McImpact: Welfare Impacts of All-Day Breakfast after HPAI Outbreak

Jada Thompson
Kansas State University

McDonalds restaurants began offering a limited breakfast menu all day in October of 2015 to catalyze business growth. This decision was made in a time when eggs were in shortage due to the outbreak of highly pathogenic avian influenza (HPAI) in U.S. poultry. The outbreak led to a limited supply of layer birds, and led to higher retail prices through direct and indirect consumption. Using a partial equilibrium model of U.S. layer flocks, welfare impacts of an increase in demand coupled with a decrease in supply were estimated and shown to slightly drive up the price of retail table egg.

INTRODUCTION

Animal disease outbreaks can have negative impacts on consumers and producers. The duration of these negative impacts are tied to the timing of the outbreak, the disease management strategies used by local, state, and federal animal health officials, and the ability for the affected industry to recover from losses in animal stocks. Any combination can lead to longer or shorter disease impact duration. Additionally, there are external, business decisions not tied to animal health that can exacerbate the impacts of a disease outbreak.

Private industry decision makers weigh the short-, medium-, and long-run returns when determining the best course of action to meet company needs. These needs can be described by two overarching categories in terms of company strategy: short-run payoffs or long-run positioning. Short-run payoff strategies have a short to medium return goals that can be complementary to long-run strategy or offer diverging strategies from long-run goals. Long-run positioning are those strategies that determine the direction and overall business strategy for a company. Decisions focused on the long-run can have negative short-run implications. Depending on the size of an operation, it is possible that losses borne in the short-run can be endured in order to make a profit in the long-run and achieve overall company direction and survivability. When businesses choose long-run positioning strategies, it is possible to have negative welfare effects on the market, especially when coupled with a market disruption.

An example of a business making a long-run decision that had potential to exacerbate the affected market is the decision by McDonald's to begin to serve an all-day breakfast. While the decision to expand their menu offerings aligns with a long-run strategy to increase foot traffic and drive profitability, the decision was made during a shortage of eggs in the United States due to an outbreak of highly pathogenic avian influenza (HPAI). The menu expansion decision has been successful in increasing the profitability for McDonald's franchisees, but it may also have created negative welfare effects on consumers. The objective of this analysis is to estimate the welfare effect of McDonald's all-day breakfast on producers and consumers that potentially occurred in conjuncture with the supply shocks due to the 2015 HPAI outbreak in U.S. poultry.

BACKGROUND

McDonald's is one of the most iconic and largest food retailers in the world with more than 14,350 locations in the United States. McDonald's is the largest fast food consumer of U.S. eggs, capturing one-fifth of the U.S. breakfast market (Strom, 2015a). Prior to the expanded breakfast menu availability, McDonald's traditional breakfast menu egg use accounted for more than four percent of total U.S. eggs production, or two billion eggs annually (Baertlein & Ramakrishnan, 2015; Strom, 2015b).

The decision to increase the available menu options to an all-day breakfast was part of McDonald's short-term strategy to bolster sales to ensure long-run survivability. McDonald's earnings had decreased by 0.9 percent leaving earnings at a meager 1.6 percent across the U.S. franchises for the second quarter in 2015, continuing a declining trend from previous quarters. The all-day breakfast initiative was driven by a consumer demand for increased all-day breakfast offering as well as a strategic plan to increase store foot traffic (Whitten, 2015). Foot traffic increases were expected to increase demand for breakfast and non-breakfast food products served across the franchises. Early projections estimated the success of the all-day breakfast to increase McDonald's profits by 2.5 percent (Patton, 2015).

HPAI Outbreak in U.S. Poultry

McDonald's decision to increase menu availability and launch an all-day breakfast initiative was made independent of the state of their input supply markets. The increase in menu options necessarily calls for increases in demand for inputs of breakfast foods including eggs. This increase in demand fell at a time in the U.S. egg industry was reeling from a HPAI event in U.S. poultry supplies.

