



The Economic Impact of Avian Influenza on Connecticut's Egg Industry

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Executive Summary

The Connecticut Department of Agriculture requested the assistance of the Connecticut Department of Economic and Community Development to produce an economic impact analysis (EIA) of a diagnosed outbreak of Avian Influenza virus at facilities owned by Kofkoff Egg Farms, LLC.

Connecticut has more chickens per square mile than any state in the nation. Kofkoff owns 4.7 million birds and seven poultry facilities located in five towns in eastern Connecticut. The firm is the largest egg producer not only in Connecticut but also in the northeastern United States. It employs 300 people, has an annual payroll of \$12 million and gross sales of \$90 million and reportedly supplies more than 90 percent of Connecticut's egg market. The company's large customers include major supermarket chains such as Wal-Mart, Stop & Shop, Big Y, Shaws, BJ's Wholesale, King Kullen, Pathmark, Shoprite, and others.

The influenza outbreak has led Japan and Korea to impose a temporary ban on all poultry imports from the United States.

The traditional response to an outbreak of a damaging disease is for the flock to be depopulated (all birds, diseased and healthy alike are destroyed). In most cases the federal and state governments provide financial assistance to off-set the cost of depopulation and for the lost inventory. Outbreaks of Avian Influenza have been documented in the United States since 1929. Numerous cases from the 1983-84 outbreak in eastern Pennsylvania to the 2002 outbreak in Virginia have cost taxpayers as much as hundreds of millions of dollars. The Connecticut Department of Agriculture (Connecticut DOA) estimates that the cost of depopulation would exceed \$30 million with Connecticut's share of that cost being approximately \$7.5 million.

In an attempt to avoid the damage to Connecticut's egg industry that would surely be caused by depopulation, the Connecticut DOA has sought and received approval from the United States Department of Agriculture (USDA), to vaccinate chickens under a pilot program . This is a preferred alternative to destroying the flock.

A simulation of the loss of the egg farm and the payments received by its vendors was conducted with the use of the Regional Economic Models, Inc. (REMI) model, a 53-sector structural econometric model. The results indicate that the combined loss of direct output of \$90 million of gross sales coupled with the

estimated indirect loss of \$71 million on an average annual basis as measured by the change in Gross State Product (GSP) (among all other industry sectors) produces an economic impact exceeding \$161 million. Together with an estimated \$25.7 million impact on consumer prices and the state's share of the depopulation cost (\$7.5 million), the total economic impact is \$194.2 million.

Personal income to all state residents declines \$67 million on an annual average basis. Net state and local tax revenues are also largely negative. The loss of the \$161 million GSP and \$7.5 million in direct state costs far exceeds the \$16 million cost associated with the vaccination program. With a benefit-cost ratio of nearly ten, the pilot vaccination program should be allowed to proceed until the Avian Influenza is eradicated, the savings to the federal and state taxpayers as well as to the industry would be significant.

Statement of the Problem

In May 2003, The Connecticut Department of Agriculture (DOA) requested the assistance of the Connecticut Department of Economic and Community Development (DECD) to develop an economic impact analysis (EIA) of a diagnosed outbreak of Avian Influenza (AI) virus detected on February 27, 2003 in a flock of 1.3 million egg-laying hens at a facility in Lebanon, Connecticut owned by Kofkoff Egg Farms, LLC. Further diagnostic testing conducted by the DOA in cooperation with the United States Department of Agriculture, Animal and Plant Health Inspection Service, Veterinary Services (USDA, APHIS, VS), confirmed the presence of a low pathogenic Avian Influenza (LPAI) virus, subtype H7N2, at the Lebanon facility and at another Kofkoff facility in Bozrah, Connecticut housing approximately 2 million birds. Avian Influenza poses no threat to humans.

Kofkoff Egg Farms

Kofkoff Egg Farms owns 4.7 million birds and seven poultry facilities located in five towns in eastern Connecticut. The firm is the largest egg producer in Connecticut as well as the largest egg producer in the northeastern United States. It employs approximately 300 people, with annual payroll of \$12 million, gross sales of \$90 million, and vendor payments of approximately \$1 million each to a rail service (the railroad's largest customer), electrical services, and local fuel companies. The company pays approximately half a million dollars per year in local taxes. The local laying coop production facilities produce nearly 900 million eggs per year. The company's large customer base includes the major supermarket chains such as Wal-Mart, Stop & Shop, Big Y, Shaws, BJ's Wholesale, King Kullen, Pathmark, Shoprite, and others.

Connecticut and New England Egg Industry

The Kofkoff Egg Farms reportedly supply more than 90 percent of Connecticut's egg market. According to the Connecticut Farm Bureau, Connecticut has more chickens per square mile than any state in the nation. The egg industry is among the top five agriculture businesses in Connecticut. Maine and Connecticut are the top two egg-producing states in New England. Connecticut is first in New England in density of egg-laying poultry as well as egg production and value per square mile. As of December 2002, New England (excluding Rhode Island) had a total of 10 million chickens with a total value for all five states of \$23.8 million¹.

Avian Influenza

"Avian influenza (AI) is a disease of viral etiology that ranges from a mild or even asymptomatic infection to an acute, fatal disease of chickens, turkeys, guinea fowls, and other avian species, especially migratory waterfowl."² A highly pathogenic form of Avian Influenza, originally known as "fowl plague", first

appeared in Italy circa 1878³. In 1955 Fowl Plague was determined to be a member of the influenza virus family⁴. “AI was first recognized in the United States in 1924-25. It occurred again in 1929 and was eradicated both times. While the less severe infections can cause serious losses in affected flocks, generally low pathogenic strains can cause serious reduced production with little apparent sign of disease”⁵. “AI has been introduced into the US poultry industry over 100 times in the last 25 years”⁶.

