Economic effects of proposed changes in living conditions for laying hens under the National Organic Program

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Primary Audience: Researchers, Policy Analysts, Organic Producers

SUMMARY

In this paper, we estimate the costs and benefits of implementing the proposed National Organic Program for laying hens compared with alternatives. For the regulatory proposals under option 2, the regulatory cost will be zero because most producers are already in compliance with the proposed regulation. The anticipated benefits of this regulation will be zero as well, because the current market prices already reflect consumers' willingness to pay for the existing animal welfare conditions. For the regulatory proposals under option 3, before market adjustments, the average regulatory burden for the entire organic egg industry will amount to $0.09 per dozen eggs, with extreme variations between $0 for small operations and $2.30 per dozen for large operations. If we rely on the average price of organic eggs, $2.69 per dozen, and assume a maximum estimated benefit associated with improved animal welfare conditions, that consumers would be willing to pay of about 30% above the current market price, the estimated benefit of regulation amounts to $0.81 per dozen eggs. Based on the findings, we conclude that option 2 is welfare neutral and could be easily adopted because it already has been adopted by representative producers. For option 3, the benefit-cost ratio is larger than 1, which indicates that the proposal passes the benefit-cost ratio test. The obtained result, however, has to be interpreted with serious reservation because of the differential effect that the proposed regulation would have on different industry participants. Under option 3, the effect of the proposed changes on small organic egg producers is negligible because most small producers are operating under conditions similar to the proposed living standards. However, costs will increase substantially for large organic egg producers and likely cause a substantial number of producers to exit organic production and switch to conventional production, which would cause a substantial decline in the prices of conventional eggs and organic feed in the short run.

Key words: organic, poultry, egg, living conditions, benefit-cost analysis

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DESCRIPTION OF PROBLEM

The USDA-Agriculture Marketing Service (**AMS**) oversees the USDA National Organic Program (**NOP**). As part of the rulemaking process, AMS may conduct economic effect analyses of amendments to the national standards for production and handling of organic agricultural

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products. With potential changes in the requirements for living conditions for organic poultry, the NOP must consider the economic effects of these changes on the regulated industry. The USDA NOP regulations at 7 Code of Federal Regulations Part 205 set forth the national standards for production and handling of organic agricultural products. The NOP regulations were first published in 2000 and were updated in February 2010 to include a substantial practice standard amendment regarding access to pasture for livestock. Livestock living conditions as they apply to poultry are regulated by §205.238 (Livestock Health Care Practice Standard) and §205.239 (Livestock Living Conditions).

The NOP regulations do not set specific stocking rates for either inside housing or outside access areas. The NOP issued a general policy memo in October 2002 affirming that outside access areas are required, but it did not specify size or other details. The NOP subsequently provided a memo regarding exemption to outside access for purposes of biosecurity, as well as a decision that outside access could be provided in a fenced, roofed, and floored outside area (a "porch or veranda" attached to a poultry house). To obtain organic certification, poultry producers must submit to NOP an organic system plan describing outside access. The organic system plan is subsequently reviewed by USDA-accredited certification agents, who then interpret the regulations, review the organic system plan for sufficiency, and conduct on-site inspections to verify compliance by organic operations.

The National Organic Standards Board (**NOSB**), the NOP citizen advisory panel, made recommendations in April 2002, November 2009, and December 2011 on animal welfare issues concerning appropriate living conditions for poultry. On December 2, 2011, based on the NOSB recommendation and independent animal welfare standards, NOP submitted 3 options for regulations regarding outdoor access for poultry. The specific regulatory options that were considered are (1) make no substantial changes to the existing regulation, (2) adopt modified animal welfare standards similar to existing standards, and (3) adopt animal welfare standards that differ substantially from existing standards. The implementation period for options 2 and 3 is 5 yr.

Option 1 provides for no substantial changes to existing regulations. Living conditions under §205.239 do not specify indoor or outdoor stocking rates but require maintaining year-round living conditions that accommodate the health and natural behavior of animals. All animals must have year-round access to the outdoors, shade, shelter exercise areas, fresh air, clean water, and direct sunlight suitable to the species, stage of life, and climate. Use of covered porches or runs is acceptable and soil contact is not required. Pullets may be confined until 20 wk of age if necessary [per §205.239(b)].

Option 2 is similar to existing animal welfare standards. In indoor housing, birds must be able to move freely and engage in natural behaviors (turn around, flap wings, scratch, and dust bathe). Scratch areas and dust baths must be provided. Houses with slatted floors must have a minimum of 15% of available floor space as dust bathing areas. For layers, perches are required with a minimum of 15.3 cm (6 in.) per bird, rails may be included in front of nest boxes, and the floor may be slatted or mesh. Layers in single-level houses must have 1,394 cm^2 (1.5 ft^2), layers in raised roost-type houses must have 1,115 cm^2 (1.2 ft^2), and layers in multi-tier houses must have 929 cm^2 (1.0 ft^2), provided that overhead perches and platforms provide for at least 55% of hens to perch. Natural light is required such that reading is possible on a sunny day with the lights turned off. With artificial lighting, a dark period of at least 8 h must be provided each day. Ventilation must be sufficient to ensure less than 25 ppm ammonia.