From December 2014 to June 2015 U.S. poultry experienced a HPAI disease event starting in a small backyard flock and moving to commercialized poultry. This event eventually lead to the destruction of 49.6 million birds and cost more than $950 million to U.S. taxpayers (Thompson & Pendell, 2016; USDA, 2015; USDA-APHIS, 2016a). The vast majority of affected birds were egg laying birds (67 percent) (USDA-APHIS, 2016b), or those birds that lay eggs to be consumed as either table eggs or further processed egg products. Further processed egg products are sold in retail stores in products such as Egg Beaters or dried eggs, or they are sold as input use in other industries such as baking.

Due to the destruction of animals as a result of HPAI and disease control measures, the U.S. market suffered shortages of eggs and egg products. The shortage of eggs on the U.S. market led to an increase in the retail price of eggs to consumers. For example, the price for grade A, large table eggs in August 2015 was $2.94, a 49 percent increase over August 2014 table egg prices (U.S. Department of Labor, Bureau of Labor Statistics, 2016). While McDonald's has a relatively small share of the total U.S. egg market, it is the largest breakfast consumer for eggs. The decision by McDonald's to increase menu offering would be expected to lead to increases in the demand for eggs during a period when many restaurants were reducing menu offerings due to egg shortages (Kieler, 2015). While the poultry industry is able to begin rebuilding stocks of birds to meet total demand for eggs and egg products there would be a period where supplies where short and demand continued to increase.

METHODOLOGY

The work aims to estimate the impacts of McDonald's all-day breakfast using a quarterly, partial equilibrium model of the U.S. egg industry. First, U.S. egg prices will be estimated by shocking the 2014 baseline using the number of birds affected during the 2015 outbreak of HPAI in U.S. layers as the shock. A second scenario will be modeled, the "McDonald's scenario", where the estimated increase in demand pressures is additionally modeled. Both sets of results will be compared to estimate the impacts of the private industry decisions during a disease event. Consumer welfare impacts will be estimated comparing these two scenarios.

Model Framework

A partial equilibrium model representing the U.S. egg industry is developed to estimate the impacts of shocks or changes to the egg industry. The model accounts for movement of eggs and egg products at the farm, processor, and consumer level where at the processor eggs must be diverted to final consumption product. The U.S. egg model starts with total egg layers producing nest-run shell eggs, called shell eggs for this model. At the egg laying level, hens also produce hatching eggs, however these are excluded from this analysis because of the special breeder houses and different layer birds used. Hatching eggs are not substitutable for table or processed eggs at the retail level.

Shell eggs are diverted to two types of intermediate products: table eggs and breaker eggs which are further processed into specific final consumption products. Table eggs must be washed, sanitized, graded, and packed into cartons before being sold at retail outlets to final consumers. Breaker eggs are further processed before reaching their final consumers. Breaker eggs are broken and processed into liquid, dried, or frozen eggs. These egg products can be packaged and sold as in their processed state to retail consumers or as inputs for use in other goods such as bakeries. For this study, all three final processed egg products are aggregately called "processed eggs." The processed eggs aggregate product is considered the final product for that diversion of shell eggs.

From farm to final consumer, the partial equilibrium model developed models the egg industry. The model is based on unknown, but underlying supply and demand equations. After fully differentiating these equations, the model is estimated. The following is a brief description of the U.S. egg model, written in its fully differentiated form. All variables presented are represented in the percent change form (*E* is used to denote dln, e.g., dlnP is noted as EP_i).

Across the full model, prices are accounted by equation 1:

$$EP_i = \theta_{l,i}\, Ew + \theta_{e,i}\, EP_e + \theta_{k,i}\, Er_i. \quad (1)$$

Price of final egg product *i* –*te*: table eggs and *pe*: processed eggs– is determined by the price of inputs used in production (*w*), the price of input shell eggs (P_e), and the returns to capital (*r*). Unit revenue shares are represented by θ for the various inputs, namely labor (*l*), shell eggs (*e*), and capital (*k*) for the *i*th good.

