THE TRANSITION TO CAGE-FREE EGGS

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Executive Summary

State regulations, retailer pledges, and final consumer demand have contributed to a rising share of egg-laying hens housed in cage-free systems over the past decade. Nonetheless, conversion from conventional to cage-free housing is costly for both egg producers and final consumers. As such, there remains uncertainty about the extent to which egg producers will be willing and able to continue the transition to cage-free housing at a rate commensurate with retailers' cage-free pledges. To explore this issue, this study investigates the challenges and opportunities associated with the transition to cage-free housing, including interviews with and a survey of egg producers, a survey of egg consumers, and economic modeling of the sector. Key insights and implications are as follows:

- While there is a high level of stated support for retailers to make cage-free pledges among the general public, more than half of consumers (56%) are unaware of whether their grocery store has made such a pledge, and only 19% believe their store has made a pledge. Consumers do not expect a full conversion to cage-free egg systems by 2026, and on average, expect a 10-percentage point increase in cage-free laying hens from now to January 2026.
- Consumers prefer government policies to subsidize the transition to cage-free or mandatory labels to policies that mandate producers adopt certain housing practices. Amongst the policies to restrict housing practices, consumers prefer minimum cage size requirements to an outright ban on conventional production.
- There are segments of consumers willing to pay significant premiums for cage-free eggs, but the largest segment (representing 55% of consumers) is primarily motivated by price and does not discriminate between cage and cage-free eggs. If prices remain unchanged and conventional eggs are removed from the market, the share of consumers choosing not to buy eggs will increase by 20 percentage points.
- Egg producer interviews reveal the prevalence of long-lasting contractual relationships with retailers, the importance of retailer demand driving the evolution of the market to cage-free, and opportunities to reset the conversation with animal advocacy organizations. However, these interviews also reveal several barriers and unintended consequences to further transition to cage-free, including:
    - Higher costs and labor requirements associated with cage-free production;

    - Challenges obtaining financing to convert or build cage-free facilities without longer-term commitments from retailers, particularly in an environment of rising interest rates and when existing facilities can no longer serve as collateral;
    - Divergent interests of grocery and food service/egg product sectors with respect to hen housing;
    - Concerns that transition to cage-free production could facilitate consolidation given that larger producers often have better resources and access to capital; and
    - Skepticism that retailer pledges can be met by January 2026 without significant financial incentives, particularly given the high costs of building materials and long construction lags associated with the permitting and supply chain disruptions.
- A majority of egg producers view conventional housing as superior in food affordability, production efficiency, and environmental impact relative to cage-free production.
- Producers anticipate revenue from cage-free systems to be 8% higher than conventional systems, on average. But costs are estimated to be at least 8-19% higher, on average, depending on the category of expense, with additional labor and capital costs anticipated to be the categories with the largest increases.
- Producers are more likely to be willing to transition to cage-free production when cost-plus contracts are available and at higher anticipated return on investment (ROI) levels.
- In aggregate, egg producers believe cage-free production will grow to 51% of total production by January 2026.
- Economic modeling focused on the shell egg marketing indicates the following:
    - For every 1% reduction in the equilibrium quantity of conventional eggs produced and sold, it takes a roughly 1.9% increase in the equilibrium quantity of cage-free eggs produced and sold and an increase of at least $21.6 million year in total wholesale egg spending to leave egg producer profits unharmed; and
    - If the share of shell eggs sold cage-free increases by 20-percentage points, the cost of producing cage-free is 20% higher than for conventional, and consumer demand does not change, egg producer profits would fall $72.5 million/year in aggregate, not counting any additional fixed costs producers would have to incur to facilitate the transition.

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Chapter 1: Motivation and Objectives

1.1. Motivation

The U.S. is the second largest egg producer in the world, with a total production of 113 billion eggs in 2019 alone (FAO, 2021; Ha, 2021). Most of the egg production takes place in the Midwest, specifically Iowa (15%), Ohio (9%), and Indiana (9%) (Ha, 2021). More than 70% of the laying hens producing eggs are held in conventional production, 22.5% are cage-free, and 6.8% are in a certified organic production system (UEP, 2023b). In the last several years, the number of cage-free layers and cage-free produced eggs has increased. Between December 2020 and December 2021 alone, the number of cage-free laying flocks increased from 80 million to 94.3 million hens, an almost 18% increase. Likewise, weekly cage-free egg production increased by 17% from the beginning to the end of 2021 (USDA AMS, 2021a, b; USDA ERS, 2021a).

Coinciding with an increase in consumer demand for cage-free and organic, two additional factors are driving the transition to cage-free egg production methods: (i) the recent legal developments such as cage-free mandates, which require eggs and egg products to come from hens raised in cage-free facilities and (ii) the widespread private sector commitments to going cage-free in the next five years (McDougal, 2021; Shanker and Pollard, 2021). Legal developments have occurred state-by-state through ballot measures and legislative action instead of federal efforts. To date, ten states have passed legislation to transition to 100% cage-free eggs (USDA ERS, 2021b, Fatka, 2021). For example, California voters passed Proposition 12 in 2018, banning the sale of caged eggs as of January 1, 2022. States with similar mandates require the transition by January 1, 2026.

While it remains too early to conclude the economic implications of cage-free mandates, Oh and Vukina (2021) predict that California's implementation of Proposition 12 will result in an annual welfare loss for California consumers and retailers of $72 million and $23 million, respectively. Studies have also explored the economic cost of previous production mandates in the egg industry, such as California Assembly Bill (AB) 1437, which banned the sale of eggs that did not meet heightened minimum space requirements. Mullally and Lusk (2018) state that the implementation of AB 1437 increased prices by 9% and cost California consumers at least $25 million per year. Carter, Schaefer, and Scheitrum (2021) suggest that AB 1437 decreased economic surplus by $2.85 billion across the country between January 2015 – December 2017, with nearly 70% of this burden borne by out-of-state market participants.

Interestingly, citizens have voted for stricter production practices despite having purchasing patterns that deviate from their ballot preferences.[1] This wedge between voting patterns and revealed purchasing behavior creates uncertainty across the supply chain and will likely elicit diverse responses from producers depending on individual circumstances. Even in states without such legislation, the largest U.S. retailers, including Wal-Mart, Kroger, and Meijer, have voluntarily pledged to 100% transition to cage-free eggs by 2025. To fulfill the pledges, around three-quarters of all egg production will have to transition to cage-free production (see Lusk, 2019). This trend has obvious implications for egg producers and other actors along the supply chain (including retailers and consumers) as production adjusts to these new circumstances.

A key challenge for producers is the need to make capital investments to transition to alternative housing when there remains high uncertainty about the future. Converting from cage to cage-free systems is costly and requires significant capital (Trejo-Pench and White, 2020). These factors lead to increased production costs. These costs are likely to be at least partially passed through the supply chain and onto the final consumer, particularly given the inelastic consumer demand for eggs. This partly explains why cage-free eggs are significantly more expensive than conventional eggs. The average market price for a dozen Grade A eggs was around $1.17 in November 2021 (USDA ERS, 2021b) compared to $1.64 for cage-free eggs in the same month (USDA AMS, 2021b), meaning an almost $0.50 premium is charged on average for cage-free eggs. The extent of this premium varies significantly across regions; see Chang et al. (2010) for a discussion and Figure 1.1 for more recent price data at a retailer level. As a result, a producer's willingness to adopt cage-free production is likely dependent on their location.[2]

This diversity in generatable premiums and the existing differences in physical and financial inventory among business operations suggest that the adaptation mechanisms of producers are expected to be highly heterogeneous. These challenges highlight the need to better understand conversion costs and how such costs might be transmitted through the supply chain. Understanding these aspects is important to producers and processors to make informed production decisions and long-term investments. Likewise, it has relevance for policymakers trying to

[1] The phenomenon is known as the vote-buy gap (Norwood, Tonsor, and Lusk, 2019; Paul et al., 2019).
[2] Note that conventional eggs in Figure 1.1. refers to Grade A large eggs. For the 2022 Northwest data, the USDA only reports the price for Grade AA large eggs instead of Grade A.

evaluate how the transition and possible subsidies or incentives could impact the wider supply chain, including consumers.

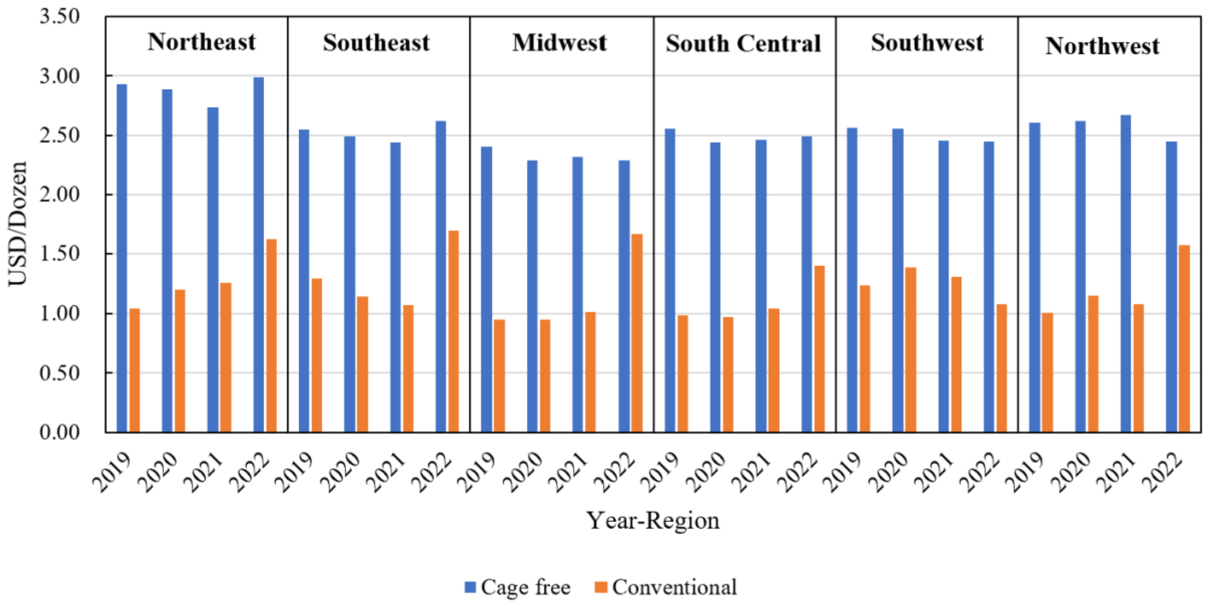


Figure 1.1. Shell egg retail prices by region over time, Source: USDA (2022)

1.2 Research Objectives

This project provides a wide-scale investigation of the U.S. egg sector, including an analysis of necessary production adjustments, changes in consumer behavior, and market effects from a potential conversion to cage-free. In particular, this project conducts a comprehensive economic evaluation of the cage-free conversion to better inform industry decisions, policymakers, and consumers. To accomplish this overall goal, the project was organized around four main objectives:

- **Objective 1**: Evaluate producer attitudes, concerns, and adoption willingness of cage-free production via egg producer individual interviews.
- **Objective 2**: Determine current egg producer's financial situation and expected transition timing regarding hen-housing methods via an egg producer survey.
- **Objective 3**: Determine consumer preferences and buying patterns for eggs in "cage-free only" marketplaces via an egg consumer survey.

- **Objective 4**: Summarize the research team's opinions and provide economic-informed recommendations to key stakeholders to navigate the future landscape of the egg market.

The remainder of this report is structured as follows. Chapter 2 describes the qualitative results of semi-structured interviews with seven egg producers on their general sentiments and concerns regarding the transition to cage-free eggs. Chapter 3 describes the results of a national producer survey sent to UEP members, providing a more granular quantitative analysis of industry attitudes and expectations. Chapter 4 outlines the findings from a national egg consumer survey, evaluating consumer perceptions and preferences toward egg products and egg policy. Chapter 5 builds on the findings from the previous chapters with an equilibrium displacement model predicting how market shifts could affect egg producer profitability. Chapter 6 concludes with a discussion of the implications of this report and the future outlook of the U.S. egg industry.

Chapter 2: Individual Interviews with Egg Producers

Summary

We conducted semi-structured individual interviews with seven egg producers to evaluate their attitudes, sentiment, and willingness to adopt cage-free production. Producers compared the operational activities of cage and cage-free facilities, spoke to the primary barriers and opportunities in cage-free markets, and offered their perspective on cage-free ballot initiatives and retailer pledges. Producers indicated higher fixed and variable costs in cage-free housing systems, with capital and labor costs being two of the central drivers of the cost increase. While several producers indicated a willingness to adopt cage-free production once their consumer wants cage-free egg products, most were hesitant to view the transition as an opportunity. The most commonly cited barriers to cage-free adoption included limited consumer demand, high capital costs, a contradiction to environmental sustainability efforts, and food insecurity.

2.1. Semi-Structured Interview Questions and Procedures

We conducted semi-structured interviews with seven egg producers in June 2022. Interviews were conducted individually via Zoom and lasted between 45-75 minutes. We followed a topic-guided approach where each interview started with a schematic presentation of the topics. Questions were arranged into four themes: (i) current business operations, (ii) cage-free production, (iii) business plan and relationship with buyers, and (iv) future industry directions. For each theme, we asked questions developed following recent debates about cage-free production and through a pilot in-person interview with a large U.S. egg producer. Table 2.1 presents the thematic areas and core questions, while the questionnaire is available as supplemental material accompanying this report.[3] Probing questions were also asked to explore issues in more detail, while closing questions were used to gain additional egg production-related information or answer producer questions. Individual responses were mapped to one of the survey themes, and patterns across each theme were identified by comparing responses across participants.

In what follows, we discuss the results of each of the four survey themes. We begin with a broad overview of the aggregate producer profile before describing the cage-free conversion and producer insights on the difference between production systems. Then, we explore the producers' relationships with their buyers and how these relationships influence their business plans and financial decisions. The section concludes with a discussion of the producers' perceptions about

[3] The full questionnaire is available here: link.

the future of the industry, including the barriers preventing further adoption of cage-free eggs in the United States, as well as potential opportunities.

Table 2.1. Thematic areas and core questions in the qualitative interviews with producers

Thematic Areas	Core Questions
Business operations	• Can you please provide a brief overview of your current production setup? This could include your (i) role in the supply chain; (ii) number of production plants and geographic location(s); (iii) annual production; and (iv) variety and type of egg products.
Cage-free production	• What share of your egg production is from cage-free facilities? • How has the switch to cage-free affected your (i) labor demand; (ii) capital requirements; (iii) feeding process; (iv) safety and quality control; (v) disease management; and (vi) marketing strategies?
Business plan and relations with buyers	• What percentage of your eggs do you sell under contracts, and how long have you had these relationships with your buyers? • How often do you communicate with your buyer about the transition to cage-free eggs? • Does your company have an annual business plan for the transition to cage-free? Does this plan include strategies on what to do with the outsourced cages? • How difficult is it to finance the new construction of cage-free facilities, and have there been significant barriers to capital?
Future industry directions	• How do you perceive the legislative changes occurring in different states towards going 100% cage-free? • What do you perceive as the biggest challenges to converting to cage-free?

2.2. Producer Profiles

Seven egg producers participated in the individual interviews (Table 2.2). We interviewed one small producer, one medium producer, and five large producers. Producers covered the shell egg and liquid egg marketplaces and supplied both grocery stores and the wider food service industry. Current cage-free adoption rates of the seven interviewed producers varied quite significantly. Six producers had less than 30% cage-free production, while one had more than 60% cage-free production. Three of the seven producers have ongoing cage-free construction projects. To maintain producer anonymity, producers' production level, employment, exact current cage-free adoption rates, etc., are withheld from this report.

Table 2.2. Egg producer profiles

Producer	Gender	Farm Size	% Cage-Free	Customers	Egg Types
A	Male	Small	< 30%	Grocery stores	Shell egg
B	Male	Medium	< 30%	Food service companies	Liquid eggs
C	Male	Large	< 30%	Grocery stores & food service companies	Liquid eggs & shell eggs
D	Male	Large	< 30%	Grocery stores	Shell eggs
E	Male	Large	< 30%	Grocery stores & food service companies	Liquid eggs & shell eggs
F	Male	Large	< 30%	Food service companies	Liquid eggs
G	Male	Large	> 60%	Grocery stores & food service companies	Liquid eggs & shell eggs

2.3. Comparing Operational Activities: Cage-Free v. Conventional

To better understand the differences between systems, we asked respondents to compare and contrast the operational activities of cage-free and caged systems. More specifically, interviewees were asked to describe how the cage-free transition affects five interrelated factors: (i) labor demand, (ii) capital requirements (infrastructure), (iii) feed system and associated costs, (iv) disease management, and (v) food safety/quality. The results are summarized in Figure 2.1.

Producers were first asked to discuss the difference in **capital requirements** for infrastructure investment for cage and cage-free systems. All seven producers stated that cage-free systems require at least two times the capital of caged facilities and would require investment in cage-free pullet houses. Producers recommended that the bird spend their entire life in a cage-free environment to be trained to maneuver through the system. For instance, Producer A stated: "*Try to get that pullet as well-trained in that [cage-free] equipment so they know where to lay the eggs, they know how to go up and down the system to get feed and water. Once you've lost that training period, you're never going to get that back*." In addition, six out of seven producers recommend against retrofitting caged facilities into a cage-free environment. They argued that while retrofitting can be seen as a way to reduce capital investments, it could sometimes create long-term problems within the facility. Producer C suggested, "*We've done some remodels of existing* *facilities. We don't really find that to be economical or in the long-term best interests from an animal care standpoint and a total best cost standpoint.*” For this particular producer, greenfield facilities are preferred.

Capital Requirements

- Cage-free systems require at least 2 times the capital to caged facilities
- Also must consider investment in new cage-free pullet houses for training purposes

Labor Demand and Worker Safety

- Cage-free production houses require 2-3 times more labor than caged facilities
- Cage-free facilities also require more specialized labor
- Fecal matter and poor ventilation are most commonly cited worker safety concerns

Feed System

- Cage-free facilities require 2-3 lbs. more feed per 100 hens than caged systems
- Slight differences in feeding schedules across systems

Disease Management and Animal Welfare

- Disease can be more common and widespread in cage-free systems due to the bird's increased contact with other birds and fecal matter
- Cage-free systems can require a more intense vaccine regime

Food Safety/Quality

- Same level of food safety can be achieved, but the presence of floor eggs in cage-free systems is a potential food safety concern
- Cage-free facilities can have lower percentages of Grade A eggs due to manure stains and cracks in the shell

Figure 2.1. Cage-free system operational activities discussed with producers

The second factor our producers unanimously discussed was increased **labor demand**. Securing willing workers for a cage-free environment and training them requires higher wages. Speaking of their own experiences, producers reported that the labor demand for cage-free systems was about 2-4 times as high as that of caged production. For example, when asked about labor demand, Producer C stated that cage-free requires “*much more of an animal care role where people are actually interacting with the birds, and they have to be much more attuned to the behaviors. It requires a lot more training, a lot more experience, and a lot more care… [and] also a different labor rate.”* Given the more specialized tasks and the enhanced need of fulfilling a "*more animal husbandry role*" (as stated by Producer D), the pool of potential employees shrinks. The pool further shrinks when considering the implications of the transition for worker welfare.

