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# avian influenza

## potential economic impact of a pandemic on Australia

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- > *A medium level outbreak of an avian influenza pandemic in Australia is estimated to result in a 6.8 per cent reduction in Australia's gross domestic product (relative to a reference case) in the short term.*
- > *Economic activity in all states and territories is estimated to decline at rates close to the national level, with Queensland incurring the most adverse short term effect – an estimated 7.1 per cent reduction in gross state product.*
- > *Key sectors that are likely to be adversely affected the most include transport services and tourism related activities. The expected increase in demand for health services in the event of a pandemic is likely to lead to an expansion in such services across the country.*
- > *Given the potential high costs to Australia and the global economy of an influenza pandemic, there is a clear need to continue to focus on preventive measures through regional and international collaboration. Prevention of an influenza pandemic is likely to be much more effective than a cure.*

### introduction

There is continuing concern and interest in the possible emergence of an avian influenza pandemic in many countries across the world, including Australia. How a pandemic might affect Australia is an important policy issue, as is formulating appropriate responses to such a pandemic. The focus in this article is on the potential short term economic impacts on Australia, its states and territories and the key sectors likely to be affected by a pandemic.

It is useful to classify the potential economic effects of a pandemic into three broad categories: direct impacts, flow-on effects and confidence effects.

### direct effects

The first category of effects relates to people being away from work because they are sick or are looking after other people who are sick, or because of measures taken to prevent the spread of disease, such as stringent quarantine measures. The severity of the direct effects depends on both the infection rate and the mortality rate from the pandemic.

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\* The Treasury. The views expressed in the article are not necessarily those of the Australian Treasury.

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### flow-on effects

The second category includes, for example, loss of exports stemming from reduced demand in other countries or stringent quarantine measures; and disruptions to supply chains either through loss of key imports or disruptions to domestic production. The impact of these factors depends in part on whether alternative sources of supply can be found. In addition, if the infection does not spread to a certain country or is contained in certain regions, there might be increased demand for domestic production to make up for lost imports. Irrespective of these considerations, there are likely to be negative demand effects on certain industries and positive effects on others. In an extreme case, there might be a breakdown in key parts of the economy. Effective measures would be required to ensure that, for example, the financial system and other key services were able to continue to operate in the face of a pandemic.

### confidence effects

These relate to consumption and investment decisions. They are difficult to quantify and in general the studies that indicate a major economic impact from a pandemic are the ones that assume substantial confidence effects.

A recent study by Kennedy et al. (2006) examined the possible macroeconomic effects of a pandemic using the Australian Government Treasury's TRYM macroeconomic model of the Australian economy (table 1). The authors considered a scenario in which a pandemic spread throughout Australia and its main trading partners and analysed several channels through which the economy might be affected – international trade, labor supply and confidence effects on domestic consumption and investment. Their analysis suggested that there could be substantial effects on consumption, investment, gross domestic product and employment in the year in which the pandemic started. It is important to recognise that the TRYM model can only provide the broad impact of a pandemic given its aggregated nature.

### Recent analyses of the economic impact of an influenza pandemic

study	impact on GDP <sup>a</sup> %	scenario
<b>Australia</b>		
McKibbin and Sidorenko (2006)	-5.6	Severe influenza pandemic, with Australian mortality of 107 000 and a global mortality of 71 million
Kennedy et al. (2006)	-9.3	Global pandemic, with 40 000 mortality in Australia
<b>New Zealand</b>		
Douglas et al. (2006)	-10 to -15	Influenza pandemic on the scale of 'Spanish flu' outbreak of 1918
<b>United States</b>		
McKibbin and Sidorenko (2006)	-3.0	Severe influenza pandemic, with US mortality of 1.01 million and global mortality of 71 million
US Congressional Budget Office (2005)	-5.0	Severe scenario, with US fatality rate of 2 million people
<b>Asia</b>		
Bloom, Wit and Jose (2005)	-6.5	Longer influenza outbreak and larger shock to consumption and export

<sup>a</sup> Relative to reference cases.

A study by McKibbin and Sidorenko (2006) on the global macroeconomic consequences of pandemic influenza, including potential impacts on Australia, had a wider representation of the international sector. As with the Kennedy et al. (2006) analysis, McKibbin and Sidorenko's study does not provide detailed results for sectors that are likely to be affected by an influenza outbreak and does not provide state and territory impacts for Australia.

