The Potential Economic Impact of Avian Flu Pandemic on Taiwan

Ching-Cheng Chang,
Research Fellow, Institute of Economics, Academia Sinica, and Professor, Department of Agricultural Economics, National Taiwan University, Email: emily@econ.sinica.edu.tw

Duu-Hwa Lee
Assistant Professor, Department of Economics, Aletheia University,
E-mail: au4218@email.au..edu.tw

Hsin-Chun Lin,
Assistant Professor, Department of Applied Economics, National Chiayi University
E-mail address: hclin@mail.ncyu.edu.tw

Shih-Shun Hsu
Professor, Department of Agricultural Economics, National Taiwan University,
E-mail address: m577@ntu.edu.tw

Selected paper prepared for presentation at the American Agricultural Economics Association 2007 Annual Meeting, Portland, Oregon, July 28-August 1, 2007

The Potential Economic Impact of Avian Flu Pandemic on Taiwan

ABSTRACT

This study analyzes the potential consequences of an outbreak of avian influenza (H5N1) on Taiwan's macro economy and individual industries. Both the Input-Output (IO) Analysis Model and Computable General Equilibrium (CGE) Model are used to simulate the possible damage brought by lowering domestic consumption, export, and labor supply. The simulation results indicates that if the disease is confined within the poultry sector, then the impact on real GDP is around -0.1%~-0.4%. Once it becomes a human-to-human pandemic, the IO analysis suggests that the potential impacts on real GDP would be as much as -4.2%~-5.9% while labor demand would decrease 4.9%~6.4%. In the CGE analysis, which allows for resource mobility and substitutions through price adjustments, the real GDP and labor demand would contract 2.0%~2.4% and 2.2%~2.4%, respectively, and bringing down consumer prices by 3%. As for the individual sector, the outbreak will not only damage the poultry sector and its upstream and downstream industries, but also affect the service sectors including wholesale, retail, trade, air transportation, hotels, restaurants, as well as healthcare services. These results can be used to support public investment in animal disease control programs and strengthen the international cooperation and surveillance in reducing the spread of the disease.

Keywords: Avian Flu Pandemic, Input-output Model, Computable General Equilibrium Model

The Potential Economic Impact of Avian Flu Pandemic on Taiwan

1. Introduction

The avian flu is an infectious disease of birds caused by type A strains of the influenza virus. As for the human cases in H5N1, the first confirmed case of this epidemic wave was found in Vietnam in December 2003. In May 2006, the world's first instance of human-transmitted avian influenza was discovered in Indonesia. It has now spread to some parts of Europe, Africa, and Central Asia. Until January 9, 2007, there were 263 confirmed cases. Reporting countries include Azerbaijan, Cambodia, China, Djibouti, Egypt, Indonesia, Iraq, Thailand, Turkey and Vietnam. H5N1 virus caused serious systemic disease in these patients. Among these patients, 157 have died. Most patients were children and young adults, with unknown reasons.

The emerging threat of a pandemic of unprecedented proportion due to the spread of the H5N1 avian flu has become a global concern. In comparison to the three pandemics occurred in the previous century (i.e., the 1918 Spanish flu which claimed the lives of 40-50 million people worldwide in less than a year; the Asian flu in 1957 which caused an estimated 2 million deaths; and the Hong Kong flu in 1968 which took 1 million lives), the genetic makeup of the H5N1 strain is predicted to stand at a daunting total of 2 to 7.4 million deaths according to the World Health Organization (WHO)'s estimate. The social and economic ramifications could be equally catastrophic. Up till January 2007, a total of 265 confirmed human cases of H5N1 avian flu have been reported to WHO, of which 159 were fatal.

