An Assessment of the Economic Impacts of the Prevention of Farm Animal Cruelty Act

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I. Executive Summary[1]

The Humane Society of the United States (HSUS), the Massachusetts Society for the Prevention of Cruelty to Animals (MSPCA), and other animal welfare organizations have proposed a ballot measure requiring minimum space requirements for egg-laying hens, veal calves, and breeding sows whose products are produced or sold in Massachusetts. The measure would require that animals be able to lie down, stand up, fully extend their limbs, and turn around freely. The measure would be presented to Massachusetts voters in the November 2016 election and, if adopted, would take effect on January 1, 2022.[2]

Citizens for Farm Animal Protection (CFAP) has asked us to conduct an independent assessment of the potential economic impacts of the proposed animal welfare measure as it pertains to eggs. According to HSUS – a major backer of CFAP – as well as the United Egg Producers (UEP), the measure would eliminate the use of cages for all laying hens on farms in Massachusetts and would prohibit the sale of shell eggs in Massachusetts if those eggs are produced by laying hens confined in cages.

As explained in the body of this report, we find that the measure would have minimal if any impact on the Massachusetts egg industry. There is only one farm, with roughly 2% of the state's laying hens, that currently confines hens in cages. Most of the laying hens in Massachusetts are certified organic, which means that they are cage-free and also have access to the outdoors. In any case, Massachusetts farms produce less than 3% of the eggs that are consumed in the state, meaning that more than 97% must be brought into the state in shell or processed form.

We also find that the measure will have a minimal impact on Massachusetts consumers. Cage-free housing raises the cost of producing eggs on the order of 1 or 2 cents per egg and these higher production costs would likely be passed through to consumers in the form of higher retail prices on the order of 1 or 2 cents. For the average Massachusetts resident the expected added outlay is less than $3 per year. This is a very small share of the typical person's food budget. Even for low income people, this represents only around one-tenth of one percent of annual food expenditures. At the same time, proponents of the measure argue that the benefits to animal welfare are substantial.

The measure specifies a minimum space requirement and requires the Attorney General of Massachusetts to promulgate rules governing the housing of hens providing shell eggs to Massachusetts by 2020 – two years before the measure becomes effective. The specific space requirement per hen and the early promulgation of rules will reduce uncertainty regarding the new requirements so that uncertainty need not impede investment by egg producers. Moreover, the measure will go into effect at a time when the egg industry will have already made substantial progress in shifting toward cage-free production to satisfy rising consumer demand

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[2] Proponents of the measure have collected a sufficient number of signatures to qualify the measure for presentation to the state legislature and are in the process of collecting enough certified signatures to qualify the measure for placement on the ballot.

for cage-free eggs. For these reasons, Massachusetts need not experience the disruption in egg prices that California experienced when its animal welfare regulations protecting laying hens became effective in 2015. California's rising egg prices reflected shortages resulting from a lack of investment by suppliers of eggs to California, not the cost of providing improved conditions for laying hens.

II. The Ballot Measure

In 2014, more than 90% of laying hens were confined in wire "battery" cages, which have become the standard conventional housing system used by large egg producers because of their cost advantages.[3] Battery cages typically have dimensions ranging from 12 by 18 inches to 24 by 20 inches and a height of 15 or 16 inches.[4] The size of the cages varies depending on how many birds they contain (five to eight hens each is common), and they generally provide approximately 67 to 76 square inches of "floor" space for each bird, which is smaller than a standard piece of letter paper. The cages are outfitted with automatic feeders and waterers, and have sloping floors to facilitate egg collection. They are often arranged in banks – or "batteries" – to minimize space requirements. Many systems have belts underneath the cages to remove chicken manure.

Critics of battery cages argue that they are inhumane because they are cramped structures that restrict hens' ability to perform natural movements such as fully extending their wings, roosting, nesting, dust-bathing, and standing upright.[5]

A small but growing share of the U.S. laying flock is housed in cage-free systems. The two most common types of cage-free systems used in commercial egg farming are barn-floor systems and aviaries, both of which are commonly used in Europe. In barn floor systems, hens are housed in a building that contains nesting boxes and may also have perches and litter for manure management. Aviaries are usually multi-tiered systems with perches, nest boxes, and litter.[6] Eggs sold in grocery stores are sometimes labeled to indicate the housing and feeding regimen of the hens. Figure 1 provides definitions of some of the terms that are commonly found on egg cartons, though these terms are often not defined by law or subject to third-party verification.

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3 Joel L. Greene and Tadlock Cowan, "Table Egg Production and Hen Welfare: Agreement and Legislative Proposals," Congressional Research Service, February 14, 2014, p. 20.

4 Daniel A. Sumner, J. Thomas Rosen-Molina, William A. Matthews, Joy A. Mench, and Kurt R. Richter, "Economic Effects of Proposed Restrictions on Egg-laying Hen Housing in California," University of California Agricultural Issues Center, July 2008, p. 2.

5 Joel L. Greene and Tadlock Cowan, "Table Egg Production and Hen Welfare: Agreement and Legislative Proposals," Congressional Research Service, February 14, 2014, pp. 20-21. See also Daniel A. Sumner, J. Thomas Rosen-Molina, William A. Matthews, Joy A. Mench, and Kurt R. Richter, "Economic Effects of Proposed Restrictions on Egg-laying Hen Housing in California," University of California Agricultural Issues Center, July 2008, p. 3.

6 Daniel A. Sumner, J. Thomas Rosen-Molina, William A. Matthews, Joy A. Mench, and Kurt R. Richter, "Economic Effects of Proposed Restrictions on Egg-laying Hen Housing in California," University of California Agricultural Issues Center, July 2008, pp. 3-5.

Figure 1
Common Terms Used on Egg Carton Labels

Term	Definition
Conventional	Laid by hens in "battery cages," that normally have average space of 67 to 76 square inches per hen.
Cage-free	Laid by hens not housed in cages. Hens roam in a building, room or open area that includes nest space and perches. Examples include aviaries and barn floor housing.
Pasture raised	Laid by hens who roam and forage on a maintained pasture area. The USDA does not recognize a labeling definition for pastured eggs.
Enriched colony	Laid by hens in cages that include perch space, dust bathing or scratch areas, and nest space. Average space is normally 116 square inches per hen.
Certified organic	Laid by cage-free or free-range hens raised on certified organic feed and who have access to the outdoors. The feed is grown without most synthetic pesticides, fungicides, herbicides or fertilizers and 100% of the agricultural ingredients must be certified organic.
Free range	Laid by hens not housed in cages and with access to the outdoors. In addition to eating grains, these hens may forage for wild plants and insects.
Omega-3 enriched	Laid by hens fed a special diet rich in omega-3s. These eggs provide more omega-3 fatty acids.
Vegetarian fed	Laid by hens fed a vegetarian diet.
Pasteurized	Eggs heated to a temperature just below the coagulation point to destroy pathogens.
Brown	The color of the egg shell has nothing to do with the egg's nutritional value, quality, freshness, or flavor. Hens with white feathers and white ear lobes lay white eggs; hens with red feathers and red ear lobes lay brown eggs. Cage-free eggs have often been brown eggs because of consumer preferences.

Sources: American Egg Board ("Defining Egg Types and Labels"), WSJ "Free-Range? Cage-Free? Organic? A Consumer's Guide to Egg Terminology," March 11, 2015

Chicken eggs can be used either as *hatching eggs* or *table eggs*. *Hatching eggs* are those that are allowed to hatch either to replenish the stock of laying hens or to provide chickens for meat. *Table eggs* are those that are eaten by humans, and can be sold either intact in their shells (*i.e.*, "shell" eggs) or can be processed and sold as liquid eggs, dried eggs, or in the form of foods containing eggs, such as ice cream or baked goods. Eggs that are processed before they are sold are referred to as "breakers."

The proposed Massachusetts measure would require 1.5 square feet of usable floor space per bird,[7] which, according to the HSUS and the UEP,[8] would effectively prohibit the use of cages. The ballot measure would apply to the housing of all laying hens used for commercial egg production within Massachusetts, though it would have no effect on producers that already employ compliant housing systems. Reports indicate that there is only one producer in the state, with approximately 2% of the state's laying hens, that currently uses cages to confine laying

[7] The ballot measure provides (§5(J)) that "[i]n the case of egg-laying hens, fully extending the animal's limbs means fully spreading both wings without touching the side of an enclosure or other egg-laying hens and having access to at least 1.5 square feet of usable floor space per hen."

[8] Daniel A. Sumner, J. Thomas Rosen-Molina, William A. Matthews, Joy A. Mench, and Kurt R. Richter, "Economic Effects of Proposed Restrictions on Egg-laying Hen Housing in California," University of California Agricultural Issues Center, July 2008, p. 6.

hens.[9] The measure would also apply to the conditions of hens whose shell eggs are sold in Massachusetts, regardless of whether those hens were raised inside or outside of Massachusetts. Processed eggs, or "breakers," from hens raised outside of the state are not affected by the measure. Figure 2 provides examples of purchases of eggs and egg products, and indicates whether or not the purchase would be subject to the act.

Figure 2
Application of Proposed Ballot Measure to Purchases of Eggs and Egg Products

Purchase	Subject to Act?
Carton of one dozen eggs purchased from local supermarket	Yes. All shell eggs purchased at retail are subject to the act, regardless of whether they come from hens in Massachusetts or other states.
Case of 30 dozen eggs purchased by restaurant for preparing breakfast sandwiches	Yes. All shell eggs purchased at wholesale are subject to the act, regardless of whether they come from hens in Massachusetts or other states.
Pint of french vanilla ice cream purchased from local convenience store	No. If the ice cream is manufactured in Massachusetts with shell eggs, then the manufacturer's purchase of shell eggs is subject to the act. But the retail purchase of the product is not subject to the act.
Egg and cheese breakfast sandwich purchased at local diner	No. If the sandwich is made with shell eggs, then the diner's purchase of shell eggs is subject to the act. But the retail purchase of the sandwich is not subject to the act.
Package of Egg Beaters (or other liquified egg products) purchased from local supermarket	No. If the product is manufactured in Massachusetts from shell eggs, then the manufacturer's purchase of shell eggs is subject to the act. But the retail purchase of the product is not subject to the act.
Gallon of liquid eggs purchased at wholesale by ice cream manufacturer in Massachusetts	No. If the liquid eggs were produced in Massachusetts from shell eggs, then the producer's purchase of shell eggs is subject to the act. But the wholesale purchase of liquid eggs is not subject to the act.
50 pound case of dried eggs purchased by bakery in Massachusetts	No. If the dried eggs were produced in Massachusetts from shell eggs, then the producer's purchase of shell eggs is subject to the act. But the wholesale purchase of dried eggs is not subject to the act.

The measure would take effect on January 1, 2022. After this date, it would be illegal within Massachusetts to house laying hens used for commercial egg production in facilities that restrict their movements as described above, and it would be illegal for businesses in Massachusetts to sell shell eggs that were produced by hens housed in such restrictive conditions. Violations would be subject to civil fines (not to exceed $1,000 per violation) and injunctive relief. The

[9] Steve LeBlanc, "Animal Advocates Begin Campaign to Prohibit Small Cages for Pigs, Calves, Chicken," South Coast Today, August 19, 2015; Shira Schoenberg, "At Center of 2016 Ballot Dispute Over Cage-Free Eggs Are 3,000 Chickens in Western Mass. Town," Masslive, December 4, 2015.

measure also provides that a business owner or operator may rely in good faith upon a written certification or guarantee by the supplier that eggs were not laid by a hen that was confined in noncompliant housing.

Importantly, the Massachusetts measure is designed to ensure that egg producers are able to plan to meet its requirements. The measure provides for a specific minimum amount of space per bird, and it provides for the Attorney General to promulgate rules and regulations for the implementation of the act on or before January 1, 2020 – two years before the measure becomes effective. Timely promulgation of rules and regulations would avoid regulatory uncertainty that might otherwise confront egg producers and other businesses that must make investments and take other steps to make sure they are ready for the new rules when they take effect.

There are already enough cage-free laying hens in the U.S. (many of which are in New England and other Northeastern states) to meet the entire demand for shell eggs in Massachusetts. And, the notable widespread rise in consumer demand for cage-free eggs is being met with a "boom" in investment in cage-free housing.[10] Big Dutchman, a major global producer of housing for laying hens, reports that the majority of new chicken houses ordered in the United States are cage-free systems.[11] When the ballot measure takes effect in 2022, the egg industry will have had six more years to expand and increase the efficiency of the nation's cage-free housing systems. These facts indicate that the U.S. egg industry can readily supply the state's demand for cage-free eggs by 2022.

III. The U.S. Egg Industry

Per capita egg consumption in the U.S. peaked in 1945 at 403 eggs per person per year and hit its lowest point in 1991 at 235 eggs per person per year.[12] In 2014 the typical U.S. consumer ate around 263 eggs, approximately 183 of which were shell eggs.[13] Figure 3 shows U.S. production of table eggs per capita each year from 1988 to 2014.[14]

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10 Terrence O'Keefe, "Cage-Free Housing Continues to Gain Momentum in 2016," WattAgNet.com, December 14, 2015.

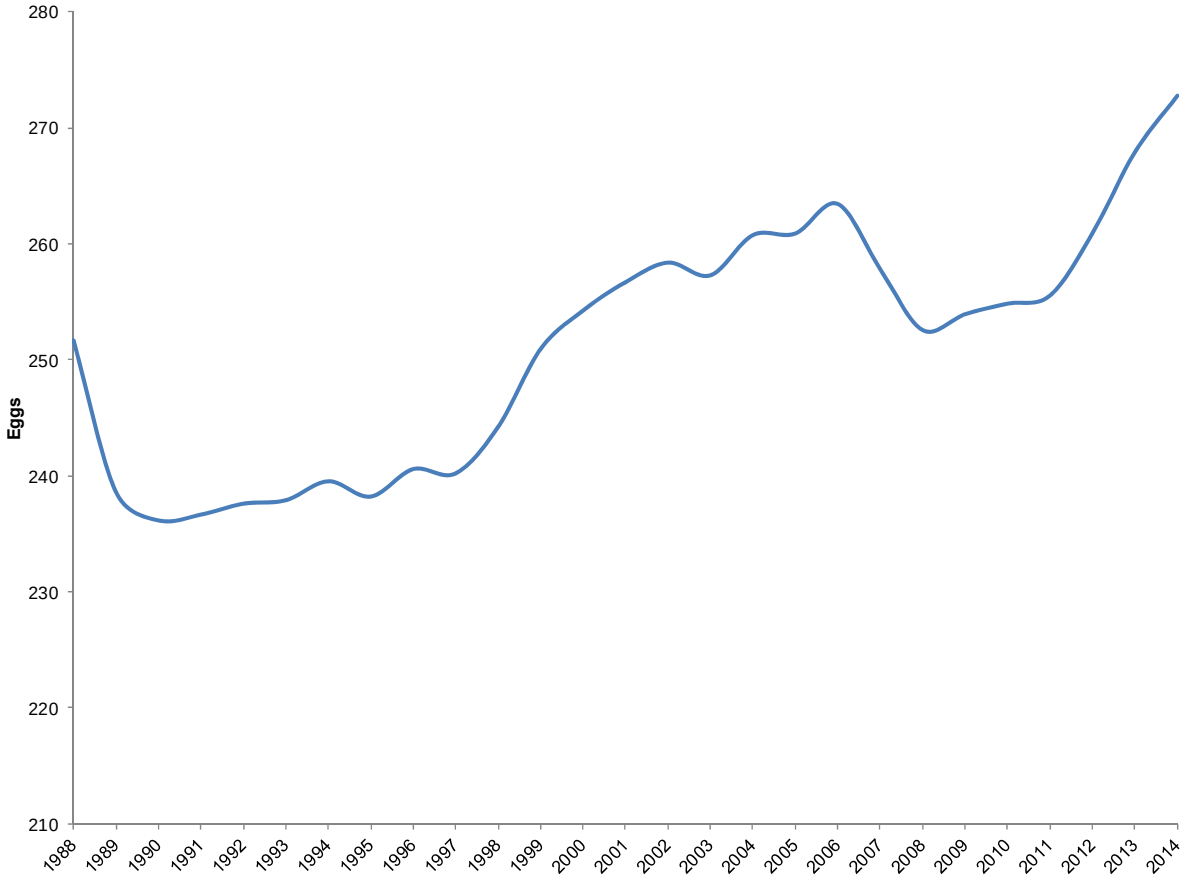
11 Dan Charles, "Most U.S. Egg Producers Are Now Choosing Cage-Free Houses," *The Salt*, NPR, January 17, 2016 (available at http://www.npr.org/sections/thesalt/2016/01/15/463190984/most-new-hen-houses-are-now-cage-free).