According to Carol J. Cardona, Extension Poultry Veterinarian, at the University of California, Davis “waterfowl act as a reservoir of avian influenza virus by carrying the virus in their intestinal tract and shedding it in their feces”⁷. “Avian influenza viruses are spread to susceptible birds through inhalation of influenza particles in nasal and respiratory secretions and from contact with the feces of infected birds”⁸. And in their Avian Influenza Fact sheet, the *International Parrotlet Society*, sites that “there is a considerable body of circumstantial evidence to support the hypothesis that migratory waterfowl, sea birds, or shore birds are generally responsible for introducing the virus into poultry”⁹.

The International Parrotlet Society’s Avian Influenza Fact sheet, also states that “once introduced into a flock, the virus is spread from flock to flock by the usual methods involving the movement of infected birds, contaminated equipment, egg flats, feed trucks, and service crews”, etc¹⁰, making it very difficult to isolate the initial source of infection. In fact, “preliminary trapping evidence” has indicated “that garbage flies in the Pennsylvania outbreak were sources of virus on the premises of the diseased flocks”¹¹.

“The H7N2 subtype of Avian Influenza virus detected in Connecticut is classified as low pathogenic (causing a low incidence of mortality). Egg laying birds usually return to full feed and production after the acute stage of the disease. However, the virus only requires a slight change in DNA structure under field conditions to be transformed into a highly pathogenic strain that causes an extremely high incidence of mortality. This potential to mutate, the extreme contagious nature of the disease and the possible foreign trade restrictions are the reasons why aggressive actions such as total flock depopulation are taken by state and federal regulatory agencies to prevent and control the spread of Avian Influenza”¹².

This disease, which is highly contagious among birds, does not affect humans nor does it affect the quality or safety of the eggs produced by chickens. Therefore, there are no problems with any of the products produced and sold by the company.

Avian Influenza Outbreaks and Their Consequences

Animal diseases have great economic significance. Animal disease increase costs to producers, consumers and government. Production yields drop and export markets can be lost. (USDA, APHIS – Animal Health Monitoring and Surveillance Report). Livestock and poultry disease represent over \$2 billion in preventable losses¹³.

The traditional response to an outbreak of a contagious animal disease is the depopulation of the affected species of livestock within a certain geographic area surrounding the site of infection¹⁴. The federal and state government has, in the past through its emergency indemnification program, provided financial assistance to cover all or most of the cost of depopulation, disinfection and the restocking of livestock¹⁵. “The traditional method of controlling the spread of Avian Influenza through total flock depopulation is costly and ineffective¹⁶”. Avian Influenza is still found in the live bird markets of the northeast and threatens commercial flocks that have any association with these markets”¹⁷.

Trade Implications

An outbreak of any disease affecting livestock (or other agricultural product for that matter) can have serious trade implications. The current AI outbreak in Connecticut led Japan and Korea to impose a temporary ban on poultry imports from the United States. Japan has since lifted its total ban on the import of US poultry products, however it still maintains a ban on poultry products originating from Connecticut¹⁸.

A 1998 outbreak of Exotic Newcastle Disease (END), another contagious and devastating avian infectious disease, though contained, dramatically affected the US commercial poultry industry when several major US trading partners placed trade embargos on the import of poultry meat. This embargo resulted in the loss of approximately \$125,000 per week for six months (\$3 million)¹⁹.

Economic Consequences of Previous Episodes and Other Cases of Avian Disease

Connecticut

“In 2001, the Connecticut Department of Agriculture implemented total depopulation of a flock of broiler birds when LPAI H7N2 was detected. This flock consisted of only 16,000 birds. The State of Connecticut paid full indemnity to the owner and also the disposal costs associated with the dead birds in excess of \$60,000”²⁰.

Other Areas

An outbreak of Exotic Newcastle Disease (END) in California seriously disrupted the commercial poultry industry from 1971 to 1973 and had a cost of more than \$56 million to destroy nearly 12 million birds²¹.

In the 1983-84 outbreak of LPAI which affected flocks in Pennsylvania, Virginia and New Jersey took two years to eradicate and resulted in the destruction of 17 million birds at a cost of \$65 to \$75 million²², and caused a 30 percent increase in retail egg prices²³ (\$350 million in increased consumer costs)²⁴. That strain also was originally diagnosed as a low-risk pathogen but mutated into the high pathogenic variant of the virus. The ability of the low pathogenic variant to mutate into the high pathogenic version, is incidentally, the main concern with the current AI outbreak in Connecticut.

The Queensland Department of Primary Industries in Australia has reported that the AI virus has been the cause of clinical disease in Australian commercial poultry operations in Victoria (1976, 1985 and 1992), Queensland (1994) and New South Wales (1997)²⁵.

The AI outbreak in Tamworth, New South Wales in 1997 resulted in the depopulation of 300,000 birds at a cost of \$2.8 million (US)²⁶. Approximately \$1.35 million was used to cover the cost of lost chickens and lost egg production of 1.2 million eggs and approximately \$1.35 million was used to cover operational cost²⁷.

A 1997 AI outbreak in Hong Kong resulted in the slaughter of 1.6 million birds to halt the spread of the disease²⁸. When AI emerged again in Hong Kong in 2001 the government took the precautionary measure of pre-emptively depopulating approximately 1.2 million birds²⁹. It is estimated that the cost of this eradication effort was \$3.86 million (US). This cost includes compensation provided to poultry vendors³⁰.