In addition, business operations will incur costs due to an increased need for **feed**. For example, Producer E stated that *"cage-free systems can require 2 lbs. more per 100 birds and can even be as high as 3 lbs. more per 100 birds."* Expanding on this point, Producer F remarked, "*Conventional housing generally requires 22.5 lbs of feed per 100 birds per day while cage-free can require two pounds more*." These numbers align with calculations by Alltech (2022), who reported a 7-8% increase in feed intake for cage-free flocks relative to caged ones.

The increased contact of the birds with feces and other birds in a cage-free environment increases the **disease risk** meaning "*a much more intensive vaccine regime for cage-free birds,*" as stated by one of the producers (Producer E), and "*higher testing requirements for diseases such as salmonella*" (Producer C) are needed. The disease pressure and rigorous vaccine regime present long-term risks and costs to producers. Additionally, three producers (Producers B, D, and E) suggested that mortality rates can be 2-3 times greater in cage-free systems compared to conventional facilities. In their opinion, this is mainly because of the birds' interaction with their fecal material, more cannibalistic behavior, and the birds' protective instinct to "crowd" one another. The higher mortality rate suggested by producers aligns with findings from Alltech (2021, 2022) and Weeks, Lambton, and Williams (2016), reporting lower mortality rates in conventional systems than in cage-free and free-range systems. However, Producer C stated that the mortality rates were similar across systems, though they agreed that mortality rates could be higher during the first few years as the producer adjusts to the transition. Indeed, research from Schuck-Paim, Negro-Calduch, and Alonso (2021) support this claim, stating that producer experience plays a role in reducing mortality rates. Their findings suggest that cage-free mortality rates have declined over time, and there is no statistical difference between the conventional and cage-free systems. Freire and Cowling (2013) also find no differences in laying-hen mortality rates between systems. Thus, debate surrounds whether cage-free mortality rates are actually higher than caged systems.

The **safety** risks affect not only the birds but also the eggs they lay. Cage-free systems result in floor eggs (i.e., any egg laid on the litter floor), and these floor eggs are more susceptible to safety concerns. One issue with floor eggs is that it is difficult for workers to know how long the egg has been on the floor. When found, there is also a higher chance that they might have been contaminated with diseases (as stated by one of the producers).[4] Even more, there can be a food **quality** concern. Producer D noted that a higher share of eggs in a cage-free system tend to be undergrade "*due to manure stains and cracks*." With poor shell appearance, Producer E reports that "*conventional systems can average from 94-97% Grade A eggs, while cage-free production generally ranges from 88-94%."* Thus, there is a potential difference in terms of overall egg quality, which will impact the profit producers can generate.

2.4. Business Plan and Relations with Buyers

Interviewees were asked to provide a broad overview of their contractual obligations, including an estimated number of buyers and the percentage of eggs for shell-egg and liquid-egg markets. Each producer stated that they sell the majority of their eggs through formal contracts to a few primary customers. Most contracts are **long-lasting relationships**, with some spanning multiple decades. Three producers explicitly described some of their contractual agreements as *need-based,* where the contract does not specify a specific quantity but rather an agreement to meet the need of the customer; two of seven producers describe having informal *handshake agreements* with buyers. Spot markets make up a small share of annual sales, ranging from 0 – 20% for our seven producers.

All producers stated that they consistently monitor the cage-free situation with their customers, but the frequency of these conversations varied. Producer F indicated that they had weekly discussions with their buyer, while Producer B said their conversations were annual. The remaining producers stated that they converse with their customers about once a month or less regarding the transition to cage-free.

One point consistently made by each producer was that their customer drives the decision to transition to cage-free. From these discussions, there also appears to be a positive correlation between the percentage of cage-free production and sales to shell-egg markets. For example, Producer E stated that most of their cage-free eggs are destined for grocery stores, while Producer B, who supplies all liquid eggs, added, "*We're not marketing to retailers and consumers who are looking at an egg as an egg. We're marketing to big branded processed food companies where we*

[4] The anticipated share of eggs ending as floor eggs differed across producers with some of our interviewees reporting losses up to 20% floor eggs at times (Producer D), while others indicated a share of around 5-6% (Producer A). Nevertheless, all producers agreed that achieving 1% floor eggs was the goal, although even 1 % loss already represents a huge loss.

are one of five to ten ingredients on a back panel, and the consumer is not as locked-in on the choice of am I eating an egg, and where does it come from. They just want to make pancakes."

This apparent relationship may stem from the fact that the cage-free attribute is more salient on a carton of eggs than on a processed food box for a product containing eggs. In other words, **there is likely a difference in the way consumers think about eggs as a final product versus eggs as an ingredient**. There also may be regional variation in cage-free adoption rates, where producers whose primary customers are located in regions without cage-free mandates are less likely to transition. For example, Producer A stated, *"In the West and the Northeast, you're probably going to continue to see a lot quicker of a transition than in other parts of the country. We're in the Southeast, and there have not been any major legislative pushes in our areas toward going cage-free. So, it really just depends on where you're located and where your customer base is."*

Interviewees were also asked whether they had a business plan to transition more of their facilities to cage-free. While three out of seven producers had ongoing projects, these were always customer driven. Each producer stated that they would not engage in speculative building based on the voluntary, informal pledges made by retailers. Relatedly, when asked whether federal support would incentivize a faster transition to cage-free, all producers stated that this would not solve the long-term issue of finding a buyer. Thus, producers will only transition to cage-free at the request of their customers.

Regarding financing their completed or ongoing cage-free construction products, each producer stated that securing funding through banks has not been a significant barrier. However, they did note that loan approval required proof of a long-term commitment from the customer. Without this contract outlining the transition timeline, banks may be hesitant to approve the loan given the significant capital investment. Producers also suggested that while funding has been available, it could become more difficult to acquire as more producers transition. That is, if mandates restricting caged production are imposed, all producers will be forced to transition at once, and funding could become more difficult to obtain. This is particularly true because cages will lose their value. As cages lose value, producers cannot claim them as collateral, which increases the producer's debt-to-asset ratio and makes the bank less likely to lend. Smaller producers are more likely to be negatively affected by this precautionary lending, which raises concerns over industry consolidation. We discuss this concern more later in the chapter.

Most producers stated that they are not opposed to any production system, but they want to know that the market demand is there before transitioning. "*We don't have a preference on the style of production, cage-free versus conventional. But our models are predicated on understanding the customer and delivering what they want, where they want it,"* claimed Producer F. Producers requested clear communication and firm commitments from their customers. With producers suggesting that it takes two to three years to build new cage-free facilities and no hard commitments made, the 2025 deadlines for the retailer pledges look infeasible.

2.5. Future of the Industry: Barriers and Opportunities

Producers were asked what, in their perspective, were the (three) largest barriers and (three) opportunities to transitioning to 100% cage-free production. As summarized in Figure 2.2, customer demand, capital financing, environmental sustainability, and food security were the most commonly cited barriers. Innovation and entrepreneurship opportunities, an industry "reset" within the animal activist community and gaining market share were listed as potential opportunities in cage-free. In what follows, we discuss key findings that express barriers and opportunities raised by the producers.

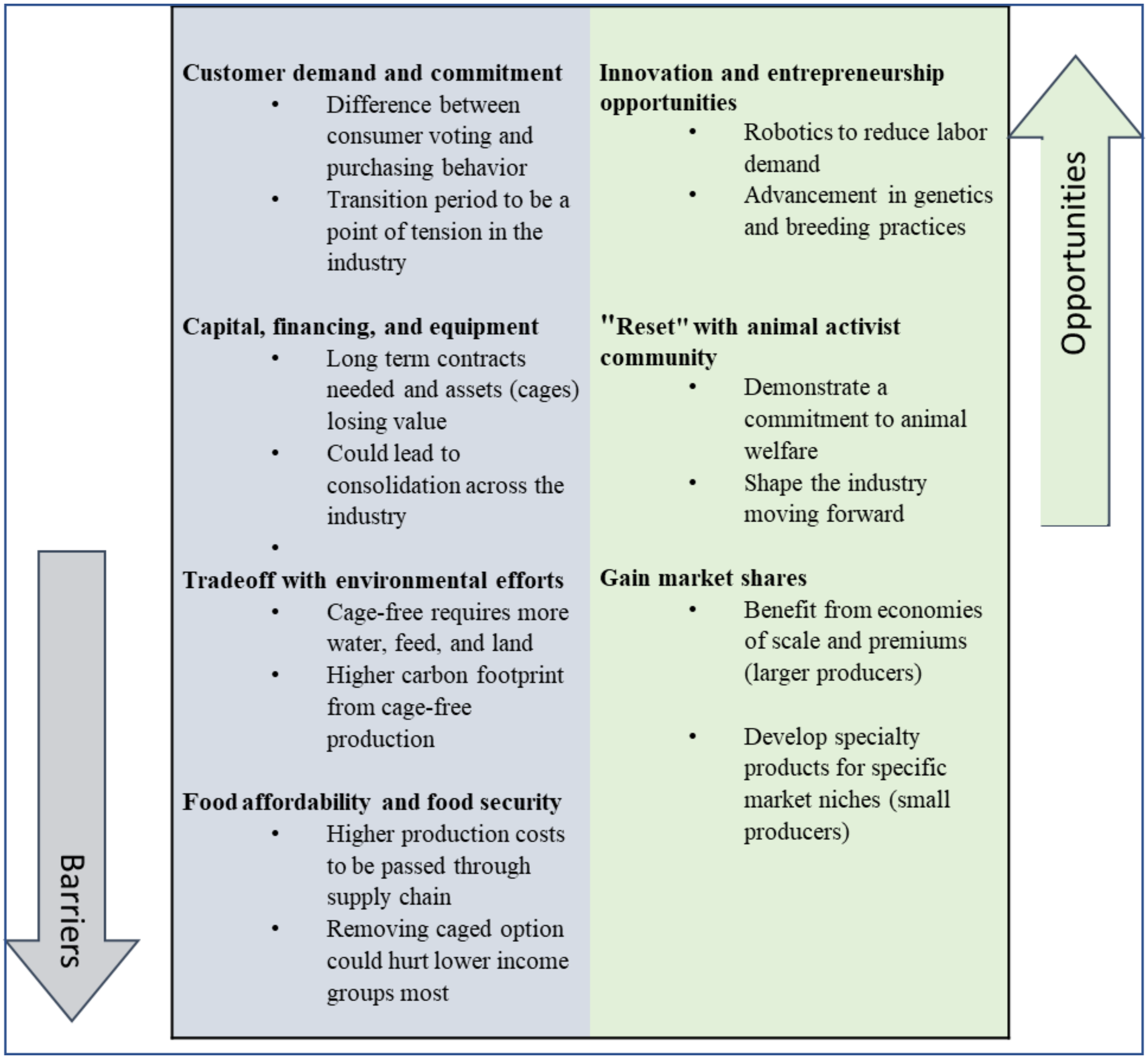


Figure 2.2. Main barriers and opportunities to cage-free adoption mentioned by producers

2.5.1. Barriers

Barrier 1: Customer demand and commitment

Customer demand and commitment by the retailers was one primary concern raised by producers during the interview. Each raised similar concerns regarding the commitments made by the retailers to transition to cage-free eggs by January 1, 2026. Producer E stated, *"Retailers that did try to make the decision when the conventional option was still present saw consumers continue to buy the conventional option. Then, when they subsequently removed the conventional option, they experienced a significant decline in egg sales."* This response addresses two key issues. First, with cage-free commitments in place, retailers will find it difficult to attain cage-free goals when consumers still have the option to purchase cage eggs. There is a disconnect between consumer voting behavior and current purchasing behavior. Indeed, three of seven producers used the phrase "**consumers vote with their wallet**" to demonstrate how consumers vote to impose stricter production standards yet continue to purchase the cheaper, caged product option. Secondly, Producer E's quote demonstrates that in states without a cage-free mandate, no retailer has a first-mover advantage to switch to cage-free. That is, if a retailer voluntarily removes the cage egg alternative from their shelves, they will experience a *"significant decline in egg sales"* as consumers shop at a competitor's store for the cheaper alternative. Indeed, research indicates that consumers compare food products/prices, shop at multiple retailers, and substitute across retail outlets (e.g., Bonfrer, Chintagunta, and Dhar, 2022; Richards and Jura Liaukonytė, 2022). Yet, there appears to be an agreed-upon, soft commitment to a 2025 deadline for all the major retailers to go cage-free.

The differences in voting and purchasing behavior create uncertainty and risk in the supply chain. In the current market, the producer is waiting for the retailer to act, and the retailer is waiting for the producer to act. As a result, producers mentioned that the cage-free transition period would be a tension point across the supply chain. For example, when describing the impending 2025 deadlines and the cage-free transition, Producer F stated, "*Most retail chains are saying, 'Yeah, do that for me, and I'll buy it in 2025.' 'Well, what about 2023 and 2024 when I have to make that transition?' 'Yeah, I'll buy them in 2025.' So that's the dilemma that, as an industry, we are perplexed with*." In other words, retailers want producers to invest in cage-free facilities to be ready for the hard switch, but retailers are hesitant to purchase cage-free eggs during the transition, given what is known about current consumer purchasing behavior. Producers, on the other hand, will not engage in the speculative construction of cage-free facilities. They will only invest once they have a long-term commitment from their customers to account for the transition period.

Barrier 2: Capital, financing, and equipment

When asked about the three limiting factors to cage-free production, Producer F's response was "*Capital, capital, and capital*." Producers, as a whole, agreed that **cage-free capital requirements are at least double that of caged systems**, and they need a **long-term contract** in place with a customer before requesting funding from a bank. Producers use this contract to demonstrate to the bank that they have a committed buyer, increasing the probability of loan approval. As discussed above, some producers feel like they are "*in the dark*" (Producer A) as to what their customer wants. Producer C added, "*The industry is being asked to make a conversion that is an expenditure and a commitment of time and resources orders of magnitude beyond anything we have been asked to consider in the past. It simply is not going to happen in a vacuum; it has to be a partnership.*"

Even when a long-term commitment is in place, it will take approximately **2-3 years to build cage-free facilities** (Producers C, D, E, and F). Producers D and F also suggested that permitting concerns and the construction of cage-free pullet facilities can add to this timeline. Moreover, limited equipment supplies and ongoing supply chain constraints could present additional hurdles. Specifically, Producers C, D, and E each mentioned that as demand for cage-free facilities increases, firms might find it more difficult to obtain equipment because there are only a limited number of suppliers. This could further delay the speed at which the industry can convert to cage-free production.

While the producers interviewed here stated that they have not had trouble securing funding to date, Producers A and D acknowledged that this could become a concern if producers were forced to transition all at once. A bank's decision to approve a loan will depend on the value of the firm's assets, and as cages lose their value, it could become more difficult for firms to secure funding (Producer D). This is particularly true for smaller firms that have a weaker market position, leading the bank to view the loan as riskier. If financing becomes difficult to acquire, larger producers may view the transition to cage-free as an opportunity to buy out smaller firms and gain market share.

Barrier 3: Environmental sustainability efforts

While cage-free production and environmental sustainability are often lumped into the same discussion, multiple producers stated that cage-free runs against their environmental goals. According to at least four of the seven producers, **cage-free production**—which is more expensive than caged production—**requires more water, feed, and land while also having a higher carbon footprint**. These insights are supported by Leinonen et al. (2012), whose life-cycle assessment of different egg production systems finds that the cage system has lower environmental impacts and global warming potential than cage-free and organic systems.[5] Shepherd et al. (2015) also suggest that cage-free systems have higher carbon dioxide emission rates than cage systems, likely driven by increased hen activity and lower stocking densities. Producer E stated that their transition to cage-free facilities had pushed them *"further away from their goal of attaining carbon neutrality,"* while Producer D suggested that cage-free production runs *"diametrically opposed"* to their environmental sustainability initiatives. There is a concern in the industry that consumers, policymakers, and actors across the supply chain do not understand this tradeoff (Producers B, C, D, and E). In these producers' eyes, mandating cage-free production counters the progress in reducing the industry's environmental impact.

With regard to a growing population and a growing demand for protein, Producer D noted that he believes environmental sustainability efforts need to be center stage "*because the need for that production, the need for more food, the need for more farmland without destroying the environment is going to become intense."* When speaking about the transition, Producer D added, *"It's hard to scale it back when it's time to say, all right, we got to get back to the environment. So, I really hope we don't make too many wrong turns that are hard to undo if it does become apparent soon that the environment is what we really need to be focused on."* As the country pivots towards a higher cost, lower efficiency system with a higher environmental footprint, producers suggest exercising caution over further mandates, and they encourage honest, open conversations about cage-free production across the supply chain.

Barrier 4: Food affordability and security

With ongoing concerns about inflation and increasing food costs, the U.S. is already experiencing issues with food security (USDA ERS, 2022). Producers B, D, E, and F see the conversion to 100% cage-free as a food security issue. Capital and variable costs are higher in the cage-free system, and the higher costs are typically passed down the value chain and borne by the consumer. This difference in production costs explains the current price premium for cage-free eggs compared to conventional caged eggs.

[5] Specifically, Leinonen et al. (2012) find that the cage system requires less feed, water, and housing or land than non-organic cage-free, organic cage-free, and free-range. With less input requirements, the cage system has lower eutrophication and acidification potential, which are commonly used metrics for assessing environmental concerns in agriculture systems. The cage system also has lower electricity use for ventilation, lighting, etc., which contributes to the lower primary energy use and global warming potential.

If the conventional caged alternative is removed from the market, and all producers and retailers must supply cage-free eggs, then the average cost for eggs increases. As the price increases, the quantity demanded decreases, and fewer eggs are bought and sold in the marketplace. The price increase will be most detrimental to the lowest income bracket, who rely on eggs as a cheap source of protein. Forcing a transition to a more expensive product with an identical nutritional profile while removing the cheaper alternative is likely to disproportionately impact the most food-insecure groups. "*We have to think smart, or we're going to have a hungry nation,"* stated Producer E.

2.5.2 Opportunities

When asked to provide three potential opportunities in cage-free production, many producers struggled to provide a complete list. Others were skeptical of viewing the transition to cage-free as an opportunity. Producer A stated that he sees the transition *"as more of a risk than an opportunity because of the capital requirements and the unknowns,"* while Producer B said that it comes down to "*educating the consumer about what they're signing up for… What are we selling to people, and do they really want it?"* Producer B added that he currently sees limited opportunity in the liquid egg marketplace but noted, *"If everybody's operating under the same rules… I think the industry can become more efficient. The more volume and scale people have in the arena, the better they are going to get at it."*

Opportunity 1: Innovation and entrepreneurship opportunities

Some producers were hesitant to suggest opportunities for entrepreneurship on the production side. For instance, when asked about areas for entrepreneurship, Producer B stated, "*I think on the processing side, for sure, there's always that flexibility. How do you add value? But on the production side, no… I think any entrepreneurship is going to get mowed down by the scale of production*." Producer C agreed with this assessment, adding that an entrepreneur "*can start small and try to build a niche brand, but by the time you look at the land and all the other resources… the capital requirements are so enormous. It's such a barrier."* Producer C instead suggested that there should be an emphasis on helping the industry *"solve the labor challenge."*

Producer C was not alone in assessing the need for technologies such as robotics to help with labor. When describing the differences in labor demand and labor tasks between caged and cage-free systems, Producer D noted that "*Well, I don't really need people if I could find a robot to do some of those things. I think robotics is a big part of where we're going as an industry, both in production and in our processing plants.*" Producers D, F, and G also mentioned advancements in ventilation and other technologies to provide a more sanitary environment for the hens and to dry the manure. For example, Producer G notes that they have installed in-floor heating, a technology that dries out the manure to a point where the robots can sweep it; it also reduces the smell for workers. Relatedly, Producers F and G discussed ways to convert manure into fertilizer, turning a byproduct of production into a new product line.