Under option 2, exit doors must be distributed around the building and provide ready access to the outdoors such that more than 1 bird can exit at a time. For layers, exit doors must be at least 41 by 36 cm (16 in wide by 14 in high). For outdoor access, pullets must be outside by 16 wk. Outdoor access must be available when temperatures are over 50°F and provide direct sunlight, although solid roofs are allowed. The surface of the run can be concrete but must have a well-maintained substrate of sawdust and wood chips, and scratch areas and dust baths in soil or suitable substrate must be available. Layers must have a minimum of 1,858 cm^2 (2.0 ft^2) per bird for a minimum of 5% of the total flock population. Mobile outdoor pen units must pro-

vide a minimum of 1,858 cm^2 (2 ft^2) per bird and be moved to provide vegetative cover at all times.

Option 3 modifies the indoor living conditions (§205.239) under option 2 to provide more indoor space, increases minimum requirements for scratch areas and dust baths, increases the exit door area, modifies outdoor living conditions to eliminate solid roofs, specifies stocking rates, requires soil scratching areas, and requires year-round vegetative cover. Under option 3, stocking rates, which are calculated by the floor perimeter of the building not including nest boxes or perch areas, must provide a minimum of 1,858 cm^2 (2 ft^2) per laying hen and 1.4 kg (3 lb) of live weight for pullets. For layers, perches are required with 15.2 cm (6 in) per bird with at least 35 cm (14 in) elevation. Pullets must have perches at 4 wk of age. Scratch areas and dust baths must be available for at least 30% of available floor space. Houses with slatted floors are permitted if scratch areas are provided.

For option 3, exit doors must provide ready access to the outdoors with a minimum of 1.8 m (6 ft) per 1,000 birds and a minimum height of 35 cm (14 in). For the outdoor area, no solid roofs are permitted except for shade structures, a shaded area must be provided in warm weather, and birds must have soil contact. In addition, 50% vegetative cover must be provided year-round. Layers must have a minimum of 1,858 cm^2 (2 ft^2) per bird.

The objective of this project was to provide an independent economic effect analysis of proposed regulatory changes for the living conditions for organic poultry. In the current paper, we estimate the costs and benefits of implementing the proposed rule for laying hens, compared with alternatives (as per Executive Order 12866 [1]). The intention is for these results to help guide the decisions of the NOSB when contemplating the adoption of any of the proposed regulatory proposals. Given other urgent priorities at this time, NOP does not anticipate addressing the NOSB proposals on animal welfare in the near future.

MATERIALS AND METHODS

The methodological approach frequently used in economics to evaluate projects or policy proposals is referred to as a benefit-cost analysis. The approach relies on measuring benefits and costs associated with the proposed project or policy; if the benefits are larger than the costs, or if the so-called benefit-cost ratio is greater than 1, the project or policy passes the test and is potentially approved.

Benefits of Regulation

Estimation of the monetary benefits of the regulatory options in this study relies on the benefits transfer approach, which consists of a systematic review of the economics literature to determine if benefits estimates can be transferred from other similar studies and adjusted to reflect the regulatory proposals. The most important part of the proposed regulations for living conditions for organic poultry relates to reducing stocking densities, both indoors and outdoors; thus, studies addressing this particular aspect of animal welfare improvement are most relevant. The economics literature shows that consumers value improvements in animal welfare, and the hypothetical willingness to pay for increased animal space could be quite substantial.

Specifically for the organic egg industry segment, the literature does not contain any consumer preference studies of animal welfare (living conditions) that are similar to the regulatory options. Therefore, we based our estimates on the assumption that benefits associated with improved animal welfare are going to be similar across poultry species, which allows us to use broiler studies to make comparable estimates about organic eggs. As we found out via industry interviews, the representative organic egg producer already satisfies the regulatory requirements related to stocking rates proposed in option 2. Therefore, consumers' willingness to pay for the reduction in animal density has been already incorporated into the price of organic eggs, so no additional benefits are associated with option 2. For option 3, we concluded that the benefits could be at most valued at a 30% increase in willingness to pay over and above the current market prices [2].

Cost of Regulation

We turn now to the methodology for estimating the increased costs associated with the

proposed regulations. The employed methodology relies on the standard enterprise budgeting techniques [3]. In constructing the budgets, we focused primarily on the cost aspects, because these are most relevant in analyzing the economic effects of various regulatory scenarios. The imputed values for total revenue were calculated based on the break-even price, which implicitly assumes the zero-profit condition [4]. The cost estimation methodology involved 2 steps. In the first step, we established the baseline cost structure and the break-even price. In the second step, we analyzed whether any of the specific regulatory requirements in options 2 and 3 will have an effect on the established baseline cost structure. All regulatory proposal items that could have an effect on the representative operation's baseline costs were quantified to obtain the new (postregulation) cost structure and the new break-even price. The comparison of the new (postregulation) and old (baseline) break-even prices is finally expressed as a percentage increase in the break-even price relative to the baseline and represents the cost increase due to regulation.