Equation 2 represents shell egg supply, which accounts for the diversion between the final egg products.

$$\phi ES = \lambda_{e,te}\, Eq_{te} + \lambda_{e,pe}\, Eq_{pe} + \lambda_{e,te}\, Ea_{e,te} + \lambda_{e,pe}\, Ea_{e,pe}, \quad (2)$$

where shell egg supply (*S*) is a function of the quantity of eggs demanded (q_i) and the per-unit derived demand for eggs of two final products types ($a_{e,i}$). The factor share of production is represented by λ. Exogenous shocks to egg supply are applied through ϕ, such as an estimated number of eggs removed from production as a result of reduced layer population.

Additionally, producer prices for shell eggs also impact the shell egg supply. Equation 3 presents this relationship as the price of shell eggs multiplied by the own price elasticity of shell eggs (ε) as follows. This additional equation is applied to calculate the change in shell egg price driven by the relationship in final demand prices.

$$ES = \varepsilon\, EP_e. \quad (3)$$

To account for limitations in the capacity for processing, industry capacity constraints are modeled as:

$$Ek_i = Ea_{k,i} + Eq_i \quad (4)$$

Industry capacity (k_i) is a function of the quantity and the per-unit derived demand of the *i*th egg type (Eq. 4). Marginal changes in efficiency can be captured given sufficient price incentives, even though there can be asset fixity in egg processing capital. The U.S. egg model assumes these marginal changes can occur allowing for small changes in industry capacity to occur.

$$Ea_{e,i} - Ea_{k,i} = -\sigma_{e,k|i}(EP_e - Er_i) \quad (5)$$

$$Ea_{l,i} - Ea_{k,i} = -\sigma_{l,k|i}(Ew - Er_i) \quad (6)$$

Equations 5 and 6 model substitutability of inputs where σ represents the elasticity of substitution between two inputs. Equation 5 models substitutability between capital and shell egg inputs depending on

the returns to capital and returns to shell eggs. Similarly, equation 6 models substitution between labor and capital.

$$\theta_{e,i}\, Ea_{e,i} + \theta_{l,i}\, Ea_{l,i} + \theta_{k,i}\, Ea_{k,i} = 0, \quad (7)$$

Equation 7 represents an adding up condition to ensure changes to the per-unit derived demand multiplied by its respective unit revenue share should sum to zero.

To ensure markets clear, market clearing equation are estimated. These are presented in equation 8:

$$q_i Eq_{\ i} + I_{i,t-1} EI_{\ i,t-1} = (X_i - M_i) E(X_i - M_i) + D_i ED_{\ i} + I_{i,t} EI_{\ i,t}\ . \quad (8)$$

The market clearing equations stipulates that the usage should equal supply in any given period. Formally net exports (exports (X_i) minus imports (M_i)), domestic consumption (D_i) and ending stocks (I_i) in the current period (t) should equal production and begging stocks ($I_{i,t-1}$) in the previous period (t-1). The market clearing condition holds for both table eggs and processed eggs.

$$EI_t = \varepsilon_{I,i} EP_e \quad (9)$$

Ending stocks (I_t) are modeled as a function of the price of shell eggs for current time period t (eq. 9).

$$ED_i = E\gamma_i + \varepsilon_{i,i}\, EP_i + \varepsilon_{i,j}\, EP_j. \quad (10)$$

Domestic demand is represented in equation 10. demand for good i is a function of own prices (P_i) and elasticities ($\varepsilon_{i,i}$) as well as cross prices (P_j) and cross price elasticities ($\varepsilon_{i,j}$). To account for potential consumer preference changes as a response to an avian health event, γ represents demand shocks. While consumption patterns are expected to change due to price changes there are no studies on the impacts of HPAI on U.S. consumer preferences. Beach et al. (2008) estimated Italian consumers responses as a result to animal health events. However, due to differences in consumer's purchasing ability, preferences, and additional factors such as specific attitudes regarding diseases that have not been researched for U.S. consumers, the exogenous change in demand is assumed zero for this analysis.