12 John Lawrence, Gary May, Dan Otto, John Miranowski, "Economic Importance of the Iowa Egg Industry," March 2003, p. 4.

13 USDA ERS, Livestock, Dairy, and Poultry Outlook, December 15, 2015, p. 22; American Egg Board, Egg Demand Dashboard.

14 Consumption per capita is slightly below output per capita because of exports.

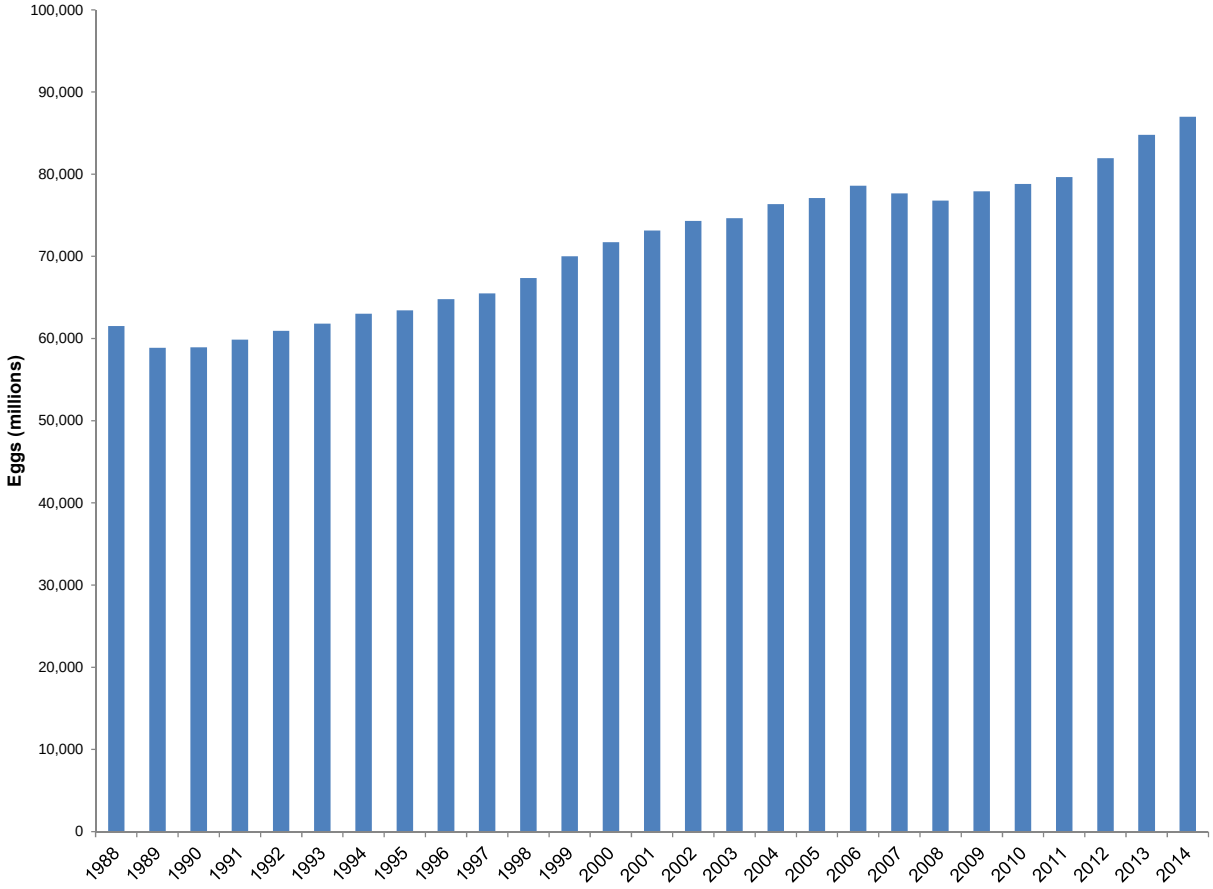
Figure 3
U.S. Table Egg Production per Capita
1988-2014



Source: Census; USDA NASS Chicken and Eggs Final Estimates (various editions)

Since 1988, the output of the U.S. egg industry has grown steadily, with occasional slight and temporary declines, as shown in Figure 4.

Figure 4
U.S. Table Egg Production
1988-2014



Source: USDA NASS Chicken and Eggs Final Estimates (various editions)

A. The Growth and Regional Concentration of the Table Egg Industry

1. Egg Production Is Increasingly Concentrated in the Midwest

There were approximately 200,000 farms with laying hens in the U.S. in 2012. However, 94% of these farms (187,000) had fewer than 100 hens. The majority of the nation's laying hens – 75% – were on 387 large operations with flocks of greater than 100,000 hens each,[15] and the average number of hens for each of these 387 large operations was almost 700,000. Approximately 86% of U.S. egg production comes from 63 companies with more than 1 million hens each, and there are 17 companies with more than 5 million hens, typically spread across multiple locations.[16]

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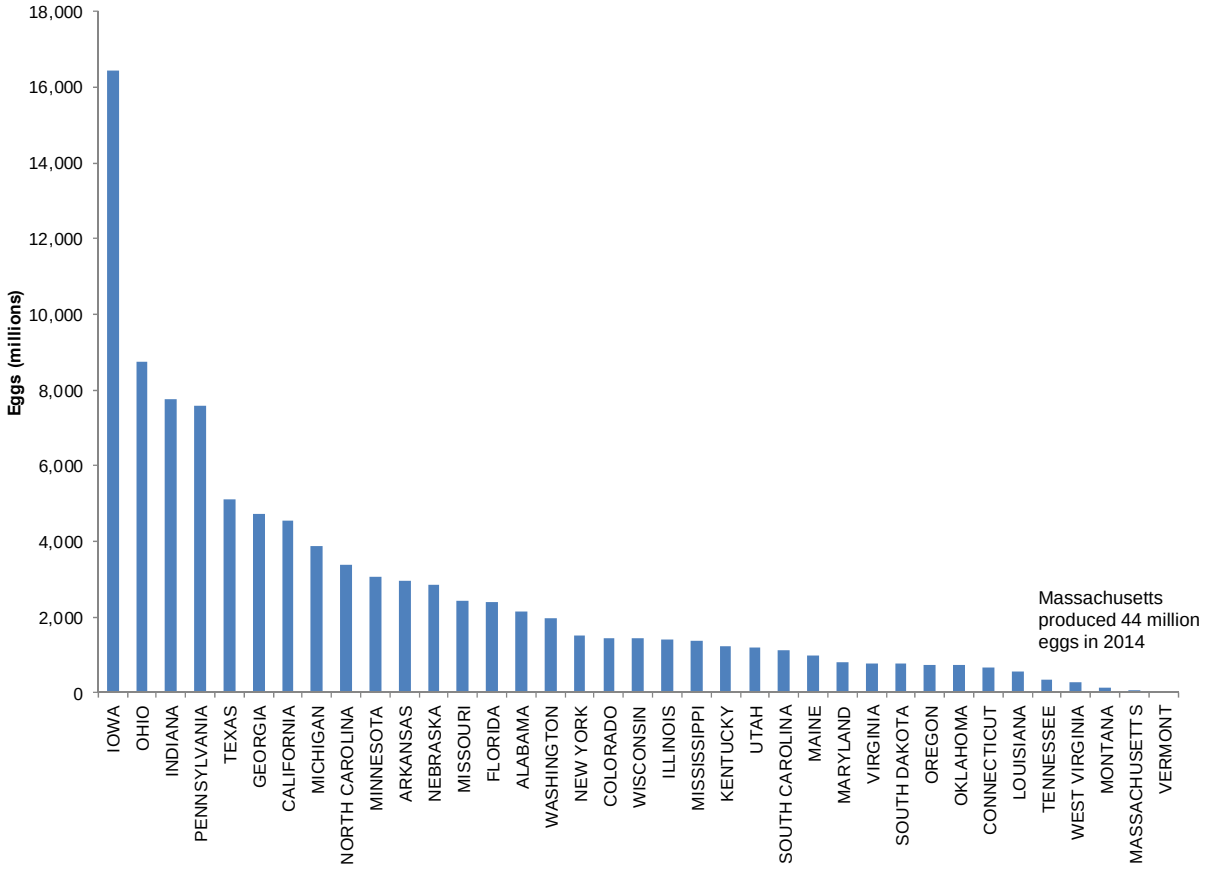
[15] In 2012, 269 million of the nation's 351 million laying hens were on 387 operations with more than 100,000 hens. USDA NASS 2012 Census of Agriculture Table 32 Poultry – Inventory and Number Sold: 2012 and 2007. These data include layers of both table and hatching eggs.

[16] American Egg Board, www.aeb.org/farmers-and-marketers/industry-overview, accessed 12/2/2015.

Eggs are produced throughout the country, but much of U.S. egg production is located in the Midwest. Figure 5 shows 2014 table egg production for 38 states.[17] Iowa alone produced more than 16 billion table eggs in 2014, approximately 17% of the U.S. total. In contrast, Massachusetts produced 44 million eggs in 2014, or approximately 0.04% of the U.S. total.

Figure 5
State Table Egg Production
2014



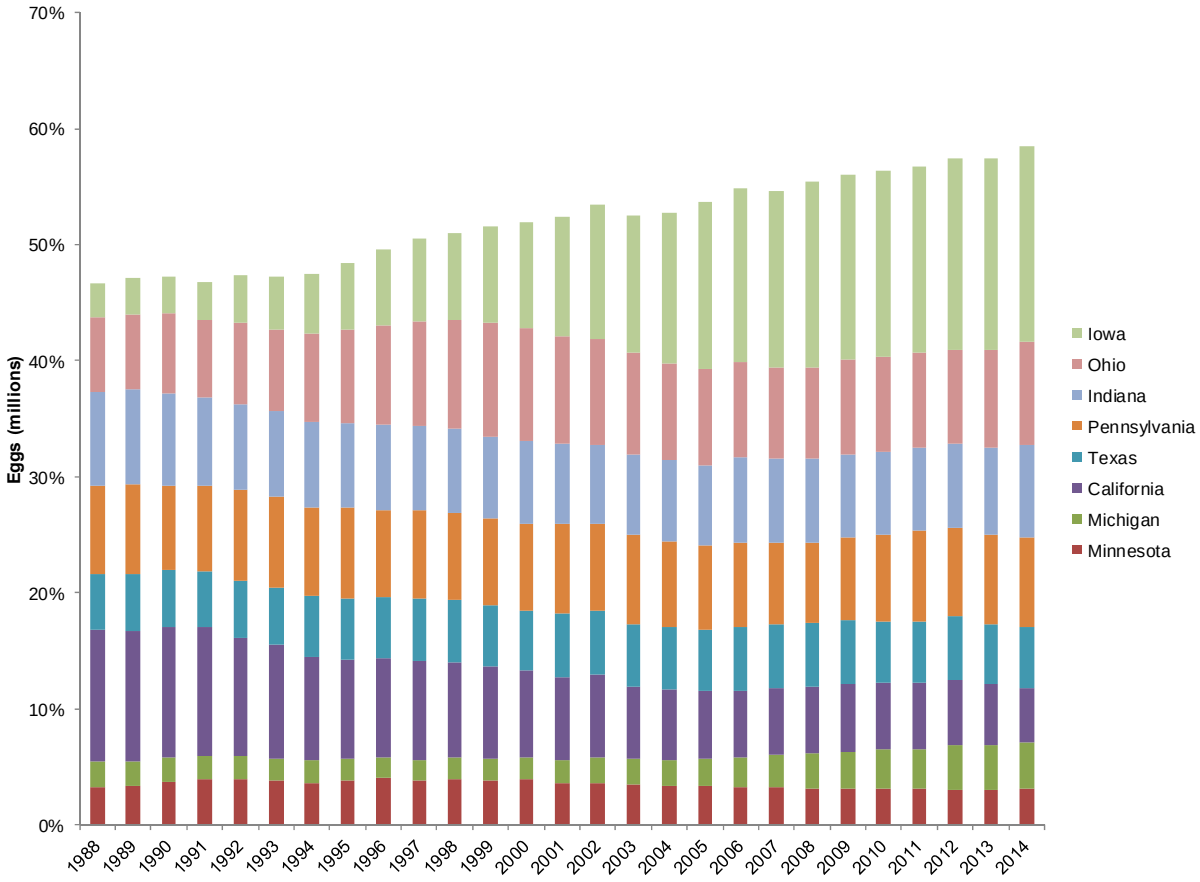
Source: USDA NASS Monthly Chicken and Egg Report

The location of egg production has shifted over time in response to competitive forces. Midwestern egg producers benefit especially from proximity to farms that grow corn and soybeans, so they avoid the cost of transporting heavy feed grains. Figure 6 shows the shares of U.S. egg production from eight top egg producing states, and shows how those shares have changed since 1988. The figure shows that egg production has become increasingly concentrated in these eight states, and they now account for approximately 60% of U.S. production. Iowa's share alone has grown from 3% to 17% of the national total. In contrast, California's share dropped from 11% to 5%. The shares of the other six states have remained relatively stable over these years. California was the nation's leading producer of eggs from

[17] All states produce eggs but the USDA does not publish egg production data for some states, such as New Hampshire and Rhode Island, for proprietary reasons.

1959 until 1996, but output declined steadily beginning in the 1970s as California lost market share to other states owing to such factors as high production costs (especially imported feed), high land costs, and the rapid spread of urban areas.[18] Between 1971 and 2003, California egg production dropped by 40%.[19] In the 1990s, California switched from being a net exporter to a net importer of eggs.