The “1999-2000 AI outbreak in Italy resulted in \$112 million in compensation for destroyed birds³¹. It was estimated that indirect costs exceeded \$400 million for a total cost of over \$512 million”³².

An AI outbreak in Virginia in 2002 resulted in the slaughter of 4.7 million birds (chickens and turkeys) and cost the industry approximately \$130 million³³ to \$140 million³⁴. Also, the END outbreak that began in California in 2002, has to date, lead to the destruction of 3.2 million birds in southern California, Arizona and Nevada at a cost of \$102 million³⁵. This outbreak, though slowing, is still ongoing and the cost of controlling it is expected to increase.

Currently the European Union is experiencing a major AI outbreak (Netherlands, Belgium and Germany) that has caused a significant disruption in its commercial poultry industry. As of April, 2003 “the Dutch poultry and egg sector has suffered well over 100 million euros (\$109 million US) in losses from the AI outbreak”³⁶. At least 25 million birds have been destroyed in the Netherlands to date³⁷. The Netherlands is the European Union's biggest poultry exporter³⁸. In this same period 2.3 million birds have destroyed in Belgium³⁹.

It is estimated that destruction of the 4.7 million birds in Connecticut could cost taxpayers \$30 million⁴⁰ (25% State of Connecticut - \$7.5 million - and 75% USDA – 22.5 million)⁴¹. This represents only costs of indemnification for depopulation, but not the cost to the industry and overall economy.

The Current Situation

“Due to the sheer size of Kofkoff Egg Farms, the personnel and financial resources that total depopulation of 4.7 million birds would require, and the economic impact that the loss of this business would have on the owners and the nearby communities, another solution was explored to eradicate the disease”⁴². As an alternative to destroying the flock and devastating the industry in Connecticut, the Connecticut DOA has sought and received approval from the USDA, APHIS, VS, under a pilot program to vaccinate chickens. “Inactivated oil-emulsion vaccines, although fairly expensive, have been demonstrated to be effective in reducing mortality, preventing disease, or both, in chickens and turkeys”⁴³. “These vaccines may not, however, prevent infection in some individual birds, which go on to shed virulent virus”⁴⁴.

On April 16, 2003, the vaccination of naïve pullets (replacement layers) with the inactivated H7N2 vaccine started. As of late May, five of the nine pullet houses (430,000 birds) or 58% have been vaccinated with a single injection⁴⁵. The protocol agreed to by all parties requires two injections for birds not exposed to the natural infection given a month apart and two weeks before placement in a layer house⁴⁶. Not until July will the second injections be logistically feasible to do. On April 28, 2003, the vaccination of exposed layers started⁴⁷. Each exposed layer is required to be injected once. Again, by late May, four layer houses (327,000 birds) have been vaccinated⁴⁸. There are 38 layer houses at various stages of production, approximately 3.5 million birds currently⁴⁹. One hundred unvaccinated sentinel birds are also required within each house to act as biological indicators of virus circulating through the population⁵⁰. Twenty sentinel birds will be blood tested each week from each house to monitor any exposure to Avian Influenza virus⁵¹. As vaccinated pullets replace infected spent layers, facilities are cleaned, disinfected and tested before placement⁵². New chicks follow in cleaned and disinfected pullet houses⁵³. It takes approximately 15 months for one production cycle to occur from chick to pullet to layer⁵⁴. More time to conduct and assess the pilot study as a method to eradicate the disease and make a fair assessment of its efficacy is still

needed. It is anticipated that the entire vaccination and monitoring process will take a total of three years before the farm is “given a clean bill of health”, that is before the farm has reached and maintained a zero infection rate. This period of three years exists because infected and vaccinated birds both test positive for the infection. It will take three years for all of the infected or vaccinated birds to be cycled out of the facilities.

The Economic Impact of a disruption in the Poultry and Egg Industry Due to Avian Disease

In their informative article entitled *Avian Influenza: What It Is and How to Protect Against Its Establishment*, the West Virginia University –Extension Service states that “the ultimate impact (of and AI outbreak) on the (poultry) industry is enormous because of the easy manner in which it can be spread, resulting in the widespread infection of many farms”⁵⁵.

“Since affected farms have to be depopulated, cleaned, disinfected, and allowed to sit without birds until they test negative, farmers lose a lot of income. Consumers pay an increased price for eggs and meat because of reduced numbers of birds and reduced egg production. Trade embargoes from neighboring states and other countries result in a loss of jobs for individuals and revenue for farmers, companies, poultry-producing states, and the affected country. State and federal officials commit extra time, personnel, and money to help test flocks, depopulate farms, disinfect them, and institute quarantine procedures. All this costs money. The ultimate result is economic in terms of money spent to control and eradicate the disease, as well as actual loss of birds, eggs, and income for farmers, poultry companies, and allied industry”⁵⁶.

“Even when economic losses can be quickly overcome, it is difficult to regain the trust and relationship with trading partners whose primary aim is to protect their flocks and industry. It takes a while because people want to be certain that infectious diseases such as this are completely eradicated before they continue with business as usual. For all these reasons, it is imperative that everything be done to avoid introducing this disease into a community and also to contain it once it does get into a community”⁵⁷.