As the avian influenza has turned from poultry-to-human to human-to-human infection, its level of impact and spreading time would be far greater than the previous outbreak of Severe Acute Respiratory Syndrome (SARS) in 2003[1]. The WHO (2006) predicted that at the height of the

[1] SARS is a pneumonia-like illness which has claimed around 800 lives globally out of some 8,000 infected cases,

influenza outbreak, 7 million people around the world could die. The World Bank estimated that a human-to-human infection of the avian flu would cause economic losses of US$2 trillion. Verbiest and Castillo (2004) stated that the short-term GDP would be trimmed by 0.5% and long-term 1.2% to 1.5%. Bloom et al., (2005) discovered that the virus would cause a drop of 2.3% in Asia's demand-side GDP, 0.3% decline in supply-side GDP, as well as 6.5% plunge in long-term GDP. Mckibbin and Sidorenko (2006) estimated that a highly pathogenic infection of avian influenza would cause 1.01 million deaths in the U.S., 710 million worldwide, and GDP would fall 3% globally. The U.S. Congressional Budget Office (2005, 2006) predicted that the U.S. would experience a 5% drop in GDP, accumulate US$670 billion in losses, and have 2 million fatalities. Buetre et al. (2006) estimated that a mid-pathogenic outbreak would cause a 6.8% downfall in Australia's GDP and a GDP drop of 3.0% to 6.8% for countries elsewhere. The degree of impact is found to be greater for developing countries than the developed ones. The most devastated sectors include traffic and transportation services and tourism related activities, and the demand for health and medical services would skyrocket.

The above literatures revealed that the economic impact of the avian influenza could be massive. Taiwan has adopted a precautionary measure of setting up nets around all pig and poultry farms nationwide to prevent wild birds from passing the flu virus to hogs and poultry. By the end of March 2007, nets will have been set up at nearly 85 percent of the farms. Meanwhile, the National Health Research Institute has been working on developing a bird flu vaccine since August 2005 and has collected H5N1 culture samples from patients in Vietnam for the development of a vaccine. Although the Bureau of Animal and Plant Health Inspection and Quarantine (BAPHIQ) that Taiwan is currently a H5N1free country, the fact that it is the pathway of migratory birds and the possibility of smuggling poultries from China could seriously threaten the H5N1 free status.

---

mostly in China, Hong Kong, Taiwan and Singapore.

Therefore early prevention of the virus is needed in order to diminish its possible detrimental effects on the economy. Because the avian influenza has exerted a full-scale impact on an entire country, it appears suitable to examine the issue via a full set of economic models for short-term and long-term analysis. The purpose of this study is to evaluate the impact of avian influenza on Taiwan's economy. Both the Input-Output (IO) Analysis and Computable General Equilibrium (CGE) Models are used to simulate the possible damage brought by lowering domestic consumption, export, and labor supply in an *ex ante* basis. The next section briefly reviews the model structures and database. The third section provides scenario specifications. Simulation results are compared in the fourth section followed by the conclusions.

2. Analytical Framework

2.1 Input-output Analysis

This study measures the direct and indirect impacts of avian flu using the multipliers from the 2001 Input-Output (IO) Table of Taiwan. According to Miller and Blair (1985), the direct and indirect effects of the demand and supply shocks on each sector are obtained by computing the Leontief Inverse Matrix. The effects of demand shocks are calculated based on a demand-side IO Model as follows:

$$X = Z + F = AX + F , \quad (1)$$

where X is a vector of total output, Z is the intermediate demand matrix, F is a vector of final demand including household consumption, investment, government expenditure and net export, and A is the input-output (or technical) coefficients matrix.

Assuming that the input-output coefficients are fixed and $(I - A)$ is nonsingular, the unique solution of total output is：

$$X = (I - A)^{-1} F , \quad (2)$$

where $(I-A)^{-1}$ is the Leontief matrix. Given a final demand (*F*) by the economy, Equation (2) calculates for each sector the gross output necessary to cover both the final demand and the corresponding intermediate demands arising from other sectors. Let $B=(I-A)^{-1}$, then the element of *B*, b_{ij}, denotes how many units of good *i* should be purchased directly and indirectly to satisfy one unit of final demand for good *j*.

The effects of supply shocks are calculated according to the supply-side IO model in which total output is equal to the value of its inputs in each industry as follows:

$$X' = Z' + V \tag{3}$$

where X' is transposed matrix of X, *Z'* is the matrix of intermediate input flows and *V* is the primary input matrix (i.e., the value-added matrix) including compensation of employees, operating surplus, depreciation, and indirect taxes.