Figure 6
Share of Total U.S. Eggs from Top 8 Egg-Producing States 1988-2014



Source: USDA NASS Chicken and Eggs Final Estimates (various editions)

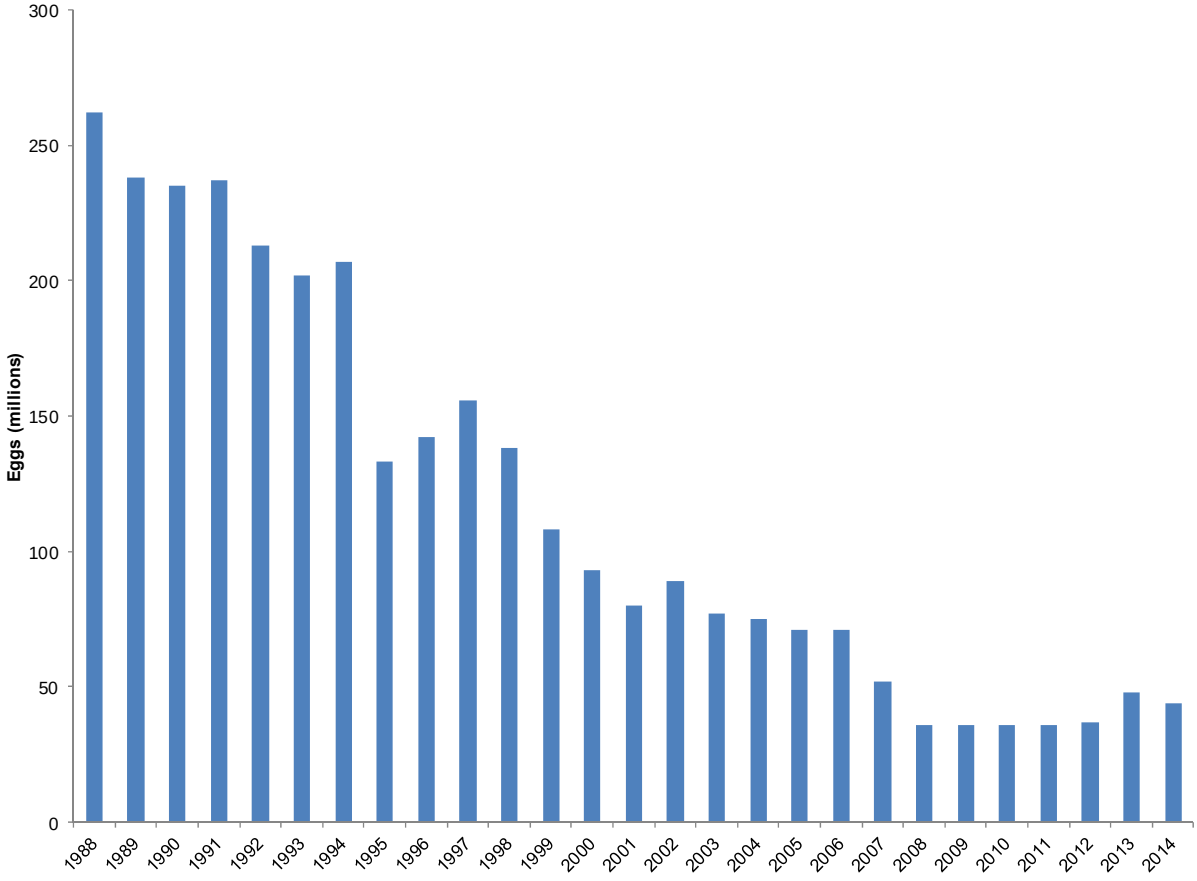
The Massachusetts egg sector is small and has shrunk as egg production has concentrated in the Midwest. As shown in Figure 7, egg production in the state has declined approximately five-fold since 1988, from a little more than 250 million eggs per year to fewer than 50 million. While many of the eggs produced in Massachusetts are presumably sold and consumed within the state,

[18] Daniel A. Sumner, J. Thomas Rosen-Molina, William A. Matthews, Joy A. Mench, and Kurt R. Richter, "Economic Effects of Proposed Restrictions on Egg-laying Hen Housing in California," University of California Agricultural Issues Center, July 2008, pp. 15-18.

[19] Daniel A. Sumner, J. Thomas Rosen-Molina, William A. Matthews, Joy A. Mench, and Kurt R. Richter, "Economic Effects of Proposed Restrictions on Egg-laying Hen Housing in California," University of California Agricultural Issues Center, July 2008, Table III.1.

some are exported to other states. Country Hen in Hubbardston is a 100% cage-free operation and its eggs are sold in Massachusetts and 24 additional states throughout the U.S., including California, Texas, and Florida, as well as in Washington, DC.[20]

Figure 7
Massachusetts Annual Egg Production
1988-2014



Source: USDA NASS Chicken and Eggs Final Estimates (various editions)

The shifting geography of egg production in the U.S. indicates that egg producers have left states that are distant from sources of feed and that have other cost disadvantages such as relatively expensive land for regions of the country where production costs are lower. This shift shows that the egg industry is able to make profitable investments in response to changing prices and market conditions. In economics jargon, egg supply is very "elastic" in the long run, meaning that relatively small changes in price elicit relatively large changes in supply. A supply elasticity of 1 means that a price increase of 1% leads suppliers to increase output by 1%. In a 2012 study of the economics of alternative egg production systems prepared for the Association of California Egg Farmers, Prof. Hoy Carman of the University of California at Davis used a supply

[20] www.countryhen.com/wheretobuy.php (accessed 12/19/2015)

elasticity of 10, meaning that a 1% increase in price would stimulate a 10% increase in output.[21] The high supply elasticity for eggs is attributable to the lack of any barriers to adjusting layer capacity over time and to the fact that the egg industry uses a small share of the quantities of the necessary inputs that are available in the marketplace. As a result, increases in egg production do not drive up the prices of inputs into egg production.[22]

2. Shell Eggs Are Transported Throughout the Country

The increased concentration of egg farming in the Midwest has led to an increasing surplus of eggs in the Midwest relative to local consumption. The blue bars in Figure 8 show the net surplus of eggs for states with available production information.[23] Iowa alone had 15 billion surplus eggs in 2014, and three other states (Indiana, Ohio, and Pennsylvania) had surpluses of several billion eggs. Many of these surplus eggs are "breakers," used to manufacture liquid egg products or powdered eggs before being shipped to other states. Others are sold and transported as shell eggs. The states indicated by the red bars in Figure 8 have egg deficits, meaning that they consume more eggs than they produce. Massachusetts is an egg deficit state and must import 97.5% of the eggs its residents consume.[24]

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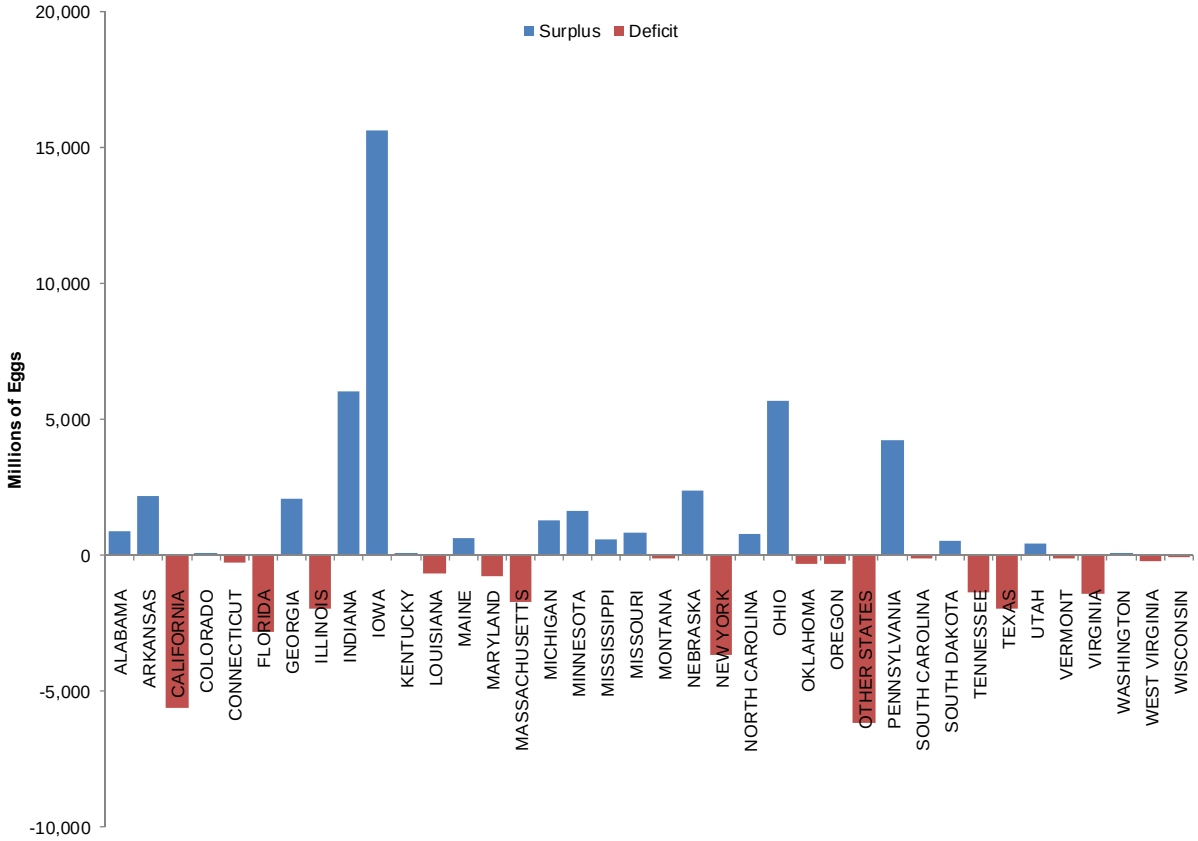
[21] Hoy Carman, "Economic Aspects of Alternative California Egg Production Systems," August 30, 2012, p. 19, Table 4.

[22] Hoy Carman, "Economic Aspects of Alternative California Egg Production Systems," August 30, 2012, pp. 16-17.

[23] Egg consumption for each state is based on estimated 2014 population and national average consumption of 263 eggs per person.

[24] Based on 2014 population of 6,745,408, average per capita consumption of 263 eggs, and state production of 44 million eggs.

Figure 8
Egg "Surplus" and "Deficit" by State
2014



Note: Number of surplus/deficit eggs is calculated as the difference between table eggs produced and the national average egg consumption rate times the state population.
Sources: U.S. Census Bureau, Population Division, Table 1, Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico, (Dec 2014); USDA NASS Monthly Chicken and Egg Report

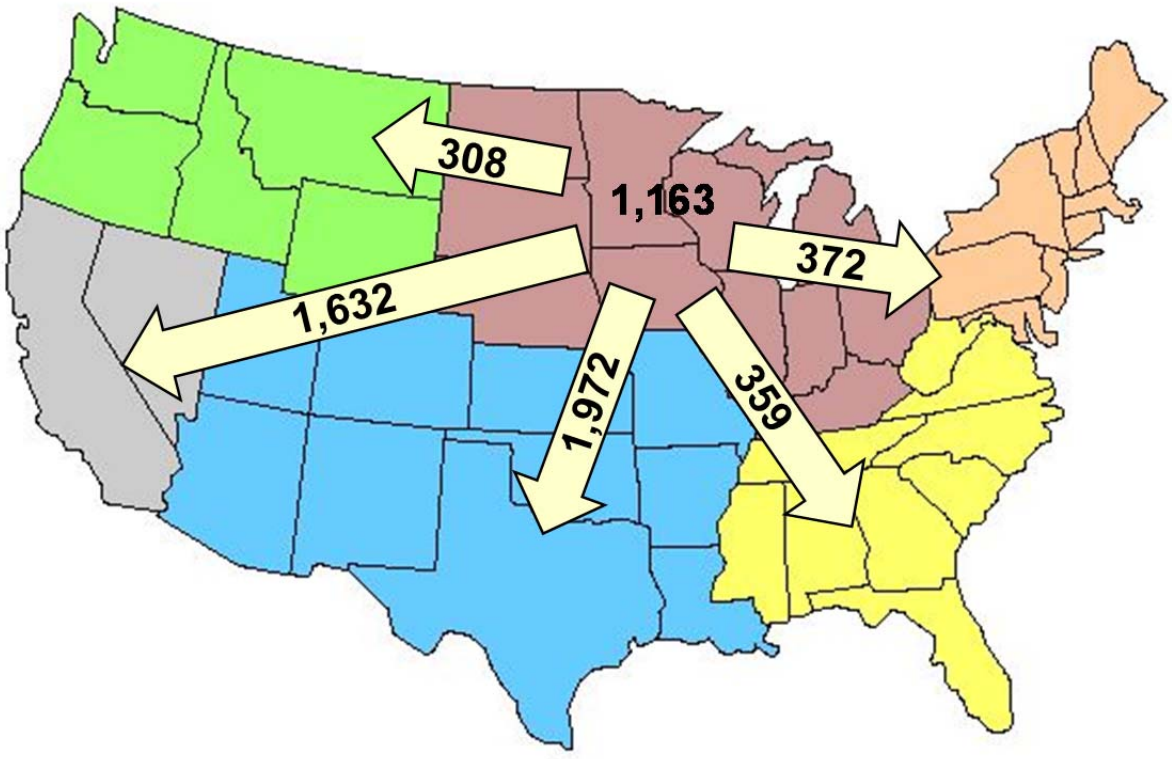
The increasing concentration of egg production in the Midwest is possible because eggs are readily transportable. Eggs are commonly shipped in large refrigerated trucks in standard loads of 800 30-dozen cases.[25]

Figure 9 shows flows of eggs from the Midwest to other regions of the country based on USDA survey data of trailer load sales. The figure shows the regional delivery locations for 5,806 loads that originated in the Midwest in 2014. Only 20% of the loads that originated in the Midwest were delivered to other locations within the Midwest, meaning that 80% were delivered to other regions, including 6.4% (372 loads) to the Northeast region which includes Massachusetts. The figure shows that eggs from the Midwest find their way to all parts of the country, which indicates that if prices in one part of the country begin to rise, egg producers will ship eggs to

[25] John Lawrence, Gary May, Dan Otto, John Miranowski, "Economic Importance of the Iowa Egg Industry," March 2003, Iowa State University, p. 18.

that region in search of increased profits. The result is that prices throughout the U.S. tend to move together, accounting for transportation cost differentials and differences in the cost of local distribution and retailing.

Figure 9
Egg Trailer Load Movements from Midwest
USDA Survey Data (2014)



Total Trailer Loads Originating in Midwest: 5,806

Source: USDA Market News, Annual Weighted Average Trailer Load Egg Sales (values rounded)

Figure 10 provides additional data in on the origin and destination of loads of eggs. The vast majority (95%) of the loads delivered to the Northeast region come either from the Northeast region itself (1,457 loads, or 76% of the 1,929 loads delivered to the Northeast), or from the Midwest (372 loads, or 19% of the total).