These limitations are addressed here using ABARE's global trade and environment model (GTEM) and Ausregion model. GTEM allows detailed modeling of interactions with other countries and examination of differences in impacts across industries. Ausregion is a model of the Australian economy with representation of all states and territories. Used in conjunction with the TRYM model, GTEM and Ausregion make it possible to examine potential differences in impacts across Australian industries, states and territories of the scenario considered by Kennedy et al. (2006). The combined use of the three models also allows an examination of alternative scenarios in which influenza is widespread in other countries but does not reach Australia. A brief description of the analytical framework and interface between the models used here is provided in box 1.

## impacts of an influenza pandemic

### pandemic phases

The World Health Organisation has identified six pandemic phases:

- > **phases 1-2** - interpandemic phases in which there is animal infection but no human infection.
- > **phases 3-5** - 'pandemic alert' phases with human cases, ranging from phase 3, with few cases and little or no human to human transmission, up to phase 5, with large clusters of infection but only localised human to human transmission.
- > **phase 6** - a full pandemic with sustained human to human transmission in the general population. A pandemic is likely to start in one locality before spreading. Past pandemics have occurred in two or three waves, so phase 6 can be divided into subphases: localised (6a), widespread (6b), subsided (6c) and next wave (6d).

At present avian influenza is in global phase 3 (human cases but no human to human transmission). But there has been no animal or human infection in Australia.

#### box 1: analytical framework

##### GTEM

ABARE's global trade and environment model (GTEM) is a dynamic, multiregion, multisector, general equilibrium model of the world economy. The model provides a useful framework for analysing economywide and sectoral impacts, including those resulting from phenomena that affect the productive capacity of an economy, such as a pandemic. The GTEM framework takes into account the interactions between different sectors and other agents in an economy and captures the interactions between economies through trade. It estimates the impacts of the changes in policies or events on key economic variables.

*continued*

**box 1: analytical framework** *continued*

Using GTEM’s population module, the wider impacts of a pandemic influenza can be estimated through effects on mortality, labor supply and labor productivity. The population in each region in GTEM is classified into one year age cohorts from 0 to 100+ years, making the model suitable for analysing the effects of a pandemic influenza on different age groups. Full documentation of the model is available on ABARE’s web site ([www.abareconomics.com](http://www.abareconomics.com)).

**Ausregion**

ABARE’s Ausregion model is a dynamic computable general equilibrium model of the Australian economy with representation of all states and territories. Ausregion has a comprehensive coverage of sectors that are important to Australia. It has a population module that is broken into 100+ age cohorts. Details of the model are also available on ABARE’s web site.

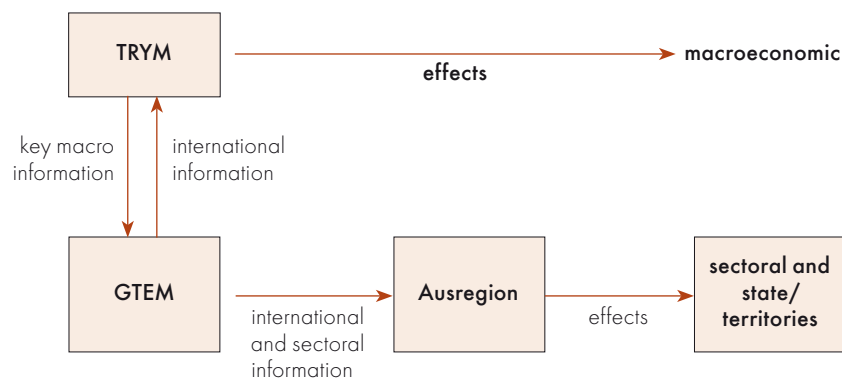
**TRYM**

The Treasury Macroeconomic (TRYM) model is a quarterly, dynamic, macroeconomic model of the Australian economy. It consists of around 30 behavioral equations and 100 accounting identities that provide for detailed short run dynamics around a theoretically consistent long run growth path. Documentation of the model is available on Treasury’s web site ([www.treasury.gov.au](http://www.treasury.gov.au)).

