Journal of Agricultural and Applied Economics, 39,2(August 2007):325–333

Economic Impacts of Regionalization of a Highly Pathogenic Avian Influenza Outbreak in the United States

Philip L. Paarlberg, Ann Hillberg Seitzinger, and John G. Lee

This analysis examines the economic impact of an outbreak of highly pathogenic avian influenza (HPAI) and the consequences of regionalization. The results suggest that an outbreak would have serious economic effects. Depending on the regionalization scenario, returns to capital and management in the poultry meat and egg sectors would fall between $602 million and $853 million dollars over 16 quarters. Consumers of poultry meat lose $900 million in consumer surplus in the first four quarters, a decline of 10.7%. Egg consumer surplus falls 17.1%. Regionalization lowers the economic welfare losses for producers because it dampens the export loss.

Key Words: high pathogenic avian influenza, international trade, poultry, regionalization

JEL Classifications: Q11, Q17, Q18

In the late 1990s highly pathogenic avian influenza (HPAI) appeared in Asia. Efforts to control the disease triggered the destruction of large numbers of birds and restrictions on international trade of poultry and poultry products. Some human deaths through direct contact with infected poultry were attributed to the strain. In 2003 the disease appeared again in Asia with similar impacts and continued to spread. Human mortality rates for those contracting the disease are around 50%. To control the disease spread large numbers of birds have been destroyed, and international trade in poultry meat and live birds has been restricted. Despite those efforts, by early 2006 the disease was detected in wild birds in Europe, the Middle East, and Africa. Its presence in wild bird populations raises concerns that it could spread to the United States.

Since the United States is a major poultry-meat–exporting nation and exports are important to the U.S. poultry industry, any export restrictions are critical to the economic impacts of an HPAI outbreak. The sanitary and phytosanitary agreement (SPS) from the Uruguay Round allows nations to be divided into disease-free regions: regionalization.

This article examines the U.S. economic impacts of regionalization in the event of an outbreak of HPAI. This is accomplished using the agricultural sector model developed under the Program for Research in the Economics of Invasive Species Management (PREISM) to

Philip L. Paarlberg and John G. Lee are professors, Department of Agricultural Economics, Purdue University, West Lafayette, IN. Ann Hillberg Seitzinger is an agricultural economist, Centers for Epidemiology and Animal Health, Veterinary Services, Animal and Plant Health Inspection Service, U.S. Department of Agriculture, Fort Collins, CO.

This research was funded by the Animal and Plant Health Inspection Service, U.S. Department of Agriculture, and extends research done under the Program of Research on the Economics of Invasive Species Management (PREISM), Economic Research Service, U.S. Department of Agriculture. We appreciate the assistance of Missy Schoenbaum in developing the computer model used.

Table 1. U.S. Domestic Regions for Poultry

Region	Name	States	Percentage Share	
			Meat Birds	Layers
1	Northeast	NY, NJ, CT, VT, NH, RI, MA, ME	0.07	4.36
2	Mid-Atlantic	NC, VA, DE, PA, WV, MD	22.80	21.36
3	Southeast	MS, AL, GA, FL, SC, TN	36.81	15.28
4	Trans-Appalachian	IL, IN, OH, MI, KY	5.15	20.37
5	Central Central	NE, KS, MO, IA	4.88	17.27
6	North Central	ND, SD, MN, WI	3.69	5.69
7	South Central	OK, TX, AR, LA	22.64	11.02
8	Mountain West	MT, ID, WY, NV, UT, AZ, CO, NM	0	2.61
9	West Coast	AK, WA, OR, CA	3.95	10.64
10	Hawaii	HI	0	1.35

Source: Calculated from U.S. Department of Agriculture, National Agricultural Statistics Service *2002 Census of Agriculture.*

examine the comparative dynamics of several scenarios (Paarlberg et al.). The article begins with the regionalization scheme used. Then the scenarios are presented. Finally, the economic comparisons are made.