We simplified the analysis by developing a set of representative operations defined by the size of organic egg operations. Development of representative operations is a method frequently used in conducting economic effect analyses because it facilitates estimation of industry costs with relatively limited data. This method avoids the need to develop a specific cost estimate for each potentially affected entity, which would be a time-intensive and costly process and likely require an extensive industry survey beyond the scope of this project. For the purposes of studying the effects of proposed regulations on the cost of producing organic eggs, we focused our analysis on 3 sizes of organic layer operations: small, midsize, and large flocks.

In line with this approach, we developed structured interview guides [5], where the first group of questions was set up to uncover the basic cost structure of the enterprise and the second group of questions focused on the typical costs involved in complying with the proposed regulations. When conducting industry interviews, we employed a method consistent with the limitations on the number of establishments that may be contacted (fewer than 9) without requiring prior approval from the Office of Management and Budget. Under the Paperwork Reduction Act, Office of Management and Budget approval is required before collecting data from more than 9 entities under government-sponsored studies [6].

Baseline Cost Estimation

The baseline cost estimates presented in this section reflect stylized approximations of highly idiosyncratic individual real-life cases and are not intended to be used to assess an individual producer's profitability or cash flow. The baseline scenarios reflect the average situations for the most frequently observed configurations of production space. In presenting the budgets, we focus primarily on the cost aspects, because these are most relevant in analyzing the economic effects of various regulatory scenarios. The hypothetical values for total revenue are calculated based on the break-even price, which implicitly assumes the zero-profit condition. The basic assumptions employed throughout can be summarized as

- simple linear (straight-line) depreciation of assets with zero salvage value;
- annual opportunity cost of capital of 3%;
- homogenous labor hired at $13.25 per h;
- property tax rate of 0.8% of the value of the assets;
- annual insurance costs of 0.5% of the value of the assets; and
- price variability for inputs according to the size of the flock.

In addition to the above assumptions, land prices were constructed based on average real estate values for farm land per acre in 2011 [7]. Land prices were calculated as the average of the published land prices in the top organic-egg-producing states. Prices for land in New York, Massachusetts, Michigan, North Carolina, and California were averaged to obtain a land price of $5,675 per acre. The annual rental rate was obtained by multiplying the value of land with the 3% interest rate, resulting in annual rates of $170 per acre.

Labor costs were estimated using data obtained on hourly wages for farming, fishing,

and forestry occupations published by the Bureau of Labor Statistics for states with high concentrations of organic egg production. We calculated an average hourly wage rate using wage rates from 8 states—California, Iowa, Massachusetts, Michigan, New York, North Carolina, Oregon, and Pennsylvania—resulting in an average hourly wage rate of $13.25. Organic certification costs were calculated as the average of California Certified Organic Farmers and Iowa Organic Certification Program posted fees for each organic production sales range category.

All budgets were prepared based on the existing literature [3, 8–19], personal communications with extensions specialists and industry leaders, and the authors' expert opinions and insights based on their research on the poultry industry [20]. The budgeting analyses show that the baseline break-even organic price for a representative small organic layer operation is $3.944 per dozen eggs, for a midsize organic layer operation it is $2.475, and for a large organic operation it is $2.396.

Regulatory Cost Estimation

Using the baseline enterprise budgets developed in the first step of the cost estimation methodological approach, in the second step, we analyzed the effect of the regulation on the baseline cost structure. We present the estimated costs of compliance for each regulatory option separately. In each case, we present costs for representative farms of different sizes. In some cases, the representative organic producers are in compliance with the regulatory options; thus, no incremental costs exist due to the proposed regulation. In other cases, the effect of the regulation on costs can be substantial.

Sizes of Organic Egg Operations

One of the important difficulties encountered in this study is the lack of precise data on the distribution of producers by farm size. Having this information is very important because the regulatory proposals we analyzed clearly have significantly different effects on producers depending on their size. Consequently, the combined effect of the proposed regulations on the organic egg industry as a whole will depend on the market shares that different size producers have in the total national production.

To solve this problem, we relied on the data on the number of certified organic egg producers and operations in 2011 obtained by the USDA-AMS survey of 36 USDA-accredited state and private organic certifiers (for details see [5]). Corresponding to our baseline enterprise budget scenarios, we divided the egg industry into 3 segments: small (fewer than 16,000 layers), midsize (between 16,000 and 100,000 layers), and large producers (more than 100,000 layers). To obtain the distribution by the defined size categories, we calculated the average producer's size for each certifying agency by dividing the number of birds by the number of producers that each individual certifying agency certified in 2011. Next, we calculated the percentage share of each certifying agency in the industry total (for each of the poultry industries separately), and we multiplied this percentage share with the average producer size for this certifying agency. Finally, we summed these numbers in each of the individual size categories to obtain the percentage shares of each size category in the industry total. As shown in Table 1, 30% of production is produced by small producers, 54% by midsize producers, and 16% by large producers. Likewise, we summed the number of producers in each size category based on the average producer size of the certifying agency. The results show that 74% of producers are estimated to be small, 25% are estimated to be midsize, and 1% are estimated to be large.