Assuming that the output sale distribution coefficients are fixed, the total output transposed matrix is

$$X' = V(I-B)^{-1}, \tag{4}$$

where *B* represent the matrix of allocation coefficients and $B=\hat{x}^{-1}Z'$ with $\hat{x}$ the diagonal matrix of output values x_j. Equation (4) depicts the summation of the direct and indirect effects resulting from a primary input vector.

In this article, we will measure the total economic effects of an avian flu outbreak from both the demand-side and supply-side model. The demand-side model reflects domestic consumers' reluctance to eat poultry meat in the bird-to-bird phase, and then demand for travel and tourism would also be affected if the outbreak has evolved into the bird-to-human or human-to-human phases. International trade may also be affected because foreign customers cancel their orders in the human-to-human cases. The supply-side model refers to the culling of poultry, factory shut-downs due to culling, workers getting ill or under quarantine which prevent them from working, and import/export disruptions.

2.2 Computable General Equilibrium (CGE) Model

Because the IO model overlooks the price response and resource adjustment mechanism, i.e., prices and resource endowments are fixed, it can only be used as a short-term assessment and the results will be upward biased. To reflect the price repercussion effects and market adjustment mechanism of the economy, a single-country multi-sectoral CGE model (Johansen , 1960; Scarf, 1967) of Taiwan is used to simulate how an economy might react to changes in external factors like a disease outbreak. This model is originated from the Australian ORANI school in Monash University (Dixon et al., 1982). The Taiwan CGE model distinguishes 170 sectors, 6 types of labor, 8 types of margins, and 184 commodities. The model database is compiled from the 160-sector Use Table of the 2001 Input-Output Tables.

The model uses a full simultaneous equations system to describe the macro economy as well as individual industries. Based on the conventional neo-classical school assumptions, all economic agents are assumed to follow optimal behaviors. Firms minimize cost and are subject to production functions. Representative households maximize utility and are subject to budget constraints. Like the ORANI model, the supply structure of the Taiwan CGE model allows for each industry to produce a mixture of all the commodities., using domestic and imported commodities, labor of several types, land, capital, energy of several types and other costs as inputs. The multi-input, multi-output production specification is kept manageable using a series of weak assumptions, as illustrated by the nested structure.

Moreover, the conversion of undifferentiated commodities into goods destined for export and those for local use is governed by a constant elasticity of transformation (CET) functional form. The input demand of industry production is formulated by a five-level nested structure, and the production decision-making of each level is independent. By assuming cost minimization and technology constraint at each level of production, producers will make optimal input demand decisions. When the economy reaches its demand-supply equilibrium, the market is cleared. To simplify the complexity associated with nonlinear models, Johansen (1960)'s method is adopted to transform nonlinear level equations to linear percentage change form. A detailed description is available in Dixon et al (1982), Parmenter (1995) and Dixon and Rimmer (2002).

The CGE models are descended from the input-output models pioneered by Leontief, but they pay special attention to market clearing conditions and price determinations. The CGE models allow prices to affect demand and supply simultaneously, but the IO models assume that all prices are fixed. Thus, the IO models is useful in calculating the short-run policy impacts of an economy, while the CGE models encompass market equilibrium effect in both the input and output markets so that an intermediate or long-run policy impacts can be portrayed. They are complementary in this context. This study will adopt both models to evaluate the short-run and long-run impacts of avian flu on Taiwan.

3. Data processing and scenarios design

The database used by this study was based on Taiwan's Input-Output (IO) Tables which spanned 162 sectors in 2001. The poultry and livestock sectors are further disaggregated to facilitate the sector-specific evaluations on the impact of avian influenza. Please refer to Table 1 for the sector specifications.

As the highly pathogenic influenza case has not yet been found in Taiwan, several simulation scenarios are proposed in an *ex-ante* basis. In accordance with the WHO's pandemic alert, the pandemic can be classified into 01, 02, A1, A2, B and C classes as illustrated in Table 2. A scale of 0 indicates that H5- and H7-type pandemic has been identified in the area and the confirmed poultry-to-human cases have been reported abroad. It is further classified into high (02) and low (01) phases. Class A1 denotes confirmed cases abroad, while A2, B and C represent local poultry-to-human or infection from abroad, human-to-human infections, and large-scale epidemic, respectively.