Regionalization

Regionalization of the U.S. poultry industry relies on 2002 *Census of Agriculture* state data from the U.S. Department of Agriculture, National Agricultural Statistics Service. For each state, the number of broilers sold, turkeys sold, plus the layer inventory is recorded. States are grouped into 10 regions according to economic and geographical ties (Table 1).

Whether a region exports or imports poultry meat or eggs from the rest of the United States is important because the domestic trade pattern affects how regionalization of that region is introduced into the model. Because state consumption data are not available, national data must be used. State population estimates are multiplied by national per capita consumption data for poultry meat and eggs to determine use in each state. For poultry meat, importing regions are the Northeast, Trans-Appalachia, Mountain West, West Coast, and Hawaii. For eggs, importing regions are the Northeast, Mountain West, West Coast, and Hawaii. Only the Trans-Appalachian region differs between meat and eggs.

Regionalization relies on expected reactions by trading partners compiled by the Foreign Agricultural Service of the U.S. Department of Agriculture. That information indicates great variety in the approaches taken by trading partners. Canada is expected to react little, a one-month ban from the affected state. In contrast, China is expected to apply a national ban of indefinite length. Other trade partners are mixed, some with national bans, some with state bans. Some partners end restrictions after three months or six months, while other countries do not explicitly indicate a termination time.

The information covers the larger trading partners, but not all partners. To complete the picture, U.S. poultry meat exports for 2001–2004 by destination are used. Each trading partner's share is calculated, and each is assigned to one of the expected trade regimes based on its geographic and political ties to nations for which there is information. Monthly [0,–1] binary values are assigned depending on whether the trade partner is willing to buy from the United States during that month. This procedure sorts the data and returns the percentage reduction of U.S. poultry exports each month. The months are aggregated into quarters to give the percentages introduced into the model. The largest impacts occur in quarter 1, and by quarter 5 the effect on trade is assumed gone. Regionalization has quite an effect on U.S.

poultry meat trade. Without regionalization first-quarter U.S. poultry meat exports are estimated to fall 89.34%. With regionalization the decline in poultry meat exports is 19.16%.

Scenarios

Several scenarios are considered, each consisting of three sets of shocks applied to a baseline of the observed data from the first quarter of 2001 to the fourth quarter of 2004. The production shocks are output losses of 3% for poultry meat and eggs in the first quarter. That translates into 267 million pounds of poultry meat and 53 million dozen eggs. The disease outbreak is assumed to be contained within one quarter. These assumed output losses are small compared to losses in Vietnam and Thailand of 15%–20% of the poultry stock (Brahmbhatt). The smaller assumed losses reflect differences in poultry production between the United States and Asia.

The second set of shocks is the loss of demand as U.S. consumers react to the outbreak. HPAI in other countries has been associated with reduced demand; sometimes extremely large drops in consumption have been reported. Nobody knows how U.S. consumers would react. The assumption in this analysis is that in the first quarter U.S. consumers reduce demand for poultry meat and for eggs by 20%. With the disease eradicated during quarter 1, U.S. demand begins to recover. By quarter 4 there are no longer demand effects. The annual U.S. demand reduction assumed is 8.75%, which is similar to the 8%–9% decline in 2006 European poultry meat consumption due to HPAI in wild bird populations projected by the FAO (Brahmbhatt).

While the production and demand shocks are common to all scenarios, the trade shocks vary. In the absence of regionalization, U.S. poultry meat export demand falls 89.3% in quarter 1 with losses of 63.5%, 16.1%, and 11.9% in subsequent quarters. Regionalization buffers the export demand reduction. First quarter exports are 19.162% lower. Quarters 2, 3, and 4 export demands are 7.707% lower. The flat export demand reductions reflect regionalization protocols where trading partners erect barriers that are in place for set times of 3 to 6 months.