Given the lack of better data, this approach only depends on an assumption that the distribution of producers by size within one certifying agency is not too wide such that the mean size is a good representation of the observed size. Practically, this means that a typical certifier does not certify very small and very large producers at the same time. To the extent that some specialization of certifying agencies exists, such that, for any particular commodity, some of them specialize in certifying small producers and others specialize in certifying large producers, the obtained size distribution should be fairly reliable.

Table 1. Estimated number of Certified Organic Poultry and Egg Producers and Operations by size in 2011[1]

Stock or species	Number of birds	Estimated percentage of production	Estimated number of producers[2]	Percentage of producers
Layer hens (inventory)	7,673,085	100	580	100
Small (1,000 to 16,000 hens)	2,301,925	30	430	74
Midsize (16,000 to 100,000 hens)	4,143,466	54	145	25
Large (more than 100,000 hens)	1,227,694	16	5	1

[1]Based on information collected by USDA-Agricultural Marketing Service [21].

[2]The number of producers for each size category is estimated by assigning all producers of each certifying agency to a size category based on the average production of operations under the certifying agency.

RESULTS AND DISCUSSION

The analysis of the proposed rules on the cost of production of organic eggs starts with the production of layer pullets as the first stage in the egg production cycle. Small pullet operations will typically not be affected by the proposed regulations in either regulatory scenario. In contrast, large pullet producers will be affected in both regulatory scenarios related to the outdoor access after 16 wk of age. To mitigate the effect of these proposed rules, the pullet growers indicated in interviews that they would shift the growing cycle so that the pullets would be moved into the laying facility by wk 16. Subsequently, this would shift the costs of raising the pullets from 16 to 18 wk, where there is no egg production to the egg producer. This would result in the suppression of feed conversion as well as the increase in some utility costs during those 2 wk. However, the price of pullets, if transferred 2 wk earlier, will have to drop, thereby offsetting an increase in cost incurred by layer operations. Therefore, the net effect of regulation on organic egg production through the pullets segment of the market is likely to be zero.

Next, we turn to eggs. Based on our information gathering, the representative typical organic egg producers, regardless of size, currently operate under the requirements proposed under option 2; hence, the effect of proposed regulation on the break-even price is zero. In contrast, the regulatory proposal summarized in option 3 will have multiple effects on the cost structure of representative midsize- and large-scale organic egg producers through

- a one-time (fixed) cost associated with retrofitting the house to install more exit holes, and
- an increased requirement for more outdoor access, which will be reflected in fencing costs and the increased cost of land; increased mortality and reduced feed conversion associated with a substantially increased outdoor area; and additional heating costs to maintain the indoor environment within the thermal neutral zone of the chickens.

However, when it comes to large producers, the most significant effect of option 3 will be reflected in the requirement to significantly reduce the population density on the established farms in response to the proposed regulation regarding the indoor density, with an enormous effect on the revenue reduction that could cause some of the large producers to exit the organic industry and convert their operations into conventional egg production. The combined effect of the proposed regulation in option 3 is estimated to be a 6.8% increase in the break-even price for midsize producers and a 96% increase in the break-even price relative to the baseline cost scenario for large producers. We describe the derivation of these estimates in subsequent sections.

Small Operations (Fewer than 16,000 Hens)

The summary of the regulatory effects of different regulatory options vis-à-vis the baseline for small egg producers is represented in Table 2 [22]. As far as indoor housing requirements are concerned, a typical small organic egg producer should automatically satisfy all of the regulatory option 2 requirements. The same is true for the outdoor access requirement. As a result, the percentage increase in the break-even organic price relative to the baseline is 0%. Similar to option

Table 2. Estimated costs of producing organic eggs under different scenarios for small operations in 2011

Item	Baseline	Option 2	Option 3
Production volume			
Birds per operation (n)	1,000	1,000	1,000
Organic eggs (dozen)	17,904	17,904	17,904
Breaker market eggs (dozen)	3,160	3,160	3,160
Costs per farm ($)			
Total fixed costs	28,892	28,892	28,892
Annualized fixed costs	4,113	4,113	4,113
Variable costs	68,830	68,830	68,830
Total annual costs	72,944	72,944	72,944
Breaker market eggs revenue adjustment[1]	2,338	2,338	2,338
Costs per dozen eggs			
Break-even revenue per bird ($)	70.61	70.61	70.61
Break-even price per dozen organic eggs ($)	3.94	3.94	3.94
Percentage increase over baseline	—	0.0	0.0

[1]Breaker market egg price assumes $0.74 per dozen.