Opportunity 2: "Reset" with the animal activist community

Producer C stated that the conversion to cage-free "*presents an opportunity for the industry to have a reset in how the consumer sees us, and how the animal welfare community perceives the industry… I think the industry has an opportunity to prove and show how effectively and efficiently they can do this while improving animal welfare.*" Over the past few decades, there has been an increase in consumer demand for animal welfare attributes in food. At the same time, there has been an increase in corporate responsibility for animal welfare standards. One example is Producer G's zero-tolerance policy for a failure to handle the bird properly. To promote animal welfare, workers must watch a three-minute video daily on how to handle a bird, body cameras and security cameras track behavior, and auditors monitor workers to ensure they are handling the bird correctly. Producer C added that the transition to cage-free serves as "*an opportunity to exit some of the oldest systems and the oldest production methodologies.*" With the expectation that most producers will build greenfield facilities instead of retrofitting caged facilities, producers can model their future facilities to incorporate technologies such as recovery pens (Producers C and G).

Additionally, now that some producers have been producing cage-free for more than a decade (Producers C, D, E, F, and G), there have been improvements in technologies and production practices that have reduced some of the early challenges. For example, when first learning about cage-free production, at least two producers (Producers E and F) consulted with European producers that were further ahead in the cage-free transition. One issue was that the European producers could not replicate the scale of U.S. production. Thus, while producers could learn about some key aspects of the business, there was still a substantial learning curve.

"*Like anything, there is a learning curve associated with transitioning to cage-free systems. This includes how you grow the pullets, transitioning the pullets to the layer house, and labor training,*" stated Producer A. One example of this learning curve comes from Producer C saying, "*over the last ten years, we've gone from a situation where mortality in cage-free was significantly higher than in convention production, to today, where it's as good if not lower.*" Noting that this has to do with bird training, a more specialized workforce, and experience, there are avenues to improve animal welfare. With more experience, producers will continue to adjust to the cage-free setting, and there will likely be improvements in housing and equipment design.

Opportunity 3: Gain market share

Whether cage-free is viewed as an opportunity depends on the company's size. In general, larger producers benefit from economies of scale, and they have larger customers that may agree to long-term cage-free agreements making funding easier to acquire. Small producers, however, may find it difficult to compete in this space due to high capital costs and barriers to entry. Producer F noted, *"I'm afraid that the industry is going to continue to consolidate… there are a lot of producers out there that are struggling to figure out what to do. Do we invest in cage-free? Do we sell the business? Do we let somebody else worry about it? I think those are all valid questions that every producer in the egg business is trying to figure out and are struggling with today."* Producer D agreed that consolidation is likely, adding, "*If we've got money, it's in chickens, in cages, and trucks. Our ability to borrow money is based on the value of our assets. And when you have 10 million cages worth of farm, and all of a sudden, your customers say, 'I'm not buying eggs from those cages in two years.' They're not worth very much."* As cages lose value, and without a long-term contract, it may be more difficult to acquire funding, and banks may view smaller producers are more risky borrowers.

Indeed, when asked to describe the potential opportunities for cage-free production, Producer A (a small producer) stated, "*I think this is going to drive consolidation. If you're a producer that can buy people out that might not be as good a financial shape, you know that's probably an opportunity to grow the business."* Producers B and D noted that small producers would have to search for ways to supply a niche market, potentially through developing more specialty products. Even amongst large producers, the excitement over cage-free was limited (except for Producer G, who has already transitioned more than 60% of their facilities to cage-free). For example, Producer E stated, "*there is an opportunity for additional revenue, but it also comes at a cost. So ultimately, it could cancel out*."

2.6. Final Remarks

In interviews with seven egg producers, we heard similar experiences and perceptions regarding the transition to cage-free production. Interviewees described the differences between cage-free and cage production and echoed common barriers preventing the transition to cage-free production.

Producers indicated significantly higher fixed and variable costs in cage-free environments. With lower stocking densities, producers estimated that cage-free capital costs are more than double those of conventional production. This is the most commonly cited barrier to cage-free adoption, with producers also speaking to the need for long-term commitments from buyers to finance construction. With limited consumer demand—where retailers are hesitant to commit to cage-free before the pledge date, and consumers continue to purchase the cheaper alternative—the transition period from cage to cage-free production may be a point of tension across the supply chain. Heightened annual expenses also result from additional pullet training, vaccinations, feed, and labor relative to cage production. These heightened costs, along with the increased risk and variability in the cage-free system, will have ripple effects across the supply chain and most likely translate to higher egg prices for the consumer.

With these production barriers and anticipated market shocks, producers emphasized a need for full transparency and honest conversations surrounding cage-free systems. This includes a better understanding of the capital investment and transition timeline and more conversations about the potential unintended consequences of cage-free production. In the wake of current macroeconomic conditions and supply chain constraints, producers believe the timeline for the transition to cage-free must better reflect current market conditions, equipment constraints, and other logistical challenges. There was a consensus amongst producers that the 100% cage-free commitments by January 2026 made by retailers are infeasible, and additional conversations are needed to better incentivize the investment and transition to cage-free production.

Chapter 3: Egg Producer Survey

Summary

Building upon the individual producer interview feedback, the research team built a survey inviting more comprehensive feedback on the transition to cage-free production. UEP members were invited to complete a survey designed to gather feedback regarding the current and future status of laying hen housing in the U.S. A total of 29 members completed the survey, representing nearly 50% of UEP membership production. While there is diversity of opinion, UEP members generally view the laying hen housing situation as more a challenge than an opportunity. The majority of UEP members view conventional housing as superior in food affordability, production efficiency, and environmental impact. Annual revenue for cage-free systems is estimated to be 8% higher than conventional systems, but annual costs are estimated to be 8-19% higher. On aggregate, respondents believe cage-free production will grow to 51% of total production by January 2026. Using information from potential investment decision environments, producers are identified to be more likely to invest when expected return on investment (ROI) increases and when Cost-Plus contracts are available.

3.1. Producer Survey Questions and Procedures

In the final week of September 2022, Chad Gregory distributed an email encouraging all UEP members to use an enclosed link and complete a 31-question survey. By November 3, 2022, 68 UEP members had opened the survey. Among these 68 respondents, 29 (mostly) completed the survey. To demonstrate when the other 39 respondents exited the survey, 48 answered the survey's first question, 38 answered the 5th question, 34 answered the 10th question, and 30 answered the 24th question.[6]

Ultimately, in this report, we focus on the 29 complete surveys such that the comparison of responses across survey questions reflects information from the same set of UEP members. Complete documentation of survey responses received is in the supplemental material accompanying this text, along with a copy of the survey instrument. To assess the possible impacts of focusing on the 29 fully complete surveys, we compare feedback from the fully available sample with the complete surveys. This comparison indicates that both samples are very similar in their

[6] Low response rates are becoming increasingly common in online surveys. While the small sample size may be seen as a limitation, it is particularly important to emphasize the share of the overall industry represented in our completed responses. As we describe later in the report, our best estimate is that the 29 completed responses represent 28-41% of U.S. domestic egg production.

assessment of current cage-free prevalence in the U.S. and expectations for the number of laying hens in January 2026 that may produce table or market-type eggs. Combined, this adds some reassurance regarding focusing on the 29 complete surveys.

We further consider the collective production of the 29 complete respondents. The survey's 24th question identified the current laying hen operation size. Consistent with the need to assure anonymity and encourage survey participation, seven answer ranges were presented, spanning from "Less than 500,000 laying hens" to "Over 5 million laying hens."[7] We can use mid-point levels of the presented size ranges to approximate operation size. It is important to note that 11 of the 29 respondents selected the largest presented size of over 5 million laying hens. If we first assume a small or conservative value of 5.5 million applies to these 11 respondents (on average), then combined, the 29 respondents may represent about 90.5 million laying hens. Knowing that some operations exceed 10 million laying hens, this estimate is likely too low. If we alternatively assume 9.5 million applies to the 11 selecting the largest presented size range, then the 29 respondents may represent about 134.5 million laying hens. For context, there are approximately 300 million layers under UEP membership (UEP, 2023a; b). Given this, we are confident that the 29 complete respondents represent over 30% of UEP membership production, and our best assessment is that about 50% of UEP membership production is represented.[8] As UEP members account for 92% of U.S. egg production (UEP, 2023a), our sample represents 28-41% of all domestic egg production.

To further classify current production practices, questions 21 and 22 asked how many facilities (barns) are currently operating as cage-free and conventional. The most common response for both production systems was operating six or more facilities. Consistent with heterogeneity in the industry, three respondents (11%) indicated they do not currently have cage-free facilities, and four respondents (14%) indicated they do not currently have conventional facilities.

Which state respondent's laying hen businesses were based in was asked to provide geographic insight into our sample [Q23]. Twenty-five respondents indicated their state of

[7] The exact survey question is available in the Appendix along with response counts, both for the sample of 29 complete responses and the entire set of responses received.

[8] For clarity note that throughout this report, simple rather than weighted-responses are reported. This reflects an inability to confidently extrapolate the available n=29 data sample to the national level in a manner consistent with the industry's actual size distribution.

business, with four in California, five in Indiana, four in Iowa, three in Michigan, two each in New York, Pennsylvania, and Utah, and one each in Maryland, North Carolina, and Oregon. Combined, this indicates that about 28% of respondents are from the West, 24% are from the East, and 48% are from the Central/Midwest regions.[9]

As a final base question, we asked the duration respondents expect their laying hen business to remain operating [Q25]. While 10% (3 respondents) indicated less than 5 years and one respondent (3%) suggested 6-10 years, the overwhelming majority (86%, 25 respondents) reported over 20 years.

We now sequentially provide results for various survey questions. A complete set of response statistics is available in the Appendix. Throughout the text, we include the question number in [.] as a guide to comparing with the Appendix resources.

3.2 Transitional Situation and Views

3.2.1. National, Industry-Wide Perspective

The beginning of the survey, Q1-Q9, focused on the national egg situation. On average, respondents believe 29% of U.S. laying hens currently are housed in cage-free systems [Q1 mid-points] and that by January 2026, this will be 51% [Q2 mid-points]. Figure 3.1 provides a distributional summary of responses.

Beyond the expected increase on average, Figure 3.1 reveals varied opinions on the future cage-free market share (wider dispersion of responses). This is not surprising given diverse discussions and likely associated views on the industry’s future. To appreciate the diversity of views on the industry’s future, note that two (7%) respondents expect less than 30% cage-free, 13 respondents (45%) expect 31-50% cage-free, 11 respondents (38%) expect 51-70% cage-free, and the remaining three respondents (10%) expect 71-80% cage-free in January 2026.

In January 2026, respondents expect that 53% of cage-free eggs will be table (vs. breaker eggs) [Q3] and that 50% of conventional eggs will be table eggs [Q4]. Combined, this indicates minimal shifts are expected. Average expectations are for about 315 million laying in January 2026 producing table or market-type eggs, representing industry growth given a current estimate of 303 million [Q5 mid-points]. Only four respondents (14%) expect less than 300 million

[9] To further assure anonymity, we do not further associate state of business with facility count nor operation size information in this report.

reflecting a shrinking industry; six respondents (21%) expect between 300 and 309 million, reflecting little to no change; and 19 (66%) respondents expect 310 to 349 million. A key point to appreciate here is that despite ongoing dialogue around housing practices, on balance industry growth is expected.

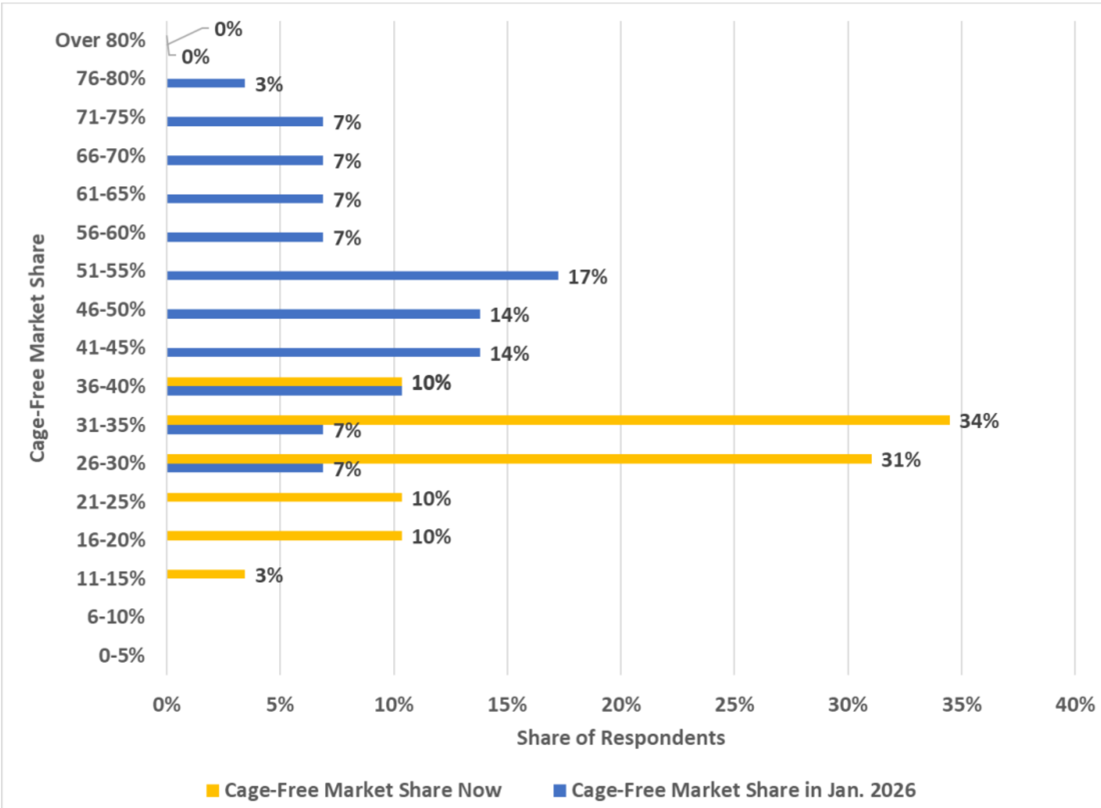


Figure 3.1. Views on national cage-free market share, now and January 2026

To assess perceptions regarding productivity, respondents were first informed that the average laying hen produced about 296 eggs per year in 2020. They were then asked, separately by housing system, what productivity they expected in January 2026 [Q6]. On average, respondents indicate cage-free yield will be 11 eggs per year lower, with 295 eggs per year expected for conventional and 284 for cage-free systems. This on-average statement masks notable variation as six (21%) respondents indicate cage-free yield will be higher, with the highest differential being 15 eggs per year (325 cage-free vs. 310 conventional). Conversely, the majority (19 respondents, 66%) expect conventional systems will yield more eggs, with one respondent expecting 75 eggs per year higher (250 cage-free vs. 325 conventional). The other four respondents (14%) suggested equivalent yields.

A qualitative question was included to broadly assess where respondents fell on an opportunity-challenge spectrum regarding laying hen housing [Q7]. On a 5-point scale, spanning from "enormous opportunity" to "enormous challenge," respondents were asked what best aligns with their view for the national industry regarding a possible increase in cage-free production. As summarized in Figure 3.2, nobody responded "enormous opportunity," 5 (18%) responded "opportunity," 10 (36%) responded "equally balanced opportunity & challenge," 5 (18%) responded "challenge," and 8 (29%) responded "enormous challenge." Combined, while there is a diversity of opinion, this indicates that UEP members view the housing situation as more of a challenge than an opportunity.

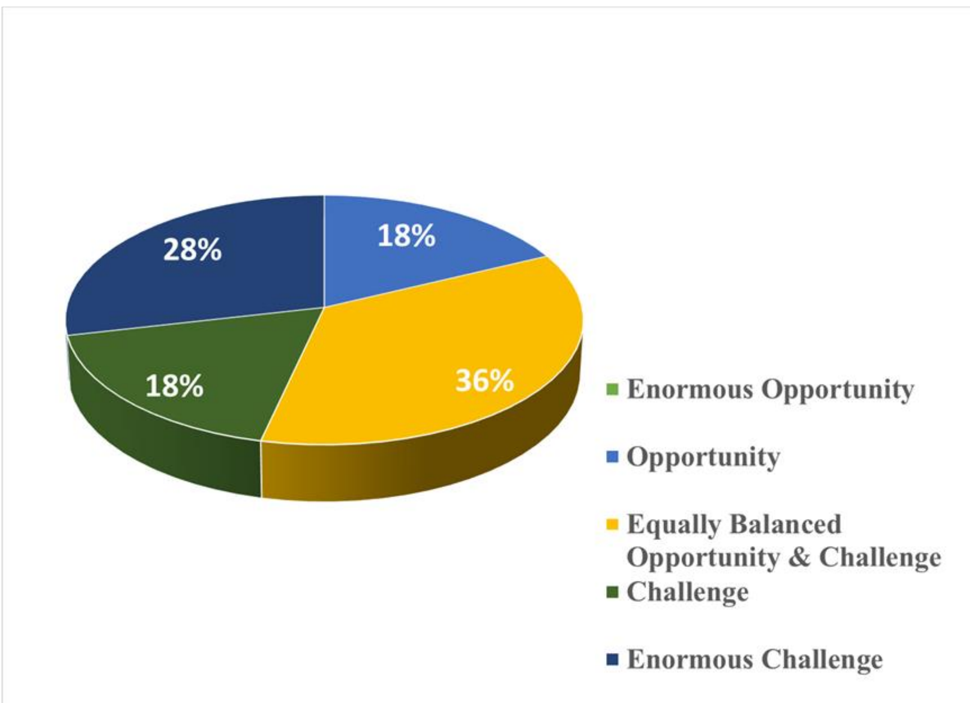


Figure 3.2. Views regarding laying hen housing, opportunity vs. challenge

To gather insight into how housing systems differ, a question asked which housing system ranked highest or best (cage-free, conventional, or no major difference) regarding specific categories of wide interest, including sustainability, animal welfare, production efficiency, food affordability, and environmental impact [Q8]. Figure 3.3 provides a summary of views revealing several key points. Overall, UEP members view conventional housing as superior in food affordability, production efficiency, and environmental impact. A slight majority (62%) view conventional systems as best for sustainability, with about one-fourth seeing cage-free and conventional as equivalent. Animal welfare is the only area where more (45%) view cage-free as superior. It is worth noting that the definitions of these terms were left to the producers' discretion, which presents a degree of subjectivity in the responses to Figure 3.3.