Agricultural Economist, Floyd Lasley of the the USDA ‘s National Economics Division of its Economic Research Service remarked in his 1984 report *Egg Economics Update – Economic Impact of the Avian Influenza Outbreak* (of 1983-1984), that “traditionally, economic impacts are measured mostly as changes in price and quantity of products. However, on a local basis, the impact of a disease outbreak such as AI may take many forms. For example, layer operations were most likely to be affected in Pennsylvania, while in Virginia the problem was mostly with turkeys. Individual producers fare quite differently. A producer with- several growers may have only a small part of his flocks infected while another may lose a high

portion of his birds. Individual growers may be hardest hit as they generally have all their birds at a single location, and must close down for a period following flock depopulation. During this period income stops completely, and expenses for cleanup increase”⁵⁸.

“Besides losing part of its local sales, a hatchery selling chicks, poults, or eggs beyond the local area loses that part of its market when quarantined. Feed mills, processing plants, and other suppliers lose part of their volume, forcing unit costs up and incomes down. There are extra cleanup and disinfecting costs facing all sectors. Normal movements, through market channels are badly disrupted. Losses are most severe to producers with high payment obligations such as for facilities. Cash flow obligations become very difficult to meet at a time when additional expenses are being incurred and incomes have been curtailed”⁵⁹.

It is important to note that “Backward business linkages spread throughout the economy as they represent purchases by the industry for production, including feed ingredients, veterinary supplies, processing equipment, packaging and labor, utilities, shipping and other business supplies”⁶⁰.

Connecticut AI Outbreak of 2002-2003: Which Course of Action to Take?

Two possible methods of dealing with the current outbreak of AI in Connecticut are presently available.

Depopulation Of Flocks To Eradicate Avian Influenza.

The first option is the quarantine of all of the affected facilities, the depopulation of all of the resident birds (healthy and infected alike), disposal of the carcasses (through incineration, burial or composting), disinfection of the property and ultimately the restocking of bird inventories. Under federal regulations, with limited exception, there is a 7 day waiting period that must occur⁶¹, commencing upon completion of the depopulation disposal and disinfection, of the facility before the repopulating of the facility can occur. In the case of an egg production only facility this would mean that the facility would be virtually non-productive for a period of approximately 16 months. (This is assuming a 2 to 3 week period for depopulation, carcass disposal and facility disinfection, 1 week “fallow” (per regulation) and the 15 month production cycle of chick → pullet → layer)⁶².

The USDA states that “in general, benefits of depopulating birds affected with LPAI come from containing the spread of the disease. Benefits of containing disease spread fall into three general categories: 1) avoided owner and grower losses from disease morbidity and mortality; 2) avoided consumer price increases resulting from decreased supplies; 3) avoided trade bans (State, regional, or national) that result when trading partners close markets during or after a disease outbreak”⁶³.

The USDA also notes⁶⁴ that consumers and those owners and/or growers whose flocks are unaffected by an outbreak reap the greatest benefit of a disease eradication campaign centered around depopulation. Conversely the principle burden of this type of eradication effort falls upon those owners and/or growers whose flocks are depopulated. “In addition to the value of lost production, the owners/growers of affected birds may also bear costs of cleanup, disinfection, transportation, foregone income, and other financial hardships”⁶⁵.

Depopulation removes the threat immediately and is, therefore, the most often used method of highly infectious disease control. The greatest concern is the impact an outbreak, however isolated, will have on international trade. The longer an outbreak persists, the greater the threat of import embargo from the nation’s trading partners. A disruption in trade would affect the entire industry – not just the producers with infected livestock. Since the national economic consequences of a protracted trade embargo placed on an entire industry would be severe, depopulation is viewed as the first, if not the only option. In this case, a local economic catastrophe is preferable to a national one and the significant cost of depopulation borne by local producers, local and state governments and the federal tax payers is small by comparison to the potential loss in economic activity of trade disruption and loss of disease containment.

Vaccination And The Sequential Depopulation Of Flocks To Eradicate Avian Influenza.

Avian Influenza is deeply embedded in the wild bird population. Wild birds are highly mobile and many species travel over long distances. As it would be impossible to eradicate the disease in the wild and due to the reality that wild birds, either through direct contact with commercial flocks or through an intermediary will continue the a threat of infection and disease dissemination, total flock depopulation is a stop gap measure at best.

An alternative method which utilizes an AI vaccine, disease surveillance, record keeping, and biosecurity measures may provide a solution that is economically beneficial to both the individual owner/growers, and consumers, national industry and international trade considerations. This disease eradication method begins with the vaccination of naive pullets (replacement layers) with the inactivated H7N2 vaccine. The protocol requires two injections for birds not exposed to the natural infection given a month apart and two weeks before placement in a layer house. Each exposed layer is required to be injected once. Unvaccinated sentinel birds are also required within each house to act as biological indicators of virus circulating through the population. These sentinel birds are blood tested each week to monitor any exposure to Avian Influenza virus. As vaccinated pullets replace infected spent layers, facilities are cleaned, disinfected and tested

before placement of new birds. New chicks are only placed within cleaned and disinfected pullet houses. Stopping the spread of disease and building up immunity in a population is not instantaneous. The risk of viral mutation exists throughout the process as does the risk of further spread of the disease. As mentioned above, the longer an outbreak persists the greater the possibility of international trade embargo.

The key to the success of this strategy is the ability to identify the presence of the disease, quickly vaccinate the population and maintain strict and stringent bio-security and bio-containment efforts. In the past, this may have not been possible. However modern containment methods and tools should be up to the task of controlling the spread of the disease and should provide the necessary time and comfort level to eliminate the problem. If successful, this method of disease eradication would prove to be extremely cost effective over total depopulation and would pose minimal disruption and economic loss to the local and national poultry industry.