$$E(X_i - M_i) = \delta_i + \varepsilon_{x-m,i} EP_i^W. \quad (11)$$

Equation 11 represents net exports, a function of the world reference price and exogenous shocks to net exports. Net exports are calculated as regional exports (X_i) minus regional imports (M_i). Exogenous trade shocks are represented by δ_i which provides a method imposing international trade restrictions on the U.S. egg industry.

To account for international trade, a world reference price is modeled (equation 12),

$$P_i^W EP_i^W = P_i\, EP_i + c_i Et_i. \quad (12)$$

The world reference price, P^w, is assumed to be a function of U.S. domestic prices and transportation costs (c) between trading partners. Using the world reference price helps the markets clear within the model.

The above system of equations (equations 1 – 12) expand to 22 behavioral equations for both table eggs and processed eggs, which can be reduced using substitution to three equations. The reduced modeling system simplifies the search for feasible solutions. In reduced form, the model is solvable using inverse matrix algebra. Solutions are then fed back in the behavioral equations to provide solutions for all endogenous variables.

Consumer and producer welfare measures are estimated using Wohlgenant's (2013) equation for estimating of changes in producer and consumer welfare in a linearized partial equilibrium model (Eq. 13 and 14).

$$\Delta CS_i = -(1+\varepsilon_i)^{-1} P_{0,i} Q_{0,i} \left(e^{(1+\varepsilon_i) EP - \varepsilon_i \delta} - 1\right) \quad (13)$$

$$\Delta PS_i = (1+\varepsilon_e)^{-1} P_{0,i} Q_{0,i} (e^{(1+\varepsilon_e) EP - \varepsilon_s \theta} - 1), \quad (14)$$

$P_{0,i}$ and $Q_{0,i}$ are the original baseline price and quantity, ε_i is the price elasticity of demand for the ith good, ε_e is the price elasticity of shell egg supply, δ is a demand shock, and Φ is a supply shock.

Model Scenarios

There are two model scenarios used in this analysis: HPAI and McDonald's. Both scenarios account for the 2015 HPAI outbreak in U.S. poultry. The McDonald's scenario additionally accounts for the increased demand of table eggs by the fast food chain. Model scenarios use USDA-APHIS reported number of affected birds during the second quarter of 2015 as the baseline HPAI scenario (USDA-

APHIS, 2016b). For the second quarter of 2015, there were 32,453,700 affected layer birds throughout the Midwest. This number of affected birds enters the economic model as calculated shocks to the quantity of shell eggs, which are calculated using the annual eggs per laying hen equivalency.

For the McDonald's scenario, the supply shock described above is incorporated into the exogenous shock, as well as a demand shock that increases the demand of table eggs. These values are entered into the economic model stochastically using a triangular distribution that limits the lower end of change in demand to zero, with an upper end as a two percent increase in egg use, which represents a 50 percent increase in egg usage by McDonald's.

Using Simetar (Richardson, Feldman, & Schuemann, 2003), the model was repeatedly estimated for 500 iterations, which provides the mean solutions reported as well as the variation around these estimates. The estimated consumer welfare was estimated for a single quarter. While pricing implications can extend beyond this period in terms of market impacts, repopulation of layer birds is an ongoing process, which reduces the duration of the disease impacts and the increased demand is incorporated into egg demand.

DATA

Baseline data for supply and demand are collected from multiple USDA resources including the Agricultural Marketing Service (AMS) (2015), Economic Research Service (ERS) (2015), National Agricultural Statistics Service (NASS) (2014), and the World Agricultural Supply and Demand Estimates (WASDE) (2016). Data include egg use, consumption, beginning and ending stocks, imports, exports, and egg prices for all levels of production. These data are used to create the baseline data for the analysis. The baseline year for this work is 2014, which was not affected by HPAI.