The scenario design is based on shock configuration focusing on both the demand and supply sides of the market. On the demand side, the impact on local consumption is evaluated according to the negative influence during the 2003 SARS epidemic on local industries. If the epidemic situation is classified as 01 (i.e., the low-pathogenic avian flu is confirmed in the domestic poultry sector), poultry consumption would fall by 30%. If the epidemic situation rises to 02 class, then poultry consumption would be reduced by 70%. The upstream and downstream business would lose NT$10 billion, while poultry export would lose NT$700 million. The government expenditure from culling infected birds would range from NT$350 million to NT$410 million. These projections are provided by the experts in the Council of Agriculture.

For the 02 level, the substitutions between poultry and non-poultry meat are taken into consideration. The elasticities of substitution between different kinds of meat are extrapolated from the historical data during the food and mouth outbreak in 1997. Based on the Food Balance Sheet, it is found that the substitution ratio between poultry and pork is 0.43, i.e., a 1% reduction of pork consumption will increase 0.43% of poultry consumption. However, during an avian flu outbreak, hogs will also be subject to infections and the reverse substitution between poultry and pork might not happen. The Council of Agriculture predicts that consumers would feel safer to consume more seafood or beef rather than pork. Therefore, we assume that 50 percent of reduction in poultry meat will be substituted by beef and seafood while only 10 percent will be replaced by pork.

For sectors other than poultry, we use the 2003 SARS outbreak as our benchmark to design their demand shock parameters. In class A, we assume that the consumption decline would be equivalent to the 2003 SARS outbreak. The decline in consumption in class B would be equivalent to the double of SARS while class C is five times that of SARS.

As for the supply-side impact, as employees could be hospitalized or absent from contracting the virus, industrial outputs would be lowered. The FluAid 2.0 software[2] is used to calculate the number of fatality and the number of person hospitalized and out-patient visits. The gross attack rates[3] of 15%, 25%, and 35% are assumed as inputs to FluAid 2.0 based on the estimates from the Center for Disease Control of the Department of Health. The productivity parameters in each sector which are endogenous in the model can be solved using the historical simulation method and they are the benchmark of setting the productivity shocks in the forecast closure for the avian flu outbreak.

This study also takes into account the possible effects on business sales due to their efforts in improving or alleviating the outbreak. From Taiwan's SARS experience, environmental sanitary services would benefit the most, followed by medical instrument and apparatus, medicine, face mask, and synthetic detergent and washing industries. We also hypothesize that the export demand in the A2 and B class would be 2% and 4% lower than the baseline, respectively, while 6%-10% reductions are assumed in class C.

4. Results

4.1 Results of IO Analysis

---

[2] FluAid is a software designed by the CDC of the U.S. to provide a range of estimates of impact in terms of deaths, hospitalizations, and outpatient visits due to pandemic influenza. The software does not use Monte-Carlo methodologies to provide ranges of estimates. Instead, it requires that the user supply minimum and maximum estimates of some inputs (e.g., rates of death per 1,000 population). These data are then used by the program to provide estimates of the minimum and maximum impact of an influenza pandemic. The major limitation of FluAid is that it cannot provide any description of how a pandemic may spread through a geographic region over time. More detailed descriptions of the characteristics of the software can be found in the website: http://www.cdc.gov/flu/tools/fluaid/#section05.

[3] Gross attack rate is the percentage of population that becomes clinically ill due to influenza.

Simulation results of the IO modeling are shown in Table 3. Scenarios 1 through 6 revealed that the negative economic effect in the event of the pandemic ranges from -0.0195% to -6.38% in total outputs. The effects on real GDP and employment are -0.0075% to -5.90% and -0.0113% to -6.38%, respectively. Thus, the bird-to-bird phase does not pose any major threat to the economy expect a few sectors, but the human-to-human phases are considered to be very serious for the economy as a whole.