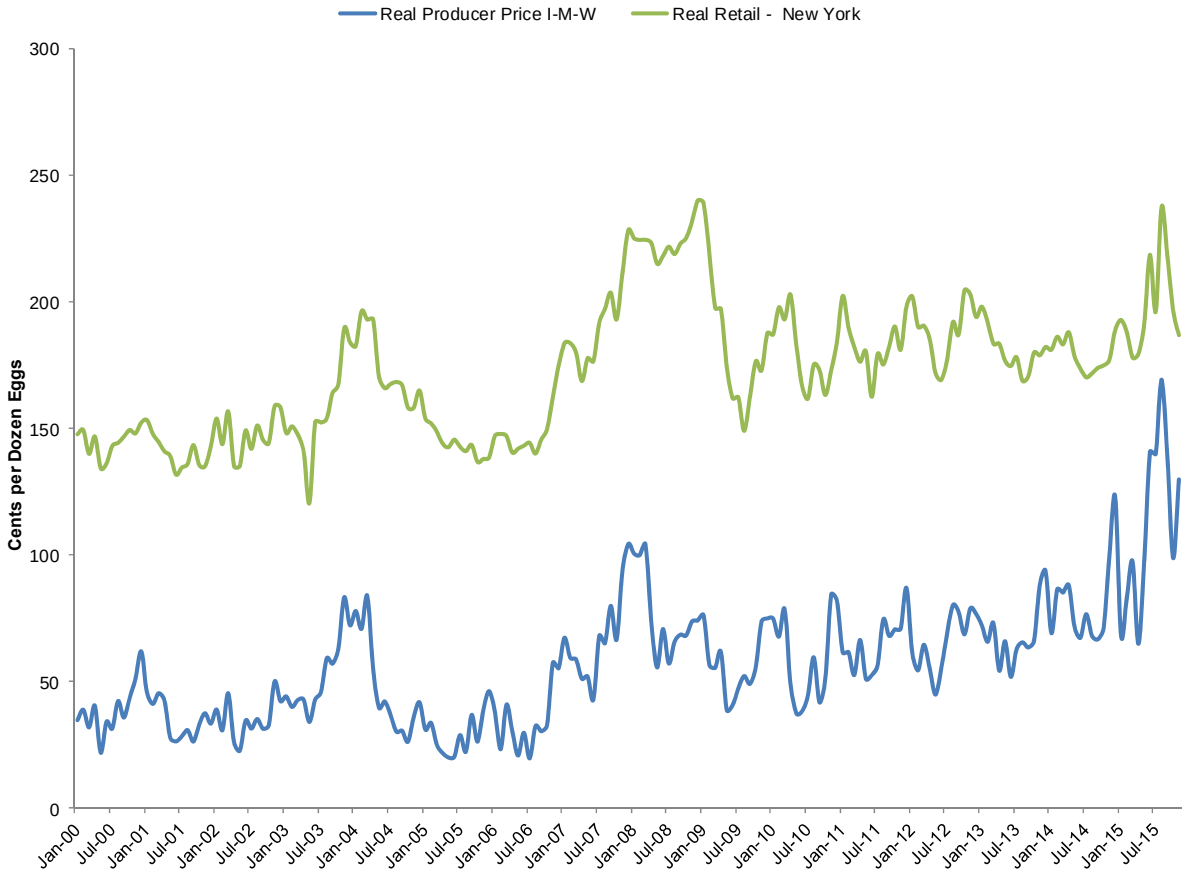
Figure 10
Egg Trailer Load Movements by Region of Origin and Destination 2014

	Destination Region						
Origin Region	**Southeast**	**Northeast**	**Midwest**	**South Central**	**Northwest**	**Southwest**	**Total Origin**
Southeast	413	97	30	80	0	0	620
Northeast	52	1,457	23	50	8	23	1,613
Midwest	359	372	1,163	1,972	308	1,632	5,806
South Central	29	2	66	163	22	341	623
Northwest	0	0	1	0	2	30	33
Southwest	7	1	0	22	1	147	178
Total Destination	860	1,929	1,283	2,287	341	2,173	8,873

Source: USDA Market News, Annual Weighted Average Trailer Load Egg Sales (values rounded)

Figure 11 shows real average monthly prices paid to egg producers in Iowa, Minnesota, and Wisconsin and real average retail prices paid by consumers in New York. The retail price of eggs is higher than the producer prices because the retail price must cover the cost of transportation, local distribution, and retailing. Notably, the retail and producer prices of eggs move together quite closely.

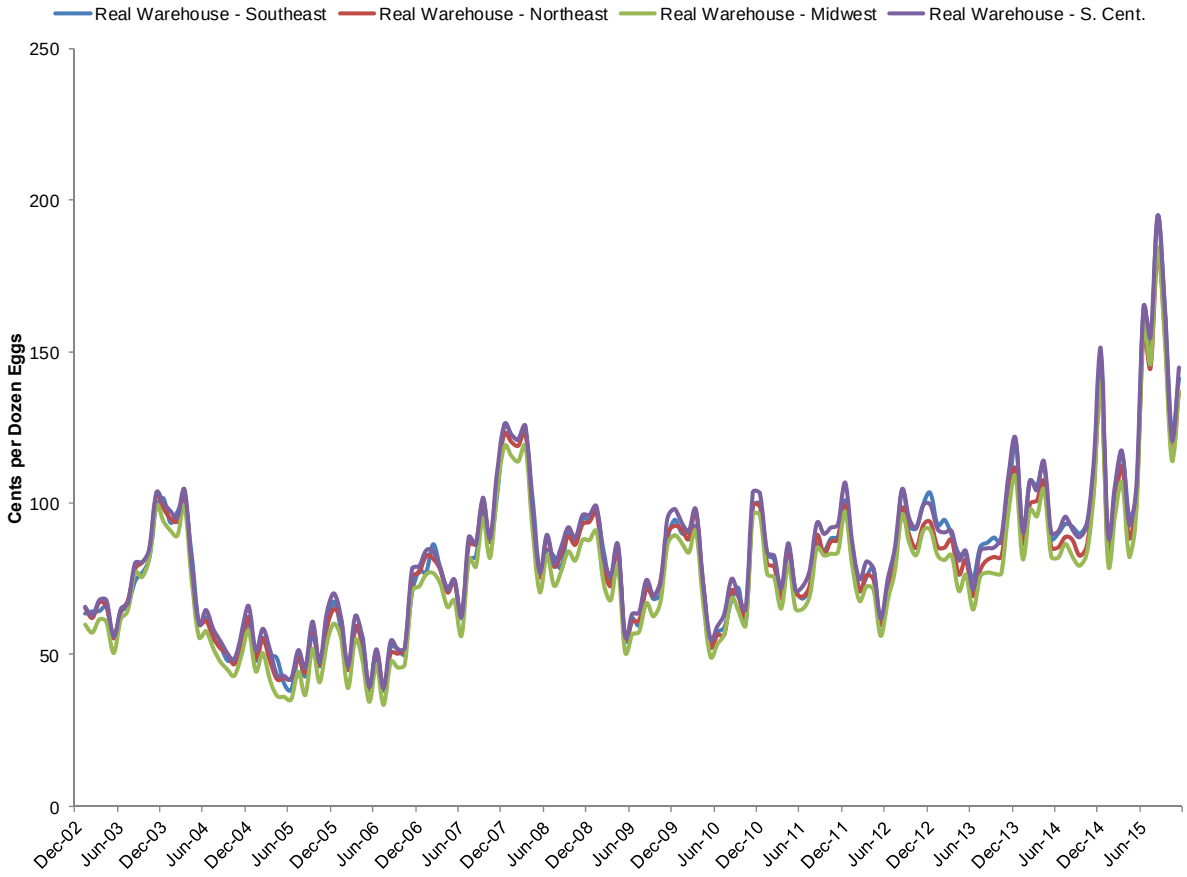
Figure 11
Real Retail and Producer Prices



Source: USDA AMS; BLS

Because eggs can easily be shipped long distances, prices in different regions of the U.S. tend to move together. This price integration can be seen in Figure 12A, which shows real average monthly prices for wholesale eggs delivered to warehouses in four geographic regions. The average warehouse price of eggs is not the same across the different regions, but the prices move together in virtual lockstep, indicating that eggs flow from regions with low prices to regions with higher prices, accounting for differences in the costs of transportation.

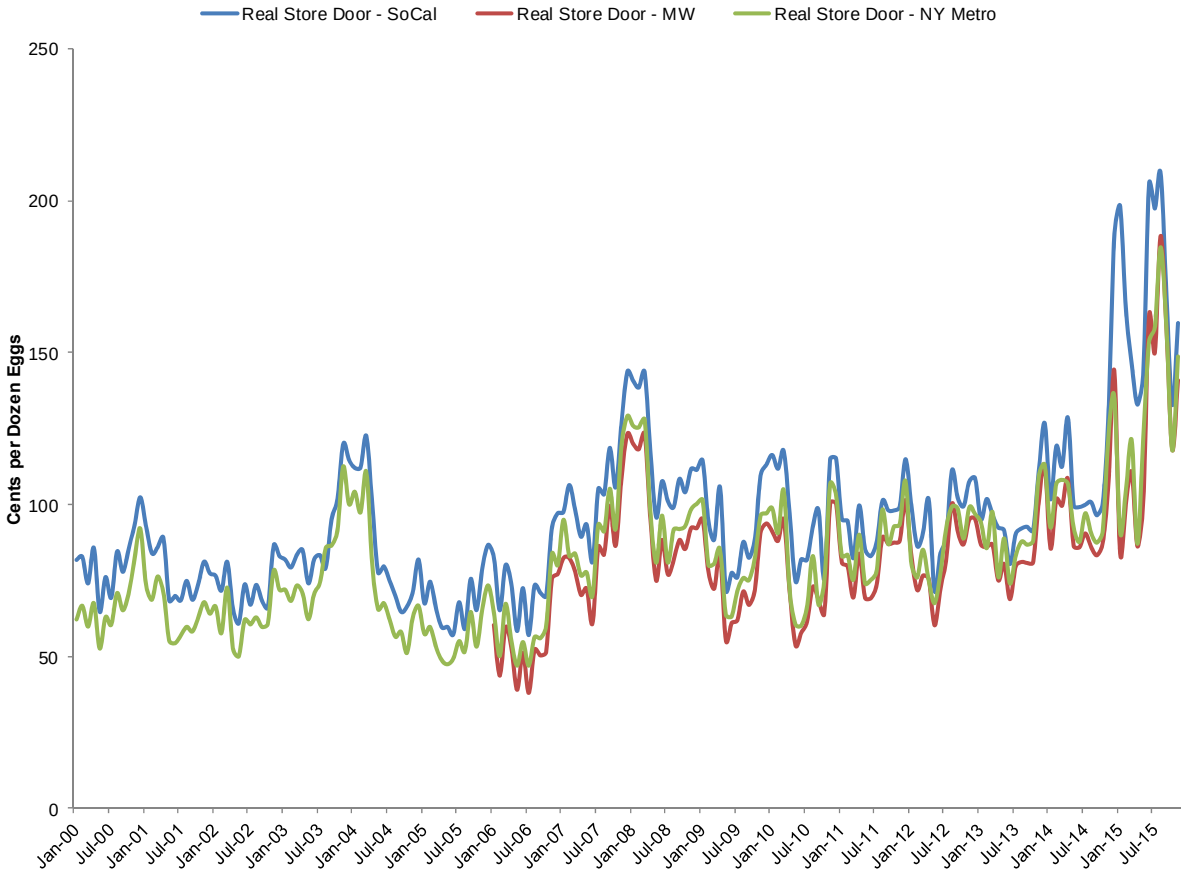
Figure 12A
Real Regional Warehouse Prices



Source: USDA AMS; BLS

Prices behave similarly, even when measured closer to the final sale. Figure 12B shows real average monthly prices for wholesale eggs delivered to retail outlets ("store door") in three regions. The differences in average store-door prices reflect the differences in transportation costs to different regions and differences in the cost of the local wholesaling required to deliver eggs to retail stores. Accounting for these differences, the average store-door prices of eggs in different regions move together very closely, consistent with the ease with which eggs can be shipped from one part of the country to another.

Figure 12B
Real Store Door Prices



Source: USDA AMS; BLS

The egg industry has consolidated over the last two decades, concurrent with the shift of egg production to the Midwest. Today, approximately 99% of the nation's laying hens are owned by 186 companies that have flocks of more than 75,000 hens, while in 1994 there were almost twice as many (350) companies with flocks of more than 75,000 hens.[26]

Despite this consolidation, egg production remains an unconcentrated industry. The Herfindahl-Hirschman Index (HHI) is a measure of the concentration of an industry based on the market shares of its participants. The index ranges from zero, indicating perfect competition, to 10,000, indicating monopoly. The HHI for the egg production industry is around 400, which is exceedingly low.[27] When analyzing competition, the U.S. Department of Justice considers HHIs below 1,500 to indicate a competitive industry.

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[26] American Egg Board (www.aeb.org/farmers-and-marketers/ndustry-overview).

[27] HHI calculated on flock size using the list of top U.S. egg producers as of December 2014 from Cal-Maine Foods, Inc. Investor Presentation, November 2015, p. 20, and accounts only for shell egg production. The HHI is calculated by squaring the market share of each firm and then summing the results.

More importantly, the concentration of the egg industry is of little importance because there are no barriers to the entry of new firms or to the expansion of existing firms. As noted, egg supply is highly elastic in the long run. This is shown, for example, by the rapid expansion of production in Iowa (Figure 6). Thus, if prices were to rise above marginal production costs, firms seeking to capture the high prices would expand their output, bringing prices back down.

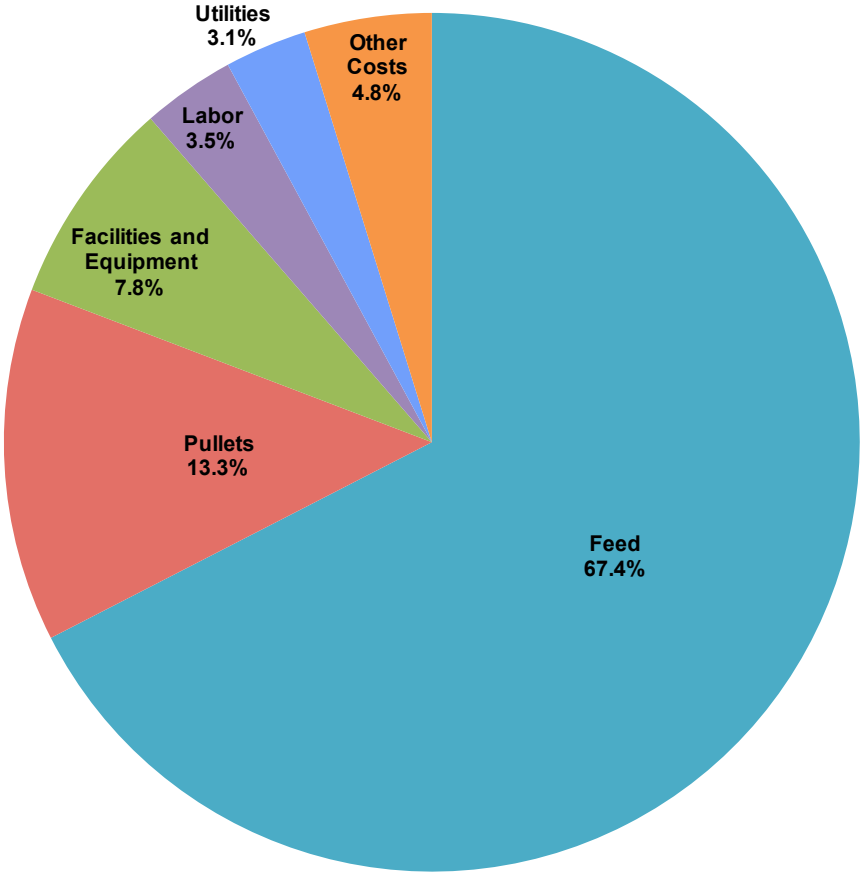
Of course, egg prices may fluctuate sharply in the short term from changes in input costs or supply disruptions. For example, as seen in the 2015 outbreak of avian flu, the price fluctuations from factors that interfere with production may be large because the number of laying hens limits the supply of eggs in the short run. The inability of the industry to immediately respond to higher prices indicates that *short-run* supply elasticity is relatively low in the egg industry.[28] But, the absence of barriers to entry or expansion means that increased supply will eventually bring egg prices back down to levels that reflect long-run production costs.

B. The Cost of Producing Eggs

Figure 13 shows the cost share per dozen eggs of each of the major inputs of egg production, estimated by economists at Iowa State University. The largest expenditures on inputs for egg production are for feed, pullets, facilities and equipment, and labor.

[28] Hoy Carman, "Economic Aspects of Alternative California Egg Production Systems," August 30, 2012, p. 16.