Exogenous shocks for the analysis were calculated as a percent change from the baseline egg production including the shocks due to HPIA for both scenarios and the changes in McDonald's demand for the McDonald's scenario. The parameters used in the analysis are summarized in Table 1 along with their sources. Calculated parameters are derived through substitution of the behavioral equations using parameters and initial baseline values where appropriate. Beginning and ending stocks, net exports, and price elasticities were specifically calculated for this analysis as they are specific to the type of product.

TABLE 1
SUMMARY OF PARAMETERS USED IN MODEL ANALYSIS AND THEIR SOURCES

Parameters	Description	Value	Source
$\theta_{l,te}$	Unit revenue shares	0.160	Bell, (2001); Industry Expertise
$\theta_{e,te}$	Unit revenue shares	0.515	Bell, (2001); Industry Expertise
$\theta_{k,te}$	Unit revenue shares	0.325	Bell, (2001); Industry Expertise
$\theta_{l,pe}$	Unit revenue shares	0.164	Bell, (2001); Industry Expertise
$\theta_{e,pe}$	Unit revenue shares	0.532	Bell, (2001); Industry Expertise
$\theta_{k,pe}$	Unit revenue shares	0.304	Bell, (2001); Industry Expertise
$\lambda_{e,te}$	Factor Share	0.700	USDA – AMS (2015)
$\lambda_{e,pe}$	Factor Share	0.300	USDA – AMS (2015)
$\varepsilon_{y,te}$	Income Elasticity	0.346	USDA – ERS (2013)
$\varepsilon_{y,pe}$	Income Elasticity	0.346	USDA – ERS (2013)
$\varepsilon_{I,te}$	Stock Elasticity	-1.315	Author's Calculation
$\varepsilon_{I,pe}$	Stock Elasticity	-0.108	Author's Calculation
$\varepsilon_{x,te}$	Net Export Elasticity	0.590	Author's Calculation
$\varepsilon_{x,pe}$	Net Export Elasticity	0.250	Author's Calculation
$\varepsilon_{te,pe}$	Cross Price Elasticity	0.149	Author's Calculation
ε_{te}	Own Price Elasticity	-0.538	Author's Calculation
ε_{pe}	Own Price Elasticity	-0.801	Author's Calculation
$\sigma_{e,k:te}$	Substitution Elasticity	0.436	Ollinger, MacDonald, & Madison (2005)
$\sigma_{l,k:te}$	Substitution Elasticity	0.436	Ollinger, MacDonald, & Madison (2005)
$\sigma_{e,k:pe}$	Substitution Elasticity	0.436	Ollinger, MacDonald, & Madison (2005)
$\sigma_{l,k:pe}$	Substitution Elasticity	0.436	Ollinger, MacDonald, & Madison (2005)
ε_{e}	Egg Price Elasticity	-0.088	USDA – ERS (2013)
η_{e}	Raw Egg Supply Elasticity	1.000	USDA – ERS (2013)

Parameters Derived from Model Specification

Parameters	Description	Value	Source
$\eta_{te,w}$	Input Elasticity	0.215	Calculation
$\eta_{te,e}$	Input Elasticity	0.692	Calculation
$\eta_{te,te}$	Supply Elasticity	0.907	Calculation
$\eta_{pe,w}$	Input Elasticity	0.321	Calculation
$\eta_{pe,e}$	Input Elasticity	0.762	Calculation
$\eta_{pe,pe}$	Supply Elasticity	0.996	Calculation

RESULTS AND DISCUSSION

While McDonald's has the largest share of the market for breakfast eggs for fast food restaurants in the United States, the total market demanded by McDonald's is a relatively small percentage of total U.S. egg production. The following discussion are measured in the percent changes with very small changes to the shocks imposed between the two modeled scenarios.