Cost Differential Vaccination And The Sequential Depopulation vs. Total Depopulation

“According to the information” represented in the report entitled *The Economics of Avian Influenza Control*, by Halvorson, et al, “the range in costs of low pathogenic AI and its control is from \$4,000 per flock in the Italy 2001 outbreak where vaccination and controlled marketing were employed to \$760,000 per flock in the Virginia 2002 outbreak where destruction was the primary control method”⁶⁶. (Italy – 88 flocks with a total control cost of \$10.3 million vs. Virginia - 197 flocks with a total control cost of \$149 million)⁶⁷.

The same report also state’s that the use of vaccination as a means of control resolved the AI outbreak in Utah in 1995 within 6 weeks (after vaccination was initiated) while the 2002 AI outbreak in Virginia, which utilized depopulation as its primary means of control, was resolved in 4 months⁶⁸. This strongly suggests that vaccination may be a more efficient means of disease control in terms of the time it takes to stop an outbreak. Both the Utah and Virginia AI outbreaks were of the low pathogenic variant.

The Estimated Economic Impact of the Connecticut AI Outbreak of 2002-2003

The Economic Impact Model and Methodology and Assumptions Static Model

The U.S. Department of Commerce’s Bureau of Economic Analysis Regional Input-Output Modeling System (RIMS-II) offers one method of estimating economic impact. The dollar value of the industry output is \$90 million per year (Kofkoff gross sales). The BEA’s “final demand multiplier” for poultry and egg production is 1.6042. Utilizing these two data points we can estimate the impact on all industries state-

wide. In this case, that impact is \$144 million (\$90 million x 1.6042). Or, applying the final demand multiplier for agricultural production in general, this impact could be as large as \$169 million (\$90 million x 1.8871) on all industries. Accordingly the loss of \$90 million worth of output would generate a \$169 million loss in output in all industries statewide. The current Gross State Product (GSP), a measure of the dollar value of all final goods and services produced in the state is \$159 billion. One limitation of this “static” (single point-in-time) analysis is that it does not take into account numerous interactions among variables such as labor, capital, wages, population, fiscal, and other effects, nor does it account for change over time.

Dynamic Model

A more “dynamic” model for assessing these effects is the Regional Economic Models, Inc. (REMI) Policy Insight™ modeling system. In order to show the total implications of the industry loss (or contribution) the REMI model, using detailed employment, population, personal income, and other data specific to Connecticut, generates a regional baseline forecast and then based on inputs provided by the model user, develops an alternative forecast that would occur in the event of the contraction (or expansion) in the sector of interest. The effects on the Connecticut economy occur over time.

The REMI Policy Insight Model

The REMI modeling system shows the *difference* between the baseline and the alternative forecast. It should be noted however, that the reported effects do not show whether the economy is predicted to grow or decline in the alternative forecast, but rather what the effects of the loss (or expansion) are compared to the control forecast, i.e. what the impact on the economy would be if the expansion or loss did not occur. REMI Policy Insight™ is the leading regional economic forecasting and policy analysis model. It is a structural econometric model; it clearly includes cause-and-effect relationships with numerically estimated parameters and forecasted future values. The model is based on classical economic theory and the underlying assumptions that households maximize utility and producers maximize profits. The REMI model brings together five major “blocks”: (1) output, (2) population and labor supply, (3) labor and capital demand, (4) market shares, and (5) wages, price & profits. Under continuous development since 1980, the REMI model’s forecast horizon is currently 2035. Typically a 10-year or 20-year analysis is done.

The REMI model is structured to rely on a solid grounding in economic theory. A “control” forecast is the basis for comparison with the “simulation” forecast. Differences between the two constitute the “economic impact” of a given project or development. Employment, sales, changes in investment in plant or equipment, for example, are among the input variables that can be modified. As input variables are

modified, one can examine their impact on other results variables such as personal income (the aggregate of new income for the whole state or county), gross state product (a measure final output state or county-wide), total employment (after taking into account multiplier effects), and the tax revenues (plus or minus) after the model takes into account induced state and local spending. Population, for example, is one of the dynamic variables. Population expands in a rapidly growing economy. This may in turn induce changes in local government spending as towns meet new demand for schools, fire, police, and other municipal services. One of the most important “results variables” is gross state product (GSP), a measure of the dollar value of all final output produced in Connecticut in a given year as a result of the employment or investment. A strong positive change in GSP is a typical indicator of a successful project, because GSP is a very comprehensive measure of impact. Other key variables are growth in total personal income and total state and local tax revenues. The Connecticut model is a multi-region 53-sector model based on eight counties and an aggregated state-wide region composed of all counties.

Underlying economic assumptions

The egg production industry in Connecticut, in particular Kofkoff Egg Farms, LLC, is assumed to employ 300 at an industry average salary of \$40,000 (wage disbursements only). Sales are reportedly \$90 million annually. The model assumes that \$90 million in gross sales (or output) are lost in the Connecticut economy. This loss is modeled in the “farm sales” policy variable. Additional changes simulated are the loss of \$21 million in feed grain sales that currently support the farm’s operations, \$1 million in fuel purchases, \$1 million in electric utility purchases, and \$1 million in rail delivery services. The model incorporates these changes over time and their “ripple” or multiplier effects on all industries to estimate the change in Gross State Product, Personal Income, State and Local Revenues, and State and Local Expenditures, and, in turn Net New State and Local Revenue (the difference between State/Local Revenues and State/Local Expenditures). Government expenditures associated with the simulation are induced depending on how the changes affect population and the demand for state/local services.