2, when indoor housing requirements are concerned, the typical small organic egg producer should satisfy all of the regulatory option 3 requirements as well. In addition, small producers typically already provide outdoor access, which would meet option 3 conditions. Hence, the percentage increase in the break-even organic price relative to the baseline is also 0%.

Midsize Operations (Between 16,000 and 100,000 Hens)

To satisfy the organic certification requirements, most typical midsize producers are already operating under the indoor stocking rates required by option 2 and, in some cases, are exceeding these stocking rates. Currently, they are operating using a combination of natural and artificial lighting to achieve the 16 h of daylight for optimal performance in the older single-level houses. Outdoor access requirements under option 2 are also being met. A typical organic egg producer is providing access at 2 ft^2 per hen based on approximately 10% of the hens using the verandas. Some producers have allowed for the outdoor space at the 2 ft^2 for 33% of the flock. As the result, the percentage increase in the break-even organic price relative to the baseline is 0%.

To satisfy option 3 organic certification requirements, most of these companies would have to alter their indoor stocking rates. This would require a reduction in flock size to meet the indoor stocking rate depending on the housing type and equipment configuration. For a single-level house, the reduction in the flock size would be 12.5%. The reduction in flock size would cause a heat loss inside the building that will need to be replaced by an additional heating requirement in winter months (120 d) in colder climates. Assuming laying hens generate heat of 40 BTU per hen per hour [12] and 91,600 BTU per gallon of propane, valued at a price of $1.51 per gallon, the heat replacement cost amounts to $3,798 annually. In addition to the reduction in flock size, some modifications to the housing structures will be required. In particular, the number and size of exit doors are typically inadequate. Our estimates are based on the installation of 14 exit doors at a one-time expense of $400 per door. On an annual basis, this cost translates into a $644 increment plus the corresponding increases in insurance and property taxes.

In our interviews with producers, we found out that midsize organic egg producers would be able to expand outdoor access to meet option 3 requirements of 1,858 cm^2 (2 ft^2) per hen housed. However, this would come at a cost of adding approximately 1 acre of land with its rental rate of $170 per year. The cost of additional fencing is assumed trivial and is not explicitly accounted for. Even though the hens would consume some nutrients on a more extensive system, typically what is seen is an increased feed consumption from 1.7 kg (3.8 lb) per dozen to 1.8 kg (4.0 lb) per dozen, or higher, due to the repartitioning of the nutrients consumed to support the foraging

Table 3. Estimated costs of producing organic eggs under different scenarios for midsize operations in 2011

Item	Baseline	Option 2	Option 3
Production volume			
Birds per operation (n)	16,000	16,000	14,000
Organic eggs (dozen)	314,899	314,899	261,595
Breaker market eggs (dozen)	78,725	78,725	65,399
Costs per farm ($)			
Total fixed costs	518,225	518,225	523,900
Annualized fixed costs	58,210	58,210	58,454
Variable costs	779,345	779,345	680,717
Total annual costs	837,555	837,555	739,172
Breaker market eggs revenue adjustment[1]	58,256	58,256	48,395
Costs per dozen eggs			
Break-even revenue per bird ($)	48.71	48.71	49.34
Break-even price per dozen organic eggs ($)	2.47	2.47	2.64
Percentage increase over baseline	—	0.0	6.7

[1]Breaker market egg price assumes $0.74 per dozen.

activity and the increased movement to reach resources. With current feed costs, this would mean an added increase in per-dozen egg costs. Finally, larger outdoor access is likely to cause mortality to increase from 8.3 to 18% [15]. The effect on reduced egg production was calculated under the assumption that mortality will be evenly distributed throughout the entire production cycle. Taking all these effects jointly into consideration, we find the projected increase in the break-even organic eggs price amounts to 6.7%.

The summary of the estimated costs of regulation and their relationship to the baseline cost scenario is presented in Table 3. As mentioned before, the typical midsize organic egg producer appears to be automatically in compliance with the regulatory proposal contained in option 2; hence, the increase in the average total cost, and thus the break-even price relative to the baseline, amounts to 0%. A negligible effect on midsize producers is definitely associated with the types of production operations they are integrating into organic egg production. These are typically modified older facilities previously used for broiler breeder fertile egg production, which is typically smaller in size and has a single production unit on a farm. This allows for greater flexibility associated with indoor hen density and outdoor access. If they were to build new facilities, the effect of the new regulations, even under option 2, would be greater and may be comparable to the effects on large producers.

Several interesting results are worth highlighting with respect to the new cost structure under regulatory option 3. First, the new indoor stocking rate requirement will force producers to reduce the number of hens, which will, in turn, reduce some of the variable cost components (e.g., feed) and increase others (e.g., energy). Second, because of required investments in land and equipment, the annualized fixed costs go up, but only moderately. Finally, the reduction in the number of birds placed reduces the quantity of eggs produced with the negative effect on both the average cost per dozen eggs and on the total revenue. All effects combined result in a required increase in price necessary to break even.