The effect of avian influenza on the industry-specific GDP is illustrated in Table 4. In the 01 and 02 classes, the agricultural service sector suffers the most, followed by the banking, chicken, and animal feeds. Fishery sector will benefit due to the substitution effect in consumption. For the C class of human epidemic, the wholesale sector will be the most severely impacted sector, dipping in a range of NT$60.87 billion to NT$67.13 billion, followed by the retailing and foreign trade. The largest beneficiary will be environmental sanitary services, rising in the range of NT$13.87 billion to NT$14.29 billion, followed by the medicine, hospital services, sanitary and cosmetics sectors. Labor demand will decrease from a minimum of 130,000 to a maximum of 500,000 people and create a huge demand for unemployment relief payment.

4.2 Results of CGE Analysis

The simulated results of avian influenza on Taiwan's overall economy are summarized in Table 5. Scenarios 1 through 6 reveal that the negative economic effect is not as strong as those obtained from the IO modeling. For example, the decline in real GDP will range from -0.0316% to -2.44% while the IO model predicts a reduction of -0.0075% to -5.90%. The larger impact from the latter reflects the short-run results because the IO model is primarily based on a set of fixed technical coefficients and prices. The results from the CGE model is medium-term in nature because it embeds in an economy the neoclassical traditions where prices are allowed to change in response to market forces and resources are reallocated accordingly to the price signals. The large discrepancy between the two sets of predictions highlights the sensitivity of model selections.

The impact of avian influenza on industrial GDP is detailed in Table 6. The CGE model predicts that in the 01 and 02 cases, the poultry sector suffers the most, followed by the banking/credit sector. The fishery sector will benefit with a positive effect of NT$186 million to NT$858 billion. In the class C scenarios, the food and beverage sector will become the most severely impacted sector, dipping NT$102.64 billion, followed by the retailing and aviation transportation. The largest beneficiary will be once again the environmental sanitary services, rising NT$16.75 billion, followed by the medical healthcare and sanitary products. Given the escalation of the pandemic, the negative impact on the overall economy in both modeling exercises are generally consistent. However, the effect of IO model will be greater than that of CGE, which is consistent with the previous literature.

5. Conclusions

The avian influenza is not only a devastating disease in the poultry sector, but also a potential source of future human influenza pandemics and could affect the entire economy. This study provides a comprehensive impact assessment of an avian flu outbreak in Taiwan with focus on the inter-sectoral linkage effect. Two analytical tools are adopted: the IO model provides a short-term estimate and the CGE provides a longer-term prediction. In comparison to the estimates from the World Bank and Asian Development Bank, the degree of negative impacts is considered to be milder and lower in Taiwan than in the other Asian economies. This study recommends that all responsive measures should be based on a comprehensive set of evaluations in which potential Pareto improvements and magnitude of the difference between gains and losses are made.

References

1. Miller, R. E. and P. D. Blair (1985), *Input-Output Analysis: Foundations and Extensions*, Prentice Hall, Englewood Cliffs, New Jersey.
2. Johansen L. (1960), *A Multi-Sectoral Study of Economic Growth*, North-Holland
3. Scarf H. E. (1967), "On the Computation of Equilibrium Prices," Cowles Foundation Discussion Papers 232, Cowles Foundation, Yale University.
4. Dixon P.B., B.R. Parmenter, J. Sutton, D.P. Vincent (1982), *ORANI: A multisectoral model of the Australian economy*. Amsterdam: North-Holland, 1982.
5. Bloom, E., V. de Wit, and M. J. Carangal-San Jose (2005), “Potential Economic Impact of an Avian Flu Pandemic on Asia”, ERD Policy Brief No.42.
6. Buetre B., Y. Kim, Q. T. Tran, Jim Thomson, and D. Gunasekera (2006), “Avian Influenza-Potential Economic Impact of a Pandemic on Australia”, *Australian Commodities*, 13(2), pp 351-359.
7. McKibbin, W.J., and A.A. Sidorenko (2006), “Global Macroeconomic Consequences of Pandemic Influenza”, Lowy Institute for International Policy, Sydney.
8. The United States Congressional Budget Office (2005), “A Potential Influenza Pandemic: Possible Macroeconomic Effects and Policy Issues”, http://www.cbo.gov/ftpdocs/69xx/doc6946/12-08-BirdFlu.pdf.
9. Verbiest, J-P.A., and C.N. Castillo (2004), “Avian Flu: An Economic Assessment for Selected Developing Countries in Asia”, ERD Policy Brief No 24, March .
10. The World Bank East Asia and Pacific Region (2005), “Spread of Avian Flu Could Affect Next Year’s Economic Outlook”, http://siteresources.worldbank.org/INTEAPHALFYEARLYUPDATE/Resources/EAP-Brief-avi

an-flu.pdf.