The analysis consists of five scenarios. Scenario 1 is the No Regionalization scenario, which consists of 3% bird loss, U.S. demand declines, and the large losses in exports of poultry meat. The remaining scenarios are regionalization patterns for the United States where the region experiencing the HPAI outbreak is isolated from the rest of the United States. A region's production and consumption of poultry meat and eggs is removed from the United States, and the rest of the United States and the region are solved as independent markets. To make the final comparison at a national level, the effects in the isolated region and in the rest of the United States are recombined. One scenario assumes that HPAI enters the United States via the Alaska flyway so the West Coast, a net importer, is quarantined. Scenario 3 assumes the Southeast, a net exporter, is affected. Scenario 4 considers an outbreak in the Mid-Atlantic, the Chesapeake flyway. Scenario 5 is the extreme case of both the Southeast and the Mid-Atlantic regions being jointly regionalized.

Results

Each scenario shifts three relationships: U.S. supply, U.S. demand, and excess demand facing the United States. Keeping track of the magnitude of these shifts identifies the direction and size of price change. The HPAI outbreak triggers a reduction in purchases by foreign buyers under each scenario. That means the first quarter excess demand shifts inward, 89.341% with no regionalization and 19.162% with regionalization. With a stationary excess supply the price would fall, but the HPAI outbreak shifts both U.S. supply and U.S demand so the excess supply shifts. This is the key to the results and the shifts vary by scenario.

Poultry Meat

The price effects for poultry meat are shown in Figure 1. The largest impacts occur in the first

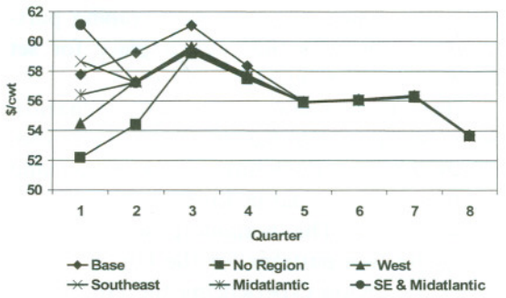

Figure 1. Broilers 12-City Price

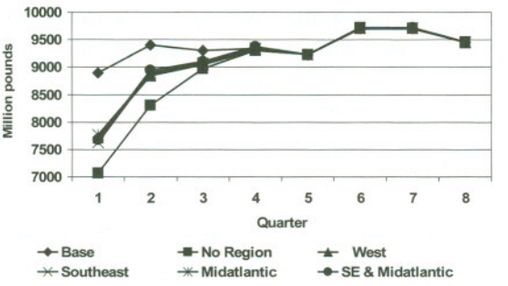

Figure 2. Poultry Meat Output

quarter during the actual HPAI outbreak. Subsequent quarters have smaller impacts that virtually disappear after quarter 5. The largest decline in the U.S. national price during the first quarter occurs when there is no regionalization with the price falling from the base of $57.76 per cwt to $52.19 per cwt. The large price reduction occurs because U.S. domestic demand falls 20%, the demand for U.S. poultry meat exports falls 89%, and the production cut is cut 3%.

Price changes under regionalization relative to the base are less extreme and the directions vary. When the outbreak occurs in the West Coast region the first quarter price falls to $54.48 per cwt. This decline in price is a result of quarantining West Coast output, a production shock of −3.954%, being less than the demand shocks for U.S. demand and exports.

Other regionalization schemes show different patterns of price changes relative to the base. When the Mid-Atlantic is regionalized, the price in the rest of the United States falls to $56.42 per cwt. Regionalization removes 22.80% of U.S. poultry meat output and isolates 12.76% of U.S. consumers from the rest of the United States. The loss of Mid-Atlantic consumers combined with the 20% reduction in consumer purchases of poultry meat due to HPAI results in a consumer shock to the rest of the United States of 30.21%. The U.S. consumer shock combined with the 19% reduction in U.S. export demand means the demand reductions dominate the output effect so the price falls slightly.

The Mid-Atlantic region is a net exporter to the rest of the United States, so it moves to autarky. Consumers in that region eat all of the region's poultry meat. That requires the wholesale poultry meat price inside the Mid-Atlantic region to fall to $48.76 per cwt.

The opposite story happens when the Southeast is regionalized. For Southeast regionalization, the output shock is −36.81%. The region contains 14.77% of consumers so the total consumer shock for the rest of the United States is −31.82%. The output shock dominates the combined demand shocks so the price in the rest of the United States rises from $57.76 per cwt to $58.66 per cwt. The price inside the Southeast region falls to $44.47 per cwt.

