lee, J.W. and McKibbin, W.J. 2003, 'Globalisation and Disease: The Case of SARS', *Asian Economic Papers*, 3(1), pp. 113-131.

Chart 1: Service sector exposure in production



Source: McKibbin and Sidorenko

Chart 2: Country risk premia weighting relative to United States



Source: McKibbin and Sidorenko

The two scenarios

The H5N1 bird flu virus could become a pandemic through two different channels. The first is that the virus mutates enabling it to transmit from person to person — something it cannot do now. If the virus does this it is possible it will be highly virulent to humans due to the low resistance in the population now to virus with the surface protein H5.[5] At present H5N1 seems to kill a third of the people it infects. But, if the H5N1 virus mutates to allow person-to-person transmission it could become less virulent. There is no way of knowing this so the main episode from history to scale this severe scenario off is estimates of the 1918 Spanish flu.

The second channel whereby the H5N1 bird flu virus can lead to a pandemic is where a currently circulating human flu picks up some of the genetic material from the H5N1 virus. This could happen if a person with a human flu also becomes infected with the H5N1 virus or it could come about through say pigs being concurrently infected with a human flu and a bird flu. Rearranging genetic material could lead to enough change in human flu to cause a new strain that people do not have immunity to. A pandemic could result, but not as bad as the 1918 case. Both the 1957 and 1968 pandemics were caused by human flu strains picking up one or two surface proteins from bird flu viruses. This second moderate scenario would be of the rate of illness and fatalities as the 1957 pandemic. The two scenarios and attack rates and fatalities are therefore:

Scenario	**Attack rate** (%)	**Fatalities** (%)
1. Moderate — akin to 1957 Asian flu	30	0.23
2. Severe — akin to 1918 Spanish flu	30	1.17

Some people argue that we have better drugs and quicker processes to make vaccines, so any pandemic would not be a repeat of history. True, but, as argued in the *New Scientist*[6], even if all the world's flu vaccine factories switched to making a vaccine against H5N1, they could only make a few hundred million doses in a year. The world's population is around 6.4 billion people. The same is true for the only (supposedly) effective antiviral drugs — Tamiflu and Relenza. To make a difference these drugs have to be taken early. So quite apart from gearing up production to make enough doses, it has to be distributed to people. This highlights how the health resources available to a country will affect the severity of an outbreak and is one of the factors to incorporate into the shocks.

The shocks — simulating the scenarios

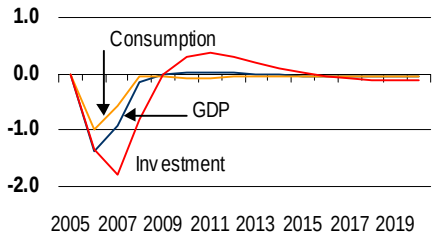
Four shocks for each country have to be devised: one for the labor force (covering both fatalities and morbidity effects), one for exogenous changes in demand, one for additional business costs and one for changes

[5] Viruses have two surface proteins; hemagglutinin(H) and neuraminidase (N). Combinations of 16H and 9N proteins give the subtypes of virus — of which H5N1 is but one. Another flu pandemic need not be based on the H5N1 virus and H9N2 and H6N1 are also reported as having pandemic potential.

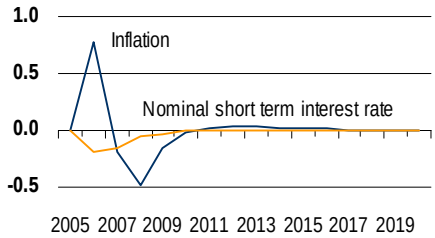
[6] *New Scientist* 2006, 'The bird flu threat: What makes flu go pandemic? Should we be worried? How can we protect ourselves?' January, 7, p. vi

Chart 3: Effects of moderate pandemic on the United States

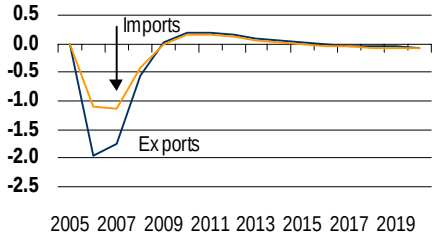
Real GDP, consumption and investment (per cent deviation from baseline)