In this particular analysis it should be noted that (due to the structural nature of the REMI Policy Insight Model), the farm sector in the model is exogenous, that is, it is determined outside the model and as such, the model’s results only reflect the indirect effect or impact of the aforementioned assumptions (the direct effect is added later) .

All eggs produced are modelled as exports. All eggs consumed are modelled as imports because the non-farm employment model treats agriculture as determined outside the system. Consequently, the loss of egg production facilities is translated into a decrease in exports and a corresponding need to import eggs. The

loss has a detrimental effect on the GSP, but not as large as the direct gross sales lost because in the model the import of eggs for regional consumption somewhat ameliorates the gross direct loss. As eggs are a commodity item, lost domestic (Connecticut) production would be easily replaced through the importation of product from other producing states. The model does not forecast egg prices, however, and in all likelihood, egg market prices faced by consumers would be substantially higher – another economic consequence of the decline in the industry. Recent empirical evidence indicates an increase of 30 percent in the retail price of eggs is possible²¹. Given the USDA estimates of average retail egg prices and U.S. per capita egg consumption, a 30 percent increase in the retail price of eggs in Connecticut would amount to an additional cost of approximately \$25.7 million to Connecticut consumers.

Model Results

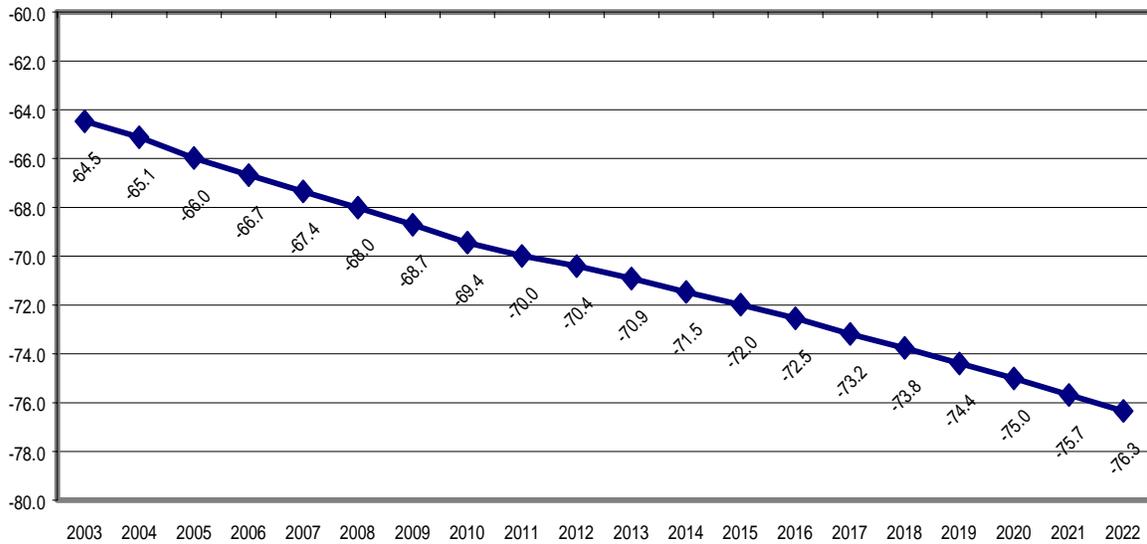
The essential results of the loss of the egg farm sales are demonstrated in Table 1. The average values reflect the sum of the changes of the variable over a twenty-year horizon divided by 20 and represent the average annual change from the baseline forecast of the Connecticut economy. The baseline, or control forecast represents the state of the economy without the egg farm losses. Simply stated, the economic impact is the difference between the baseline economic forecast (how things are) and the new economic forecast that reflects the loss of the business (how things could be).

Table 1	2003	2022	Average	NPV
Total Employment	-1,385	-1,122	-\$1,214	
GRP (Million \$)	-64.5	-76.3	-\$71	-\$867
Personal Inc (Million \$)	-42.5	-92.9	-\$67	-\$787
State Revenues	-84,220	-58,710	-\$59,989	-\$775,079
Local Revenues	-14,570	-33,060	-\$26,500	-\$312,908
State Expenditures	5,633	-42,750	-\$25,703	-\$271,820
Local Expenditures	-3,186	-33,960	-\$22,562	-\$250,191
Net State Revenues	-89,853	-15,960	-\$34,286	-\$503,259
Net Local Revenues	-11,384	900	-\$3,937	-\$62,718

The NPV column contains the net present value of monetary variables and represents the value today of the future stream of the variable discounted to the present at 5 percent per year over the period 2003 to 2022. The terminal year value of each variable is its value in 2022. Thus we see that this industry generates economic losses of \$71 million in gross state product on average annually (not cumulative) to the Connecticut economy, eventually reaching -\$76.3 million (Table 1). Personal income measures the aggregate income of state residents. Personal income decreases on average \$67 million, eventually reaching -\$93 million as seen in Chart 1.

Chart 1

Gross Regional Product



Of particular importance is that the combined total loss of direct output of \$90 million and indirect output as measured by the change in gross state product of \$71 million exceeds \$161 million. This implies an output multiplier of 1.7888 which is consistent with the BEA RIMS II published multiplier for the egg and poultry industry in Connecticut which was utilized in the static impact analysis cited earlier.