The final scenario combines the Southeast and Mid-Atlantic regions. In this regionalization scheme 59.61% of U.S. poultry meat output is isolated and the consumer shock in the rest of the United States is −42.03%. The output shock dominates the demand shocks so the poultry meat price rises to $61.10 per cwt in the rest of the United States while falling to $45.25 per cwt in the isolated region.

The differences in U.S. poultry meat outputs are shown in Figure 2. Given the short production time for meat birds, output has time to adjust to the demand reduction within the quarter. U.S. poultry meat output falls the most in the initial quarter and then begins to recover. By the fifth quarter output has mostly recovered but slight differences in output remain throughout the simulation period since prices and inventories are affected.

The No Regionalization scenario shows the sharpest first quarter decline in total U.S. poultry meat output because that solution reports the lowest poultry meat price. Base

U.S. poultry meat output in the first quarter is 8,896 million pounds. Without regionalization U.S. poultry meat output falls to 7,065 million pounds, a decline of 20.6%.

The regionalization schemes show reductions in total first quarter U.S. poultry meat output compared to the base output, but little differences among the scenarios. Under regionalization, U.S. poultry meat output varies from 7,625 million pounds when the Southeast is isolated to 7,764 million pounds when the Mid-Atlantic is separated into a region.

The aggregate numbers hide regional shifts. When the Southeast is regionalized, output in that region falls from 3,275 million pounds to 1,546 million pounds. This decline reflects the loss of the birds plus the price decline in the region. Output in the rest of the United States expands from 5,621 million pounds to 6,079 million pounds. When the Mid-Atlantic is regionalized there is a slightly different outcome since the price in the rest of the United States is lower. Poultry meat output in the Mid-Atlantic region falls from 2,028 million pounds to 1,148 million pounds. Because of the lower price in the rest of the United States, output in the rest of the United States is slightly lower, falling from 6,868 million pounds to 6,616 million pounds. When the regions are combined, the price in the rest of the United States rises so output increases from 3,593 million pounds to 4,869 million pounds. Regional output drops from 5,303 million pounds to 2,807 million pounds.

The assumption is an initial 20% demand reduction followed by recovery over the next three quarters. First quarter poultry meat consumption falls from 7,386 million pounds to 6,884 million pounds under No Regionalization. There is little difference in consumption among the regionalization scenarios, but consumption at around 6,500 million pounds is lower than under the No Regionalization outcome. That result occurs because regionalization reduces the export loss and the price decline. The aggregate numbers hide regional consumption shifts. Consumers in the Mid-Atlantic region increase consumption from 942 million pounds to 1,148 million pounds because the price falls sharply in that region.

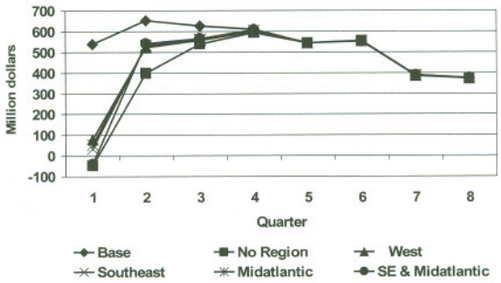

Figure 3. Net Returns to Poultry Meat

Consumers in the rest of the United States lower consumption from 6,444 million pounds to 5,389 million because the small price decline is insufficient to counteract the demand shift. The same pattern occurs when the Southeast is regionalized. Despite a 20% demand shock Southeastern consumers expand poultry meat consumption from 1,091 million pounds to 1,546 million pounds. In the rest of the United States, the 20% demand shock is amplified by the price increase and consumption falls from 6,295 million pounds to 4,879 million pounds.