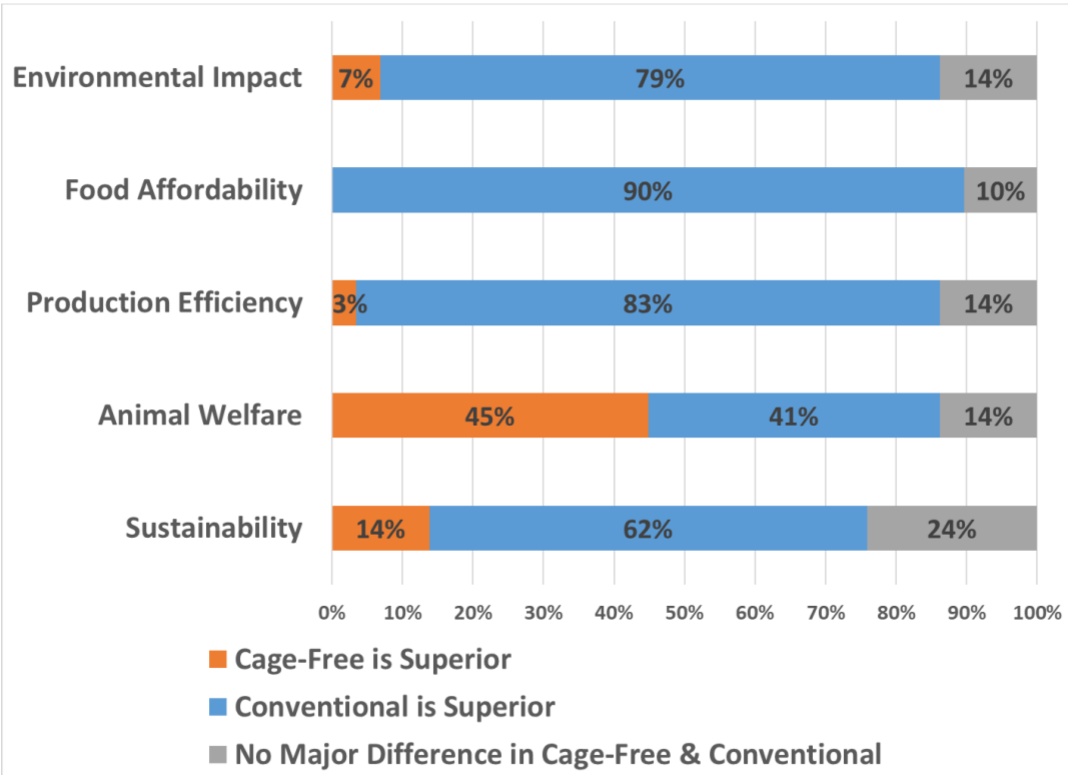


Figure 3.3. Views on which production method ranks best across different characteristics

3.2.2. Own-Operation Perspective

Questions 10-25 in the survey focused on the respondent's situation and views, rather than the national industry perspective discussed above [Q1-Q9].

On average, respondents indicate that 38% of their laying hens currently are housed in cage-free systems [Q10 mid-points]. Comparing back to the first survey question discussed above, this reveals that current cage-free adoption is higher among survey respondents than what is believed nationally (29%). However, there is wide variation in our survey sample as three respondents (10%) indicate 0-5% of their laying hens are currently cage-free, and four respondents (14%) state that 96-100% of their laying hens are currently cage-free.

When asked to consider the situation in January 2026, respondents believe 62% of their laying hens will be cage-free, on average [Q11 mid-points]. This also points to our survey sample being, on average, slightly skewed more toward cage-free adoption, as the national, industry-wide projection was 51% (Q2).

The survey's 12th question asked respondents to consider how annual expenses across nine different categories would be impacted if converting an existing conventional housing facility to cage-free. Respondents were instructed to answer this presuming they maintained the same number of laying hens. The full set of response frequencies are available in the appendix. Here we note very few instances where cage-free is believed to have lower expenses than conventional. In fact, the most prevalent response in four of the nine categories is cage-free is more than 20% higher (the highest presented difference) in annual costs than conventional. If one presumes 25% reasonably applies to this highest presented category, then an average cost difference can be derived from the survey responses. As shown in Figure 3.4, this leads to an average estimate of cage-free annual costs being 19% higher for labor, 11% higher for feed, 17% higher for fixed/non-operating capital, 14% higher for variable/operating capital, 8% higher for electrical/utilities, 14% higher for bedding/wood chips, 10% higher for repairs/maintenance, 10% higher for mortality, and 9% higher for morbidity when compared to conventional housing.[10]

Question 13 in the survey is intentionally very similar to question 12 but alternatively assesses annual cost impacts when building a new cage-free facility. Figure 3.4 presents implied average cost increases. If again one presumes 25% reasonably applies to this highest offered category, average cost difference estimates for new construction are cage-free annual costs being 18% higher for labor, 11% higher for feed, 17% higher for fixed/non-operating capital, 16% higher for variable/operating capital, 9% higher for electrical/utilities, 15% higher for bedding/wood chips, 8% higher for repairs/maintenance, 11% higher for mortality, and 8% higher for morbidity when compared to conventional housing.

Combined, this indicates that similar impacts on annual costs are anticipated, whether converting an existing facility or building a new cage-free facility. Annual costs are estimated to

[10] Here and in several other cases where answer options are ranges, interval-censored models are used to derive mean estimates.

be at least 8-19% higher for cage-free systems, depending on the expense category, with labor and capital being areas of magnified expense differences.[11]

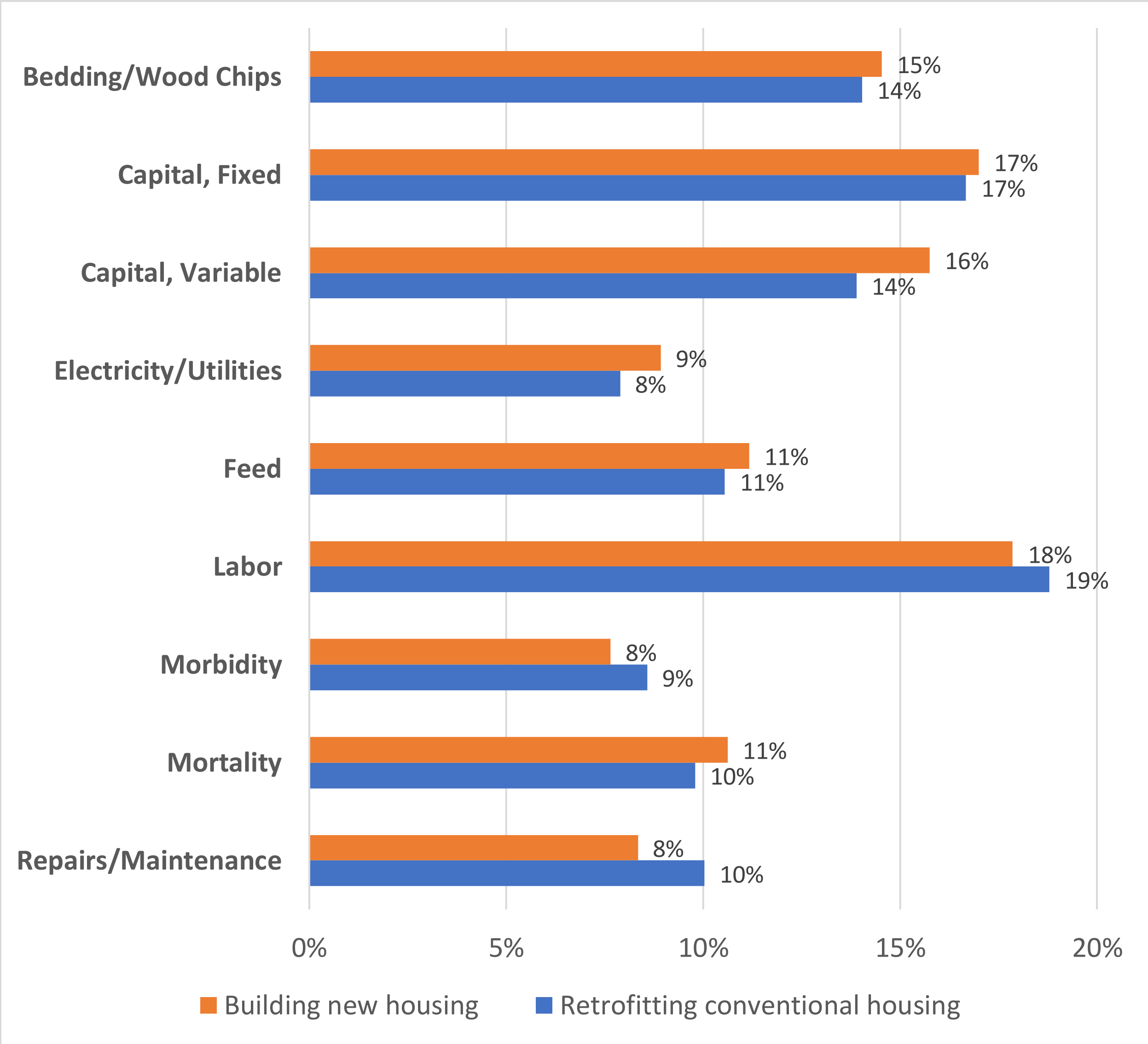


Figure 3.4. Percent premium for cage-free annual expenses compared to caged, retrofit v. new

[11] The estimated 8-19% higher costs for cage-free systems could be seen as a lower bound estimate of the anticipated increase in cost. In the survey, participants were asked to state how much less/greater cage-free expenses would be per expense category. The range of categories only went up to "20% or more." Our estimates presume that 25% reasonably applies to this range. It is possible, however, that some producers anticipate costs for a given expense category to be much greater than 20% or 25%. Indeed, the data from the qualitative interviews presented in Chapter 2 suggest that capital and labor can be more than double the rates of conventional. Thus, these estimates should be seen as a lower-bound estimate of the increase in cost.

It is also prudent to consider the revenue aspects of housing decisions. Accordingly, a similarly designed question was included to assess expected differences in operational revenue, again presuming the same number of laying hens when operating a cage-free rather than conventional housing facility [Q14]. Three respondents (11%) anticipate more than 5% lower revenue from cage-free, four respondents (14%) expect about the same revenue in cage-free and conventional systems, and the remaining respondents expect cage-free revenue to be higher. Using these responses, we derive an average implied estimate that cage-free revenue will be 8% higher than conventional.[12]

We then asked respondents to consider the expected return on investment (ROI) in laying hen facilities, separately for conventional and cage-free systems with the same number of laying hens [Q15]. The most common expected ROI for both systems was 6-10%. Taking the full set of responses into account, we derive an average estimate of +10.3% for cage-free (with a 95% confidence interval of 8.0% to 12.6%) and +10.6% for conventional (with a 95% confidence interval of 8.7% to 12.4%).[13]

A key take-home point is worth highlighting from questions 12-15. The 8% revenue impact from question 14 is on the lower end of cost impacts, summarized in questions 12 and 13 points. Meanwhile, a similar return on investment is expected when directly assessed, per question 15. While this suggests some inconsistencies, combined, these points align with ongoing inner-industry discussions around the transition in housing being complicated and varied.

We included a 5-point Likert scale question to assess views on what collateral would be accepted to secure financing in support of expanding cage-free production [Q16]. While some diversity of views exists, the majority anticipate lenders would utilize existing conventional facilities, existing cage-free facilities, farmland, and other business assets as collateral.

We then turned to gather information on the share of eggs sold under different egg pricing methods, separately by housing practice. First considering conventional eggs [Q17], 11% are sold on the Spot/Open-Market (no contract), on average. However, this masks notable variation, with 55% (16 respondents) indicating no use of the Spot/Open-Market, two respondents (7%) selling

[12] This reflects an interval-censored model presuming lower-end values of -10% (three over 5% lower than conventional responses) and higher-end values of +25% (four over 20% higher than conventional responses).

[13] This reflects interval-censored models presuming lower-end values of -4% (one cage-free response of below 1%) and higher-end values of +25% (two cage-free and one conventional response of over 20%).

50% on the Spot/Open Market, and one respondent (3%) selling all their conventional eggs on the Spot/Open Market.

On average, 32% of conventional eggs are sold with contracts tied to an external price (e.g. Urner Barry report), with 45% (13 respondents) indicating no use of external price contracts and 41% (12 respondents) indicating over one-half of their conventional eggs are sold on external price contracts. On average, 29% of conventional eggs are sold using cost-plus contracts (e.g., considering feed or other costs), with 52% (15 respondents) indicating no use of cost-plus contracts and 31% (9 respondents) selling over one-half of their conventional eggs are sold on cost-plus contracts.

Respondents indicating that they sold conventional eggs under contracts either tied to external prices or with cost-plus considerations were presented with a follow-up question [Q17 follow-up] to assess the typical length of these agreements. While there was one instance of an external price-based contract exceeding 15 years in length, all other responses indicated durations of five years or less, with two years being the most common.

The methods used to sell cage-free eggs were then assessed [Q18], using parallel questions to Q17 on conventional eggs. As a summary statement based on averages, cage-free eggs are more likely than conventional eggs to be sold using cost-plus contracts. On average, 9% of cage-free eggs are sold on the Spot/Open-Market (no contract), with 64% (18 respondents) indicating no use of the Spot/Open-Market and only 1 respondent (4%) indicating majority use.

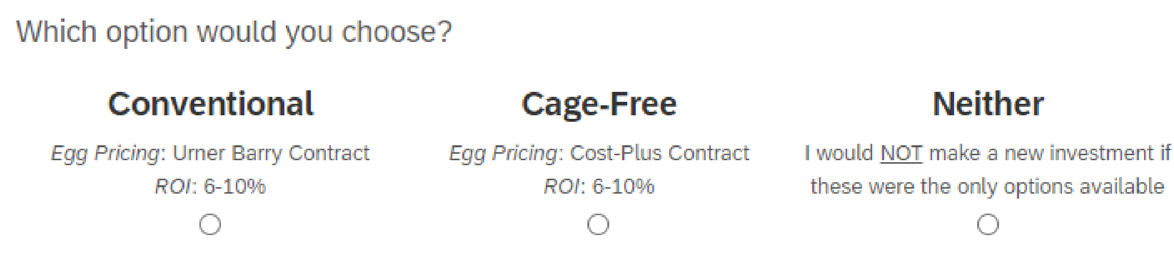
On average, 14% of cage-free eggs are sold with contracts tied to an external price (e.g., Urner Barry report), with 66% (19 respondents) indicating no use of external price contracts and 14% (4 respondents) indicating over one-half of their cage-free eggs are sold on external price contracts. On average, 49% of cage-free eggs are sold using cost-plus contracts (e.g., considering feed or other costs), with 38% (11 respondents) indicating no use of cost-plus contracts and 55% (16 respondents) selling over one-half of their cage-free eggs are sold on cost-plus contracts.

The longest duration of external price-based contracts for cage-free eggs was three years, with two years being the most common [Q18 follow-up]. The reported duration of cost-plus based, cage-free contracts is more varied. While two years remained the most common duration, three respondents indicated contracts of eight or more years, and two others reported five-year contracts.

We then gathered information on the distribution of eggs to consumers. Namely, we asked what share of produced eggs are ultimately sold through retail (grocery), food service (restaurant), manufacturing, or export channels [Q19 & Q20]. As a summary statement, a higher share of eggs is believed to move through retail outlets today (59% on average) than in January 2026 (52% on average), with slight differences expected in the other three outlets.

3.3. Laying Hen Housing Investment Decisions

The final section of the survey included a set of four questions designed to examine producer decisions under alternative laying hen facility investment situations respondents may face. The general intent here is to examine housing investment decisions with an elevated interest in how changes in egg pricing arrangements and expected returns on investment impact these decisions. Specifically, a choice experiment, a widely applied approach in economics research that our team has noted experience with, was designed where respondents were asked if they would make a *Conventional* (not cage-free), *Cage-Free*, or *Neither* (would not invest) construction investment. An example question is provided in Figure 3.5.


Which option would you choose?

Conventional	Cage-Free	Neither
Egg Pricing: Urner Barry Contract	*Egg Pricing*: Cost-Plus Contract	I would NOT make a new investment if
ROI: 6-10%	*ROI*: 6-10%	these were the only options available

Figure 3.5. Example laying hen investment decision question

Across four presented questions to each respondent, investment situations varied in the possible egg pricing arrangement and expected return on investment (ROI) that applied. This variation in investment situations allows researchers to map how producer investment decisions may be impacted by egg pricing arrangement and ROI. Survey responses indicate details on the producer's selection and the two options that were not selected. Combined, this information informs models that estimate probabilities of *Conventional*, *Cage-Free*, and *Neither* construction investment.

Three possible egg pricing arrangements were considered: *Open/Spot Market* ("cash" price situation and no contractual agreement), *Urner Barry Contract* (formula contract where the received price is tied to Urner Barry reported price), and *Cost-Plus Contract* (formula contract where received price is tied to feed and/or other production costs). Three possible expected ROI ranges were included: 1-5%, 6-10%, and 11-15%.

Ultimately, 27 respondents completed the four-question investment decision sequence.[14] Among these respondents, 11 (40.7%) made the same selection in all four presented cases. This likely indicates factors besides egg pricing arrangement and ROI underlie decisions for many UEP members. Another pragmatic implication here, combined with the limited sample size, is that we are constrained to rather simple logistic models as more sophisticated approaches are not viable in this application.

It is useful to summarize the frequency of selections across all respondents and presented scenarios. Cage-free investment is selected in 44% of presented scenarios, conventional investment in 19%, and no investment in 38%. Before analyzing how decisions may change with alternative egg pricing arrangements and ROI situations, this reveals notable hesitation in investing (over one-third electing neither housing investment) and particularly in making conventional housing system investments.

We ultimately estimate multinomial logistic models that estimate how the probability of investment changes with adjustments in egg pricing arrangements and expected ROIs. Figure 3.6 presents the estimated probability of Conventional, Cage-Free, and Neither investment option being selected in different situations. An upfront summary statement is that producers are more likely to invest when expected ROI increases; they prefer Cost-Plus contracts to Urner Barry external price contracts; and they are least likely to invest when facing Spot/Open market pricing of their eggs.

[14] These 27 respondents ultimately reflect 324 observations in our estimated models based upon a panel-data setup (27 respondents, 4 scenarios/respondent, and 3 options/scenario).