The impact of HPAI and McDonald's all-day breakfast are presented in Table 2. The main driver of price changes throughout the supply chain is the reduction of layer birds due to the HPAI outbreak shocks imposed. The disease outbreak led to euthanasia of more than thirty-two million layers, and removing these from production leads to a reduction in total egg supplies. The modeled increase in shell egg price is 32.6 percent. Adding the additional supply pressure by McDonald's all-day breakfast, there is an

additional 0.07 percent change in the shell egg price. When comparing these results to the final product prices, table eggs are impacted by an additional 0.17 percent higher price increase due to the additional demand.

TABLE 2
IMPACT OF ALL-DAY BREAKFAST AND HPAI OUTBREAK (PERCENTAGE)

	Unit	HPAI Only	HPAI and McDonald's	Difference
Shell Egg Price	$/Dozen Eggs	32.58	32.65	0.07
Table Egg Price	$/Dozen Eggs	19.57	19.75	0.17
Processed Egg Price	$/Equivalent Dozen Eggs	7.54	7.50	-0.05
Production Table Eggs	Dozen eggs	-4.80	-4.69	0.11
Production Processed Eggs	Equivalent Dozen Eggs	-17.32	-17.42	-0.10

Contrarily, the price for processed eggs was estimated to increase by 7.54 percent versus 7.5 percent with the change in demand to table eggs. This is to be expected, as the product demanded by McDonald's are table eggs, which were estimated to have an increase in demand. The difference between the price increases represents the change in final demand. The estimated price change for processed eggs as a response to HPAI and McDonald's increase in demand are conservative, based on modeling assumptions. Some users of processed egg products such as liquid eggs saw prices more than double (Lowe, 2015), which is in response to how industry chose to divert shell eggs.

As expected, production for both table eggs and processed eggs decreased by 4.8 and 17.2 percent respectively for the HPAI only scenario. With the decrease in supply, processing volumes would need to be reduced. What this implies is given the changes in prices of final products, processed egg products are more greatly impacted as a result of the outbreak. When comparing the HPAI scenario to the McDonald's scenario, table egg processing actually benefit by 0.11 percent from the increase in demand by the fast food chain. Processed egg production is worse off by 0.10 percent. The trade off in production is driven by the shortage of supplies, and the subsequent allocation of shell eggs used to meet demand.

Welfare Effects

While the estimated direct impacts, discussed above, show the changes in magnitude of price changes, it does not take into account the total welfare effect. The estimated welfare impacts are presented in Table 3.

TABLE 3
WELFARE IMPACTS OF HPAI OUTBREAK AND ALL-DAY BREAKFAST ($1,000)

	HPAI Only	HPAI and McDonald's	Difference
Producer Surplus Change	5,984	6,102	33
Depopulation Producer Impacts	-28,884	-28,884	0
Total Producer Surplus Change	-22,899	-22,867	33
Consumer Surplus Change	-9,828	-10,048	-220
Total Change in Welfare	-32,728	-32,915	-187

Total producer welfare is the combination of calculated changes in producer surplus plus the exogenous cost of the shocks that are imposed. The model does not account for the excess burden on

producers infected by HPAI including the explicit costs related to depopulation. The depopulation impacts are based on a conservative estimate of total depopulation costs ($0.89 per bird based on industry and animal health expert opinions), including disposal costs, depopulation, including supplies and labor, cleaning and disinfection, and indemnity, multiplied by the number of affected birds where indemnity is estimated to be the average value of a layer for weeks 20-110, the typical lifespan of layer birds in commercial layer operations.

Producers able to sell their products during the HPAI outbreak benefit from increased prices, which result from the reduction in supply. Changes in producer surplus are positive across both scenarios. The model-predicted results for the HPAI scenario show an additional $33 thousand as a result of McDonald's all-day breakfast. However, once accounting for depopulation impacts that are not included in the model-predicted results, total producer surplus is negative both scenarios.