Consequently, the loss of the egg farm sales, the loss of the grain feed sales, the loss of rail customer transportation service, the loss of electricity and fuel operating expenses has a significant negative consequence for the Connecticut economy, far exceeding the estimated remedial expenses of the pilot program of \$16 million.

Direct and Indirect Economic Impact on Connecticut's Economy

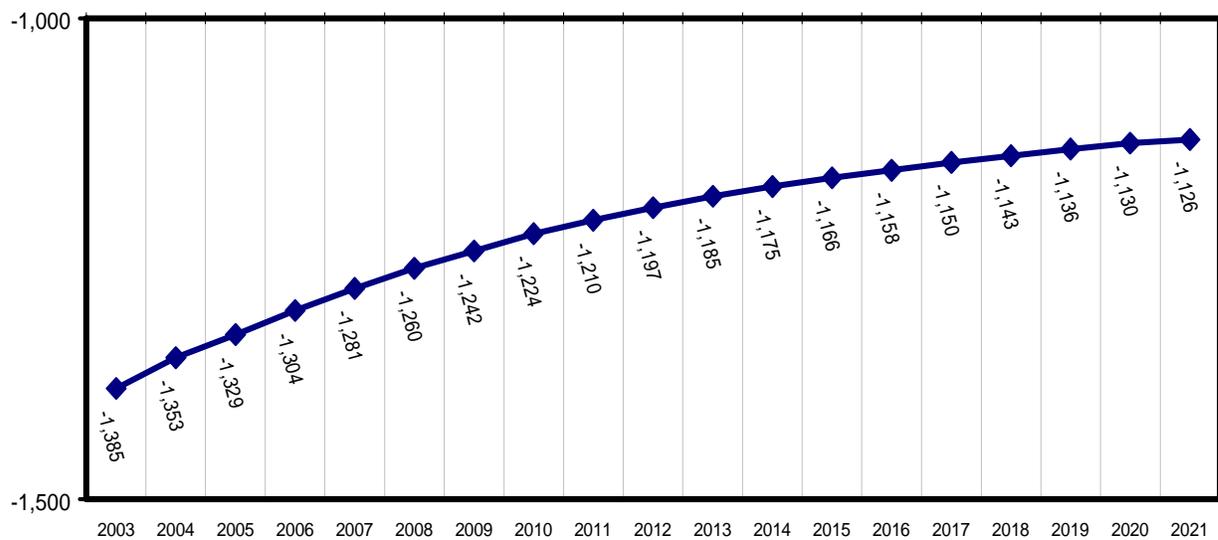
The total economic loss, or economic impact, as estimated by the multipliers and the economic modeling simulation, amounts to \$161 million in direct and indirect output. An estimated \$25.7 million impact on consumer prices plus \$7.5 million in direct state depopulation costs brings the total impact to \$194.2 million. It has been reported that the financial state of the rail company utilized by KofKoff is tenuous. The loss of its largest customer, even short-term, could result in the further loss of customers as the rail company will need to raise freight fees on their remaining customers which may in turn seek cheaper transport, still further weakening the stressed carrier. The economic trauma of losing close to 40% of its revenue could force the rail company out of business altogether. The shipping alternative available to the

former rail service customers would most likely take the form of trucking which would undoubtedly increase their shipping costs. This situation would also add additional traffic to Connecticut’s already congested highway system. The economic impact of the loss of this rail service, the added shipping costs imposed on its former customers and the added cost in terms of lost productivity and air quality degradation caused by increased highway congestion have not been estimated, however it is clear that there would be an impact and that the impact would most likely have significant local consequences.

Direct and Indirect Impact on Connecticut Employment

In addition to the 300 jobs at the egg farm, the loss of the industry would reduce new jobs in all sectors of the economy by 1,385 in year 2003 and 1,126 in 2022 as seen in Chart 2. On average over a 20-year horizon the loss would reduce new jobs in all sectors of the economy by 1,214.

Chart 2 **Employment Loss**



Impact on State and Local Revenues

The positive change in state expenditures exceeds the negative change in state revenues for some years. This means that net state revenues are negative in those years in the study period. The same is true of local expenditures and revenues.

Conclusion

As indicated by these results, the loss of the egg farm industry would have overall significantly negative consequences for the Connecticut economy, its residents’ personal income, and net state and local tax

revenues with potentially even international trade consequences for the U.S. The ratio of the change in industry share of gross state product to the cost of remediation exceeds 9.6. This implies a benefit-cost ratio of almost ten times the cost of remediation. The loss of \$161 million in gross state product far exceeds the estimated \$16 million three-year cost of remediation. The loss of the industry would also exacerbate any indemnification cost that might be incurred by the state.

As the virus that causes AI is deeply rooted in the global wild bird population and given that the repeated use of depopulation as a means of disease control over the years has failed to eradicate the disease, it is apparent that AI is going to continue to be a threat and a significant cost factor to the worldwide poultry and egg industry for the foreseeable future. Also given the increasingly interconnected global marketplace, the accelerating ease, speed and lower cost of international travel and the extremely large range of migratory waterfowl (as well as the continuing encroachment into their habitat areas by people, housing and commercial operations) it can be assumed with some certainty that the incidences of outbreaks of AI (and other communicable animal diseases) will continue to increase. At some point the economic losses and costs to state and national taxpayers, that accrue from depopulation as a means of disease control, will reach a level at which they can no longer be absorbed by the industry and government without causing long-term competitive harm.

It is in light of this conclusion and the negative economic consequences of depopulation in the Kofkoff farm case, the pilot vaccination program should be allowed to proceed until the Avian Influenza outbreak in Connecticut is eradicated.