Figure 13
Estimated Egg Production Cost Shares



Source: Otto, D., Ibarburu, M., and Schulz, L. Economic Importance of the Iowa Egg Industry, Iowa State University Extension and Outreach, January 2013, p. 7

Feed is the largest single input cost in the production of eggs. A typical diet for a laying hen in a conventional system is corn (67 percent), soybean meal (22 percent), limestone (8 percent), and supplements such as vegetable oil, vitamins, minerals, and amino acids (3 percent).[29] Feed costs are somewhat volatile, and are generally lower in regions that have grain farms, such as the Midwest.[30] Feed costs are higher for brown eggs than for white eggs because hens that lay brown eggs are larger and eat more per egg produced, and their eggs are larger and often more expensive.

The pullets (young hens) placed into laying barns at approximately 19 weeks of age also represent a large share of production costs. The cost of pullets per dozen eggs depends on a number of factors including the cost of raising the pullets or purchasing them from another

[29] Dan Otto, Maro Ibarburu, Lee Schulz, "Economic Importance of the Iowa Egg Industry," Iowa State University Extension and Outreach, January 2013, p. 8.

[30] Dan Otto, Maro Ibarburu, Lee Schulz, "Economic Importance of the Iowa Egg Industry," Iowa State University Extension and Outreach, January 2013, p. 7.

operation, revenue received for "spent hens," and factors that influence the number of eggs each pullet produces over its lifetime, such as bird mortality and rate-of-lay.

Most laying hens in commercial operations are between 100 and 130 weeks of age when they have finished their egg production cycle and are subsequently slaughtered.[31] This means that producers are constantly replenishing their flocks with new hens, even if they are not expanding their production capacity. Some egg producers hatch their own chicks to raise laying hens, others purchase day-old female chicks and raise them into laying hens, and still others purchase pullets at approximately 19 weeks, when they are ready to begin laying eggs.

Commercially raised laying hens typically begin laying eggs at 18 to 22 weeks of age, at a rate-of-lay of approximately 10 to 20 percent. (This means that a flock of 100 hens will produce 10 to 20 eggs per day.) Hens reach peak production around 30 to 32 weeks of age, at a rate-of-lay of 90 percent or more. After that, rate-of-lay declines to around 50 percent by 60 to 70 weeks of age. At that point, depending on farm management decisions, hens commonly enter a molting period, during which they shed feathers and temporarily cease laying eggs. After the molting period, the hens enter a second lay cycle and resume laying eggs until they are around 100 or 110 weeks of age. At this point most hens are replaced, though some farms induce a second molt.[32]

The average rate-of-lay for the U.S. flock as of September 2015 was 77.6%, meaning that on average 77.6 eggs were laid per day for each 100 hens.[33] At that rate, the average hen in a commercial operation produces approximately 283 eggs per year. The average number of table eggs produced by hens on U.S. farms has increased from around 250 in 1983.[34] Getting more eggs per hen lowers the average cost of producing each egg.

It is normal in commercial operations for some percentage of birds to die from such causes as cannibalism ("pecking"), smothering, and disease. The mortality rate affects the cost of pullets because it reduces the number of eggs per pullet.

Facilities and equipment costs are the third largest cost for most egg farms. These costs primarily include land, buildings, and equipment. Facilities costs are sensitive to factors such as choice of technology and scale, land cost, and cost of capital. One recent study reported a cost of approximately $15 per hen for a conventional housing system in the upper Midwest. The majority of these costs were for equipment (66%), while house construction accounted for most of the rest (33%).[35]

Labor is a relatively small share of cost in conventional egg production and includes management as well as the workers required to maintain facilities and to monitor the hens. Egg

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31 Ryan Meunier and Dr. Mickey A. Latour, "Commercial Egg Production and Processing," Purdue University (http://ag.ansc.purdue.edu/poultry/publication/commegg)

32 Ryan Meunier and Dr. Mickey A. Latour, "Commercial Egg Production and Processing," Purdue University (http://ag.ansc.purdue.edu/poultry/publication/commegg)

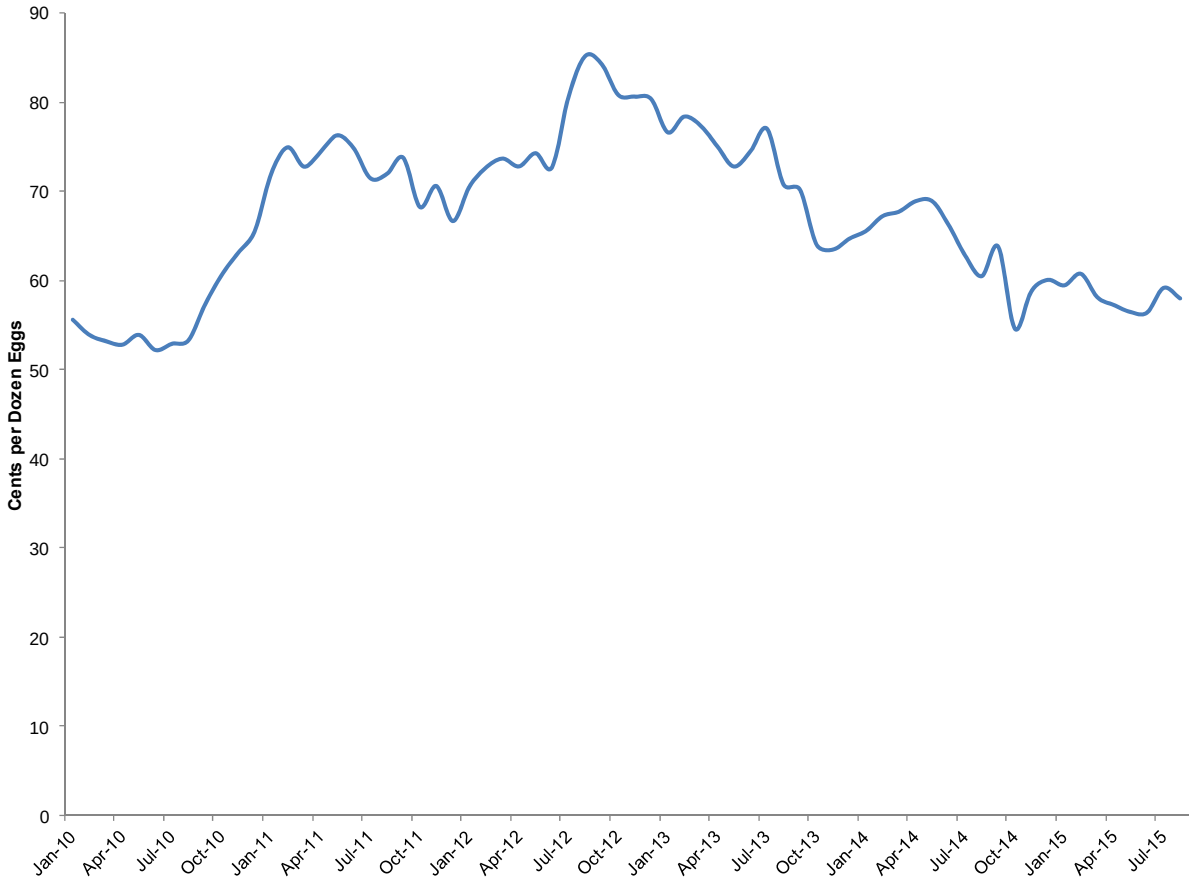
33 American Egg Board, Industry Overview.

34 Daniel A. Sumner, J. Thomas Rosen-Molina, William A. Matthews, Joy A. Mench, and Kurt R. Richter, "Economic Effects of Proposed Restrictions on Egg-laying Hen Housing in California," University of California Agricultural Issues Center, July 2008, Figure III.3.

35 W. A. Matthews and D. A. Sumner, "Effects of Housing System on the Costs of Commercial Egg Production," 2015 Poultry Science 94:552-557, p. 556.

production today on the very large operations that produce the bulk of the nation's table eggs is a highly automated process, using very little labor. It is estimated that a single worker can usually oversee more than 100,000 hens.[36]

Figure 14
Estimated Production Cost: Cents per Dozen Eggs
Midwest Region (2010-2015)



Source: Egg Industry Center

Production costs vary across geographic regions, based on differences such as relative proximity to grain production and cost of land, with the Midwest being the low-cost producer. Figure 14 shows estimated monthly egg production costs in nominal cents per dozen for farms in the Midwest between 2010 and August 2015.

IV. Rise of Cage-Free Eggs

Today, there is a growing demand for cage-free eggs and this demand is driving changes in egg farming. For example, large restaurants and top food companies such as McDonalds, Dunkin

[36] Daniel A. Sumner, J. Thomas Rosen-Molina, William A. Matthews, Joy A. Mench, and Kurt R. Richter, "Economic Effects of Proposed Restrictions on Egg-laying Hen Housing in California," University of California Agricultural Issues Center, July 2008, p. 29.

Donuts, and Unilever (manufacturer of Hellman's Mayonnaise and Ben & Jerry's ice cream) have announced plans to shift entirely to using cage-free eggs, indicating that they expect consumers to increasingly demand cage-free eggs and products made with cage-free eggs. Figure 15 is a list of commitments to use cage-free eggs announced by selected top food companies. In cases where available, the table indicates the number of eggs the company purchases each year. At 2 billion eggs per year, McDonalds alone uses more eggs than would be affected by the Massachusetts ballot measure (approximately 1.1 billion based on 2014 population and per capita consumption).

Figure 15
Cage-Free Commitments by Top Food Companies

Company	Annual Egg Use	Commitment (Announcement Date)
Costco	2.9 billion	Working toward 100% cage-free; sold 763 million (26%) cage-free in 2015; expects to sell more than one billion cage-free eggs in 2016 (2007, 2015)
McDonalds	2 billion	Switch to 100% cage-free by 2025 (Sep 2015)
Burger King	"hundreds of millions"	Switch to 100% cage-free by 2017 (Apr 2012)
Dunkin Donuts	380 million (based on 1.4 millon hens and lay rate of 273)	100% cage-free eggs by 2025; 10% of all eggs for breakfast sandwiches to be cage-free by end of 2016; already met goal of 5% cage-free by end of 2013 (Dec 2015)
Unilever (Hellmann's Mayonnaise, Ben & Jerry's)	350 million	Working toward 100% cage-free (already achieved 50%) (2013)
Taco Bell (Yum Brands)	130 million	Switch to 100% cage-free by end of 2016 (Nov 2015)
Panera	120 million	Switch to 100% cage-free by 2020 (Nov 2015)
Compass Group USA	48 million eggs plus 30 million pounds of liquid eggs	Cage-free policy introduced in 2007 extended to purchases of liquid eggs by end of 2019 (2007 and 2015)
Sodexo	39 million shell eggs plus additional liquid eggs	Switch to 100% cage-free for liquid eggs by 2020; already met 100% cage-free goal for shell eggs in 2014 (2012 and 2015)
Aramark	30 million	Switch to 100% cage-free shell eggs by end of 2014 (Jan 2013)
TrustHouse Services Group	10 million	Switch liquid egg purchases to 100% cage-free by 2020 (Mar 2015)
Nestlé	20 million pounds	Switch to 100% cage-free by 2020 (Dec 2015)
Starbucks	N/A	Switch to 100% cage-free by 2020 (Sep 2015)
Kellogg	N/A	Switch to 100% cage-free by 2025 (Oct 2015)
Target	N/A	Switch to 100% cage-free by 2025 (2016)
General Mills	N/A	Working toward 100% cage-free (2015)
Supervalu	N/A	Switch to 100% cage-free for Wild Harvest brand eggs by end of 2015 (2015)
…and more than 70 additional companies		

To meet this growing demand for cage-free eggs, many egg producers have invested in cage-free housing systems. The USDA estimates that in September 2015 there were approximately 23.6 million cage-free laying hens in the U.S. (including organic and non-organic flocks), up 37% from the previous year.[37] And this number is rising rapidly. Observing that there is currently a "building boom" among egg producers, one source reports that 26 egg producers (with approximately 100 million combined hens) are investing in housing for 7 million hens in 2016,

[37] Terrence O'Keefe, "US Cage-Free Egg Layer Flock Is Rapidly Increasing," WattAgNet.com, November 16, 2015.

of which 4 million will be in newly constructed cage-free facilities.[38] Industry analysts report that for the first time in decades the majority of new housing capacity being installed, in terms of the number of hens that can be housed, is cage-free, and that if all of the new cage-free systems planned for installation could be fully stocked by the end of 2016 the cage-free flock (including organic) would increase by 19 million birds, relative to September 2015. In fact, these projects will not be fully stocked in 2016 because stocking a new housing system can take a year or more.[39]

Figure 16 provides a selection of specific investments in cage-free housing by major egg producers. For example, in October 2015 the two largest egg producers, Cal-Maine Foods and Rose Acre Farms, announced a joint venture to build and operate a cage-free operation in Texas, with capacity for 1.8 million hens and permitted to house 2.9 million hens.[40] The CEO of Rose Acre announced that every facility it builds or refurbishes will be cage-free.[41] The third largest producer, Rembrandt, announced that it would make cage-free eggs its standard.[42] The sixth largest producer, Michael Foods, recently acquired Willamette Farms, a producer of cage-free eggs in Oregon and Washington.[43] Midwest Poultry, the ninth largest, reported adding capacity to house 500,000 cage-free hens to meet its customers' needs.[44] In announcing cage-free projects, producers explain that they are responding to the strong and growing demand for cage-free eggs. For example, the CEO of Hickman Family Farms says that "customers are moving to cage-free faster than the regulatory environment is requiring it, so we want to ensure abundant supplies. It's the future of our industry and our business."[45]

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38 Terrence O'Keefe, "Cage-Free Housing Continues to Gain Momentum in 2016," WattAgNet.com, December 14, 2015.

39 Terrence O'Keefe, "US Cage-Free Layer Flock Is Rapidly Increasing," WattAgNet.com, November 16, 2015.

40 Cal-Maine website.

41 David Kesmodel, "Flap Over Eggs: Whether to Go 'Cage-Free' – As states ban tight confinement of hens, farmers weight the cost of open layouts against simply larger coops," Wall Street Journal, March 16, 2015.

42 Rembrandt website.

43 Eric Schroeder, "Post Holdings to Purchase Willamette Egg Farms," Food Business News, September 23, 2015.

44 Terrence O'Keefe, "Adding Cage-Free Production Was Good for Business," WattAgNet.com, October 17, 2013.

45 Poultry Times, "Hickman's Family Farms Announces Cage-Free Egg Expansion," September 15, 2015.

Figure 16
Selected Cage-Free Investments by Top Egg Producers

Rank	Egg Producer	Total Layers (thousands)	Action Related to Cage-Free Eggs
1	Cal-Maine Foods	34,200	Joint-venture with Rose Acre Farms to build and operate a cage-free egg production complex with capacity for 1.8 million hens and permitted for 2.9 million hens.
2	Rose Acre Farms	24,800	Cage-free joint-venture with Cal-Maine Foods. All future new facilities and refurbishments will be cage-free.
3	Rembrandt Foods	14,500	Announced plans to make cage-free eggs their "standard" in order to accommodate the growing demand for cage-free eggs coming from major food companies.
6	Michael Foods	11,330	Acquired Willamette Egg Farms, producer of cage-free eggs in Oregon and Washington. Will continue to invest in cage-free facilities to meet customer demand.
9	Midwest Poultry	8,500	Added capacity to house 500,000 cage-free hens to meet existing customers' needs.
11	Weaver Brothers	7,500	Constructed two new organic cage-free farms in 2015; began construction for two more cage-free layer farms with capacities of over 1 million cage-free chickens per farm; constructing new cage-free pullet farms; identifies organic and cage-free as "future of our company" and intends to focus growth in those areas.
12	Hickman's Eggs	7,300	Announced 2 million hen cage-free expansion.
13	Sparboe Farms	7,250	Plans to double cage-free production in next three to five years.