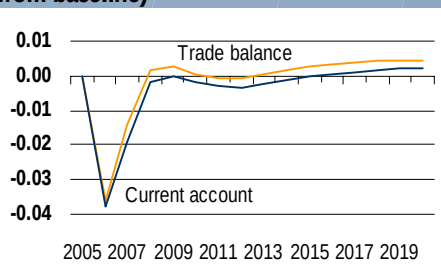
Interest rates and inflation (percentage point deviation from baseline)



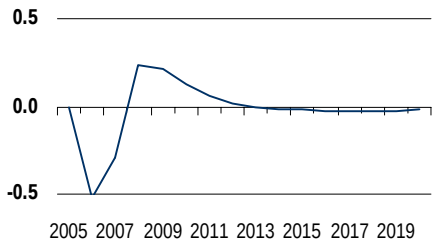
Exports and imports (per cent deviation from baseline)



Current account (per cent of GDP change from baseline)



Equity prices (manufacturing) (percentage point change from baseline)



to country risk premia. The methodology for constructing these shocks is outlined by McKibbin and Sidorenko[7] and follows a similar methodology to that adopted for evaluating the SARS pandemic.[8]

The approach taken by McKibbin and Sidorenko is to construct a series of indexes to reflect a country's exposure to a pandemic, the incidence of attack and fatalities and other factors such as the availability of heath resources, differences in costs, risk premia and changes in demand. So the starting point is to take each of the two pandemic shocks and first scale these for the impact on mortality by an index of geography and an index of health policy. Once mortality rates are determined, a labor force shock incorporating morbidity effects assuming an attack rate of 30 per cent and absenteeism of 10 days is calculated. Combined with absenteeism to care for sick family members an index of sickness is derived and applied to the two scenarios.

Since the model contains one services sector, but the make-up of services varies across countries, a 'services sector exposure' index is constructed to reflect that some countries have higher exposure to travel and tourism, such as Hong Kong (see chart 1).

Similarly, a risk premia shock across countries is scaled off a risk index constructed by combining indexes of governance, financial risk and health policy. These give a country risk premia weighting relative to the United States as in chart 2.

The extra costs of business across countries and sectors were taken from the experience with SARS as documented in Lee and McKibbin[9] and scaled in the services sector by the index of service sector exposure.

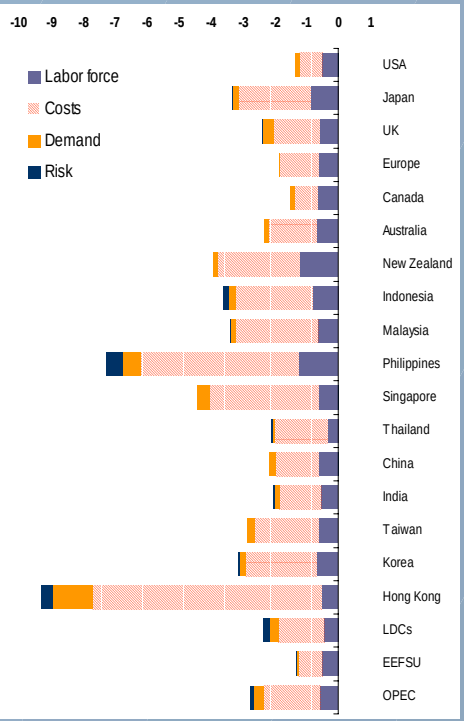
1. Deaths in each region in 2006 ('000)

	Moderate		Severe	
	Number	Population	Number	Population
USA	201.9	0.07	1009.3	0.35
Japan	214.6	0.17	1073.1	0.84
UK	76.0	0.13	380.0	0.64
Europe	565.5	0.10	2827.4	0.50
Canada	30.9	0.10	154.5	0.49
Australia	21.4	0.11	107.1	0.54
NZ	5.2	0.13	25.8	0.65
Indonesia	1142.5	0.54	5712.6	2.70
Malaysia	108.9	0.45	544.5	2.24
Philippines	415.5	0.52	2077.5	2.60
Singapore	14.4	0.35	72.0	1.73
Thailand	162.1	0.26	810.3	1.32
China	2848.6	0.22	14242.8	1.11
India	2423.6	0.23	12118.1	1.16
Taiwan	55.9	0.25	279.4	1.24
Korea	117.5	0.25	587.6	1.23
Hong Kong	16.4	0.24	82.0	1.21
LDCs	3308.6	0.22	16543.1	1.08
EEFSU	670.7	0.13	3353.7	0.66
OPEC	1816.3	0.35	9087.5	1.77
Total	**14216.5**	**0.22**	**71082.3**	**1.10**

Source: McKibbin and Sidorenko.