Large Operations (More than 100,000 Hens)

As it relates to option 2, the interviews with industry participants revealed that large producers are already operating under the required indoor stocking rates. Their production facilities are operated using predominantly artificial lighting; natural sunlight is provided by outdoor access. Outdoor access requirements under option 2 are also being met; large organic egg producers are providing outdoor access using verandas at 2 ft^2 per hen based on the flock utilization ranging from 10 to 33%. Most of the veranda areas are wire pens with covers to prevent wild birds and predators from having direct contact with the flock. This does not prevent indirect contact from occurring nor small rodents

from entering the verandas. The construction of verandas ranges from concrete covered in a litter to soil with no vegetation. From the perspective of a typical large organic egg producer, compliance with the proposed option 2 requirements will have no appreciable additional costs; hence, the percentage increase in the break-even organic price relative to the baseline is 0%.

For option 3, the most significant effect of the proposed regulation will be felt by large-scale egg producers. Based on our analyses, the representative large-scale egg producer could satisfy the proposed requirements only through a rather dramatic increase in costs. The typical production system is some type of multi-level housing, either an aviary or an integrated multi-level slat system. In addition, many of the large producers have integrated their production into complexes that contain multiple houses along with feed milling and waste disposal facilities. Their ability to provide increased indoor and outdoor space, for which they are approved under the current standards, is limited. The limiting space requirements are related to both indoor and outdoor stocking rates. Even after a dramatic reduction in indoor population density, the outdoor space requirement under option 3 still remains a binding constraint. In the example provided by our baseline scenario, the indoor stocking rate of 2 ft^2 per hen, calculated by floor perimeter of the building, would require a reduction in the number of hens from 100,000 to 13,500 hens because the typical house (60 × 450 ft) has the floor surface of 27,000 ft^2. This dramatic reduction in flock size has consequences over the entire cost structure. A particularly important cost item becomes the cost of providing additional heat in a significantly depopulated house. After this 86.5% reduction in flock size, it is interesting to note that the outdoor space requirement of 1,858 cm^2 (2 ft^2) per bird proposed by option 3 is still not met. To satisfy this requirement, outdoor space has to be increased from the current 1,855 m^2 [20,000 ft^2; 1,858 cm^2 (2 ft^2)/bird for 10% of 100,000 birds] to 2,505 m^2 (27,000 ft^2). From our interviews, this 35% increment in outdoor space could be accommodated by most large producers at the proportionate 35% increase in the annual veranda-related cost. The only other cost related to increased outdoor access is reflected in the reduced feed conversion from 1.7 to 1.8 kg (3.8 to 4.0 lbs) per dozen eggs. According to our estimates, all these effects combined produce a stark increase in the break-even price of 96%.

The summary of the estimated costs of regulation and their relationship to the baseline cost scenario for the representative large organic eggs producer is presented in Table 4. As seen from the table, the typical large organic eggs producer is automatically in compliance with the regulatory proposal contained in option 2; hence, the increase in the average total cost, and thus the break-even price relative to the baseline, amounts to 0%. However, this is most definitely not the case for option 3. The reduction in the number of birds and, consequently, the reduction in the number of eggs and total revenue are staggering.

At this point, it is important to emphasize that the time horizon of 5 yr that we implicitly used in this analysis eliminates the need to consider the possibility of constructing an entirely new production complex that would satisfy the stringent stocking rates requirement envisioned in option 3. Moreover, based on our interviews with producers, they unanimously ruled out the possibility of investing in the construction of new houses, even in the long run, and claimed that they would exit the organic industry instead. A few other points are worth clarifying. First, a small reduction in annualized fixed costs exists due to the reduction in annual organic certification fees resulting from the reduction in revenue. Second, a dramatic reduction in total variable cost was noted due to the reduction in the volume of output. This reduction in total variable cost is somewhat dampened by the need to use more energy to offset the heat loss inside the building resulting from lower population density, the phenomenon that was well explained in the section regarding midsize producers. All these effects combined produce a dramatic increase in break-even price of 96% over the baseline.