The economic cost to producers consists of changes in the returns to capital and management on sales less the costs of birds destroyed (Figure 3). The cost of meat birds destroyed is $218 million. With the HPAI outbreak, losses in returns to capital and management are incurred. Returns in the base case are $538 million in the first quarter. The largest loss occurs when there is no regionalization due to this scenario having the largest price decline. First quarter total returns to the poultry meat sector fall to −$46 million. Regionalization recovers some of those losses. The largest decline in returns to the poultry meat sector in the regionalization scenarios happens when the Southeast and Mid-Atlantic is isolated, total U.S. first quarter returns falling from $538 million to −$39 million. The smallest decline in first quarter returns, to $80 million, occurs when the West Coast is isolated because producers in the West Coast region receive the U.S. price since the region imports poultry meat. Regionalization of the Southeast generates returns to capital and management in the U.S. poultry sector of

$35 million. Regionalization of the Mid-Atlantic gives national returns of $55 million.

Again there are regional differences hidden in the aggregate values. Under regionalization the isolated region's net returns become negative. For example, producers in the Southeast that can continue to sell poultry meat earn $30 million, down from $66 million. Adjusting for the $218 million value of birds destroyed gives a negative total. When the Mid-Atlantic is treated as a region, returns drop from $60 million to $38 million, but if the costs of destruction are included, the regional return is negative. Domestic and export demand reductions hurt producers in the rest of the United States. When the Southeast is regionalized, returns to producers in the rest of the United States fall from $381 million to $223 million. When the Mid-Atlantic is regionalized, returns to poultry growers in the rest of the United States fall from $390 million to $233 million.

Consumers of poultry meat are affected in two ways (Paarlberg, Lee, and Seitzinger). First, price changes cause consumers continuing to eat poultry meat to experience changes in economic welfare. Second, some consumers decide to give up poultry meat consumption and sacrifice the economic welfare gained from eating poultry meat. Consumers that give up poultry meat experience an economic welfare loss equal to consumer surplus prior to the HPAI outbreak.

In this HPAI outbreak, U.S. consumer surplus falls. The initial level of consumer surplus is $1,990 million. Consumers who stop eating poultry meat lose $398 million in the first quarter. As consumers react less strongly in subsequent quarters, this loss diminishes, and it vanishes by quarter 4. With no regionalization the price falls so consumers that continue to eat poultry meat increase their consumer surplus from $7.08 per capita to $8.55 per capita. Because many consumers no longer eat poultry, total consumer surplus for the consuming population falls from $1,990 million to $1,945 million. National consumer surplus in the No Regionalization scenario is $1,547 million. When the outbreak occurs in the West Coast and that region is isolated, consumer surplus is $1,396 million because the price decline is smaller. When regionalization is applied to the exporting regions there is little national difference in consumer surplus, ranging from $1,427 million when the Mid-Atlantic region is isolated to $1,583 million when the Mid-Atlantic and the Southeast are both regionalized. Nevertheless, there are differences in per capita consumer surplus because the price changes differ. When the Southeast is treated as a region, the price in the rest of the United States rises while that in the Southeast falls. Consumers eating poultry meat in the Southeast gain much consumer surplus while those in the rest of the United States lose slightly. When the Mid-Atlantic is treated as a region both prices fall but to differing degrees so consumers eating poultry meat gain but to differing extents.

Eggs

Since meat birds are regionalized, other poultry must be treated equivalently. The assumptions for eggs are similar with one key difference: there is no export shock. Thus, there is a 3% production shock, and the consumer response is assumed to be the same since U.S. consumers are eating fresh eggs.

The wholesale price of eggs falls from the base price of 75.80 cents per dozen. Under the No Regionalization and West Coast regionalization scenarios the price of eggs falls to 66.63 cents per dozen and 66.62 cents per dozen, respectively. Treating the Southeast as a region yields a price of 67.88 cents per dozen. The Mid-Atlantic region has slightly more egg production and fewer people, so the egg price drops to 72.69 cents per dozen. When the Southeast and the Mid-Atlantic are treated as a region, the egg price remains nearly unchanged at 75.68 cents per dozen since the demand and supply shocks in the rest of the United States nearly offset.