[7] McKibbin, W.J. and Sidorenko, A.A. 2006, *Global Macroeconomic Consequences of Pandemic Influenza*, *Lowy Institute Analysis*, February.
[8] Lee, J.W. and McKibbin, W. J. 2003, 'Globalization and Disease: The Case of SARS', *Asian Economic Papers* **3**(1) and *.Economic Scenarios.com*, 'The SARS outbreak: how bad could it get', Issue 5, May 2003
[9] Lee, J.W. and McKibbin W. J. 2003, pp. 113-31.

Chart 4: Composition of real GDP change by shock for moderate scenario (per cent deviation from baseline 2006)



Source: APG-Cubed model.

2. Key variables for moderate scenario by country/region: change from baseline, 2006

	GDP %	Exports %	One year interest rate Basis point	Equity prices[a] %
USA	-1.4	-2.0	-18	-0.6
Japan	-3.3	-2.6	-18	-1.0
UK	-2.4	-2.0	-35	-0.6
Europe	-1.9	-1.5	-16	-0.6
Canada	-1.5	-1.2	-18	-0.5
Australia	-2.4	-1.9	-24	-0.5
NZ	-4.0	-1.1	-85	-0.2
Indonesia	-3.6	-0.8	-32	-0.9
Malaysia	-3.4	-1.4	-54	-1.4
Philippines	-7.3	-1.1	-103	-1.4
Singapore	-4.4	-2.7	-99	-0.9
Thailand	-2.1	-0.3	-17	-1.0
China	-2.1	-1.0	-25	-1.0
India	-2.1	-0.4	-19	-0.7
Taiwan	-2.9	-.09	-47	-1.0
Korea	-3.2	-1.6	-14	-1.3
Hong Kong	-9.3	-3.2	73	-4.4
LDCs	-2.4	-1.0	44	-1.1
EEFSU	-1.4	-1.2	-6	-0.9
OPEC	-2.8	-1.5	-16	-1.2

[a] Manufacturing sector
Source: APG-Cubed model.

The SARS experience is also used to derive a demand shock to reflect the exogenous shift in preferences by consumers. These are spelt out in the paper by McKibbin and Sidorenko.

These demand, risk, cost and labour force shocks are then adjusted for each scenario by the mortality rates and applied to the APG-Cubed model. The deaths in each region are shown in table 1.

Results

Moderate pandemic

The dynamic effects for the moderate scenario are shown for the United States in chart set 3. The contractions in the supply of labor, rising business costs and exogenous drop in demand causes real GDP to fall and with it an endogenous drop in real consumption from baseline (panel 1 of chart set 3). Real GDP could be 1.4 per cent below baseline in 2006 and nearly 1 per cent below in 2007.

The pandemic shock is expected to be temporary, so households smooth their consumption pattern causing demand to remain stronger than income. With the fall in output greater than in demand there is a spike in inflation in 2006 (panel 2 of chart set 3).

It will be seen later that this is not a universal outcome and for some economies the drop in demand exceeds that of output so inflation falls relative to baseline.

The inflation impact in the United States is exacerbated by the rise in the cost of doing business.

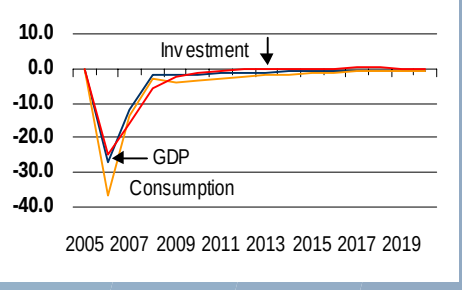
The fall in labor supply reduces the marginal product of capital in the economy and the consequent fall in returns on capital causes equity prices to fall as investors substitute into bonds causing long bond prices to rise. Most of the action is in the short term interest rate which spikes in 2007 due to the monetary policy response to the spike in inflation. Nominal one year interest rates in the United States could be 18 basis points below baseline in 2006.

The changing risk premia and flight to safety leads to more capital inflow into the United States so the current account, expressed as a per cent of GDP, deteriorates from baseline in 2006 (panel 4). The trade balance worsens to affect this change so exports decline from baseline by 2 per cent in 2006 — roughly double the decline in imports (panel 3).