11. World Health Organization (2006), “H5N1 Avian Influenza: Timeline”, http://www.who.int/csr/disease/avian_influenza/timeline.pdf.

12. World Health Organization (2005), “Avian Influenza: Assessing the Pandemic Threat”, WHO/CDS/2005.29.

13. World Health Organization (2006), “WHO Pandemic Influenza Draft Protocol for Rapid Response and Containment”, http://www.who.int/entity/csr/disease/avian_influenza/guidelines/protocolfinal30_05_06a.pdf.

14. World Health Organization (2006), “Review of Latest Available Evidence on Risks to Human Health through Potential Transmission of Avian Influenza (H5N1) through Water and Sewage”, WHO/SDE/WSH/06.1.

Table 1. Sectoral Specification of the IO model

Sector Classified in 2001 IO Table		Sectors in this study	
009	Other Livestock	163	Cattle
		164	Eggs
		165	Chickens
		166	Other poultry
		167	Other Livestock
017	Other Livestock	168	Pork
		169	Beef
		170	Other meat
		171	Other Slaughtering & By-Products

Table 2. Scenario Design for different epidemic situation of avian flu in Taiwan

Unit: billions NT dollars

Epidemic classes	01	02	A1	A2	B	C
Negative impacts on sectors						
1.Consumption (poultry)	-30%(NT -4.285 to 8.571)	NT -10 to -20				
2.Production (poultry)		NT -10				
3.Export (poultry)		NT -0.7				
4.Government Expenditure		NT 3.5 to 4.1				
5.Substitution meet						
Pork	NT +0.217 to +0.43	NT +0.507 to +1.013				
Fishery Products	NT +0.92 to 1..84	NT +2.145 to +4.29				
Beef	NT +0.097 to +0.14	NT +0.227 to +0.453				
Mutton	NT +0.042 to +0.08	NT +0.097 to +0.193				
6.Consumption			Same as SARS	Same as SARS	Twice as SARS	5 times as SARS
Air Transportation			NT -2.96	NT -2.96	NT -5.93	NT -14.82
Travel Agent Service			NT -1.43	NT -1.43	NT -2.87	NT -7.18
Hotel Services			NT -3.48	NT -3.48	NT -6.96	NT -17.4
Food & Beverage Services				NT -5.99	NT -11.99	NT -29.97
Commerce				Wholesaling: NT-14.5 Retailing: NT -11.62 International Trade: NT -12.22	Wholesaling: NT -20.9 Retailing: NT -23.25 International Trade: NT -24.44	Wholesaling: NT – 72.7 Retailing: NT – 58.12 International Trade: NT – 61.1
Motion picture & related recreational services				NT -0.69	NT -1.39	NT -3.47
Railway Transportation				NT -0.99	NT -1.98	NT -4.95
Other Land Transportation				NT -0.99	NT -1.98	NT -4.95
Medical & Health Services				NT -0.13	NT -0.26	NT -0.66
Positive impacts on sectors						

7. Consumption Medicines Medical Instrument Gauze masks Synthetic detergents and Washing Environmental Sanitary Services				 NT 0.77 NT 1.48 NT 0.09 NT 0.08 NT 4.71n	 NT 1.54 NT 2.95 NT 0.19 NT 0.16 NT 9.23	 NT 3.86 NT 7.38 NT 0.46 NT 0.39 NT 23.57
8. Export				-2%	-4%	(1) infection rate 15 %: -6% (2) infection rate 25 %:-8% infection rate 35%: -10%
9. Supply reduction						(1) infection rate 15%: GDP NT -40.1 (2) infection rate 25%: GDP NT NT -66.8 (3) infection rate 35% GDP NT -93.5