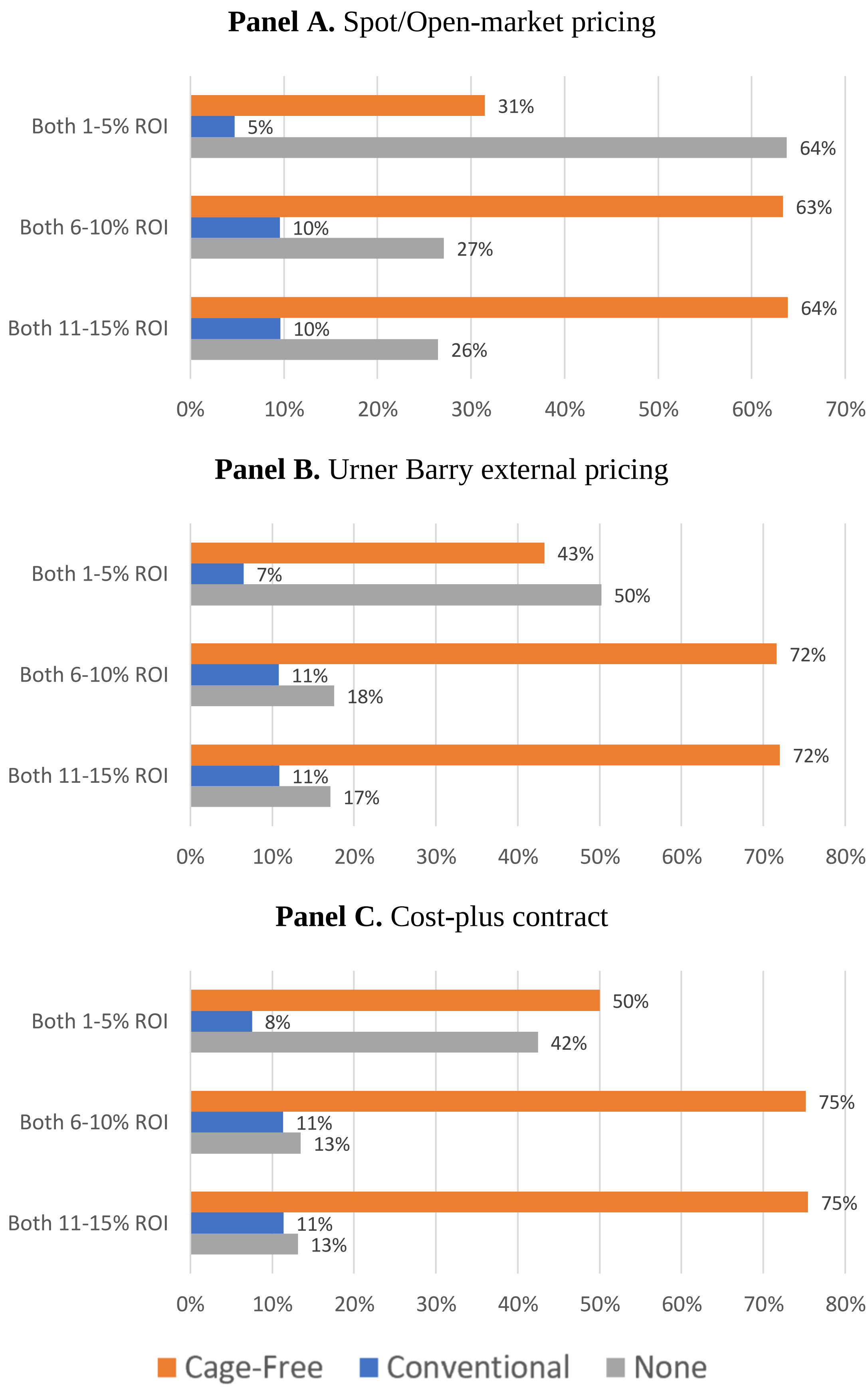


Figure 3.6. Projected investment: Contract options and common ROI in both production settings

Panel A of Figure 3.6 presents the estimated probabilities of Conventional, Cage-Free, and Neither option being selected when a common expected ROI and use of Spot/Open-market pricing applies to both Conventional and Cage-Free investments. Considering the intermediate case of 6-10% expected ROI, we estimate 27% would not invest, 63% would invest in Cage-Free systems, and 10% would invest in Conventional systems. As anticipated, both the Cage-Free and Conventional investment rates are higher if the expected ROI is 6-10% than when it is 1-5% (63% vs. 32% for Cage-Free and 10% vs. 5% for Conventional).

Panels B and C of Figure 3.6 are similarly designed, portraying the case of laying hen housing investments having common Urner Barry, external price and Cost-Plus contracts, respectively. Comparing these figures to Panel A reveals producer preferences to avoid Spot/Open-market pricing. For instance, in the intermediate 6-10% expected ROI case, Panel B indicates 72% would invest in Cage-Free and 11% would invest in Conventional housing vs. the 63% and 10% in Figure 3.6 reflecting a Spot/Open-market situation. Meanwhile, Panel C (also for 6-10% expected ROI) indicates 75% would invest in Cage-Free and 11% would invest in Conventional housing.

Combined, comparing values across Figure 3.6 reveals a strong preference, particularly in Cage-Free investing, for Cost-Plus contracts. As a final figure to illustrate this further, Figure 3.7 presents estimated investment rates when Conventional investments are made in a Spot/Open-market pricing environment while Cage-Free investments have Cost-Plus contracts available. Sticking with the intermediate, 6-10% expected ROI case, Figure 3.7 indicates 81% would make Cage-Free investments, 5% would make Conventional investments, and 14% would not invest. This much lower rate of Conventional investing and a higher rate of Cage-Free investing is consistent with revealed preferences for Cost-Plus contracts. This also sheds insight into how alternative market situations may correspond with higher or lower investment rates.

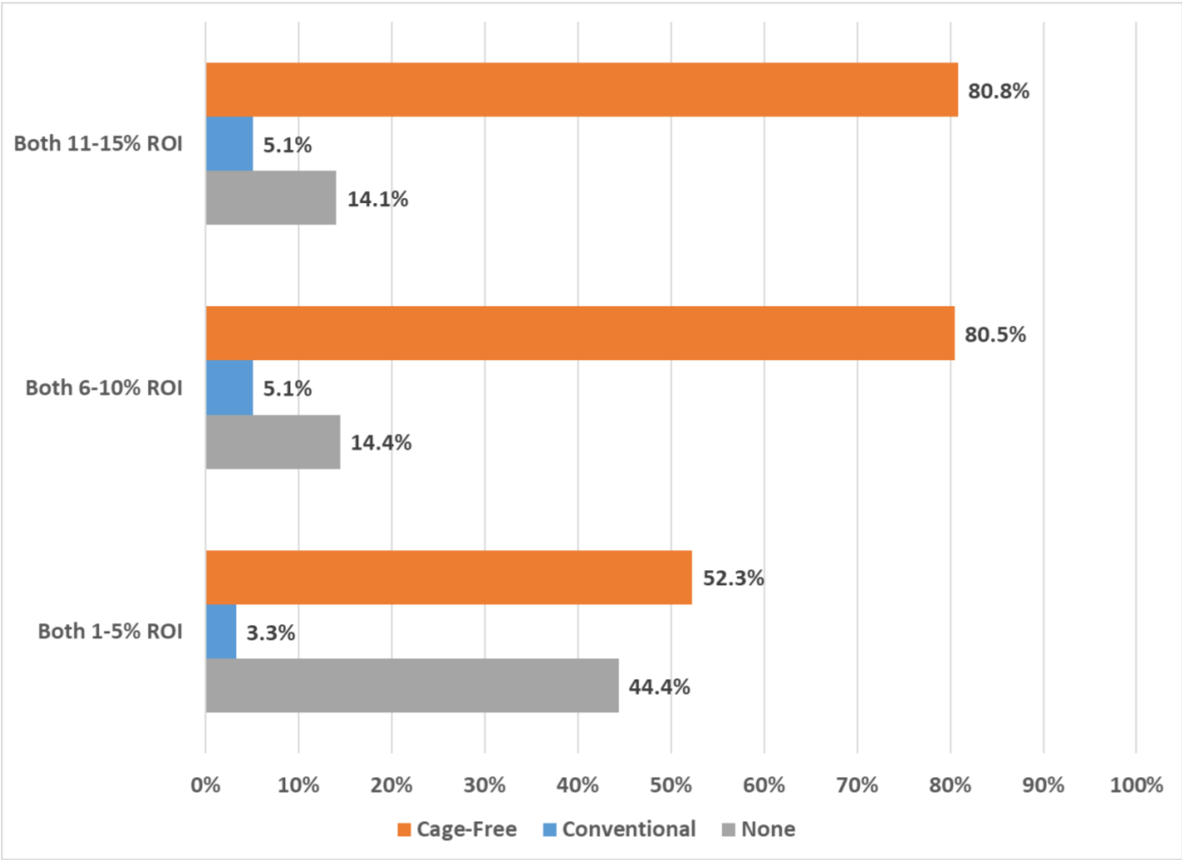


Figure 3.7. Projected investment: Conventional with spot pricing and cage-free with cost-plus

3.4. Provided Comments

The survey ended with two open-ended questions, allowing respondents to provide additional feedback [OpenEnded; Qend]. The exact typed feedback is included in the Appendix. Here we include three comments to depict the varied views shared:

- *"Cage-free is based on consumer demand. The consumer will ultimately decide what we produce."*
- *"A lot is up in the air – will companies and grocery stores hold their comment (commitment) to change over by 2026"?*
- *"Producers will make the transition to cage-free when they can receive the right customer commitment. Without the contracts it is too risky to make the investment. It costs $70 per bird to build a cage-free facility today."*

3.5 Final Remarks

This chapter analyzes producer expectations, sentiment, and decision-making surrounding the transition to cage-free production. We surveyed 29 egg producers whose annual production accounts for approximately 50% of all UEP production. Results are largely consistent with those from the semi-structured qualitative interviews presented in Chapter 2.

UEP members generally view the laying hen housing situation as more of a challenge than an opportunity. Producers estimate an 8% increase in annual revenue relative to conventional systems, but this revenue increase is coupled with an 8-19% increase in annual costs. Cost estimates vary by expense category, with labor and capital being two areas of notable expense increases. Food affordability, production efficiency, and environmental impact are also concerns, where producers commonly rank conventional production as superior to cage-free production. The results of hypothetical investment decision environments indicate that producers are more likely to invest when the expected ROI increases and Cost-Plus contracts are available. Ultimately, respondents believe that 51% of U.S. laying hens will be in cage-free environments by January 2026.

An Appendix is available in an online repository containing four additional resources to provide complete documentation.[15] First is additional detail on the multinomial logit model estimated using available choice experiment data. Second is the survey instrument distributed to UEP members by email for online completion. Third is a Qualtrics standard output file, constrained only to the respondents who completed the survey, which corresponds with the majority of the results presented in this report. Finally, a parallel Qualtrics standard output file includes all available responses, with the number of observations generally declining as the survey questions progressed.

[15] The additional resources are available here: link.

Chapter 4: Consumer Survey on Egg Product and Policy Preferences

Summary

We conducted a national survey of 961 egg consumers in November 2022 to understand consumer preferences and perceptions of the U.S. egg market. Using various statistical tools, this chapter offers insights into how consumers may react to the transition to cage-free eggs. While less than 20% of the sample was aware of retailers' cage-free pledges, nearly 80% stated that they would support a pledge. Additionally, results suggest that consumers prefer minimum space requirement policies to bans on conventional production, but even the least preferred policies are capable of passing through ballot initiatives. However, the results to a discrete choice experiment provide conflicting evidence of what the consumer wants. While they may state a level of support for cage-free production, the removal of conventional eggs from the marketplace will result in a significant decline in egg purchasing behavior. Put differently, there is a gap between the way consumers vote at the ballot versus with their wallet at a retail outlet.

4.1. Consumer Survey Questions and Procedures

To assess consumer attitudes and preferences for egg products and related policies, we surveyed 961 U.S. egg consumers. The survey was delivered to an online consumer panel maintained by Qualtrics. In addition to having purchased eggs in the three months before the survey, respondents had to be above 18 years old and buy at least half of their household's groceries to participate in the study. The survey included six primary sections, described in greater detail below.

4.1.1 Section 1: Sample demographics and egg purchasing habits

Respondents first reported various demographic and household characteristics, enabling insights into how egg product preferences, attitudes, and policy preferences vary by consumer characteristics. Demographic questions included respondent gender, age, income, education, race, and region of residence. Household questions included household size, whether they have received (and are currently receiving) Supplemental Nutrition Assistant Program (SNAP) benefits, and whether they have ever worked on a farm or ranch, among others.

4.1.2 Section 2: Egg Purchasing Habits

Respondents reported their egg purchasing frequency, quantity purchased per shopping occasion, and most frequent place of purchase to elicit general egg purchasing habits. They also identified the characteristics of the eggs they preferred to buy, including egg color, size, and labeling claims. They were also asked to identify the three most and least important factors in their egg-purchasing decisions from a list of 12 characteristics.

Given the current economic conditions, respondents were asked how egg prices have changed over the past year and how they believe prices will compare next year. Respondents indicating that 2022 egg prices are higher than 2021 prices were asked a follow-up question regarding the factors driving this year-over-year increase. Specifically, they were given six factors and asked to select all the factors that applied.

4.1.3 Section 3: Word Associations

Before providing respondents with information on the differences in egg production systems and labels, we asked respondents word association questions. Each question was structured as follows: "What one word or phrase comes to mind when you hear _______ eggs?" The six questions include (i) caged, (ii) conventional, (iii) USDA organic, (iv) cage-free, (v) free-range, and (vi) pasture-raised. These questions provide an initial reaction to how respondents view different egg products. The order in which these were presented to participants was randomized to prevent ordering effects, and each question was presented on a separate page.

4.1.4 Section 4: Consumer knowledge, attitudes, and perceptions of the egg industry

Consumer knowledge was measured through questions related to the structure and state of the egg industry. Questions included what gender laying hens were, approximately how many laying hens there were in the United States in 2020, and what percent of laying hens are housed in cage-free systems, among others. Respondents were also asked whether the retail outlet they most commonly purchase eggs from has pledged to discontinue selling conventional (caged) eggs in the near future. Potential responses include *yes*, *no*, or *I don't know*. They then stated whether they would support or oppose such a pledge. To obtain a general perspective on how egg consumers view the industry, respondents reported the percentage of egg producers they believe offer various amenities to their laying hens. This list included the ten different services that factor into the UEP certification program, as shown in Figure 4.1 (UEP, 2023c). Each characteristic had a sliding scale allowing respondents to select a percentage between 0 – 100%.

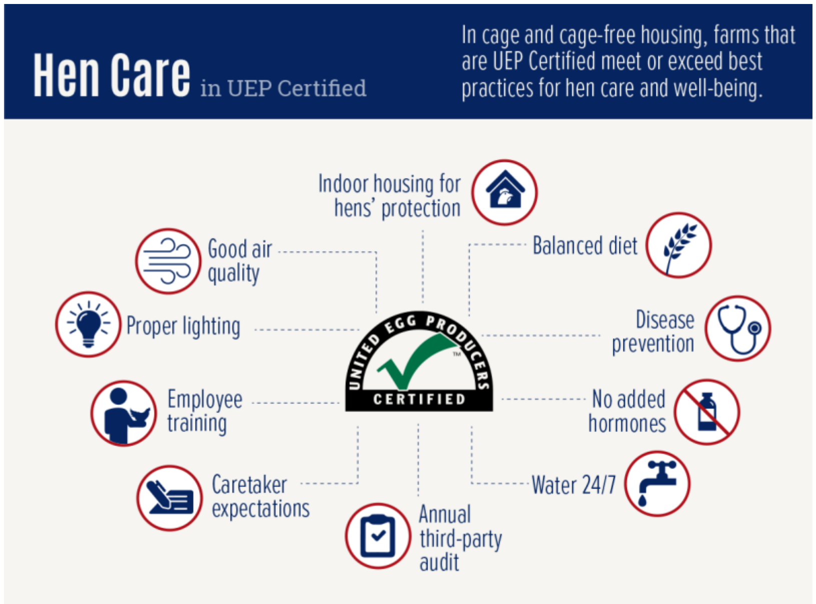


Figure 4.1. United Egg Producers certification criteria, Source: UEP (2023c)

4.1.5 Section 5: Choice Experiment on Egg Selection

To elicit consumer preferences and willingness to pay for various egg products, we designed a discrete choice experiment on egg selection. Choice experiments (see Louviere, Hensher, and Swait, 2000 for more details about the method) have become commonplace in food economics and marketing due to their simplicity, resemblance to real-world retail choice environments, and external validity (Brooks and Lusk, 2010; Caputo and Scarpa, 2022). In a choice experiment, survey respondents are presented with a collection of products that vary in multiple ways, including price, and are asked to select the one they most prefer. For example, respondents are presented with various food products offered at different market prices and asked to choose the product they would purchase in an actual shopping situation.[16] Examples of food discrete choice experiments designed to elicit consumer preferences and demand for eggs include Lagerkvist and Hess (2010) and Lusk (2019).

In this study, the choice experiment was designed to mimic the U.S. egg market. Respondents were presented with different egg alternatives, including (i) conventional, (ii) cage-free, (iii) USDA- certified organic, (iv) free-range, (v) pasture-raised, and (vi) an alternative that bears all four of the specialty labels. By incorporating these alternatives in the design, the study

[16] See the review in Caputo and Scarpa (2022) for recent developments in food choice experiments.

effectively captured all production housing systems. Each product was offered at different price levels to reflect the range of actual egg prices of eggs observed in supermarkets and supercenters.[17] Prices varied in $1.00 increments and ranged from $1.99 - $4.99 for conventional eggs; $3.99-$6.99 for eggs labeled as cage-free, USDA-certified organic, free-range, and pasture-raised; and $4.99-$7.99 for eggs reporting all labels. While eggs vary in other ways besides the housing system used in production and price, respondents are asked to assume that all other characteristics are similar across products and in line with their preferences. Each choice question included six different egg alternatives of the same size (12 large eggs) and color (brown).

The prices appearing in each choice were determined by a main effects orthogonal fractional factorial design, which resulted in 24 choice questions blocked into three sets of eight. Each person was randomly assigned to one of the three blocks. In other words, the experimental design required each individual to go through the choice exercise eight times, where prices varied across the tasks. The order of the choice questions and the egg products shown to respondents in each choice question varied randomly across respondents to avoid ordering effects. Figure 4.2 presents an example choice task.

In each choice task, respondents selected only one egg alternative or the "no-purchase" option. In doing so, respondents were asked to answer as honestly as possible and in a manner that would genuinely reflect how they would shop. Respondents were also provided with a table summarizing the meaning of the labels before the choice experiment began (Table 4.1). The table was adapted from Lusk (2019).

[17]As shown in Figure 1.1 of this report, there is price heterogeneity across regions. To select the price levels that best captured market prices, the research team identified prices for a dozen large eggs for each label at various grocery stores (e.g., Walmart) across all 50 states. Additional price data were collected from the USDA (2022) and U.S. Bureau of Labor Statistics. We then used these data to select the prices that incorporate the range observed in the choice experiment on egg selection.

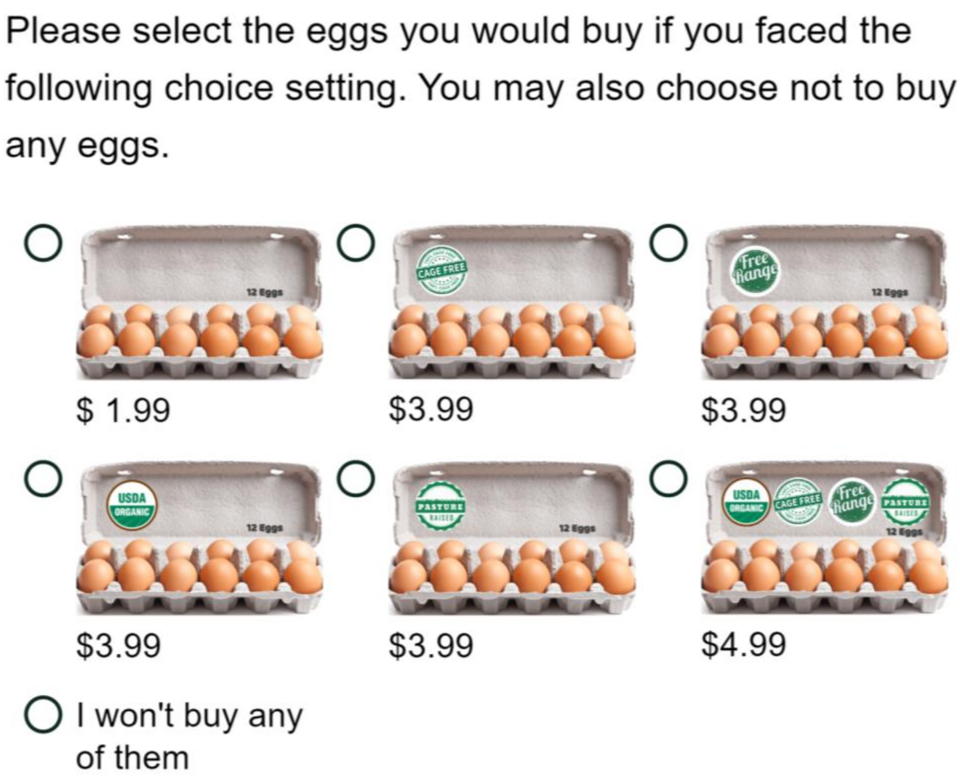


Figure 4.2. Example choice experiment task

Table 4.1. Labels used in the consumer choice experiment and their meaning

What does your egg label imply?