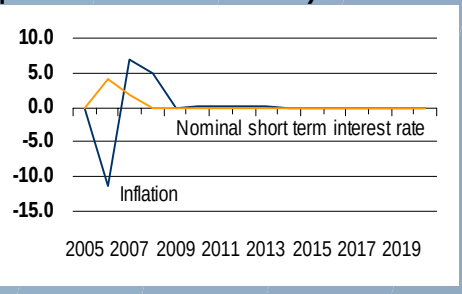
Most of the effects are in 2006, but also 2007 which mostly reflects the assumptions regarding the duration of the pandemic. The effects of the pandemic on the real GDP for countries in 2006 are shown in chart 4 along with the composition of the change from baseline. The biggest effect comes from the labor force changes and the extra business cost effects. The effect on business costs is particularly pronounced for Hong Kong, which has a large 'services sector exposure' index shown earlier in chart 1. Changing risk premia across countries does not have as large an effect on the results. The Philippines are also hit hard by the pandemic with a fall in real GDP of over 7 per cent below baseline. The large result

Chart 5: Effects of severe pandemic on Hong Kong

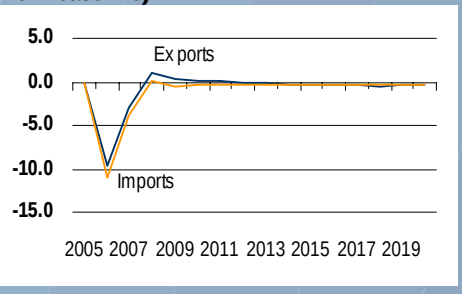
Real GDP, consumption and investment (per cent deviation from baseline)



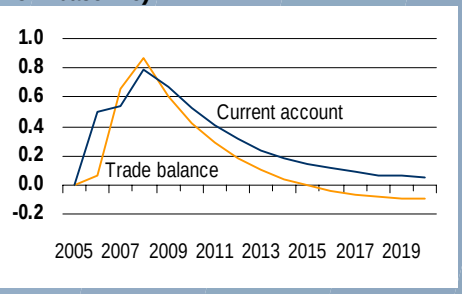
Interest rates and inflation (percentage point deviation from baseline)



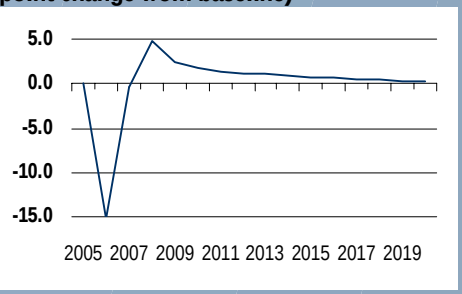
Exports and imports (per cent deviation from baseline)



Current account (per cent of GDP change from baseline)



Equity prices (manufacturing) (percentage point change from baseline)



for the Philippines reflects the large labor force shock due to mortality and absenteeism plus the import of their exports of services in the region that suffers as economies turn down.

Some key variables for other countries are shown in table 2 for the moderate scenario for 2006 where most effects are seen. There are only small effects for exports with many economies experiencing changes in the 2-3 per cent range from baseline.

There is deflation in Hong Kong of 3.8 percentage points below baseline in 2006 because the drop in consumption is greater than production. This deflation causes short term real rates of interest to rise by 307 basis points from baseline in 2006 (see table 2). Long rates also rise but the effect is small give the assumed temporary nature of the pandemic. Equity prices change little given the small change in long term interest rates. The greatest impact is for Hong Kong given their exposure to the pandemic through the various indexes of geography and nature of their services sector and the increase in long term real interests rate of 41 basis points over baseline in 2006.

Severe pandemic

The dynamic effects from the severe scenario for Hong Kong are shown in chart set 5. Hong Kong is chosen since the effects are the most severe for the reasons noted above. The dynamics are also different for Hong Kong and the monetary policy rule they follow makes matters worse.

As with the moderate scenario, a severe pandemic causes a sharp drop in output due to a contraction of supply of labor and rising business costs. But now the effects are much worse. For Hong Kong the drop in real GDP in 2006 is over 26 per cent below baseline so a severe flu pandemic would plunge their economy into recession (panel 1 of chart set 5).

The fall in output is compounded by a sharp drop in exogenous demand — one of the assumptions of the severe scenario. Real consumption could fall by 36 per cent below baseline (panel 1) in 2006 before mostly recovering by 2008.