Table 3. The Macroeconomic Impacts of Avian Flu in Taiwan using IO model

Unit：%

	01		02		A1	A2	B	C		
	Lower Limit	Upper Limit	Lower Limit	Upper Limit				Infection ratio 15%	Infection ratio 25%	Infection ratio 35%
Export						-2	-4	-6	-8	-10
Output	-0.0195	-0.06	-0.26	-0.47	-0.05	-1.11	-2.17	-4.24	-5.31	-6.83
GDP	-0.0075	-0.03	-0.18	-0.36	-0.06	-1.01	-1.96	-4.19	-5.04	-5.90
Employment	-0.0113	-0.05	-0.24	-0.48	-0.07	-1.28	-2.44	-4.94	-5.66	-6.38
Net Indirect Tax	-0.0287	-0.09	-0.39	-0.76	-0.07	-1.65	-3.24	-6.03	-7.14	-8.25

Source: Simulation results of this article.

Table 4. The Sectoral Impacts of Avian Flu in Taiwan using IO model

Unit：NT million dollars

Epidemic classes		01		02		Epidemic classes		A1	A2	B	C		
Sectors		Lower Limit	Upper Limit	Lower Limit	Upper Limit	Sectors					Infection ratio 15%	Infection ratio 25%	Infection ratio 35%
Positive Impacts													
012	Fishery Product	503	1,000	1,109	2,227	154	Environmental Sanitary Services	-35	2,773	5,440	14,292	14,085	13,879
168	Pork	21	41	45	91	061	Medicines	-1	309	624	1,684	1,620	1,556
008	Hogs	14	27	30	60	063	Synthetic Detergents and Washing Preparations and Cosmetics	-19	13	25	155	109	62
169	Beef	9	14	21	2	062	Pesticides and Herbicides	-2	14	27	108	88	69
Negative Impacts													
010	Agricultural Service	-394	-1,104	-3,795	-7,438	121	Wholesaling	-34	-13,425	-21,156	-60,877	-64,002	-67,130
136	Finance	-193	-710	-3,062	-6,282	122	Retailing	-51	-12,797	-25,557	-56,499	-60,251	-64,005
165	Chicken	-747	-1,494	-3,545	-5,394	123	International Trade	-38	-10,568	-21,126	-46,048	-49,443	-52,839
022	Feed	-164	-475	-2,060	-3,702	136	Finance	-479	-7,628	-14,868	-27,891	-33,019	-38,149
122	Retailing	-95	-303	-1,217	-2,401	103	Semi-conduct	-1	-7,689	-15,377	-23,060	-30,752	-38,444
018	Edible Oil & Fat	-65	-183	-685	-1,300	126	Food & Beverage Services	-13	-4,416	-8,834	-21,915	-22,004	-22,093
						125	Hotel Service	-2,144	-2,208	-4,407	-10,959	-10,999	-11,039
						140	Real Estate Services	-160	-2,529	-4,840	-10,740	-11,693	-12,647
						114	Electricity	-116	-2,619	-5,182	-8,863	-10,981	-13,099
						105	Electronic Components & Parts	-2	-2,937	-5,874	-8,751	-11,718	-14,685
						065	Petroleum Refining	-128	-2,633	-5,219	-8,707	-10,936	-13,165
						128	Other Land Transportation	-42	-2,052	-4,088	-7,660	-8,966	-10,274
						135	Telegram & Telephone	-126	-1,617	-3,148	-6,502	-7,295	-8,088
						069	Plastic Products	-20	-1,784	-3,534	-5,698	-7,309	-8,920
						130	Air Transportation	-1,106	-1,136	-2,275	-5,650	-5,669	-5,689
						132	Traveling Service	-919	-963	-1,929	-4,783	-4,808	-4,834

Source: Simulation results of this article.