Appendix A: REMI OUTPUT

REMI RESULTS										
Egg Farm Closing										
Variable	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total Employment	-1,385	-1,353	-1,329	-1,304	-1,281	-1,260	-1,242	-1,224	-1,210	-1,197
GRP (Million \$)	-64.5	-65.1	-66.0	-66.7	-67.4	-68.0	-68.7	-69.4	-70.0	-70.4
Pers Inc (Million \$)	-42.5	-45.8	-48.7	-51.4	-53.8	-56.1	-58.4	-60.7	-63.0	-65.4
State Revenues	-84,220	-74,790	-72,400	-68,960	-67,070	-62,420	-64,690	-59,890	-58,860	-56,170
Local Revenues	-14,570	-16,590	-19,210	-21,160	-23,080	-23,690	-26,000	-26,810	-27,430	-27,820
State Expenditures	5,633	190	-5,791	-10,440	-14,610	-16,730	-21,380	-25,010	-26,370	-28,130
Local Expenditures	-3,186	-6,385	-9,845	-12,820	-15,390	-16,920	-19,360	-21,920	-22,390	-23,980
Net State Revenues	-89,853	-74,980	-66,609	-58,520	-52,460	-45,690	-43,310	-34,880	-32,490	-28,040
Net Local Revenues	-11,384	-10,205	-9,365	-8,340	-7,690	-6,770	-6,640	-4,890	-5,040	-3,840
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total Employment	-1,185	-1,175	-1,166	-1,158	-1,150	-1,143	-1,136	-1,130	-1,126	-1,122
GRP (Million \$)	-70.9	-71.5	-72.0	-72.5	-73.2	-73.8	-74.4	-75.0	-75.7	-76.3
Pers Inc (Million \$)	-67.8	-70.3	-72.9	-75.5	-78.3	-81.1	-83.9	-86.7	-89.8	-92.9
State Revenues	-50,460	-50,460	-50,940	-50,490	-52,060	-51,380	-53,110	-55,720	-56,970	-58,710
Local Revenues	-27,460	-28,490	-29,230	-29,520	-30,170	-30,590	-30,910	-31,700	-32,500	-33,060
State Expenditures	-29,560	-32,940	-34,270	-35,230	-36,790	-38,460	-38,790	-40,450	-42,180	-42,750
Local Expenditures	-24,600	-26,950	-27,560	-28,580	-29,620	-30,980	-30,940	-32,230	-33,630	-33,960
Net State Revenues	-20,900	-17,520	-16,670	-15,260	-15,270	-12,920	-14,320	-15,270	-14,790	-15,960
Net Local Revenues	-2,860	-1,540	-1,670	-940	-550	390	30	530	1,130	900

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POSTSCRIPT

June 15, 2005

The USDA allowed the vaccination program to go forward and Connecticut avoided depopulation. A subsequent outbreak of AI in Delaware, however, led to aggressive depopulation - Ordered by the USDA.

Threat to Humans from Avian Influenza

The DECD report states that the avian flu is not transmissible to humans. This was true at the time (or at least thought to be by the both the agricultural and medical communities).

Since the date of this report scientists have discovered that under the right circumstances avian influenza is transmissible to humans. Numerous reports of animal to human transmission have been documented.

However, to date no case of human-to-human transmission has been documented. There is rising concern within the world health community that there is a real possibility that over the next couple of years the virus will mutate to allow for human to human transmission and that if this does occur there is an equally real possibility that an outbreak of a human to human transmissible disease will lead to a pandemic occurring as humans have no immunological history with this strain of influenza virus. A vaccine for a human variant would be several years away.

Current plans for an outbreak human-to-human transmissible disease includes strict quarantine of the area and judicious use of anti-viral medications. It is hoped that these measures will "nip it in the bud".

Vietnam is the area of most concern right now.

This "flu" is coming out of Asia, as it is still the practice in most Asian countries to keep poultry in close proximity to humans. Asian cities are more densely populated than western cities and sanitary conditions are not at the standard of western cities. It is still an Asian preference to purchase poultry as fresh as possible - you pick out the chicken you want and they slaughter it for right there. This is/was mainly due to the lack of refrigeration. It is very common to see cages of live food birds in cages on the sidewalks and in alleyways of many Asian cities (especially is the lesser developed ones).

Note: The strain of the avian influenza virus present at the Koffkoff facility was **at no time a threat to humans.**

Mutation of Animal Viruses to Human Viruses – Historical Perspective

For the most part animal viruses are not a threat to humans. You generally cannot catch a virus from another species; however, close human/animal habitation/interaction has caused mutations to occur in

animal viruses, in the past, that have allowed them to infect a human. The first jump an animal virus makes from an animal to a human generally results in an infection that is not contagious – from one human to another. Further mutation is necessary for the virus to be spread from human to human.

As stated above, further mutations of an animal virus within a human host can lead to the emergence of new human viruses for which the human body has little or no defense against. A prime example of this is the so-called "Spanish flu" that caused the deaths of millions in 1918. Though referred to as the Spanish flu, it actually began in rural Kansas at an army base where they were burning large amounts of pig manure from surrounding farms. The virus had mutated due to the close proximity/habitation of the pig farmers to their animals, resulting in the occasional sick pig farmer. It was not until a nearby Army base offered to help out the local community with the disposal of accumulated pig waste, that the virus became a "true human" virus. The mutated virus rapidly spread through the US military and spread throughout the world, as soldiers were deployed overseas - seventy million people died as a result of this flu pandemic.