In regions that export to the rest of the United States, regionalization creates unique prices. The price in the Southeast at 66.36 cents per dozen is about the same as in the rest of the United States since the demand and supply

shocks are balanced. For the Mid-Atlantic region, the restriction on egg sales outside of the region dominates the demand shock, and the price falls to 46.55 cents per dozen.

Falling U.S. demand and prices lower egg output in the first few quarters. By quarter 4 the sector has recovered. The base level of U.S egg production is 1,764 million dozen. In the absence of regionalization, U.S. egg production in the first quarter falls to 1,483 million eggs. Regionalization changes national production very little. Yet there are shifts in egg production under regionalization in response to regional differences in price changes. If the outbreak occurs in the Mid-Atlantic and that region is regionalized, first quarter egg output declines from 377 million dozen to 160 million dozen. Egg output in the rest of the United States drops only from 1,387 million dozen to 1,320 million dozen.

Egg consumption falls and first quarter consumption vary little by scenario. Egg consumption recovers by quarter 4. Base first quarter egg consumption is 1,488 million dozen. As a result of the HPAI outbreak U.S. national egg consumption falls to around 1,200 million dozen.

Returns to capital and management less the value of layers destroyed fall in the event of a HPAI outbreak and begins to recover over the next three quarters. The base first quarter returns to capital and management in the egg sector is $177 million. A 3% loss of eggs generates a cost of $41 million. With no regionalization the return less the value of layers destroyed falls to $52 million. Regionalization causes further losses as the price improvement in the rest of the United States does not offset the effect of much lower prices in the isolated region. When the Mid-Atlantic region is regionalized, returns to egg producers in that region fall from $38 million to $3 million. Adjusting for the cost of layers destroyed yields a negative return for the sector in the Mid-Atlantic region. Returns to egg producers in the rest of the United States are also lower due to lower market price, falling from $139 million to $93 million. The story is the same when the Southeast is regionalized.

Impacts on Other Commodities

There are two channels for the HPAI outbreak to affect other commodities. One channel is through cross-price effects in demand. The second channel occurs through feed demands and the associated prices.

The general pattern of elasticities is that there is substitution among the meats but no interaction with other foods or nonagricultural goods. The price movements are sympathetic but small, so changes in economic welfare for consumers of alternative meats and for packers and processors are small.

The second channel operates through the markets for feedstuffs. Crop prices are lower as the reduction of poultry meat and egg outputs cuts feed use. The impacts by crop reflect the importance of poultry in feeding and the importance of feeding to total demand of the crop. The smallest impact is on wheat while soybean meal shows the largest relative impact from the HPAI outbreak because most soybean meal is used for feed or export and use by poultry represents 34% of soybean meal feed use.

Aggregate Impacts on U.S. Agriculture

The aggregate impacts of the HPAI outbreak under the different scenarios on returns to capital and management in U.S. agriculture summed over 16 quarters are given in Table 2. Returns to capital and management for meats are generally adversely affected while returns to capital and management for animals are higher. The returns to capital and management for other meats fall as substitute meat prices weaken in sympathy with the decline in the price of poultry meat. The maximum change for beef over the 16 quarters is $12 million while the minimum decline is $6 million. Returns to beef cattle improve as feed costs fall. The largest gain is $307 million, or 1.8%, and the smallest gain is $39 million.

Returns to capital and management for pork are $7–$23 million lower, declines of less than 1%. Returns to hogs show a mixed pattern. The largest gain is $139 million, 1.2%. Scenarios where the poultry meat prices fall

Table 2. Returns to Capital and Management in Agriculture, Sum of 16 Quarters (Billion Dollars)

Scenario	Beef	Beef Cattle	Pork	Hogs	Poultry Meat	Eggs	Dairy	Lamb Meat	Lambs/Sheep	Crops
Base	3.93	17.04	3.27	10.70	9.42	0.28	7.90	0.09	0.30	136.93
No regionalization	3.92	17.08	3.25	10.57	8.70	0.15	8.13	0.00	0.30	136.80
West Coast	3.93	17.08	3.25	10.64	8.70	0.13	8.10	0.09	0.30	136.84
Southeast	3.93	17.24	3.26	10.76	8.92	0.13	8.09	0.09	0.30	136.78
Mid-Atlantic	3.93	17.17	3.26	10.70	8.92	0.15	8.09	0.09	0.30	136.80
SE & Mid-Atlantic	3.93	17.35	3.26	10.84	8.83	0.13	8.13	0.09	0.30	136.73

the most, No Regionalization and regionalizing the West Coast, spill over into small declines in returns to hogs of $123 million and $61 million.