Note: Rank and total number of layers for Michael Foods is prior to the acquisition of Willamette (Willamette has 2,300 layers that will add to Michael Foods' flock).

Increasing demand by consumers for cage-free eggs demonstrates that many people derive benefit from knowing that farm animals are not confined in battery cages. While the specific dollar value of this "public good" benefit is uncertain, cage-free pledges by fast food providers like McDonalds, Burger King, and Taco Bell suggest that such benefits are felt by a large cross section of U.S. consumers and not limited to animal rights activists or other special interest groups.

V. Economic Impact of the Proposed Ballot Measure

A. The Cost of Cage-Free Production Systems

Several studies have analyzed the costs associated with cage-free housing systems.[46] The studies differ materially in methodology, and rely on data from different time periods, different conventional housing systems, different cage-free housing systems, and different geographic locations. Also, studies tend to rely on accounting data meaning that their findings are affected by arbitrary decisions about cost allocation. As a result of these differences in data and methodology, it is difficult to directly compare results. While these studies are quite diverse in a

[46] These studies are listed in the bibliography.

number of dimensions and their findings exhibit a range of impacts, they all conclude that cage-free eggs are modestly more costly to produce than conventional eggs. Most of them find the most significant impacts are on pullet, labor, and capital (facilities and equipment) costs.

Feed is the highest single cost element in conventional egg production (Figure 13 above). Cage-free eggs require somewhat more feed because when hens have more freedom of movement they burn more calories. However, most studies find that the transition to cage-free housing has a relatively small impact on feed costs.

Pullets are the second highest cost element in conventional egg farming. Cage-free housing raises pullet costs because it costs more to raise pullets that are acculturated to cage-free housing. Also, hens in some early cage-free systems may have higher mortality rates than hens confined in some battery cage systems. However, this difference is likely to be reduced with more experience and better flock management.[47] The magnitudes of these impacts on egg production costs differ across the various studies, but the effect is to raise initial pullet costs and lower the number of eggs produced per pullet, leading to a higher pullet cost per egg.

Facilities and equipment is the third highest cost element in conventional housing systems and also one of the costs most affected by the transition to cage-free housing. The amount by which cage-free housing raises the cost of facilities and equipment depends on numerous factors, including especially the scale and technology of the cage-free operation. Costs are also affected by numerous other factors such as relative land costs, construction services costs, and the cost of capital. Facilities and equipment costs for cage-free operations also depend on whether the operation is newly constructed or whether it is converted from an existing conventional system. According to an industry source, in 2005 it would have cost $4.50 per bird to convert an existing laying house to a cage-free floor house, and between $12 and $25 per bird to build a new cage-free floor house.[48] The largest egg producer in Rhode Island said it would cost between $12.50 and $15 per bird to convert his farm to cage-free housing.[49] A capital outlay of $15 per bird is roughly equal to a half cent per egg on a simple payback basis, assuming the facility has a 10 year life and the hens have average output.[50]

Labor costs are also higher in cage-free operations. Conventional egg farming is highly automated whereas cage-free operations usually require more labor for certain functions such as monitoring bird health and collecting eggs.

As noted, comparing the results of these studies is challenging because of the differences in their methods and data sources. Ultimately the authors of these studies express their results in terms of the percentage by which cage-free housing raises egg production costs relative to conventional

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47 Joel L. Greene and Tadlock Cowan, "Table Egg Production and Hen Welfare: Agreement and Legislative Proposals," Congressional Research Service, February 14, 2014, p. 20-21.

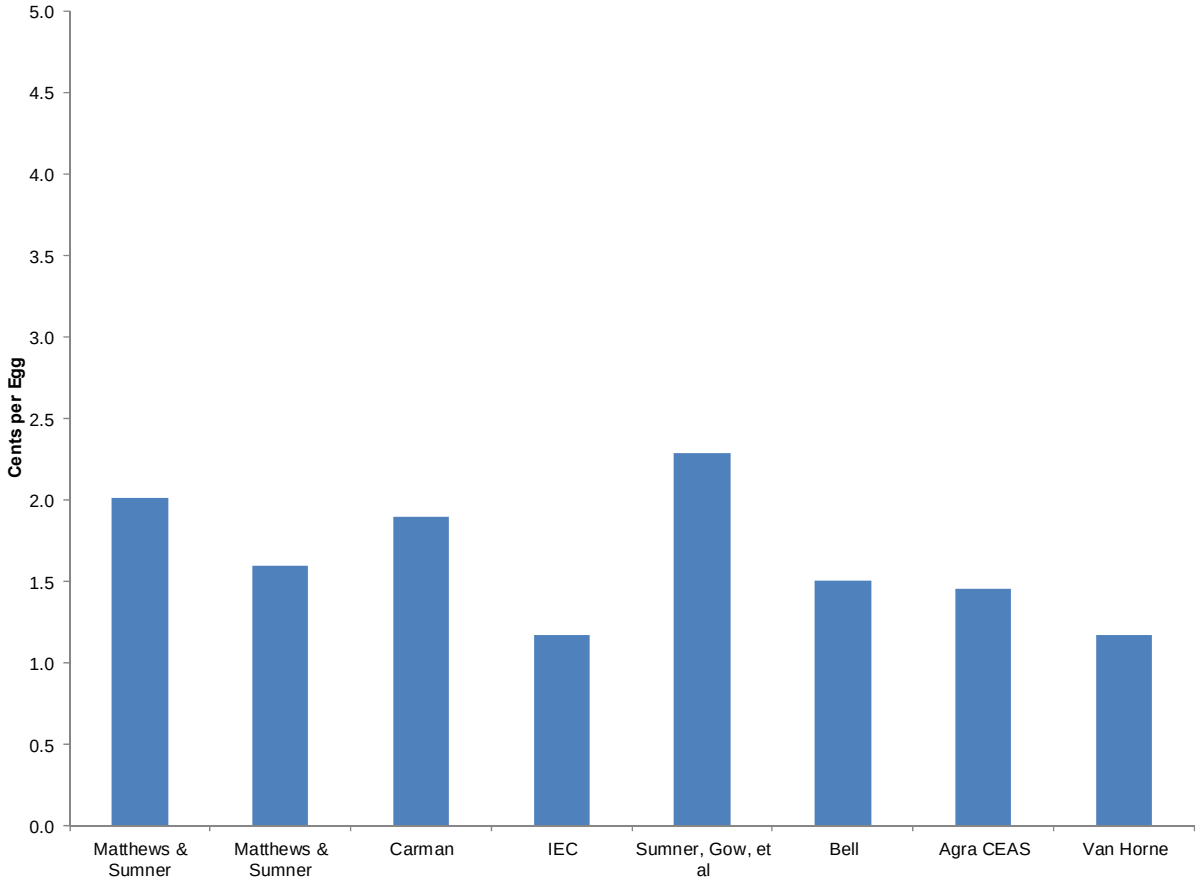
48 "Cost to Convert to Cage-Free," from the July 21, 2005 issue of United Voices, the United Egg Producers Newsletter, posted on website of Sauder's Eggs (www.saudereggs.com/CosttoConverttoCage-Free.htm). Sauder's Eggs is a top producer with around 3 million hens.

49 Based on estimated cost of $500,000 to $600,000 for 40,000 hens. Jennifer Bogdan, "A Chicken Kerfuffle: Humane Society Clucks over Blocked Bill Requiring More Cage Space," *Providence Journal*, July 2, 2015.

50 Total egg output for the facility of 113.2 million is calculated as 40,000 hens times 283 eggs per year.

housing. When these percentage impacts are applied to a representative cost, they find production cost impacts of roughly 1.2 to 2.3 cents per egg as shown in Figure 17.[51]

Figure 17
Estimated Impact of Transition to Cage-Free Eggs (Cents per Egg)



Sources: Studies identified in bibliography; based on conventional egg production cost of 67 cents

The most recent of the studies represented in Figure 17 finds an impact of 1.6 to 2 cents per egg.[52] The study is based on two single-cycle flocks housed in three different housing systems at the same farm in the upper Midwest in 2011-2013. The three housing systems are a conventional house with battery cages, constructed in 2004 and housing 199,680 laying hens; a cage-free aviary, newly built and housing 50,000 hens; and an enriched colony house, newly built and housing 46,800 hens.[53] The first flocks were placed in the respective houses at 19 weeks of age in April 2011 and were removed at 78 weeks of age in June 2012. The second

[51] Based on 67 cents per dozen production costs for conventional housing system. W. A. Matthews and D. A. Sumner, "Effects of Housing System on the Costs of Commercial Egg Production," 2015 Poultry Science 94:552-557, Table 4.

[52] W. A. Matthews and D. A. Sumner, "Effects of Housing System on the Costs of Commercial Egg Production," 2015 Poultry Science 94:552-557, Tables 3 and 4.

[53] W. A. Matthews and D. A. Sumner, "Effects of Housing System on the Costs of Commercial Egg Production," 2015 Poultry Science 94:552-557, p. 553. Enriched colony systems confine hens in cages but provide more space per bird (e.g., 116 square inches) and can include perch, nest, and scratch pad space.

flocks were placed in the houses at 17 weeks of age in June 2012 and removed at 79 weeks of age in August 2013.[54]

Some economic aspects of the study suggest that it may represent the high end of the likely cost impacts, consistent with Figure 17, and that its results may indicate opportunities for future cost reductions through learning. The operators had experience producing eggs in the conventional house using battery cages in the study, whereas they had no prior experience operating the cage-free aviary, which was newly built and which received its first flocks specifically for the study. A companion study on hen performance and egg quality using data from the same experiment notes that some of the results may change as experience with cage-free systems increases. For example, the companion study notes the cage-free aviary had a higher mortality rate relative to the conventional house, and that "[a]lthough the reasons attributed to the difference is unknown, the increase might be due to the learning curve of managing a new housing system and larger hen groups within the pen resulting in pecking and crowding."[55] This higher mortality rate affected the results of the cost impact study because it reduced the number of eggs produced per pullet stocked to the aviary and thereby increased the pullet and capital cost per egg.

The cost estimates in the study also reflect the allocation of fixed costs between the three houses used in the experiment. It appears that each house was allocated the same amount of management expense, although the conventional house held approximately four times as many hens as both the aviary house and the enriched colony house used in the study. The authors recognize this issue, noting that one reason labor costs are lower for the conventional house relative to the other systems is that management costs are spread over a larger flock of birds in the conventional house.[56] Thus, a significant portion of the cost difference is the result of the allocation of management costs to small barns with fewer layers (and therefore eggs) than in the barn employing traditional battery cages. The allocation of such costs is always economically arbitrary and at a minimum raises the question of whether cage-free egg costs would be lower if operations were on a scale comparable to the conventional barn used in the study.

The study reports that capital costs (primarily building and equipment) per dozen eggs are 180% higher in the aviary than in the conventional facility.[57] This is higher than the impact found in all but one of the studies we reviewed. Capital costs for the aviary are based on an initial outlay of approximately $39 dollars per hen housed, which is also at the high end of the costs found by other studies. For example, a 2008 study of the cost of new or converted cage-free housing in California – a notably high-cost state for egg farming – reported costs of "$10 to $40 per bird."[58]

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54 Y. Zhao, T.A. Shepherd, J.C. Swanson, J.A. Mench, D.M. Karcher, and H. Xin, "Comparative Evaluation of Three Egg Production Systems: Housing Characteristics and Management Practices," 2015 Poultry Science 94: 475-484, p. 476.

55 D. M. Karcher, D. R. Jones, Z. Abdo, Y. Zhao, T. A. Shepherd, and H. Xin, "Impact of commercial housing systems and nutrient and energy intake on laying hen performance and egg quality parameters," 2015 Poultry Science 94:485–501, p. 494.

56 W. A. Matthews and D. A. Sumner, "Effects of Housing System on the Costs of Commercial Egg Production," 2015 Poultry Science 94:552-557, p. 555.

57 W. A. Matthews and D. A. Sumner, "Effects of Housing System on the Costs of Commercial Egg Production," 2015 Poultry Science 94:552-557, Table 4.

58 Daniel A. Sumner, J. Thomas Rosen-Molina, William A. Matthews, Joy A. Mench, and Kurt R. Richter, "Economic Effects of Proposed Restrictions on Egg-laying Hen Housing in California," University of California Agricultural Issues Center, July 2008, p. 36.

Some recent sources report costs in the range of $10 to $15 per bird.[59] And, as with the other costs, the impact on capital costs is driven partly by the difference in bird mortality. The authors provide alternative calculations of capital costs using 5% and 10% for interest and depreciation.

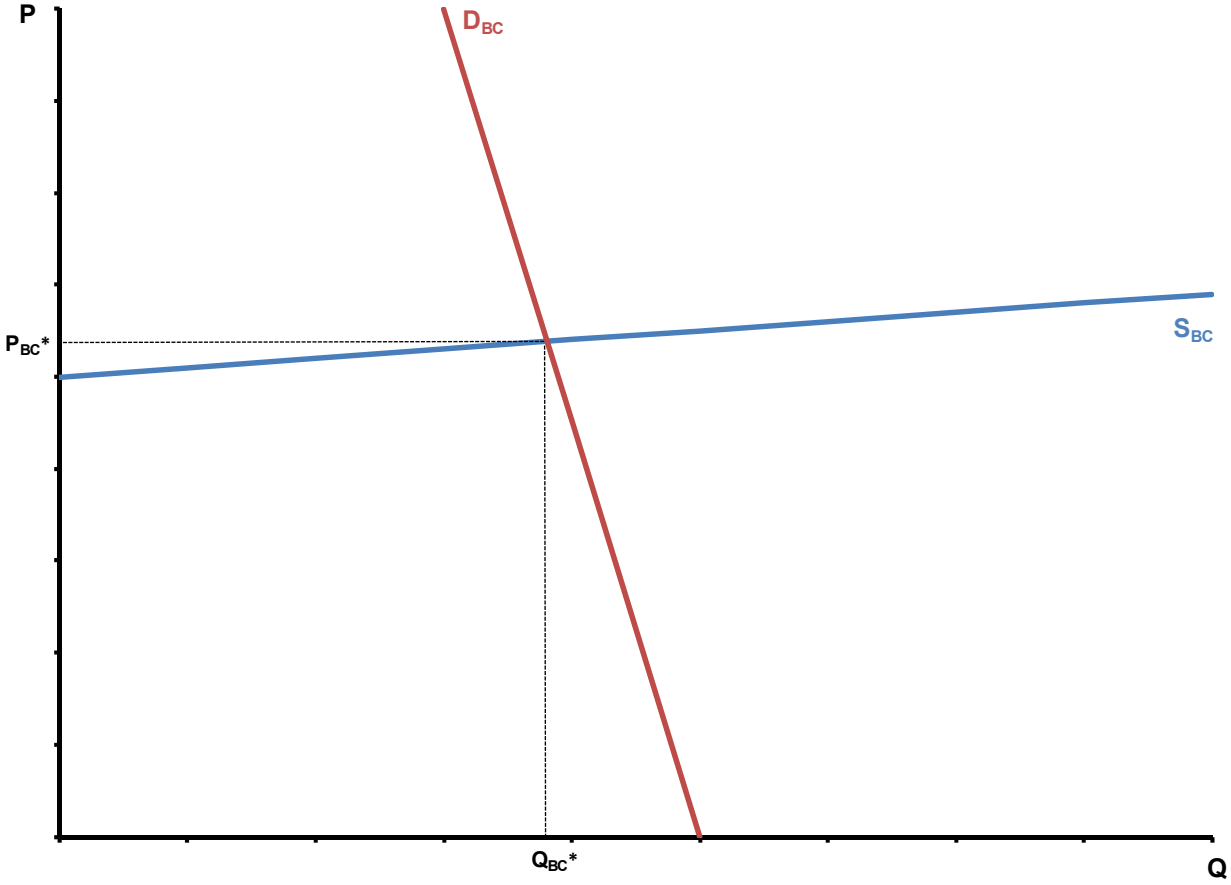
Based on the foregoing, we conclude that the likely near-term cost impact of producing a cage-free egg relative to a conventional egg is between around 1 and 2 cents per egg. That cost impact is likely to be reduced through the normal processes of learning, innovation, and competition that have made U.S. agriculture highly efficient.