Despite smoothing by households that expect a short term downturn the fall in consumption is greater than the fall in output so there is a short deflationary pulse through the economy of 11 per cent below baseline in 2006 (panel 2 of chart set 5). The deflationary effect is net of the rise in business costs as a result of the pandemic.

The large loss of output, contraction of investment and higher risk premia put on Hong Kong due to its high exposure to a flu pandemic, means there is a capital outflow. To facilitate this outflow there has to be a surplus in the trade balance and an improvement in the current account balances (panel 4 of chart set 5). Since the nominal exchange rate is fixed to the US dollar under Hong Kong's monetary policy, the real exchange rate depreciation is affected by the large domestic deflation.

All of this takes its toll on Hong Kong's equity market. Equity prices (represented by Tobin's *q*) for manufacturing fall by 15 per cent below baseline in 2006 before recovering (panel 5).

3. Key variables for severe scenario by country/region: change from baseline, 2006

	GDP %	Exports %	One year interest rate Basis point	Equity prices[a] %
USA	-3.0	-5.2	-50	-0.5
Japan	-8.3	-5.6	-38	-2.3
UK	-6.0	-5.0	-83	-1.0
Europe	-4.3	-3.6	-37	-1.1
Canada	-3.1	-2.5	-47	-0.6
Australia	-6.0	-5.0	-59	-0.9
NZ	-9.4	-3.0	-190	-0.5
Indonesia	-9.2	-0.1	-12	-3.1
Malaysia	-8.4	-3.2	-109	-3.4
Philippines	-19.3	-5.1	-180	-5.0
Singapore	-11.1	-6.9	-246	-1.6
Thailand	-5.3	-0.2	-10	-3.0
China	-5.0	-2.6	-57	-1.9
India	-5.0	-0.4	-16	-1.9
Taiwan	-7.1	-1.4	-91	-3.1
Korea	-8.0	-3.4	-1	-3.4
Hong Kong	-27.0	-10.0	407	-15.3
LDCs	-6.3	-1.6	260	-3.6
EEFSU	-3.0	-2.4	4	-1.8
OPEC	-7.0	-3.0	10	-3.6

[a] Manufacturing sector
Source: APG-Cubed model.

The effects of a severe pandemic on other countries is shown in table 3. The Asian economies are hardest hit including Japan. Japan also suffers from being more closely integrated with collapsing East Asian economies than other developed nations. There are significant falls in exports with the United States experiencing a 5.2 per cent drop below baseline. Apart from Hong Kong, he equity price drops are not dramatic due to the assumed short term nature of the pandemic and therefore small impact on long term investment rates.

Conclusions

There are many caveats to an exercise like this. For example, a pandemic may be enough to trigger a financial crisis in China where the banking system is technically bankrupt, potentially making the results for China far worse. But several conclusions do emerge.

Even a moderate pandemic of the scale of the 1957 Asian flu will likely have significant impacts on global GDP, reducing it by 2.1 per cent relative to what it otherwise would have been. A more severe pandemic of the scale of the 1918 Spanish flu would likely cause a global recession.

The more severe the pandemic, the larger the economic costs and the more developing countries are hurt relative to North America and Europe. Japan is partly caught in the Asian slowdown both due to large mortality shocks and because of greater integration into Asia.

The asymmetries in the epidemiological outcome will generate flows of capital out of impacted developing countries into industrialised economies worsening the current account positions of the receiving countries and putting downward pressure on developing countries' exchange rates.

The US dollar will likely appreciate relative to all currencies while the Euro, and Pound will strengthen relative to the Yen. All these currencies appreciate relative to currencies of developing countries.

Short term interest rates will likely fall globally while long rates fall by less (given the short duration of the shock) — thus the yield curve is likely to steepen, except in countries that place a large weight on minimising exchange rate fluctuations. In these countries the yield curve might invert.

Equity prices will likely fall globally although not as sharply as might be expected because of falling interest rates and if the shock is expected to be temporary and mostly passed after the first year.

Whether the pandemic causes inflation or deflation depends on the relative size of declines in demand and supply across sectors. Consumption smoothing implies that aggregate demand may decline by less than the loss of supply from the labor force contraction. This together with an increase in the costs of doing business suggests an inflationary impulse is more likely, but a sufficiently strong shift in spending preferences or lack of cost increase can lead to deflation.

Countries that try to prevent exchange rate changes are more likely to experience a deflationary shock as relatively tight monetary policy compounds the economic contraction caused by a pandemic.

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