**interface**

The three models have unique characteristics that, when used together, provide a robust and rigorous framework for analysing policy issues that have international, national, sectoral and state level impacts. The interface between the models is illustrated below:

**model interface**



- > TRYM is used to assess the macroeconomic impacts on Australia of an avian influenza pandemic. TRYM is focused on the macroeconomic impacts of the demand and supply side changes that are likely to result from an influenza pandemic.
- > GTEM is used to take into account the likely international trade flow impacts associated with the pandemic in different parts of the world.
- > Taking the relevant results from TRYM and GTEM as inputs, Ausregion is employed to analyse the possible impacts on Australia’s individual states and territories as well as their key sectors.

## scenarios

Two scenarios are analysed here. Both assume a worldwide pandemic outside Australia (phases 6b–6d overseas), but they differ in their assumptions about the spread of the pandemic in Australia.

### scenario 1: influenza outbreak – whole world

Under this scenario, the whole world is assumed to be affected by the influenza outbreak (phases 6b–6d). The purpose in the scenario is to illustrate how an influenza pandemic across the world may affect economic activity in Australia, including the states and territories.

### scenario 2: influenza outbreak – rest of the world (excluding Australia)

Under this scenario, it is assumed that there is an outbreak of influenza all over the world except in Australia. It is also assumed that strict quarantine and border control measures enable Australia to protect itself from the outbreak of influenza.

## assumptions

### mortality

There is obvious uncertainty over the actual number of people that are likely to be infected and die from an influenza pandemic. The distribution of possible infected cases among countries and age groups is also uncertain (Bloom, Wit and Jose 2005; Cooper and Coxe 2005). For example, during the Spanish Influenza outbreak of 1918–19 the young and robust sections of population suffered significant mortalities (Brainerd and Siegler 2003; Almond 2005). In the United States, mortality rates appeared to have been randomly distributed, with no pattern related to economic development, climate or geography (Brainerd and Siegler 2003).

Taking into account these uncertainties, several assumptions about the influenza outbreak are made in the current analysis. First, it is assumed that the severity of a global pandemic influenza is medium scale, if the Spanish flu of 1918–19 was considered severe. (Osterholm 2005 estimated that a global influenza pandemic of similar virulence to the 1918–19 influenza striking today would result in 180–360 million deaths.) A global mortality of around 80 million is assumed here. A similar number of fatalities was assumed by McKibbin and Sidorenko (2006) under a severe scenario.

Mortality rates, by country, are assumed to be influenced by each country's ability to deal with a highly contagious disease. Several factors including health infrastructure and services are assumed to affect mortality rates (as was assumed by McKibbin and Sidorenko 2006). As many of these factors are income related, different mortality rates in developed and developing countries are used here. The assumed mortality rates are based on best available estimates. In this study, the mortality rate for Australia and other developed countries is assumed to be 0.20 per cent of total population, while in developing countries, it is 1.39 per cent of the population. This results in 40 000 deaths in Australia and 80 million for the whole world under scenario 1 (table 2).

In each country, mortality is distributed among four age groups regardless of gender (0–18, 19–45, 46–

## 2 assumed mortality

	scenario 1	scenario 2
	'000	'000
Rest of world	79 960	79 960
Australia	40	0
World	80 000	79 960

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64 and 65+ years of age). It is assumed that people in the 65+ age group are at high risk of contracting and dying from the disease. As with the Spanish flu, the young and robust age group (19–45 years) is also assumed to sustain higher mortality in all countries. People in the 0–18 years age group are assumed to have the smallest rate of mortality. The fatalities by age group and by country are introduced as specified reductions in the population in the pandemic scenarios.

### **labor productivity**

It is expected that an influenza pandemic will affect labor productivity by reducing the number of working days of those infected. Absenteeism from illness, caring for family members and funeral service attendance are also assumed to affect labor productivity and are calculated for all countries using the rates similar to those in Meltzer et al. (1999). An infection rate of around 40 per cent is assumed for all countries.

### **quarantine measures**

Government imposed measures to prevent entry or spread of pandemic influenza, such as border closures and restrictions or bans on travel and trade in goods, are modeled as changes in trade in goods and services.