B. Retail Prices for Cage-Free Eggs

A key economic question is who will bear these higher production costs of approximately 1-2 cents per egg. The egg industry is competitive, so we can use the standard competitive market model to get a general answer to this question. Figure 18 shows a supply and demand graph for eggs.

[59] David Kesmodel, "Flap Over Eggs: Whether to Go 'Cage-Free' – As states ban tight confinement of hens, farmers weight the cost of open layouts against simply larger coops," Wall Street Journal, March 16, 2015; Jennifer Bogdan, "A Chicken Kerfuffle: Humane Society Clucks over Blocked Bill Requiring More Cage Space," *Providence Journal*, July 2, 2015.

Figure 18
Illustration of Supply and Demand for Eggs

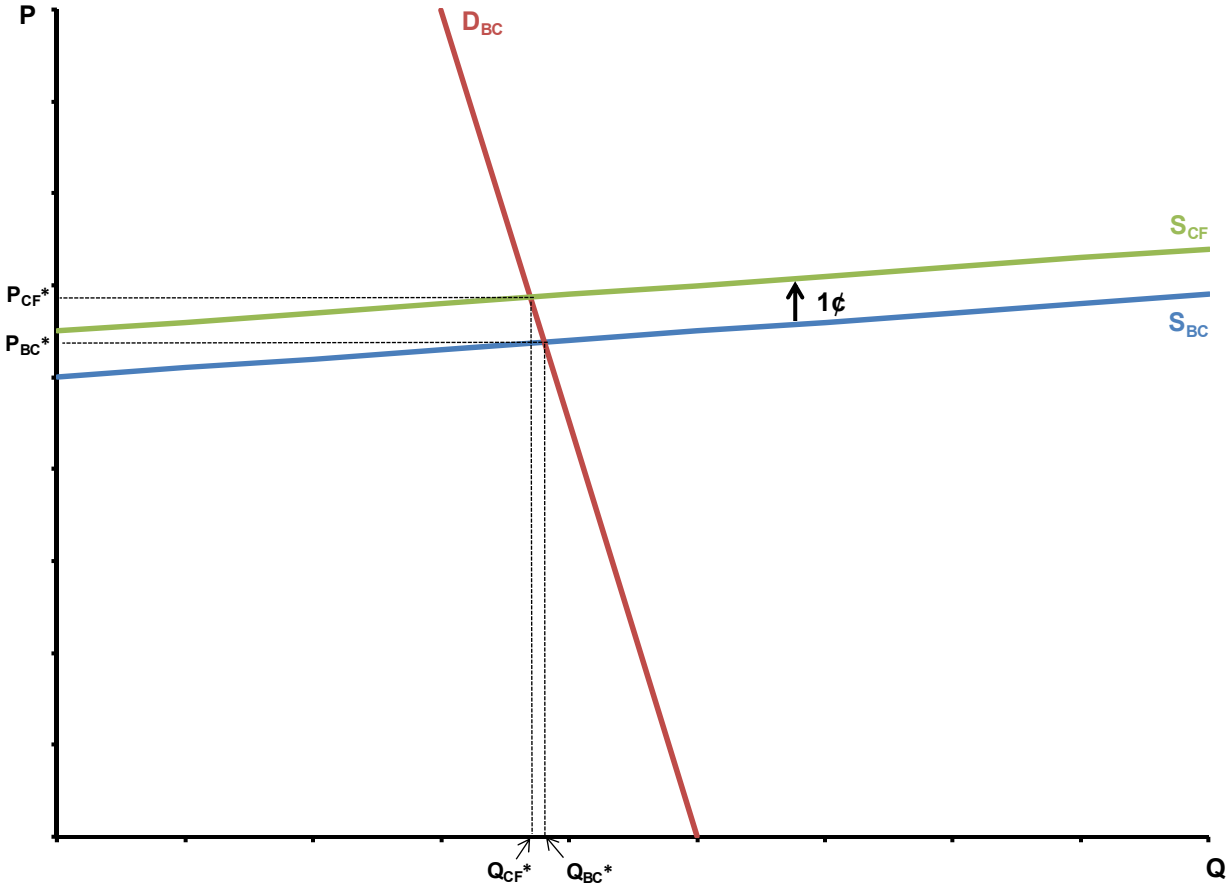


As explained above, the supply of eggs is very elastic in the medium- to long-run, which means that the quantity of eggs produced will increase by a large amount from a small increase in price.[60] This is illustrated by the nearly flat supply curve (S_{BC}) in Figure 18. In contrast to supply, the demand for eggs is highly inelastic, which means that consumers reduce their consumption of eggs very little as the price of eggs rises.[61] This is illustrated by the steep demand curve (D_{BC}) in Figure 18. The equilibrium price and quantity in the market are found where the supply and demand curves intersect, (Q_{BC}*, P_{BC}*). At a price of P_{BC}*, the number of eggs consumers want to buy and the number of eggs suppliers want to produce are the same.

[60] Economists have used supply elasticities of 5.0 and 10.0 in analyses of the economic impacts of new housing regulations. Hoy Carman, "Economic Aspects of Alternative California Egg Production Systems," August 30, 2012, pp. 16-17.

[61] Estimates of the demand elasticity for eggs range from -0.08 to -0.32. Hoy Carman, "Economic Aspects of Alternative California Egg Production Systems," August 30, 2012, pp. 15-16.

Figure 19
Illustration of Supply and Demand for Eggs with 1 Cent Increase in Price



As explained above, the farm cost of producing a cage-free egg is 1 to 2 cents higher than a battery-cage egg, which implies that the supply curve for cage-free eggs is higher than the supply curve for battery-cage eggs. Figure 19 shows the shift in the supply curve caused by the switch from battery-cage to cage-free production methods (*i.e.*, the supply curve shifts upward from S_{BC} to S_{CF}). The figure allows us to compare qualitatively the equilibrium price and quantity with both traditional battery-cage production and with cage-free production.[62] The figure shows that the equilibrium quantity falls by a very small amount, from Q_{BC}* to Q_{CF}*, as a result of the switch to cage-free production. Moreover, the market price of eggs rises by almost the full amount of the increase in production costs of cage-free eggs, from P_{BC}* to P_{CF}*. Thus, the relative slopes of the supply and demand curves imply that the quantity of eggs demanded and the profitability of producers will be little affected by regulations regarding the housing of laying

[62] For simplicity, the figure assumes no change in the demand curve. In fact, some consumers may choose to purchase more eggs if eggs with cage-free characteristics are available at lower prices than the price of today's specialty eggs.

hens. The quantity of eggs consumers demand from producers will fall by only a small amount and the price received by producers will increase to cover the costs of cage-free production.[63]

3. The Relationship between Farm Prices and Retail Prices of Eggs

Competition ensures that egg producers will only be able to increase prices by the increased cost associated with cage-free production relative to battery-cage production. Most studies of the egg industry assume that increases in egg production costs will be passed through to consumers on a penny-for-penny basis.[64] This conclusion is consistent with the structure of the egg industry, and more detailed economic analysis of egg pricing data provides further confirmation.

As shown above, the egg industry has many firms and has no barriers to entry and no barriers to expansion. Moreover, U.S. egg producers are in competition with one another because eggs are shipped throughout the country, and in particular from the Midwest to all parts of the country. Thus, if the farm price of eggs were to rise above production costs, egg producers would increase their output to take advantage of the high, profitable prices available in the market. Competition will keep prices to egg producers in line with their (marginal) production costs.

Competition in the other levels of the egg distribution channel will similarly protect consumers from price increases that exceed increases in production costs. The trucking and distribution required to get eggs from regions where they are produced to regions where they are consumed is competitively supplied. Thus, there is no reason to believe that distribution costs will rise if the farm price of eggs rises somewhat. Similarly, retailing in most regions of the country is quite competitive, with many supermarkets competing for customers' business. Competitive retailers will also be compelled by competitive forces to pass through only their increase in costs. Competitive wholesaling, distribution, and retailing sectors protect consumers and ensure that any increases in the farm prices of eggs are not further "marked up" as eggs make their way to consumers.

The hypotheses that the wholesale and retail prices of eggs in importing regions will increase penny-for-penny with the farm price of eggs is testable using price information from the USDA. The USDA reports prices paid to egg producers in Iowa, Minnesota, and Wisconsin for large eggs. Economic reasoning indicates that these prices reflect the (marginal) costs to the surveyed producers of producing eggs.[65] Moreover, eggs from the Midwest are sold throughout the country, indicating that the prices in different parts of the country are sufficient to cover the costs

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[63] This does not mean that egg producers will not need to adapt to the consumer preferences for cage-free eggs. Of course, adapting to consumer preferences is simply a cost of being in business in a competitive marketplace. Moreover, since the shift to cage-free production can be expected to take place over a relatively long period of time and current laws do not cover all types of eggs, there is little reason to believe that egg producers will find that recent investments in conventional housing need to be replaced in the near term.

[64] E.g., Colin A. Carter and Tina L. Saitone, "California's Egg Regulations: Implications for Producers and Consumers," Agricultural and Resource Economics Update, Giannini Foundation of Agricultural Economics, University of California, v. 18 no. 4, Mar/Apr 2015, p. 3; Agralytica Consulting, "Economic Impacts of Converting US Egg Production to Enriched Cage Systems, A Report for United Egg Producers," June 1, 2012, pp. 2-3, 24-25; Promar International, "Impacts of Banning Cage Egg Production in the United States, A Report Prepared for United Egg Producers," August 2009, p. 30.

[65] In a competitive industry, prices are equal to the marginal cost of production in equilibrium. The marginal cost of production is the farm's cost of producing one more egg. It is not the accounting cost of producing an egg.

of purchasing and transporting eggs from the Midwest. Thus, we can evaluate whether regional egg prices at the wholesale and retail level change by more or less than changes in the price of eggs to producers in the Midwest.

The USDA publishes the price of eggs at retail in New York. Analysis of the effect of the price of eggs received by producers on these prices shows that they respond relatively slowly to changes in the producer price of eggs, but that after some lag, retail prices rise penny-for-penny with producer prices. Analysis of warehouse prices and store-door prices shows a similar penny-for-penny response to increases in producer prices, but warehouse and store-door prices respond more quickly to changes in producer prices.

These results confirm empirically that the cost increases associated with providing higher-quality housing to laying hens will not be marked up in the supply chain. Thus, consumers will see price increases that just cover the costs of improved hen welfare.

C. California's Experience with Proposition 2

In 2008 California voters adopted Proposition 2, which required that laying hens in the state be able to stand up, lie down, turn around, and fully extend their limbs. Subsequently, the state enacted a law (Assembly Bill 1437) requiring that all shell eggs sold in the state come from hens that meet the same standard.[66] These policies took effect in January 2015. As explained below, we conclude that California's experience with Proposition 2 has very limited usefulness for forming expectations about what is likely to happen in Massachusetts.

1. California Egg Prices Relative to Egg Prices in Chicago and New York

Researchers noted a sharp increase in California egg prices that coincided with the effective date of Proposition 2 and AB 1437 and attributed that price increase to the new policies. For example, the USDA Economic Research Service (ERS) compared egg prices in California with those in New York and concluded that "[i]n the short term, the new regulations have widened the price difference between the California market and other parts of the United States."[67] Similarly, economists at the University of California's Giannini Foundation of Agricultural Economics compared egg prices in Southern California with egg prices in Chicago and found that the California prices had been jumped by as much as $2.00 per dozen at one point in January 2015 as a result of the new regulations. They also note, however, that the price premium had somewhat dissipated by April 2015.

The data these researchers use is shown in Figure 20. The figure shows monthly average prices for one dozen large white eggs delivered to retailers ("store-door") in Southern California, New York, and Chicago between January 2014 and August 2015. Through the first 11 months of 2014, eggs were more expensive in Southern California than in Chicago or New York and the price differentials were relatively stable, with egg prices in Southern California averaging 13 and 21 cents per dozen higher than in Chicago and New York, respectively.

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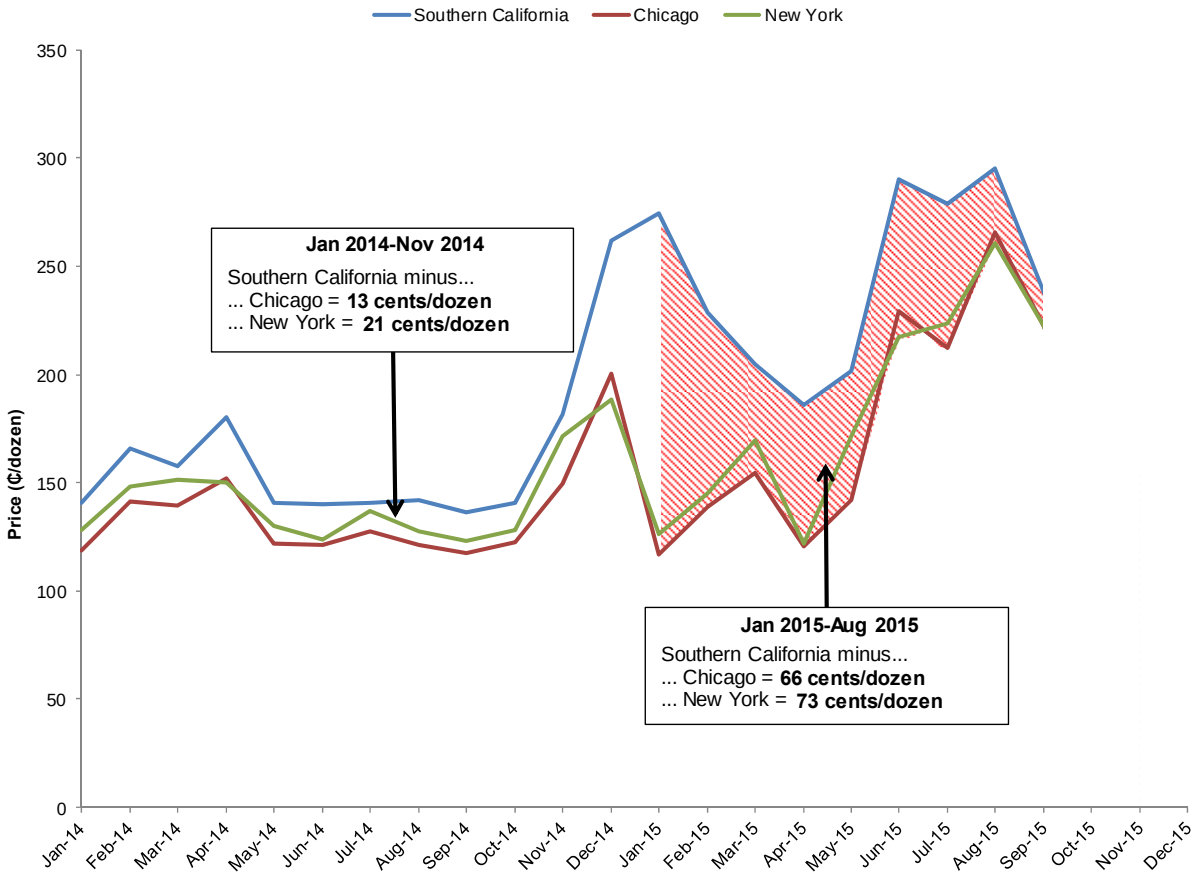
[66] Joel L. Greene and Tadlock Cowan, "Table Egg Production and Hen Welfare: Agreement and Legislative Proposals," Congressional Research Service, February 14, 2014, pp. 22-23.