Table 5. The Macroeconomic Impacts of Avian Flu in Taiwan using CGE model

Unit：%

	01		02		A1	A2	B	C1	C2	C3
	Lower Limit	Upper Limit	Lower Limit	Upper Limit						
Real GDP	-0.0335	-0.0325	-0.1431	-0.1332	-0.01	-0.42	-0.83	-2.02	-2.18	-2.35
Employment	-0.0330	-0.0316	-0.1472	-0.1373	-0.02	-0.42	-0.85	-2.27	-2.35	-2.44
Export	-0.0383	-0.0373	-0.1541	-0.1449	-0.24	-0.50	-1.00	-1.16	-1.88	-2.60
Import	-0.0302	-0.0297	-0.1249	-0.1172	-0.20	-0.81	-1.62	-2.05	-3.09	-4.14
GDP inflation	0.0226	0.0220	0.0913	0.0859	0.12	-0.80	-1.60	-2.52	-3.21	-3.89
CPI	0.0226	0.0218	0.0912	0.0858	0.11	-0.76	-1.53	-2.39	-3.05	-3.71
Export price	0.0089	0.0086	0.0355	0.0334	0.05	-0.35	-0.71	-1.14	-1.44	-1.74
Capital return	0.0073	0.0072	0.0295	0.0277	0.07	-0.30	-0.60	-1.00	-1.26	-1.52
Wage	0.0226	0.0218	0.0912	0.0858	0.11	-0.76	-1.53	-2.39	-3.05	-3.71
Capital	-0.0457	-0.0455	-0.1823	-0.1681	-0.04	-0.57	-1.15	-2.42	-2.75	-3.09
Primary Inputs	-0.0334	-0.0325	-0.1426	-0.1325	-0.02	-0.42	-0.85	-2.08	-2.23	-2.38

Source: Simulation results of this article.

Table 6. The Sectoral Impacts of Avian Flu in Taiwan using CGE model

unit：NT million dollars

	01		02		A1	A2	B	C1	C2	C3
	Lower Limit	Upper Limit	Lower Limit	Upper Limit						
009 Other Livestock	-810	-805	-2121	-2102	17	-29	-57	-17	-79	-140
012 Fishery Products	186	387	387	858	-41	-550	-1100	-1579	-2095	-2611
018 Edible Oil & Fat By-Product	-77	-76	-196	-195	8	-14	-29	-13	-43	-73
061 Medicines	-41	-41	-1167	-1167	-56	1645	3343	7816	8075	8330
063 Synthetic Detergents and Washing Preparations and Cosmetics	0	0	-2	-2	-13	253	505	1224	1242	1260
065 Petroleum Refining	-43	-42	-166	-160	-105	-794	-1589	-2573	-3338	-4111
103 Semi-conduct	-87	-89	-358	-337	-564	-570	-1138	-949	-1990	-3053
114 Electricity	-66	-66	-267	-252	94	-429	-858	-1691	-2270	-2861
121 Wholesaling	-179	-177	-749	-736	1856	-3555	-7115	-23049	-23424	-23846
122 Retailing	-20	-16	-22	-37	1196	-6367	-12735	-34913	-35668	-36469
123 International Trade	-66	-67	-226	-217	389	-970	-1942	-5093	-6059	-7052
125 Hotel Service	29	30	119	111	129	-1832	-3664	-5891	-7462	-9025
126 Food & Beverage Services	34	36	146	139	-297	-20547	-41093	-104055	-103347	-102647
127 Railway Transportation	-2	-2	-10	-9	-13	-153	-306	-841	-809	-779
128 Other Land Transportation	-68	-68	-282	-271	398	-204	-410	-3063	-2949	-2856
129 Water Transportation	-8	-8	-33	-31	-51	-600	-1201	-1704	-2361	-3020
130 Air transportation	-4	-4	-16	-15	-9634	-9510	-19019	-27592	-27639	-27690
131 Services Incidental to Transport	-16	-14	-71	-63	-432	-593	-1187	-1545	-1920	-2300
132 Travel Agency Services	4	5	18	17	-4857	-4860	-9720	-11586	-11590	-11594
135 Telegram & Telephone	17	17	44	47	-138	-1760	-3520	-5760	-6995	-8227
136 Finance	-434	-469	-1688	-1618	-922	-837	-1676	-2506	-3402	-4340
138 Insurance	38	42	167	159	-96	-1750	-3500	-4718	-6264	-7795
140 Real Estate	-26	-31	-131	-124	605	-525	-1052	-4070	-4301	-4549
149 Medical & Health Services	88	93	391	370	76	-18426	-36852	-92390	-92408	-92429
154 Environmental Sanitary Services	-3	-3	-18	-18	-31	3355	6711	16816	16785	16753

Source: Simulation results of this article.