### **changes in consumption**

Changes in final consumption away from goods or activities that are likely to put consumers at risk of being infected with influenza are modeled as changes in consumption. Examples include reduced demand for travel affecting services such as airlines and tourism related activities, and higher demand for health services resulting in an increase in consumption of such services.

### **confidence effects**

Changes in consumer and investment confidence are modeled in TRYM. They are assumed to be related to the severity of the pandemic, in particular to the scale of mortality. In scenario 1, it is assumed that there are substantial confidence effects on consumption and investment in Australia. In scenario 2, the presence of a pandemic overseas is expected to affect international trade, in part because of likely quarantine measures. The impact on Australia will depend on whether precautionary measures taken domestically affect labour supply and on the size of adverse confidence effects. It is not easy to assess what these measures might be – in part because they depend on perceptions of whether it will be possible to prevent infection reaching Australia. By way of illustration, in scenario 2, however, no labor supply effects are assumed for Australia but confidence effects are estimated to be half the size of those in scenario 1.

In analysing the impact of an influenza pandemic, the two scenarios are benchmarked to 2007. The economic impacts of these scenarios are determined as the difference between a reference case (in which no policy or other external changes occur) and the pandemic scenario.

### **simulation results**

According to the analysis undertaken in this study, a global influenza pandemic could impose significant costs on the Australian economy. Losses of about 6.8 per cent of Australia's gross domestic product, relative to the reference case, are estimated for an influenza outbreak benchmarked to 2007 in the whole world including Australia (table 3). The estimated decline in Australia's economic activity stems mainly from the constraints imposed by

the pandemic on the production side of the economy and the reduction in demand. These economic costs reflect short term impacts.

Even when the influenza outbreak is confined to other countries only (scenario 2), economic activity in Australia could still be affected negatively. This reflects the uncertainties over the spread of the disease, which can dampen consumer and investment confidence. At the same time, the combination of stringent border control measures and reduced overseas demand for goods and services are expected to lead to a decline in exports of Australian products. Under this scenario, Australia's gross domestic product could fall by about 3 per cent relative to the reference case (table 3).

Overall, the cost to the Australian economy is most significant when the whole country is exposed to the influenza virus, resulting in significant mortality. An important finding of the analysis is that Australian economic activity could fall even in an event where Australia was free from any influenza outbreak while there was a pandemic in other countries.

The results of the analysis in this study are consistent with the few studies conducted so far on an influenza pandemic (table 1).

#### state impacts

When the whole of Australia is affected by an influenza outbreak, as in scenario 1, economic activity in all states and territories is estimated to decline (relative to the reference case) at rates that are close to the national level. Small interstate differences in impacts reflect differences in economic structure. The state of Queensland, which has a relatively large tourism sector, is estimated to be the most adversely affected by a pandemic (table 4).

#### impact on key sectors

In addition to the negative effects of an influenza outbreak on the production side of the economy, changes in demand can be expected to have impacts as consumers move away from activities that would be likely to expose them to the disease. Some sectors may be affected more than others. For example, health services are likely to expand during an outbreak because of higher demands for their services.

As the results of the two scenarios are similar, only the results of scenario 1 are presented and discussed here. Under scenario 1, tourism related activities are likely to be affected the most by an influenza outbreak, falling by as much as 18 per cent relative to the reference case (table 5). The transport sector, particularly air transport services, is estimated to decline by 11 per cent relative to the reference case.

The sensitivity of these sectors, in general, to outbreaks of highly contagious diseases such as influenza is illustrated by the recent SARS (severe acute respiratory syndrome) outbreak in Asia. During the outbreak of SARS, retail sales dropped by 10–40 per cent in Hong Kong, flights by Dragon Air were cut by 48 per cent (Cooper and Coxe 2005),

### 3 change in Australian gross domestic product <sup>a</sup> relative to the reference case

Scenario	%
1: Influenza - whole world	-6.8
2: Influenza - rest of world only	-3.0

<sup>a</sup> Estimates using TRYM, GTEM and Ausregion. Simulation results benchmarked to 2007.