Consumer surplus changes are negative for both scenarios, as expected due to shortages of egg supplies. Importantly, the difference between the HPAI scenario and the McDonald scenario -$220 thousand, show the exacerbation the all-day breakfast was estimated to have on consumers on top of the HPAI outbreak. This value is relatively small compared to the value of all eggs sold in the United States. However, it does show the importance of business decisions by industry actors that have a significant share. McDonald's business strategy to drive profitability has negative effects on traditional egg consumers. This analysis is limited in would be the lack of estimation of the welfare McDonald's consumers gain by having access to an all-day breakfast, which is outside the scope of this analysis.

CONCLUSIONS

Consumer demand for all-day breakfast coupled with lackluster quarterly growth, led to the all-day breakfast initiative to help meet customer demand and increase foot traffic across McDonald's restaurants. The decision to extend McDonald's breakfast menu availability was driven by business strategy for short-term growth. In terms of driving foot traffic, the strategy has been successful. That success leads to increased demand for egg inputs by the fast food chain. McDonald's already has a large share of the breakfast food market, individually demanding close to five percent of total eggs produced in the United States The implications of potential increased demand pressure during a period of supply shortages as a result of an animal health event is estimated to effect consumers.

Estimating the impact of both the 2015 HPAI outbreak in U.S. poultry coupled with private industry decision to extend breakfast menu availability, an approximation of the value of this decision was estimated to be $187 thousand in terms of lost surplus. While marginal in comparison to the value of the U.S. egg industry, this estimation provides an insight into the importance of market actors' decision when making short and long-term strategies. The unique feature of the decision to extend breakfast at that given time, provides an interesting case where the supply market did not affect the marketing or rollout of a new business direction. Business are typically sensitive to prolonged supply shortages, but with forward contracting or a secure supply of inputs despite market events these short term market disruptions can be weathered to help sure market power and presence. U.S. egg production has since recovered to pre-outbreak levels, and McDonald's has expanded the operations offering all-day breakfast outlining the success of the strategy despite any nonpecuniary negative effects.

ACKNOWLEDGEMENTS

This material is based upon work supported by the U.S. Department of Homeland Security under Cooperative Agreement Number DHS 2010-ST-061-AG0002. The views and conclusions in this document are those of the authors and should not be interpreted as necessarily representing the official polices, either expressed or implied, of the U.S. Department of Homeland Security or the Institute for Infectious Animal Diseases.

WORKS CITED

Baertlein, L., & Ramakrishnan, S. (2015, September 9). McDonald's in U.S., Canada to use only cage-free eggs by 2025. *Reuters*. Retrieved from http://www.reuters.com/article/us-mcdonalds-eggs-idUSKCN0R91SJ20150909

Beach, R. H., Kuchler, F., Leibtag, E. S., & Zhen, C. (2008). *The Effects of Avian Influenza News on Consumer Purchasing Behavior: A Case Study of Italian Consumers' Retail Purchases*. United States Department of Agriculture, Economic Research Service. Retrieved from http://ideas.repec.org/p/ags/uersrr/56477.html

Bell, D. (2001). *California Egg Processing, Transportation, and Marketing Costs - 2000* (An Egg Economics Update No. 239). University of California.