Egg type	Uncaged	Access to the outdoors	Organic feed
Conventional (caged)	No	No	No
Cage-free	Yes	No	No
Free-range	Yes	Yes	No
Pasture-raised	Yes	Yes	No
Organic	Yes	Yes	Yes

4.1.6. Section 6: Policy Preferences and Ballot Initiatives

To understand consumer preferences for various egg policies, we incorporated best-worst scaling (BWS), following Caputo and Lusk (2020). In BWS, respondents are presented with a collection of policy options, and they select the most desirable (best) and least desirable (worst) option. In our analysis, respondents were presented with seven questions, each including three policy options that the government could apply to shape the U.S. egg market. Each question reported three of seven different policy options selected for this study. These included:

1. **Federal ban on the production and sale of caged eggs:** All eggs produced and sold in the U.S. must be from cage-free facilities
2. **Federal mandate on minimum average space requirements:** All eggs produced and sold in the U.S. must meet minimum standards related to cage size
3. **State-wide ban on the production of caged eggs:** Egg producers in your state cannot house hens in conventional cages, but caged eggs can still be sold in your state
4. **State-wide ban on the sale of caged eggs:** All eggs produced and sold in your state must be from cage-free facilities
5. **State mandate on minimum average space requirements:** All eggs produced and sold in your state must meet minimum standards related to cage size
6. **Mandatory labeling on eggs:** Require all eggs produced and sold in the U.S. to have a label indicating the housing system used in production; no restriction on production methods
7. **Farm subsidy:** Provide funding to farmers that want to convert part or all of their operations to cage-free facilities; no restriction on production methods

Figure 4.3 shows one of the BWS questions. After responding to each of the seven questions, respondents were asked to vote on each of the seven policies as if it were on an election ballot. Respondents would indicate whether they would vote for or against each policy; they are also allowed to withhold their vote. They were asked to consider each policy option independently of one another.

Which policy option or program you think is the **best (most desirable)** and which is the **worst (least desirable)**?

Best | Worst

State mandate on minimum average space requirements
(All eggs produced and sold in your state must meet minimum standards related to cage size)

State-wide ban on the sale of caged eggs
(All eggs produced and sold in your state must be from cage-free facilities)

Federal ban on the production and sale of caged eggs
(All eggs produced and sold in the U.S. must be from cage-free facilities)

Figure 4.3. Example best-worst policy question

4.2 Data Analysis

The choice experiment data were analyzed using the latent class model (LCM) (Train, 2009), following similar procedures applied in Lusk (2019). The LCM was selected among other models, such as the multinomial logit model, to account for heterogenous preferences among egg consumers. Indeed, past studies document substantial differences in how consumers evaluate poultry production practices (e.g., Lusk, 2019). In addition, the LCM was preferred to other discrete choice models that account for random taste variation like the mixed logit model (Train, 2009) to avoid biases from making erroneous parametric assumptions regarding preference distributions, which are often found asymmetric and bimodal (Caputo et al., 2018).

Given our experimental approach, the LCM was specified as follows:

$$Prob(n\ chooses\ j\ in\ choice\ t) = \sum_{c=1}^{4} P_{nc} \prod_{t=1}^{8} \frac{\exp\,(\beta_c' PRICE_{jtc} + \alpha_{cnjt}')}{\sum_g \exp\,(\beta_c' PRICE_{gtc} + \alpha_{cngt}')}$$

where n represents consumers in our sample, j = conventional, cage-free, organic, pasture-raised, free-range, and multi-labeled eggs and the no-purchase alternative (none); t indicates the choice questions included in the experiment (T=8); P_{nc} is the estimated probability of individual n being in latent class (or segment) c; $PRICE_{njtc}$ is a continuous variable populated with the four price levels selected for each egg alternative j.

We estimated a four-class LCM and accounted for inattentive responses by constraining all the parameters of the fourth class to equal zero, as suggested by Malone and Lusk (2018). To improve the quality of the consumer survey data, the individuals projected to fall into this fourth class were removed from the subsequential analysis. In estimation, the "none" alternative is normalized to zero for identification purposes. The estimates from the model were then used to calculate willingness to pay (WTP), market shares, and elasticities. Following Carlsson et al. (2011), we also implemented simulations to predict how the market will respond to changes in the market, e.g., the removal of the conventional (caged) alternative. In addition, we used Bayesian calculations (see Scarpa and Thiene 2005) to derive individual-level WTP estimates, which were then used in various regression models to determine individual-level determinants of WTP for conventional, cage-free, organic, pasture-raised, free-range, and multi-labeled eggs. These individual-level WTP values were then used to explore variations in mean WTP premiums across demographics.

The additional consumer survey data were analyzed using various statistical and econometric techniques. For instance, the data from the word association questions were analyzed utilizing the word cloud generator "worditout.com," which allowed us to calculate and visualize the frequencies of the words associated with each egg alternative. The data from the remaining survey questions were analyzed using descriptive statistics (e.g., means, frequencies, relative importance) and graphical representations (e.g., bar graphs).

4.3 Results

4.3.1 Sample Characteristics

Through the consumer survey, we collected 961 responses. Table 4.2 reports the demographics of the sample (first column of table 4.2) relative to that of the U.S. Census (second column of table 4.2). The sample is representative of the U.S. population with respect to gender and region. The sample is older and over-educated with higher relative income compared to the U.S. census. Differences across these characteristics are common in online surveys (Caputo et al., 2020; Caputo et al., 2022). Note, however, that we should not expect a sample that is necessarily representative of the U.S. population as our screening criteria ensured we sampled respondents that purchase/consumer eggs and do at least half of the grocery shopping for their household. However, there is no existing census-level data on the demographics (gender, education, etc.) of egg consumers. Therefore, following Lusk (2018), we weighted our sample according to the stated number of eggs each respondent purchased. Consistent with Lusk (2018), such weighting had relatively minor effects on sample characteristics. Therefore, in what follows, we report the results of the responses from the respondents who purchase/consume eggs without any special weighting.

Table 4.2. Consumer sample demographics relative to U.S. census (n = 961, % frequencies)

Characteristic	**Sample Unweighted (n = 961)** [a]	**U.S. Census**	**Weighted by Egg Purchase Volume**
Male	45.8	48.6	44.5
Age			
18-34	27.7	30.5	29.5
35-44	20.4*	17.0	21.4
45-54	12.4*	18.4	14.1
55-74	28.9	26.1	26.5
75+	10.6*	8.0	8.5
I*ncome*			
Less than $20K	9.1*	15.8	7.3
$20K - $79K	49.3	47.1	46.7
$80K and above	41.7*	37.1	46.0
Education			
Less than high school	1.6*	9.6	1.4
High school diploma	18.3*	28.3	17.6
Some college, no degree	20.7*	17.1	19.8
College degree	38.2*	32.2	38.6
Advanced degree	21.2*	12.8	22.7
Region			
Midwest	20.6	21.1	18.2
Northeast	16.3	17.5	16.3
South	41.3*	37.7	41.9
West	21.7	23.7	23.4
Race and Hispanic Origin			
White alone	83.1*	75.8	82.0
Black or African American alone	9.8*	13.6	9.9
Hispanic or Latino [b]	8.0*	18.9	10.0
SNAP recipient [c]	18.8	17.7	18.1

[a] Superscript * denotes statistically significant differences between the sample and the U.S. population at the 5% level.
[b] Following the Census Bureau, Hispanic origin is asked separately from the race question. As such, the percentage indicating Hispanic, White, and Black or African American sum to more than 100%.
[c] The percentage of recipients currently receiving SNAP benefits is calculated as the number of households receiving SNAP benefits (USDA-FNS, 2022) divided by the total number of households (U.S. Census, 2022).

4.3.2 Egg Purchasing Habits

Table 4.3 summarizes the sample's egg purchasing habits. Supermarkets (38%) and supercenters (35%) are where consumers most frequently purchase their eggs. Most consumers purchase eggs occasionally (33.8%) (every two weeks) and often (32%) (1-4 times per week). Consumers most commonly purchase a dozen eggs per shopping occasion (52%)

Table 4.3. Egg purchasing habits of the sample

Egg Purchasing Characteristic	% of respondents
Most frequent purchasing location	
Supermarket	37.6
Supercenter	35.3
Warehouse Club	7.3
Natural or organic store	5.9
Low-price, no-frills grocery store	10.0
Ethnic store	0.0
Farmer's market	1.8
Other	2.2
Purchasing frequency (Frequency)	
Very Often (Daily or 5-6 times per week)	12.8
Often (1-4 times per week)	32.0
Occasionally (Every two weeks	33.8
Rarely (once a month)	10.1
Other	1.4
Eggs purchased per occasion (Volume)	
Less than 6 eggs	18.7
6 eggs	4.0
12 eggs	52.0
18 eggs	25.3
24 eggs	10.6
More than 24 eggs	6.2

Figure 4.4 reports how consumers perceive the importance of various product attributes and claims when purchasing eggs. Specifically, the figure shows the differential between the percentage of consumers that rate an attribute as most important versus least important. Attributes with a positive differential are more commonly selected as "most important," while those with a

negative differential are more commonly chosen as "least important."[18] The results suggest that price (+48%), taste (+41%), and safety (+36%) are the most important egg characteristics to consumers. Amongst the least important features are novelty (-45%), color (-31%), and environmental impact (-21%).

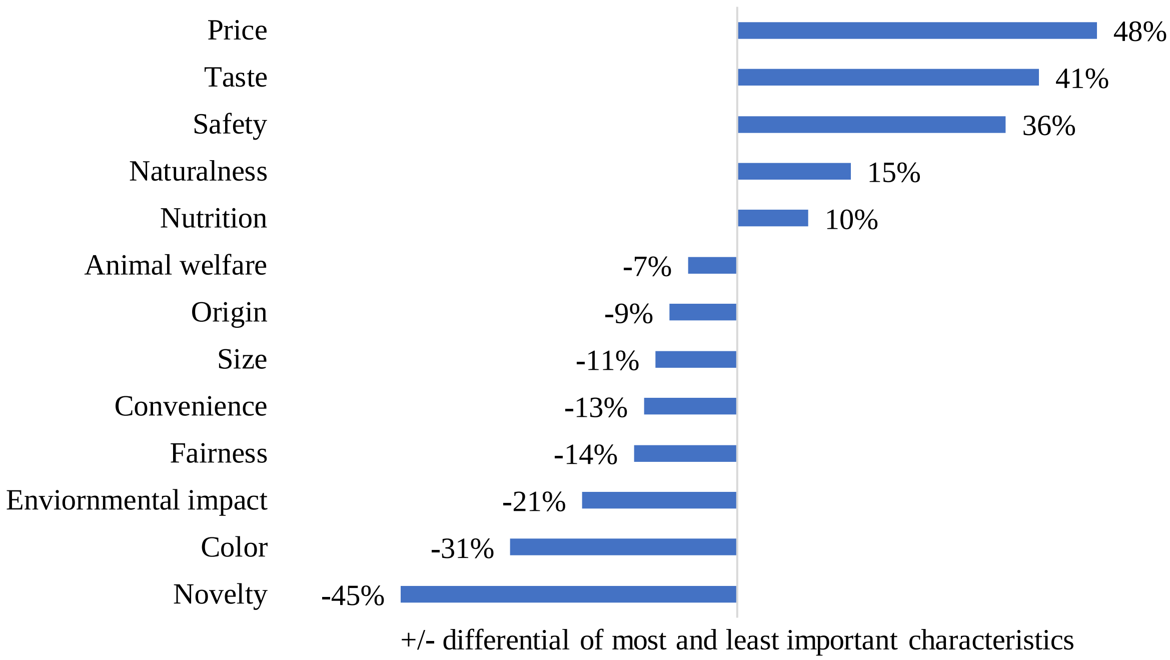


Figure 4.4 Attributes that are most and least important to consumers when buying eggs

Figure 4.5 reports how consumers report prices changing since November 2021 and how they think egg prices will adapt to this time next year. The figure shows that 80% of respondents have noticed a price increase, with nearly a third stating prices are more than 30% higher. The respondents stating that egg prices are higher were asked what was driving the increase, amongst a list of six different factors (select all that apply).

[18] Respondents were asked to indicate the three egg attributes they would consider the most important and the three egg attributes they would consider the least important. The relative importance of each attribute was then derived by coding answers for most important as +1, answers for least important as -1, and all non-selected attributes as 0. The average of this exercise then represents the relative importance. Thus, the score ranges from a minimum of -1 (all respondents indicate the attribute to be among the least important ones) to +1 (all respondents indicate the egg attribute to be among the most important ones).

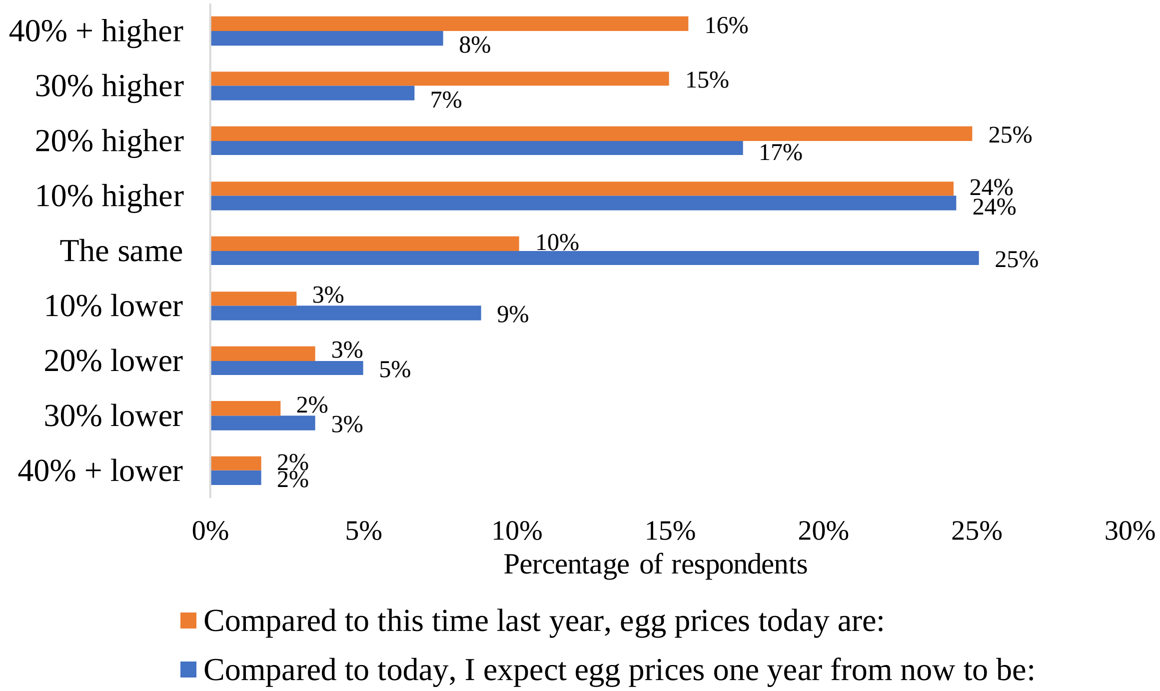


Figure 4.5. Consumer perceptions over past and future egg prices

Figure 4.6 summarizes these results. Inflation (85%), higher production and transportation costs (52%), and other supply chain challenges (45%) are the most commonly indicated reason for the higher egg prices. Just 15% of consumers perceive the higher prices to be associated with the greed of retailers; 13% for the greed of egg producers. A notable finding from Figure 4.6 is that only 22% of consumers report avian influenza (AI) as a reason for the price increase. This statistic comes despite heightened media coverage of the record number of AI outbreaks, where approximately 50 million U.S. birds have been culled from the outbreak (CDC, 2022). As for the price consumers expect to pay one year from now compared to now, over half (56%) of respondents predict next year's egg prices to be higher than current egg prices, but the most common response was that egg prices would remain the same (25% of the sample). Just 19% of consumers believe egg prices will decline over the next year.

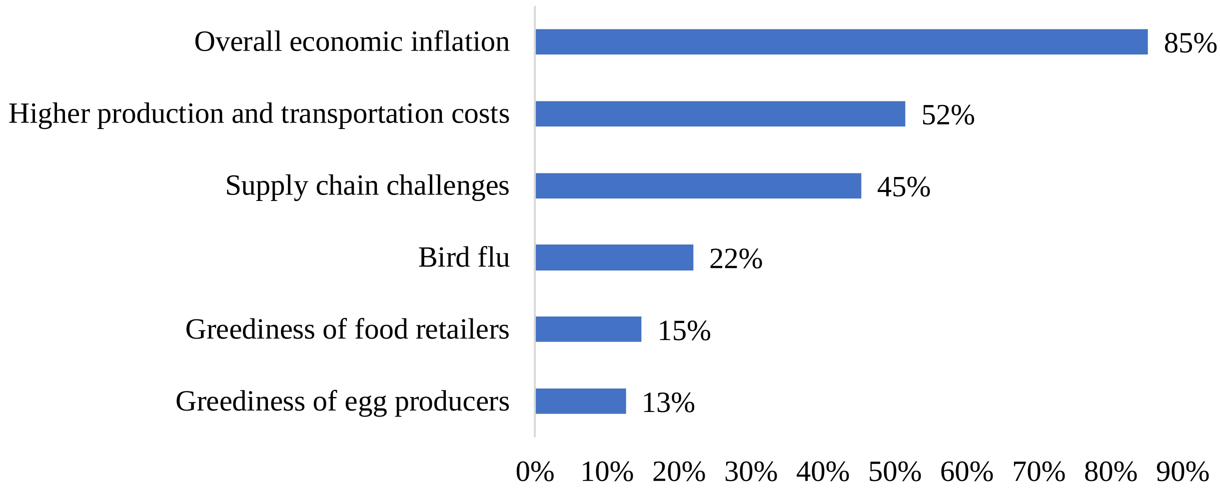


Figure 4.6. Consumer perceptions over why egg prices have increased over the past year (n = 766)

4.3.3 Consumer knowledge, attitudes, and perceptions of the egg industry

Figure 4.7 presents the distribution of consumer beliefs about the current and projected future (January 2026) share of cage-free laying hens in the United States. The average estimate is 35% of hens currently housed in cage-free environments, with the most common response in the 20-29% range. This answer aligns with the correct answer using the UEP (2023b) estimate of 29%. Figure 4.7 also shows the predictions for the percentage of cage-free laying hens in January 2026. The figure shows a shift in the distribution to the right, where the average response is 45%. In other words, the average consumer expects a 10-percentage point increase in cage-free laying hens from now to January 2026. Compared to the results from the producer survey, the consumers have a lower estimate of cage-free production in January 2026. The difference likely stems from unawareness of retailer pledges to transition to 100% cage-free.