### 4 change in gross state product <sup>a</sup> relative to the reference case

	Scenario 1
	%
New South Wales	-6.6
Victoria	-6.9
Queensland	-7.1
South Australia	-6.4
Western Australia	-6.5
Tasmania	-5.8
Northern Territory	-5.8
ACT	-4.3

<sup>a</sup> Ausregion estimates. Simulation results benchmarked to 2007.

**5** impact on key sectors of a global pandemic influenza: scenario 1 <sup>a</sup>  
relative to the reference case

	Australia	NSW	Vic	Qld	SA	WA	Tas	NT	ACT
	%	%	%	%	%	%	%	%	%
Tourism related activities	-18.4	-18.9	-18.8	-18.7	-17.3	-15.8	-16.5	-16.4	-19.2
Air transport	-11.2	-11.7	-11.0	-9.9	-10.5	-10.9	-11.1	-12.1	-9.5
Other transport	-5.2	-5.3	-5.4	-4.7	-5.0	-5.8	-4.0	-6.7	-3.4
Other services and Insurance	-5.0	-5.2	-5.1	-5.0	-4.9	-4.8	-5.1	-5.3	-4.0
Services including health	3.9	5.6	4.7	3.8	0.3	0.8	0.3	2.3	1.0

<sup>a</sup> Simulation results benchmarked to 2007.

while tourist arrivals in Singapore were down by two-thirds and hotel occupancy rates for five star hotels in Beijing were down around 20 per cent (The Economist 2003).

In contrast to tourism related activities, services that include health are expected to expand in response to increasing demand. An implied assumption in the analysis is that despite concern about the influenza virus, health workers will be available (as it is assumed that health workers sustain negligible mortality because they are given priority for access at a very early stage of the pandemic to vaccines and other protective drugs and supplies) to provide the workforce for the expanding health sector.

Another sector that could potentially expand during an influenza outbreak is communications and information technology services. This sector provides services that are alternative to international travel to conduct business and related activities. Self confinement to avoid exposure to the influenza virus would also boost the use of communications and information technology services.

The direction of impact on key sectors in the states and territories is similar to the changes at the national level (table 5). For all states and territories, tourism related activities are expected to be affected the most, followed by transport services. In all cases, activities that include health services are expected to expand under an Australiawide influenza outbreak, although there are some small differences in estimates among states and territories. Two factors driving the differences in services including health are the absolute number of influenza cases assumed in different states and the differences in their economic structures.

**6** economic impact of a global influenza pandemic on selected countries: scenario 1 change in GDP relative to the reference case <sup>a</sup>

	%
China	-8.7
ASEAN	-7.1
Korea, Rep. of	-6.7
Japan	-6.1
United States	-3.5
European Union	-3.7
Canada	-3.0

<sup>a</sup> Estimates using GTEM. Simulation results benchmarked to 2007.

**international impacts**

The economic impacts of an influenza pandemic on various countries/regions are presented in table 6. The estimated impacts on developing countries/regions are larger than the impacts on developed countries. This largely reflects the high mortality rate expected in developing countries/regions compared with rates in developed countries in the event of an influenza pandemic.

**concluding remarks**

The findings in this study show that a global influenza pandemic could potentially result in substantial costs for Australia's economy. Reducing these costs through measures to prevent the virus from entering Australia is

an important policy objective for Australia. Considerable work is currently being undertaken by federal and state governments to prepare for a possible pandemic (Department of Health and Ageing 2006).

A global influenza pandemic could create fear similar to that during the SARS outbreak in 2003. Potentially, fear of a disease that causes mortality at the scale assumed in this study could create panic or chaos that could disrupt the supply of food, basic services, the financial system and even compromise public order. Under such circumstances, the economic costs imposed by an outbreak would be far greater than what is estimated in this study.

It is important to recognise that many countries, including Australia, are potentially vulnerable to a pandemic, regardless of where the initial outbreak occurs. Hence, it is more efficient for Australia and other countries to continue to be active in international efforts aimed at eradicating, preventing or containing the influenza virus at its source before it reaches international boundaries. A collective approach in dealing with the spread of the virus may be more effective and efficient than individual or unilateral measures. Cooperation involving sharing of information, resources and expertise at the regional, interregional and international levels could play an important role in preventing a pandemic. Prevention of an influenza pandemic is likely to be much more efficient than a cure.

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