[67] USDA ERS, "New Cage Size Regulations Contribute to Widening Egg Price Gap," undated.

The figure shows that egg prices spiked in all three of these locations in December 2014, prior to California's measure becoming effective. In January 2015, prices in Chicago and New York quickly returned to pre-December levels, but those in California remained at elevated levels for several months. After spiking in January, California egg prices fell steadily until April 2015, but still remained relatively higher than Chicago and New York. In June the prices in all three areas spiked again, this time in response to the detection of avian flu on many farms throughout the Midwest and west, which led to the loss of many laying flocks.[68] California prices remained at elevated levels relative to those in Chicago and New York.

As shown in the figure, between January and August 2015, egg prices in Southern California were 66 and 73 cents per dozen more expensive than in Chicago and New York, respectively. This increase in the differential of approximately 53 cents per dozen is the "premium" that the researchers attribute to Proposition 2 and AB 1437.

Figure 20
Egg Prices in California, Chicago and New York
January 2014-August 2015

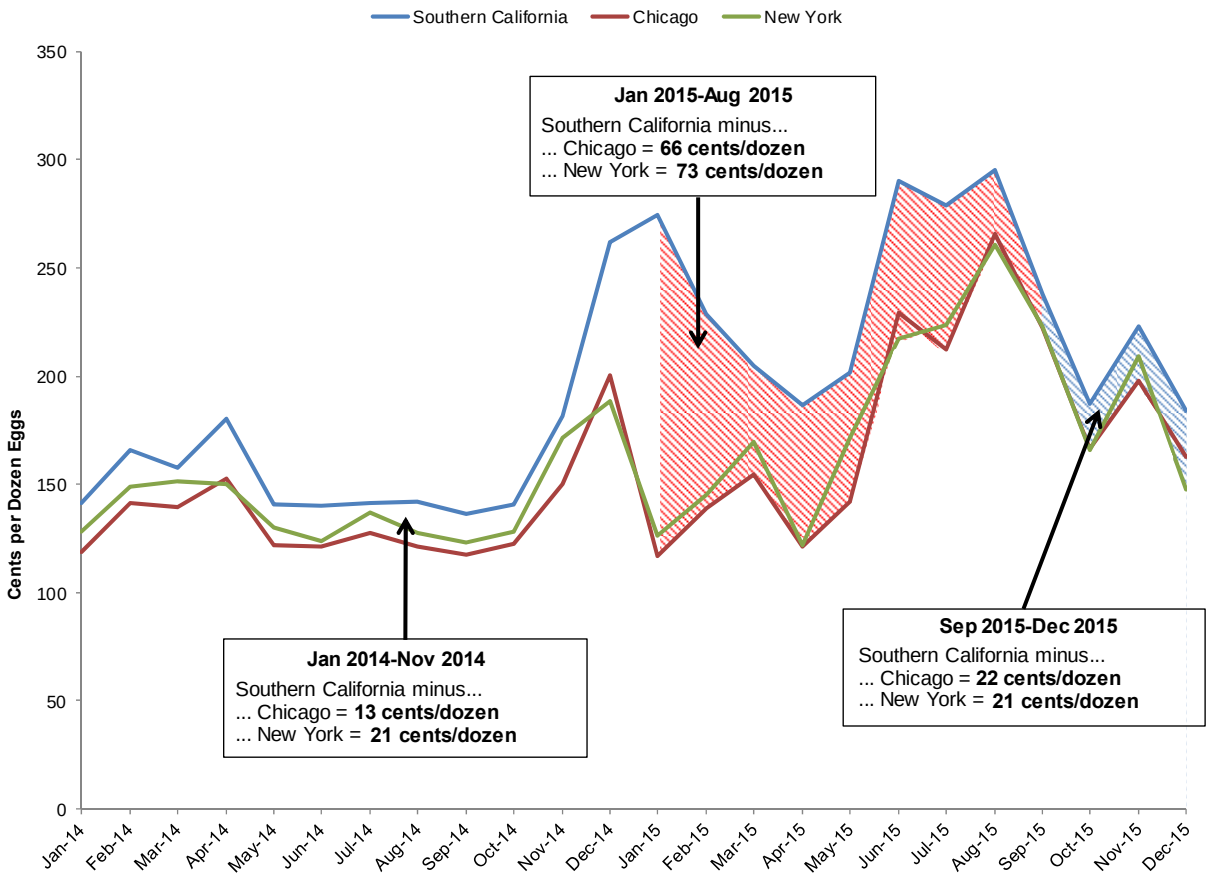


Source: USDA AMS delivered store door prices for Southern California, New York, and Chicago

[68] The US table laying flock in September 2015 was 273 million birds, down from 296 in May 2015. American Egg Board (www.aeb.org/farmers-and-marketers/industry -overview).

As noted, the USDA researchers had called this price increase a "short term" effect. And, the University of California researchers noted that by April the premium had substantially dissipated and they anticipated that it would continue to decline until it reflected the production cost difference between California-compliant eggs and battery-cage eggs.[69] Figure 21 extends the analysis in Figure 20 with more recent data. As shown, these differentials did indeed decline further after August 2015, and between September and December they were 22 and 21 cents for Chicago and New York, respectively. This means that in the final three months of 2015, compared to the differentials that existed in the first 11 months of 2014 California prices were unchanged (relative to New York prices) or 9 cents per dozen higher (relative to Chicago prices.

Figure 21
Egg Prices in California, Chicago, and New York
January 2014-November 2015



Source: USDA AMS delivered store door prices for Southern California, New York, and Chicago

[69] Colin A. Carter and Tina L. Saitone, "California's Egg Regulations: Implications for Producers and Consumers," Agricultural and Resource Economics Update, Giannini Foundation of Agricultural Economics, University of California, v. 18 no. 4, Mar/Apr 2015.

2. What Caused Egg Prices in California to Rise?

There appears to be no disagreement that the disruption in California egg prices in the first few months of 2015 was caused by a shortage of California-compliant eggs. The price rose by far more than the cost of complying with the new law by any estimate. Indeed, this shortage had been predicted by industry analysts and economists who had warned of a lack of investment by egg producers to prepare for the new laws. For example, economists at Iowa State University reported a shortfall of around 2 or 3 million hens to supply California with its normal demand for eggs, and they projected that this shortfall would lead to price increases of between 28% and 42%.[70]

Similarly, researchers at the University of California attribute the price premium to a shortage of California-compliant eggs, which they say was caused by regulatory uncertainty, noting that producers in California and those selling into California face "great uncertainty" as to whether their housing systems will be found to comply with the new law.[71] Moreover, they concluded that the premium "will eventually approximate production cost differences." This conclusion illustrates that they expected the shortage to end as eggs that are compliant with California's regulations became available.

Price spikes are the natural market outcome from shortages in markets (like eggs) where demand elasticity is very low and short-run supply elasticity is also very low. However, shortages are also self-correcting in competitive markets. Unless a shortage can somehow be made permanent – which is antithetical to competition – then price spikes will induce increased supply, and this relieves the shortage.

While recent data shown in Figure 21 seem to suggest that California's shortage conditions have been relieved, some uncertainties remain – e.g., public disagreement as to whether eggs must be produced by hens in cage-free systems in order to comply with the law,[72] and unresolved litigation – and it may be a while before we have price data that will be useful for understanding the impact of the new policies on the prices California consumers will pay for compliant eggs. In the meantime, one source reports that egg producers who supply California are already working to convert their existing housing systems to cage-free and that the California market will be almost entirely cage-free within five years.[73]

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70 "The California Situation: A Special Report," compiled by Maro Ibarburu, Iowa State University, December 29, 2014, p. 3.

71 Colin A. Carter and Tina L. Saitone, "California's Egg Regulations: Implications for Producers and Consumers," Agricultural and Resource Economics Update, Giannini Foundation of Agricultural Economics, University of California, v. 18 no. 4, Mar/Apr 2015, p. 3.

72 Colin A. Carter and Tina L. Saitone, "California's Egg Regulations: Implications for Producers and Consumers," Agricultural and Resource Economics Update, Giannini Foundation of Agricultural Economics, University of California, v. 18 no. 4, Mar/Apr 2015, pp. 2-3.

73 Terence O'Keefe, "Cage-Free Housing Continues to Gain Momentum in 2016," WattAgNet.com, December 14, 2015. See also Dave Horvath, "Opal Foods Acquires Moark," Neosho Daily News, May 13, 2014.

3. The Massachusetts Ballot Measure Will Not Lead to Egg Shortages

The key question for Massachusetts is whether we should expect to experience similar shortages in 2022 if we adopt the proposed ballot measure. For two main reasons, we believe the prospect for Massachusetts is very different.

First, the Massachusetts measure has important features that differentiate it from California's Proposition 2. The California measure has been criticized by some egg producers and economists as "vague" and leading to a climate of regulatory uncertainty that impeded investment because it did not specify an engineering standard in the form of minimum space requirements and instead included only the performance standard of behavioral rules for hen confinement.[74] Others argue that the lack of numerical specificity in the California rules was a feature that was intended to provide for flexible response by egg farmers, and that egg producers failed to make adequate timely investments to prepare for the new rules because they instead chose a strategy of litigating against the rules.[75] Federal and California judges have rejected claims by California egg producers that the language of Proposition 2 is unconstitutionally vague.[76]

In any case, the Massachusetts measure contains provisions that can avoid concerns about regulatory uncertainty. Specifically, it provides for a specific minimum amount of space per bird. Also, it directs the Attorney General to promulgate rules and regulations for the implementation of the act on or before January 1, 2020. Timely promulgation of rules and regulations would also help to avoid regulatory uncertainty that might otherwise confront egg farmers and other businesses that must make investments and take other steps to make sure they are ready for the new rules when they take effect.

Second, Massachusetts will also benefit from the fact that its egg demand is a very small share of the national egg market (2%). California is a very large state with the nation's largest egg demand (12% of national consumption, roughly six times that of Massachusetts). In order to have sufficient California-compliant eggs at the time Proposition 2 went into effect, approximately 12% of the U.S. laying flock needed to be in housing other than battery cages. (As noted, there is an ongoing disagreement as to exactly what housing is compliant.) However, industry analysts estimated that around 95% of hens in the U.S. flock in 2014 were confined in battery cages.[77] This meant that meeting California's new policy would now require massive changes in the little time left during the phase-in period. Proposition 2 was designed to provide a 6 year transition period, but, as noted, insufficient investment was undertaken to meet California's egg demand from compliant housing.

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[74] Colin A. Carter and Tina L. Saitone, "California's Egg Regulations: Implications for Producers and Consumers," Agricultural and Resource Economics Update, Giannini Foundation of Agricultural Economics, University of California, v. 18 no. 4, Mar/Apr 2015, pp. 2-3.

[75] HSUS, "What's Going on with Egg Prices in California?" (http://cagefreeca.com/egg-shortage-california/)

[76] Joel L. Greene and Tadlock Cowan, "Table Egg Production and Hen Welfare: Agreement and Legislative Proposals," Congressional Research Service, February 14, 2014, p. 24.

[77] Joel L. Greene and Tadlock Cowan, "Table Egg Production and Hen Welfare: Agreement and Legislative Proposals," Congressional Research Service, February 14, 2014, p. 20.

Massachusetts need face no such shortage in 2022. In 2014 there were approximately 4.2 million hens outside the state of Massachusetts whose eggs were shipped into the state for sale as shell eggs, or less than 2% of the U.S. table laying flock.[78] As noted above, there were already more than 20 million cage-free layers in the U.S. in September 2015 (including organic and non-organic birds), and new cage-free housing is being constructed that will provide capacity for millions of additional hens to meet the demand of consumers and many restaurants and food companies for cage-free eggs. When the ballot measure takes effect in 2022, the egg industry will have had six more years to continue its investment in cage-free housing and to increase the efficiency of cage-free housing systems.

For these reasons, we do not agree with those who would make predictions of the impact of the ballot measure based on 2015 price data from California.[79] Using data from a period when prices reflect shortage conditions does not tell us what will happen to prices when there is no shortage. Even in California the shortage will not be permanent and the high prices seen in 2015 will not persist. Indeed, the data shown in Figures 20 and 21 indicate that California's spike has mostly dissipated, though uncertainties remain.

VI. Conclusions

We conclude that the proposed ballot measure would have minimal impact on farming in Massachusetts and would lead to a small increase in retail prices for consumers who now purchase conventional shell eggs or who purchase foods prepared in Massachusetts from conventional shell eggs.

The production cost impact is an increase of around 1 to 2 cents per egg, which will be reflected in the prices businesses and consumers pay for shell eggs. This impact will apply predominantly to imported shell eggs, because 98% of the hens in Massachusetts are already cage-free, and will apply only to those Massachusetts consumers who do not currently choose to purchase cage-free eggs. Given Massachusetts demographics and the high numbers of organic layers in Northeastern egg surplus states (e.g., more than 1.3 million organic layers in Maine and Pennsylvania[80]), it is likely that a relatively high share of the shell eggs currently consumed in Massachusetts would comply with the requirements of the ballot measure, meaning that the cost impact of the measure on producing these already cage-free eggs would be zero. Nevertheless, if we assume conservatively that none of the eggs currently consumed in Massachusetts are cage-free, and the price of these eggs is 1.6[81] cents higher as a result of the ballot measure, then the out-of-pocket cost to the average Massachusetts consumer is $2.93 per year. This cost represents a very small share of the average person's food budget – i.e., approximately one-tenth of one

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78 Based on per capita consumption of 183 shell eggs, an average lay rate of 77.6%, and Massachusetts production of 44 million eggs.

79 For example, the authors of one study of the impact of Proposition 2 conclude that consumers will face "between a 30% and 70% price increase." Trey Malone and Jayson L. Lusk, "What Is the Real Consumer Cost of Mandating Animal Welfare? An Ex Post Analysis of the Effect of California's Proposition 2," p. 13.

80 USDA NASS 2014 Organic Survey, Table 16, Organic Livestock and Poultry Inventory and Sales – Certified and Exempt Organic Farms: 2014.

81 W. A. Matthews and D. A. Sumner, "Effects of Housing System on the Costs of Commercial Egg Production," 2015 Poultry Science 94:552-557, Tables 3 and 4.

percent.[82] Even for low income consumers, the impact is only roughly one-tenth of one percent of annual per capita food expenditures.[83]

With a long lead time prior to implementation and timely promulgation of clear rules and regulations by the Attorney General, Massachusetts is unlikely to experience a disruption in egg prices when the new measures take effect.

[82] Based on average 2014 per capita food expenditure of $2,703. US Bureau of Labor Statistics, Consumer Expenditure Survey, Table 1110. Consumers who eat more than the average number of shell eggs will face a higher cost.

[83] Based on average 2014 per capita food expenditure of $2,073 for poorest 10% of population. Per capita expenditures on eggs for food consumed at home were similar for the poorest 10% ($23.53) and for the total population ($23.20), representing 1.7% and 1.5% of total expenditures for food consumed at home, respectively. US Bureau of Labor Statistics, Consumer Expenditure Survey, Table 1110.

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