Indeed, when asked whether the store the respondent most commonly purchases eggs at has made a pledge, most respondents did not know (56%), and only 19% of respondents said their store had made a cage-free pledge. However, when asked whether they would support their retailer in making this pledge, 79% of respondents said yes.

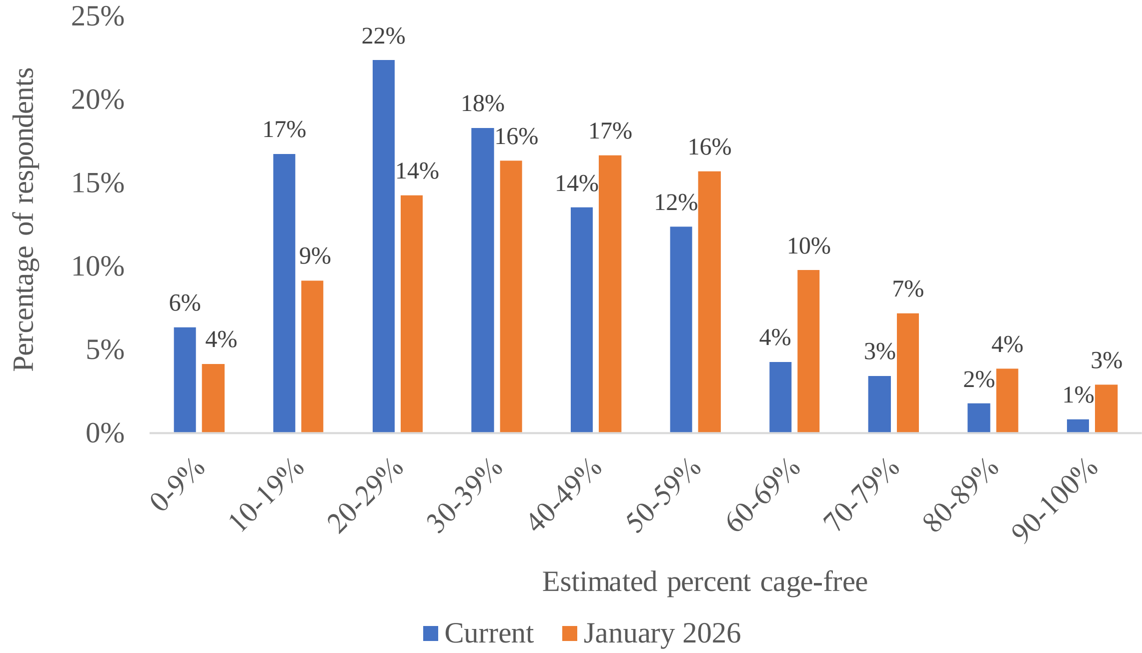


Figure 4.7. Respondent estimates for percentage of cage-free laying hens, currently and Jan. 2026

Exploring consumer perceptions of the industry, respondents were asked to report the percentage of producers that provide various amenities to their laying hens. The list of ten amenities comes from the UEP certification (UEP, 2022c). Figure 4.8 reports the average responses for each characteristic. On average, amenity rates are below 70%, meaning the average consumer believes that less than 70% of producers provide these amenities to the laying hens. The amenities that rank highest are water 24/7 (69%), disease prevention (61%), and indoor housing for hens protection (61%). Amongst the lowest scores are for veterinarians on staff (43%), annual third-party audits (47%), and no added hormones (49%). We do not have statistics on the exact percentage of producers providing each of these amenities. Thus, the purpose of reporting these statistics is to provide industry leaders with a general overview of how consumers view the industry and potentially generate discussion on marketing mechanisms to promote consumer perceptions.

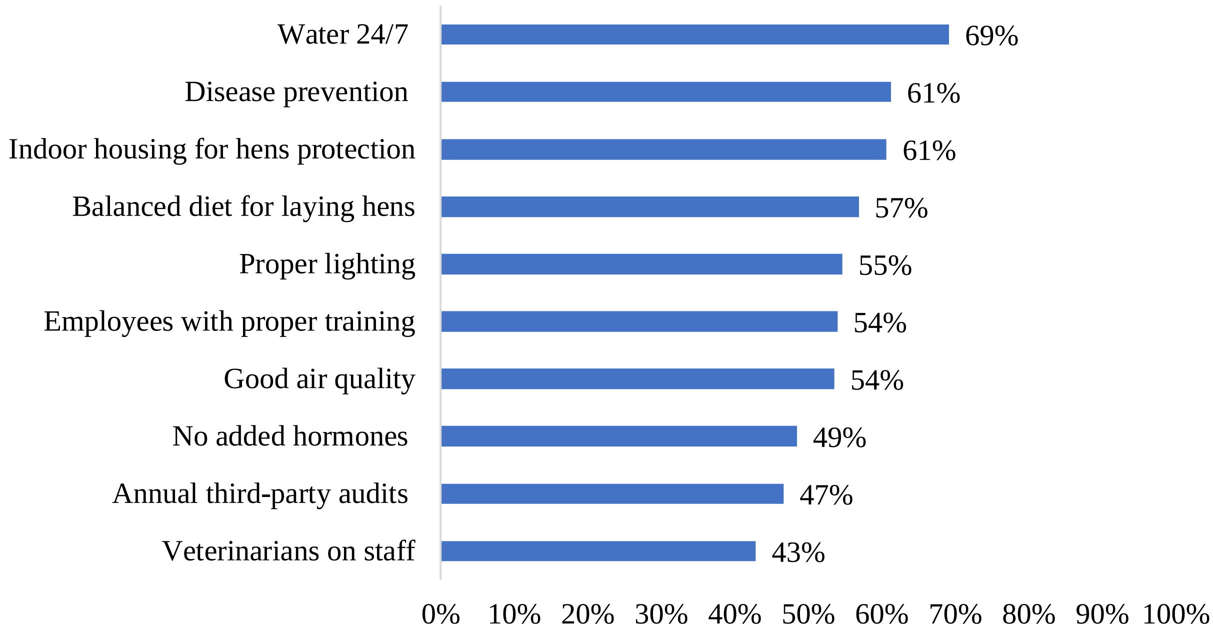


Figure 4.8. Consumer perceptions of egg producers providing different services to laying hens

4.3.4 Word Association

Respondents were asked to report the first word or phrase that came to mind when hearing different egg production systems. The figure included in this link presents word clouds for each system, where the size of the word corresponds to the frequency it was used. There are a few interesting takeaways from these consumer reactions. First is the difference in perceptions between "conventional" and "caged." Despite implying the same system, respondents attach more negative associations when caged is used. Rather than use words like "normal," "regular," and "traditional," respondents frequently resort to terms such as "inhumane," "cruel," and "sad." This distinction signals a lack of consumer awareness in production systems while demonstrating the importance of framing, messaging, and marketing. A notable second takeaway is the *health halo* attached to the labeled eggs, where "healthy" is commonly used to describe cage-free, organic, free-range, and pasture-raised systems. Lastly, there is significant overlap in the word clouds for the cage-free, organic, free-range, and pasture-raised systems, suggesting consumers may view these products as substitutes for one another.

4.3.5 Choice Experiment

The results from the LCM are provided in the Appendix (see Table A1). As mentioned, we estimated a four-class LCM and removed inattentive responses from the subsequential analysis.[19] This included the calculation of WTP, market share, and elasticities. In what follows, we present aggregate-level results and then explore underlying heterogeneity in consumer segments identified by the LCM.

Table 4.4 presents aggregate WTP estimates for each egg product. The first column reports the mean WTP for each egg product relative to "none" (total WTP), while the second column reports the mean WTP premium for the labeled differentiated eggs versus conventional eggs (marginal WTP). The total WTP estimates suggest that respondents show the highest total WTP for the eggs carrying all the labels (cage-free, organic, free-range, and pasture-raised) ($6.86) relative to "none." This is followed by organic ($5.90), free-range ($5.06), pasture-raised ($5.04), and cage-free ($4.79), with conventional eggs having the lowest total WTP ($3.49). Examining marginal WTP estimates, cage-free eggs have the lowest mean WTP premium (relative to conventional eggs). The results also indicate a high level of substitutability between the labels: the sum of the total WTP values consumers attach to each single-labeled egg (cage-free, organic, free-range, or pasture-raised) is significantly higher than WTP for eggs displaying these labels altogether.

Table 4.4. Total and marginal WTP estimates from the LCM ($/Dozen)

Egg Alternative	**Total WTP: Mean WTP relative to "none"**	**Marginal WTP: Mean WTP premium vs. conventional**
Conventional	$3.49	---
Organic	$5.90	$2.41
Cage-free	$4.79	$1.31
Pasture-raised	$5.04	$1.55
Free-range	$5.06	$1.57
Multi-labeled [a]	$6.86	$3.37

[a] The multi-labeled egg option includes eggs with the organic, cage-free, pasture-raised, and free-range labels.

[19] The optimal number of classes to be used in the analysis was selected in accordance with the usual information criteria such as the Akaike Information Criteria (AIC), the Bayesian Information Criteria (BIC) and the modified Akaike Information Criteria (3AIC).

In addition to estimating aggregate WTP for each egg product, we also conducted simulations to explore the effects of different market conditions and relevant policies. For instance, Figure 4.9 reports consumer WTP to retain each egg product in the choice setting. These measures were estimated following the procedures described in Carlsson et al. (2011), showing the amount of money that would make consumers indifferent between two choice conditions. In our case, we are measuring the amount of money that would make consumers indifferent between keeping each egg product in the market versus removing it from the market. Consumers were assumed to have the option to choose “none” or select one of the egg products included in the choice experiment: conventional egg (priced at $2.50/dozen), organic eggs ($4.50/dozen), pasture-raised ($4.50/dozen), free-range eggs ($4.50/dozen), and multi-labeled eggs ($5.50/dozen). These price levels were used to reflect the average actual market prices for each of the studied eggs. Results indicate that consumers are willing to pay up to $0.60 to simply have the option of buying conventional eggs. For the single-labeled option, consumers are willing to pay up to $0.04 to have the option of buying cage-free eggs, but their WTP increases to $0.46 when cage-free eggs also display organic, pasture-raised, and free-range labels.

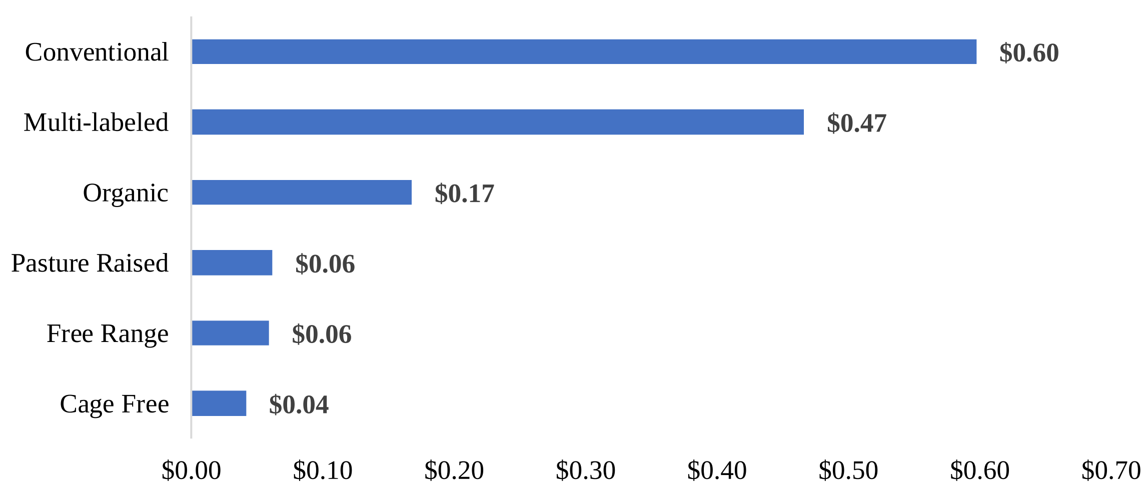


Figure 4.9. Mean WTP to keep each egg product in the choice environment ($/dozen)

Next, we projected how removing conventional eggs might affect purchasing behavior following Lusk (2018). The left panel (Scenario 1) of Figure 4.10 shows a market scenario when all products are present, while the right panel shows the market shares when conventional eggs are excluded.[20] The simulation provides two key takeaways. First, market shares for the non-conventional alternatives increase marginally, between 2-8 percentage points. Secondly, the percentage of consumers opting out of the marketplace increases substantially, from 5% to 25% of consumers. This increase is greater than the increase presented in Lusk (2018), who found that the share of consumers who would refrain from buying eggs would increase from 4% to 17% if conventional eggs were removed from the market. This may reflect the current environment of higher egg prices and elevated inflation in the economy, leading to a large share of consumers exiting the collective egg market if conventional eggs are no longer available.

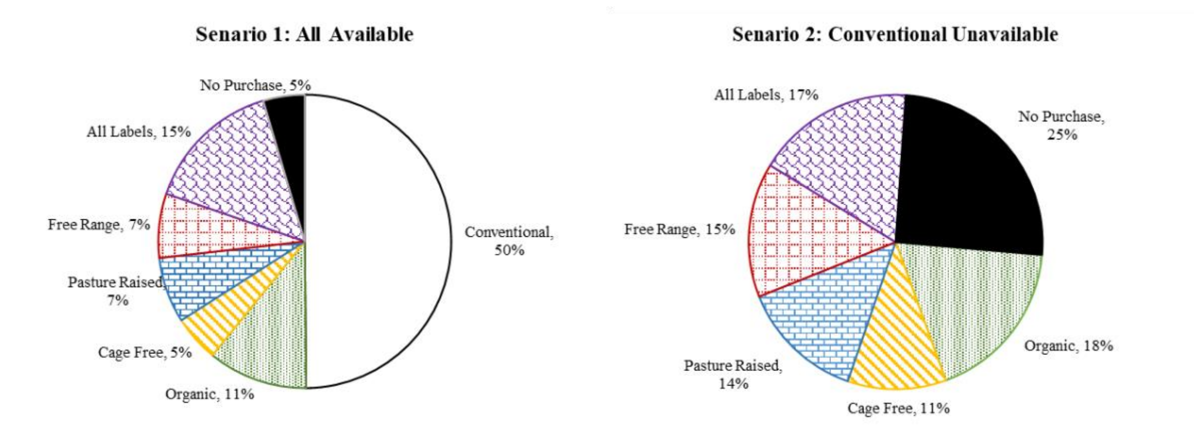


Figure 4.10. Market simulation demonstrating the effects of the removal of conventional eggs

In addition to demonstrating the impact of removing conventional eggs from the marketplace, we also calculated the price elasticities (see Table 4.5). The diagonal entries represent own-price (direct) elasticities, while the off-diagonals represent cross-price elasticities. Own-price elasticities describe the percentage change in the probability of each egg product (cage-free) being chosen given a percentage change in its price. Cross-price elasticities measure how the probability of choosing an egg product (cage-free) changes given a change in the price of another egg alternative (conventional). Consistent with economic theory, all own-price elasticities are negative,

[20] It is important to note how the elasticities play a role in determining the outcomes presented in Figure 4.10. Elasticities measure the slope of the demand curve for each egg product. When simulating the removal of the conventional eggs from the marketplace (Scenario 2 of Figure 4.10), new elasticities are calculated for each of the remaining egg alternatives. Put differently, we are on new demand curves for each of the labeled alternatives, and these new demand curves have different elasticities than the market with conventional eggs (Scenario 1 of Figure 4.10). This explains why we can observe a large jump in opt-out rates despite the inelastic own-price elasticity of demand shown in Table 4.5.

indicating that a price increase decreases the probability of selection. However, there are varying degrees of price sensitivity, highlighting different behavioral responses to price changes. At the selected price levels from the aforementioned market simulation,[21] consumers appear less price sensitive with conventional eggs; more price sensitive with labeled, differentiated eggs, especially organic, cage-free, pasture-raised, and free-range eggs. For example, the model predicts that a 1% increase in the price of conventional eggs will lead to a 0.7% reduction of conventional being chosen, while a 1% increase in the price of cage-free eggs will lead to a 5.8% reduction of conventional being chosen. Consumers also appear less price sensitive with multi-labeled eggs than single-labeled eggs: organic, cage-free, pasture-raised, or free-range eggs. For example, the model predicts that a 1% increase in the price of cage-free eggs will lead to a **-5.84**% reduction of cage-free being chosen, while a 1% increase in the price of multi-labeled eggs will lead to a **2.28**% reduction of multi-labeled eggs being chosen. All cross-price elasticities are positive, suggesting a degree of substitutability across the egg products. A custom-made Excel tool was developed to allow the user to explore welfare estimates, market shares, and price elasticities under alternative market price conditions. The tool can be downloaded here.

Table 4.5. Own- and cross-price elasticities of demand

Change in Price of …	Change in Quantity of …					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Conventional (1)	**-0.74**	0.51	0.87	0.73	0.84	0.14
Organic (2)	0.19	**-4.01**	1.13	1.17	1.14	0.65
Cage-free (3)	0.15	0.52	**-5.84**	0.79	0.77	0.23
Pasture-raised (4)	0.18	0.77	1.13	**-5.40**	1.14	0.34
Free-range (5)	0.21	0.73	1.08	1.12	**-5.55**	0.33
Multi-labeled (6)	0.09	1.09	0.84	0.87	0.84	**-2.29**

We now focus on heterogeneity in consumer preferences for different egg types and market segments. We first evaluated whether consumer demographic characteristics significantly affect WTP premiums for labeled eggs (organic, cage-free, pasture-raised, free-range, multi-labeled)

[21]The elasticities presented in Table 4.5 are calculated by determining the proportionate change in market shares resulting from a 1% increase in the price of each respective egg when conventional eggs are priced at $2.50/dozen; organic, pasture-raised, and free-range eggs are priced at $4.50/dozen; and multi-labeled eggs are priced at $5.50/dozen.

versus conventional eggs. We did so by following two steps. We first utilized the estimates from the LCM to calculate the individual-level WTP values using the Bayesian procedure illustrated in Scarpa and Thiene (2005). Then, we used these individual-level WTP to 1) evaluate variations in WTP premiums across demographics using graphs and 2) determine the demographics associated with significant changes in WTP using a seemingly unrelated regression model (see Zellner (1962) for more computational details). Figure 4.11 illustrates the variation in mean WTP premiums for cage-free and multi-labeled eggs by gender, income, education, and age. On average, age is negatively correlated with premiums for specialty labels. Education and income, on the other hand, are positively correlated with cage-free and multi-labeled mean premiums relative to conventional eggs. These results are consistent across the results from the regression (see here), which suggest that: i) Age is negatively associated with WTP for all specialty egg products, as is residing in the southern region; ii) education is positively associated with WTP, while income was a relatively weak predictor of WTP estimates; iii) males were less likely to pay premiums for each of the specialty eggs than females.