Kieler, A. (2015, September 2). Analysts Say McDonald's All-Day Breakfast Could Drive Up Egg Prices, Exacerbate Shortage. Retrieved from http://consumerist.com/2015/09/02/analysts-say-mcdonalds-all-day-breakfast-could-drive-up-egg-prices-exacerbate-shortage/

Lowe, P. (2015, June 12). For Bakers And Restaurants, Egg Supply Is Getting Ugly. Retrieved January 9, 2016, from http://www.npr.org/sections/thesalt/2015/06/10/413206232/for-bakers-and-restaurants-egg-supply-is-getting-ugly

Ollinger, M., MacDonald, J. M., & Madison, M. (2005). Technological change and economies of scale in US poultry processing. *American Journal of Agricultural Economics*, *87*(1), 116–129. Retrieved from http://ajae.oxfordjournals.org/content/87/1/116.short

Patton, L. (2015, September 2). McDonald's All-Day Breakfast Might Make America's Egg Shortage Worse. Retrieved January 9, 2016, from http://www.bloomberg.com/news/articles/2015-09-02/mcdonald-s-all-day-breakfast-risks-further-crimping-egg-supplies

Richardson, J. W., Feldman, P., & Schuemann, K. (2003). Simetar™. *Department of Agricultural Economics, Texas A&M University. College Station, TX*.

Strom, S. (2015a, May 21). Food Companies Fear Bird Flu May Cause Egg Shortages. *The New York Times*. Retrieved from http://www.nytimes.com/2015/05/22/business/food-companies-fear-avian-flu-may-cause-egg-shortages.html

Strom, S. (2015b, September 9). McDonald's Plans a Shift to Eggs From Only Cage-Free Hens. *The New York Times*. Retrieved from http://www.nytimes.com/2015/09/10/business/mcdonalds-to-use-eggs-from-only-cage-free-hens.html

Thompson, J. M., & Pendell, D. L. (2016). Proactive Risk Assessments to Improve Business Continuity. *Choices*, *31*(2).

U.S. Department of Agriculture. (2015). *HPAI Outbreak 2014-2015: Control Area Release*.

U.S. Department of Agriculture, Agricultural Marketing Service. (2015). *USDA Egg Market News Report* (Livestock, Poultry, & Seed Programs) (p. December 2010-May 2015).

U.S. Department of Agriculture, Animal and Plant Health Inspection Service. (2016a). *2016 HPAI Preparedness and Response Plan*.

U.S. Department of Agriculture, Animal and Plant Health Inspection Service. (2016b, January). Update on Avian Influenza: Poultry Findings Confirmed by USDA's National Veterinary Services Laboratories. Retrieved January 1, 2016, from https://www.aphis.usda.gov/wps/portal/aphis/ourfocus/animalhealth/sa_animal_disease_information/sa_avian_health/sa_detections_by_states

U.S. Department of Agriculture, Economic Research Service. (2013). *Income elasticities for food subcategories* (International Food Consumption Patterns). Retrieved from http://www.ers.usda.gov/data-products/international-food-consumption-patterns.aspx

U.S. Department of Agriculture, Economic Research Service. (2015, December 18). International Macroeconomic Data Set. Retrieved June 10, 2016, from http://www.ers.usda.gov/data-products/international-macroeconomic-data-set.aspx

U.S. Department of Agriculture, National Agricultural Statistics Service. (2014). *Agricultural Prices* (No. ISSN: 1937-4216). USDA. Retrieved from http://usda.mannlib.cornell.edu/usda/current/AgriPric/AgriPric-10-31-2014.pdf

U.S. Department of Agriculture, Office of the Chief Economist. (2016). *World Agricultural Supply and Demand Estimates Report (WASDE)*. Retrieved from http://www.usda.gov/oce/commodity/wasde/

U.S. Department of Labor, Bureau of Labor Statistics. (2016). Bureau of Labor Statistics Data. Retrieved January 2, 2016, from http://data.bls.gov/cgi-bin/surveymost

Whitten, S. (2015, October 15). McDonald's franchisees optimistic about sales growth. Retrieved January 9, 2016, from http://www.cnbc.com/2015/10/15/mcdonalds-franchisees-optimistic-about-sales-growth.html

Wohlgenant, M. K. (2013). Consumer Demand and Welfare in Equilibrium Displacement Models. In *The Oxford Handbook on the Economics of Food Consumption and Policy*. New York: Oxford University Press.