Returns to capital and management in crop agriculture fall slightly. The maximum decrease is $201 million, a loss of 0.15%.

The largest impacts are for poultry meat. In the No Regionalization scenario returns to capital and management are $718 million lower over the 16 quarters. Regionalization of the HPAI outbreak reduces the loss to the poultry meat sector to around $500 million.

Returns to capital and management in the egg industry are adversely affected as prices and output fall. Unlike poultry meat regionalization does not by assumption improve exports so there is little difference among the scenarios. The largest loss is $155 million summed across 16 quarters.

Conclusions

This article examines two interrelated issues. The first is the economic impact of an outbreak of high pathogenic avian influenza. The second is the impact of regionalization under the sanitary and phytosanitary rules.

The results suggest that an outbreak of HPAI would have serious economic effects. Prices for poultry meat and for eggs would fall. Production, consumption, and exports of meat and eggs would decline. Depending on the regionalization scenario, returns to capital and management in the poultry meat and egg sectors would fall between $602 million when the West Coast is regionalized and $853 million under No Regionalization over a 16-quarter time horizon. Such declines are losses of 6.2%–8.8% over the 16 quarters. However, the bulk of the losses occur in the first four quarters, with declines in returns to poultry meat producers in the first quarter ranging from $458 million to $534 million. The recovery is nearly complete by the fourth quarter, and by the fifth quarter there is little difference between the HPAI scenarios and the baseline. Poultry meat and egg consumers also are hurt. While consumers who continue to eat the products gain from the lower prices,

consumers who renounce poultry meat and egg consumption lose. Consumers of poultry meat lose $900 million in consumer surplus in the first four quarters, a decline of 10.7%. Egg consumers experience a decline of 17.1%.

Regionalization lowers economic welfare losses for producers because it dampens the loss in exports. Under regionalization the loss in return to poultry meat producers is around $500 million instead of $718 million. Regionalization affects the distribution of gains and losses between regions by separating prices. Prices in the isolated region fall by more than the rest of the United States. Under some regionalization patterns, prices in the rest of the United States rise in an outbreak. The direction of price change depends on the production and population share in the isolated region. As the price inside the isolated region falls there is a consumer surplus gain for consumers who continue to purchase the product. Growers in the isolated region see a lower price and cut output beyond the disease induced loss, magnifying the loss in returns to capital and management. With a smaller price decrease or even a price rise, the situation in the rest of the United States is much different. Output expands or contracts by less so there is a regional shifting of returns. Consumers who continue to purchase the product gain less than those in the isolated region if the price in the rest of the United States falls. If it rises, consumers in the rest of the United States lose consumer surplus.

References

Brahmbhatt, M. "Economic Impacts of Avian Influenza Propagation." Paper presented at the First International Conference on Avian Influenza in Humans. June 29, 2005. Internet site: www.worldbank.org (Accessed July 12, 2006).

Paarlberg, P.L., J.G. Lee, and A.H. Seitzinger. "Measuring Welfare Impacts of an FMD Outbreak in the United States." *Journal of Agricultural and Applied Economics* 35(2003):53–65.

Paarlberg, P.L., A.H. Seitzinger, J.G. Lee, and K.H. Mathews Jr. "Economic Impacts of Foreign Animal Disease." Report submitted to the Economic Research Service, U.S. Department of Agriculture as part of the Program of Research on the Economics of Invasive Species Management. Forthcoming.

United States Department of Agriculture–National Agricultural Statistics Service. *2002 Census of Agriculture*. Internet site: www.usda.nass.gov (Accessed May 18, 2006).