Estimated Total Industry Costs

Using the per-farm estimated regulatory costs above and the estimates of production volumes and actual prices, we calculated the total estimated industry costs due to regulation under

Table 4. Estimated costs of producing organic eggs under different scenarios for large operations in 2011

Item	Baseline	Option 2	Option 3
Production volume			
Birds per operation (n)	100,000	100,000	13,500
Organic eggs (dozen)	1,968,120	1,968,120	265,696
Breaker market eggs (dozen)	492,030	492,030	66,424
Costs per farm ($)			
Total fixed costs	3,986,200	3,986,200	3,986,200
Annualized fixed costs	418,234	418,234	414,184
Variable costs	4,661,742	4,661,742	882,758
Total annual costs	5,079,975	5,079,975	1,296,943
Breaker market eggs revenue adjustment[1]	364,102	364,102	49,154
Costs per dozen eggs			
Break-even revenue per bird ($)	47.16	47.16	92.43
Break-even price per dozen organic eggs ($)	2.40	2.40	4.70
Percentage increase over baseline	—	0.0	96.0

[1]Breaker market egg price assumes $0.74 per dozen.

each of the regulatory options and contrasted these numbers with the industry total revenue. Under some scenarios, the estimated total industry costs are zero because the representative operations are in compliance with the regulation. Table 5 shows that the estimated total organic eggs industry costs due to the proposed regulation under option 2 are $0. Table 6 presents the estimated total industry costs under option 3, for which the total annual regulatory costs are estimated to be $68.1 million. These estimates represent 17% of estimated total industry revenue.

All baseline and cost-shifting scenarios are based on the assumption of a representative producer. To the extent that the entire egg industry is fairly homogenous with respect to its cost structure within each size category, the representative agent approach is adequate. However, if the industry is technologically highly heterogeneous, then the representative agent approach is not going to capture all specific nuances and idiosyncrasies of different production processes, and a complete industry survey would be required.

All cost-shift scenarios are based on the intermediate length of the run (5-yr horizon), where changes in variable cost through input and output adjustments are possible together with some changes in fixed cost through smaller adjustments in land, buildings, and equipment. However, potential entry and exit of firms, as well as the new construction of large-scale production facilities by existing firms as the result of regulation, is not considered in the current analysis.

In light of this information, the proposed regulation regarding indoor and outdoor stocking rates was analyzed by first adjusting the indoor stocking rates by reducing the number of animals until the condition is satisfied. In other words, we ignored an unlikely possibility that a producer would opt to construct a brand new housing facility to satisfy the indoor stocking rate constraint to keep the production at the original preregulation level. If and when, after this adjustment took place, the new proposed outdoor stocking rate is still binding, the producer was allowed to purchase additional land at the prevailing market land prices. In some cases, the stocking rate regulation requirements are so severe, based on the interview responses, we found out that the reduction in revenue associated with the required reduction in the number of animals and the corresponding increase in average total cost would force some firms to exit.

Regulatory Feasibility of Organic Egg Production Under Option 3

In conducting data collection and analyses for the regulatory options, we identified several concerns regarding the feasibility of complying with the requirements under option 3 for egg production. The interviews with organic egg industry participants and other experts revealed important reservations about the proposed regulations as presented in the option 3 scenario.

Table 5. Total estimated annual industry costs of regulations under option 2

Item	% of Production	Baseline number of units[1]	Unit	Total industry revenue in 2011[2] ($)	Regulatory cost per unit ($)	Total industry cost ($)
Total organic egg production	100	148,858,000	Dozen eggs	400,366,000	0.00	0
Eggs, small operations	30	44,657,000	Dozen eggs	120,110,000	0.00	0
Eggs, midsize operations	54	80,383,000	Dozen eggs	216,197,000	0.00	0
Eggs, large operations	16	23,817,000	Dozen eggs	64,058,000	0.00	0

[1]Total estimated dozens of organic eggs are based on laying hen counts published by USDA-National Agricultural Statistics Service [23, 24] assuming 19.4 dozens of eggs per laying hen. Note that there is a small difference between this assumption and the assumption of 308 eggs per hen that we use in our midsize and large producers' budgets with 20% loss to the breaker market (20.5 dozens of organic eggs per hen) and 284 eggs per hen with 15% loss to the breaker market in small producer budget (21.1 dozens per hen).

[2]Revenue derived from production estimates obtained by USDA-Agricultural Marketing Service [21] and prices based on simple averages of monthly prices provided by Lawrence Haller, Chief Economist, USDA-Agricultural Marketing Service, Poultry Programs.

Table 6. Total estimated annual industry costs of regulations under option 3

Item	% of Production	Baseline number of units[1]	Unit	Total industry revenue in 2011[2] ($)	Regulatory cost per unit ($)	Total industry cost ($)
Total organic egg production	100	148,858,000	Dozen eggs	400,366,000	0.09	68,118,000
Eggs, small operations	30	44,657,000	Dozen eggs	120,110,000	0.00	0
Eggs, midsize operations	54	80,383,000	Dozen eggs	216,197,000	0.17	13,334
Eggs, large operations	16	23,817,000	Dozen eggs	64,058,000	2.30	54,784

[1]Total estimated dozens of organic eggs are based on laying hen counts published by USDA-National Agricultural Statistics Service [23, 24] assuming 19.4 dozens of eggs per laying hen.

[2]Revenue derived from production estimates obtained by USDA-Agricultural Marketing Service [21] and prices based on simple averages of monthly prices provided by Lawrence Haller, Chief Economist, USDA-Agricultural Marketing Service, Poultry Programs.

- The number and size of exit doors required per 1,000 hens appears to be excessive because their installation could sometimes jeopardize the physical integrity of the housing structure, rendering it unusable for continued production. The number of exit doors added depends on the ultimate determination of indoor stocking rates. The proposed regulation for increased outdoor space was indicated as excessive by all producers interviewed. The numbers of layers that actually go outside decreases as the flock size increases. Typically, most of the midsize and large producers indicated that less than 10% of the flock was outdoors at any point in time. Granted that these are anecdotal observations, they are consistent across regions and producer sizes. Also chickens are prey animals and are unlikely to venture very far away from the chicken house; hence, significant areas of added space could be left unused. If a requirement for 50% forage cover is added, the costs for paddock expansion would need to more than double to provide sufficient space. None of the mid- to large-size producers indicated that they would be capable of maintaining this type of forage cover within the outdoor access areas.
- Organic producers that have more than 50,000 hens are currently subject to the Food and Drug Administration's Egg Safety Plan, and, as of July 9, 2012, producers having 3,000 to 49,999 hens were under the same regulation. Regulation 21 CFR Part 118.4(b) [4] states that, as part of an effective biosecurity program, producers must "prevent stray poultry, wild birds, cats, and other animals from entering poultry houses"; based on the interpretation of the rule and the need for a rodent and pest control program [21 CFR Part 118.4(c)], a prevention program must be instituted to limit rodents in the building as well. Currently, large producers use verandas and covered porches, which in essence does limit other animals' access to poultry facilities. Introduction of rules that mandate greater outdoor access areas eliminates the use of covered verandas and porches. This eliminates the ability of midsize and large producers to restrict the access of wild animals and rodents to the flock of laying hens and, ultimately, increases access to the poultry by wild birds and aerial predators. Under the proposed extensive outdoor access systems, it would be impossible for the producers to meet the intent of the Food and Drug Administration Egg Safety Plan.
- Most of the large producers indicated that the option 3 regulatory levels for both indoor and outdoor space would induce them to exit the organic industry and convert their operations to conventional production practices. In the interviews, they indicated that because of the capital investment in their operations they would not be able to produce organic eggs.
- Within the Clean Water Act [25, 26], operations that confine poultry to a specific paddock for more than 45 d out of 12 mo are defined as animal feeding operations. Many of the midsize organic producers fall into the medium contained area feeding operation (**CAFO**) definition. As with all free-range poultry operations, a significant portion of the paddock is bare soil throughout the year regardless of the season. In our interviews with producers, we learned that several producers with operations in sensitive watersheds have been informed [27, 28] that they would be prohibited from providing free-range access to their laying flocks without adding 600 acres to their operation, constituting a $3.4 million investment in land that is not available in their area. They indicated that they would have to close their operations and move to another location to continue production. The current CAFO Rule [25] prohibits the discharge of fecal coliforms from manure into surface waters from CAFO. All of the producers in this case indicated they would be forced to abandon organic production because of the inability to acquire land, or they would have to construct a new facility to accommodate potential changes in current and future regulations. In the future, the US Environmental Protection Agency is examining the regulations pertaining to all

of the sensitive watersheds and is looking into establishing new runoff rules for the Mississippi watershed, which will affect some of the larger organic operations in the United States.

CONCLUSIONS AND APPLICATIONS

1. For the regulatory proposals under option 2, we found that the regulatory cost will be zero because most of the producers are already in compliance with the proposed regulation. We also found that the anticipated benefits of this regulation are going to be zero as well because the current market prices already reflect consumers' willingness to pay for the existing animal welfare conditions.
2. For the regulatory proposals under option 3, we found that, before market adjustments, the average regulatory burden for the entire organic egg industry will amount to $0.09 per dozen eggs, with extreme variations between $0 for small operations and $2.30 per dozen for large operations. If we take the average price of organic eggs, $2.69 per dozen, and assume the maximum estimated benefits associated with improved animal welfare conditions, that consumers would be willing to pay of about 30% above the current market price, we end up with an estimated benefit of regulation of about $0.81 per dozen eggs.
3. Based on our findings, we conclude that option 2 is welfare neutral and could be adopted because it has already been adopted by representative producers. As for option 3, we found that, on average, the benefit-cost ratio is larger than 1, which indicates that the proposal would pass the benefit-cost ratio test.
4. However, that option 3 passed the benefit-cost ratio test has to be interpreted with serious reservation because of the differential effect that the proposed regulation would have on different industry participants. Under option 3, the effect of the proposed changes on small organic egg producers is negligible because most small producers are operating under conditions similar to the proposed living standards.
5. However, under option 3, costs will increase substantially for large organic egg producers and likely cause a substantial number of producers to exit organic production and switch to conventional production. The switch from organic to conventional production for large organic egg producers could substantially disturb the conventional egg market causing substantial price declines, at least in the short term. This change would also affect markets for organic corn and soybeans used as feed and cause a substantial decline in the prices of organic feed.

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