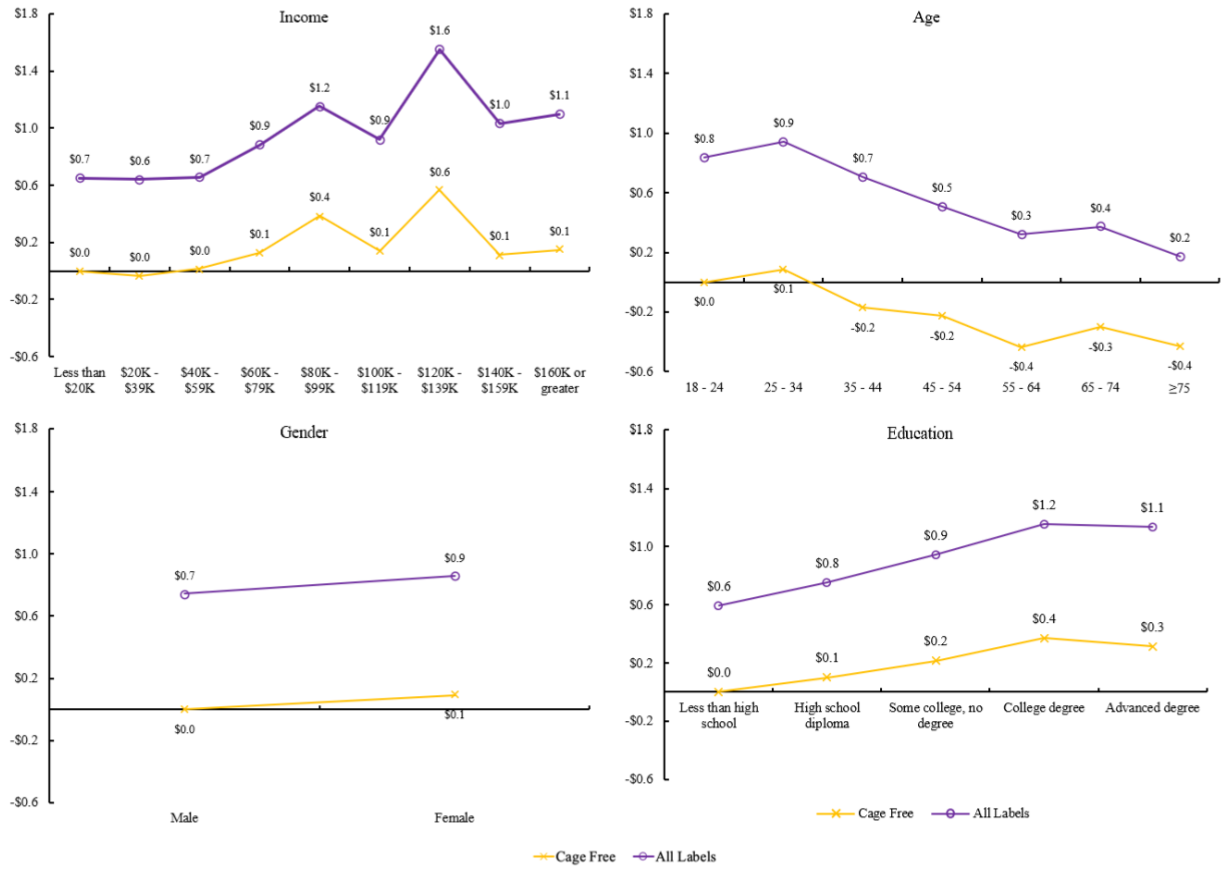


Figure 4.11. Variation in mean WTP premiums for cage-free and multi-labeled eggs ($/dozen) relative to conventional, by select demographics.

To further explore heterogeneity in consumer preferences, we also calculated total and marginal mean WTP values ($/dozen) across three distinct consumer segments revealed by the LCM (the class probabilities exclude the 22% who have provided inattentive responses and have zero coefficients for all parameters). The results are reported in Table 4.6. Segment 1 (55% of our sample) is represented by consumers who are more sensitive to price changes, resulting in fairly low WTP values for almost all egg types, ranging from $3.82 to $4.27. Indeed, consumers who belong in this class have a relatively low, often negative, premium for cage-free (-$0.10), organic (-$0.01), pasture-raised (-$0.05), free-range ($0.05) and multi-labeled ($0.35) eggs. We define Segment 1 as “Price Sensitive.” Segment 2 (19% of our sample) is more price insensitive, as they show relatively high WTP values for all the other egg types, especially for multiple-labeled eggs ($15.71) and organic eggs ($12.48). The WTP for cage-free, pasture-raised, and free-range eggs ranges from $7.17 to $7.99. For this reason, we call Segment 2 “Price Insensitive.” Lastly, Segment

3 (26% of our sample) is the most animal welfare conscious. Compared to the other segments, this consumer segment exhibits the lowest WTP for conventional eggs relative to none ($2.63). The WTPs for the other products are similar in magnitude, ranging from $5.14 to $5.98. We define this group as "Animal Welfare Oriented."

Table 4.6. Total and marginal mean WTP values ($/dozen), by market segment

WTP by Egg Product	Segment 1: Price Sensitive	Segment 2: Price Insensitive	Segment 3: Animal Welfare Oriented
Percentage of sample	55%	19%	26%
Total WTP: Mean WTP relative to "none"			
Conventional	$3.92	$3.42	$2.63
Organic	$3.92	$12.48	$5.37
Cage-free	$3.82	$7.17	$5.14
Pasture-raised	$3.87	$7.99	$5.40
Free-range	$3.97	$7.82	$5.37
Multi-labeled	$4.27	$15.71	$5.98
Marginal WTP: Mean WTP premium vs. conventional			
Organic	-$0.01	$9.05	$2.74
Cage-free	-$0.10	$3.74	$2.51
Pasture-raised	-$0.05	$4.57	$2.77
Free-range	$0.05	$4.40	$2.74
Multi-labeled	$0.35	$12.29	$3.35

Overall, the results from the choice experiment are robust across egg consumers; for example, the results from the choice experiment where responses were weighed by egg purchasing volume reported by our respondents during the survey (see here).

4.3.6 Policy Preferences

Table 4.7 and Figure 4.11 report the results of the best-worst scaling (BWS). In short, Table 4.7 shows the share in which each policy was selected as the best and the worst when presented in one of the policy questions. Figure 4.12 graphically illustrates the percentage difference between the best and worst responses. A positive point differential means the policy was preferred more often than not, and vice versa for the negative point differential.

Two main takeaways come from the BWS. First, there is a clear divide between policies banning caged production versus policies mandating minimum size requirements. Each of the three bans on the production/sale of caged products has a negative differential, meaning consumers more commonly vote this as the worst policy than the best one. On the other hand, both of the minimum size requirement policies have positive differentials. The second key takeaway is that consumers are more likely to prefer policies that do not restrict egg production systems. That is, the two policies with the highest point differential are mandatory labeling and farm subsidies for cage-free housing.

Table 4.7. Best-worst scale response frequencies

	% selected when present	
Policy	**Best**	**Worst**
Mandatory labeling on eggs	46.2	27.2
Farm subsidy	40.6	25.6
Federal mandate on minimum average space requirements	38.1	30.8
State mandate on minimum average space requirements	34.8	28.9
Federal ban on the production and sale of caged eggs	28.3	44.7
State-wide ban on the sale of caged eggs	23.8	36.7
State-wide ban on the production of caged eggs	21.5	39.4

Following the BWS, respondents were provided with traditional ballot questions, where they voted for or against each of the seven policies; they also had the option to withhold their vote. Figure 4.13 reports the results of the ballot-style questions. The results are mostly in-line with those described in the BWS, but some key differences emerge. Mandatory labeling was viewed as the most preferred initiative, with 70% of respondents stating they would vote for the policy. Other commonly "approved" measures include state (62%) and federal (59%) mandates on minimum average space requirements, whereas the policies banning the production and/or sale of caged eggs reached a 50% majority. However, when removing consumers who withhold their vote, more people voted for the policies banning the production and/or sale of caged eggs at the state level than against it. Comparing this result to the point differential in Figure 4.12, we see how ballot initiatives can pass without being a preferred policy amongst the public.

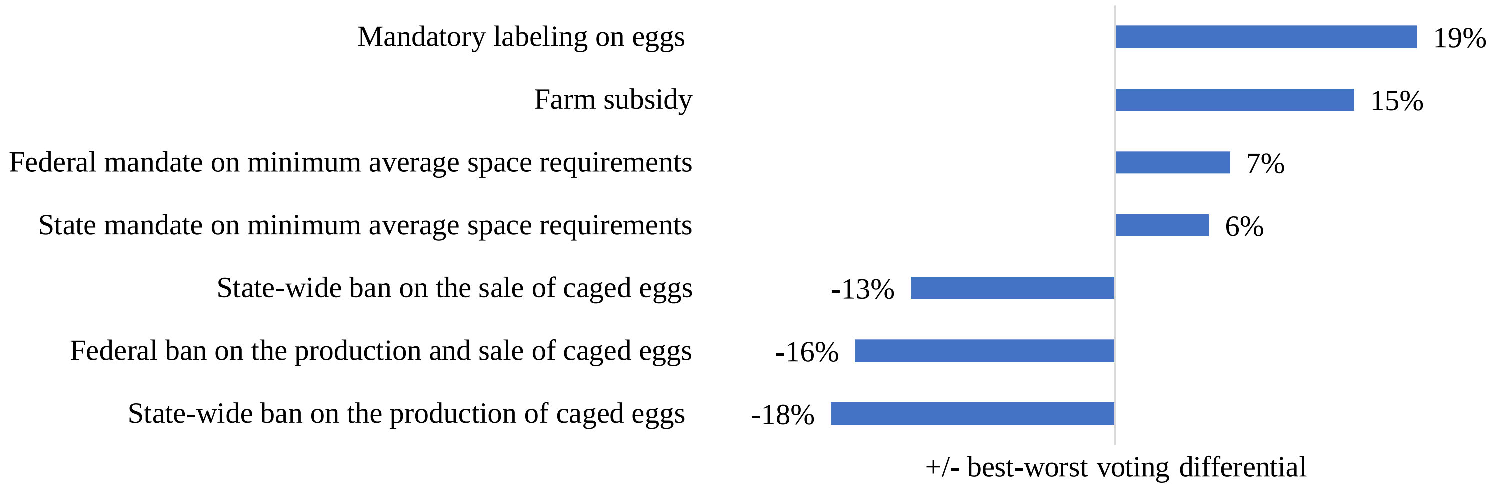


Figure 4.12. Best-worst scaling (BWS) results, differential in voting

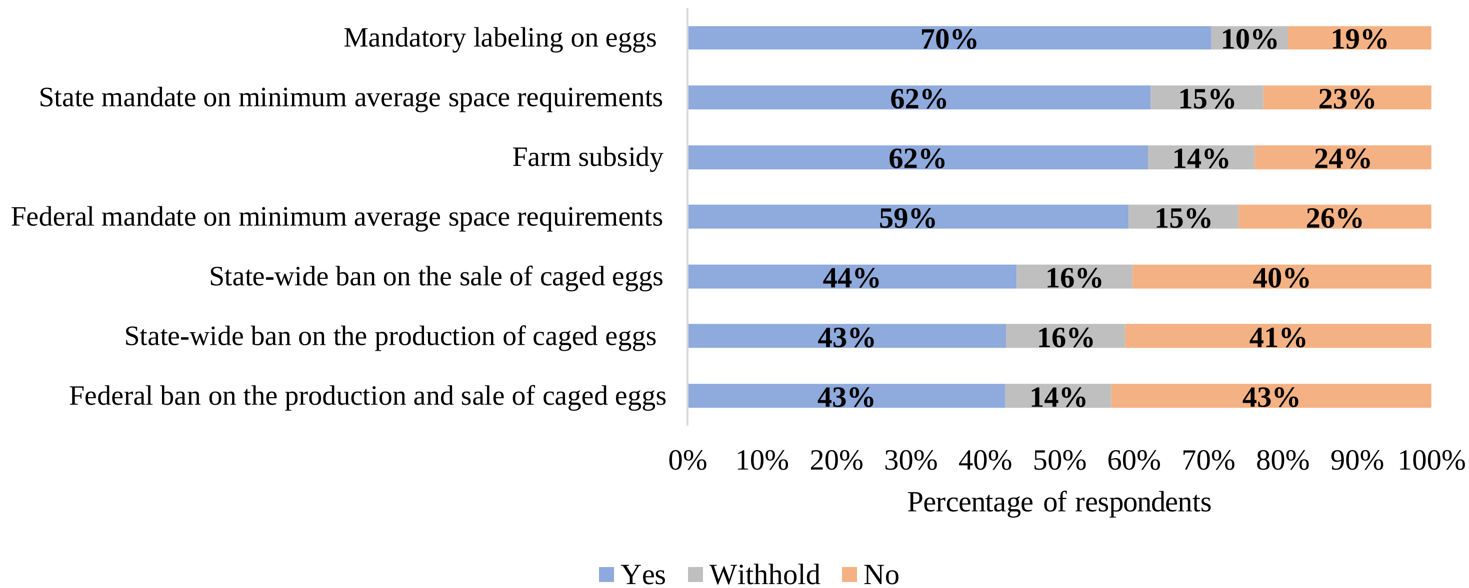


Figure 4.13. Responses to various ballot initiatives

4.4 Final Remarks

We surveyed 961 U.S. consumers to assess attitudes and preferences toward egg products, the industry, and policy options. We find that price, taste, and safety are the most important attributes for consumers when buying eggs. About 80% of respondents have noticed an increase in egg prices, with nearly a third stating prices are more than 30% higher. Inflation (85%), higher production and transportation costs (52%), and supply chain challenges (45%) are the most commonly indicated reason for the higher egg prices.

Regarding consumer knowledge, attitudes, and perceptions of the egg industry, consumers believe that less than 70% of producers provide the various amenities to the laying hens, with water 24/7 (69%), disease prevention (61%), and indoor housing for hens protection (61%) ranking among the highest amenities.

Results from the choice experiment show that consumers are willing to pay $1.31 for cage-free eggs over conventional eggs, but their WTP goes up to $3.37 when cage-free eggs also display the USDA organic, pasture-raised, and free-range labels. Results from the choice experiment also show differences in WTP across three consumer segments. More than half of consumers (55%) have a negative WTP value (-$0.10/dozen) for cage-free eggs compared to conventional eggs. About 26% of consumers made choices that indicate a WTP value of $2.51 for cage-free eggs over conventional eggs, while only 19% of consumers have a WTP premium higher than $3.00 ($3.74/dozen). In simulating the egg market with and without the conventional (caged) alternative, the results suggest that removing the conventional egg alternative will result in a larger share of consumers (25%) opting-out of the marketplace due to a high-degree of price sensitivity.

From a policy perspective and of notable importance, just 19% of consumers were aware of retailer cage-free pledges, but nearly 80% of consumers stated they would support such a pledge. Further, the average consumer prefers policies on minimum size requirements instead of banning conventional production. Yet, when it comes to ballot initiatives, even the least preferred policies have a high likelihood of passing, heightening concerns over how consumers vote versus behave in the retail outlet.

Overall, the findings from the consumer survey provide insights for the industry to prepare for the impending transition to cage-free.

Chapter 5: Market and Producer Impacts of the Conversion to Cage-Free Egg Housing

Summary

We construct an equilibrium displacement model to assess how changes in market conditions could affect egg producer profits. Specifically, in this chapter, two types of shell egg market shocks are modeled. First consider a world where retailers transition toward cage-free eggs but hold constant their total spending on eggs. That is, the demand curve for cage-free eggs at the retail-level has shifted but total spending on egg products remains fixed. In this scenario, the model predicts that producer profits could fall due to fewer total eggs purchased given the higher- average-cost cage-free systems. The second simulated market shock considers a supply shock from the higher cage-free expenses, drawing insights from the producer survey reported in Chapter 3, while holding demand steady. Under varying sets of assumptions, the results suggest a decline in producer profits ranging from $27-136 million. Importantly, both scenarios modeled here capture a single shock, meaning that the estimates may not extrapolate to market scenarios where multiple shocks hit the system simultaneously.

5.1. Equilibrium Displacement Model

Previous sections of this report provided insights into producer and consumer preferences and expectations regarding conventional and cage-free eggs. These insights are now brought together to understand market-level impacts in which the aggregate actions of producers and consumers combine and interact to affect market prices, market quantities, and egg producer profits.

These issues are studied in two ways. First, a disaggregate market for cage and cage-free eggs is modeled, where producers supply both types of eggs to market and consumers choose between them. In this context, we explore how demand shifts by retailers away from conventional and toward cage-free eggs affect egg producer profitability. Second, a simple supply and demand model of the aggregate egg market (including cage and cage-free) is constructed. In this environment, we study how an aggregate supply shift, induced by extra costs brought about by conversion to cage-free housing, affects egg producer profitability in an environment where aggregate egg demand remains stable. In both the aggregate and disaggregate cases, we focus only on shell eggs and ignore liquid eggs or other egg products; we also focus on the wholesale market between egg producers and egg retailers rather than the final consumer market.

In both cases, we utilize the approaches developed in Alston (1991), Lusk and Tonsor (2021), and Wohlgenant (2011), in which an equilibrium displacement model is constructed. The approach considers *changes* in prices and quantities from an initial equilibrium brought about by an assumed exogenous supply shock, such as an increase in cost from housing conversion, or a demand shock, such as shifts in retailer demand for conventional vs. cage-free eggs. The changes calculated by the model may not align with changes observed in "real life" because, in reality, there are multiple supply and demand shocks routinely hitting markets. However, what this modeling approach permits is the ability to identify and study the market effects of a single shock in isolation (in this case, the shocks associated with conversion from conventional to cage-free housing), recognizing that future observed market changes would be muted or amplified as other shocks (e.g., changes in feed prices, changes in consumer income, avian influenza) invariably hit the system.

5.2. Disaggregated Egg Market Analysis

We begin with a model of the shell egg market in which retailers choose how many conventional and cage-free eggs to purchase at a given set of prices. The demand-side of the model is as follows:

(5.1) $$\hat{Q}_C = \eta_{C,C}\hat{P}_C + \eta_{C,CF}\hat{P}_{CF} + \delta_C$$

(5.2) $$\hat{Q}_{CF} = \eta_{CF,C}\hat{P}_C + \eta_{CF,CF}\hat{P}_{CF} + \delta_{CF}$$

where $\hat{P}_j$ is the proportionate change in egg price (i.e., $\hat{P} = \Delta P/P \approx \mathrm{dln}P/P$), $\hat{Q}_j$ is the proportionate change in quantity demanded, and $\eta_{j,k}$ are the price elasticities of demand. Subscript *C* represents conventional eggs, and *CF* represents cage-free eggs. Equation (5.1) is the change in demand for conventional eggs, and equation (5.2) is the change in demand for cage-free eggs. One expects $\eta_{C,C}$ and $\eta_{CF,CF}$, the own-price elasticities of demand for conventional and cage-free eggs, respectively, to be negative: as egg prices rise, retailers are expected to buy fewer of them. It is expected that retailer-consumers consider conventional and cage-free eggs as substitutes, and as such, it is expected that $\eta_{C,CF} > 0$. δ_j are demand shocks representing the proportional change in quantity demanded; they are the magnitudes of the horizontal shift in the demand curve expressed relative to the initial equilibrium quantity.

The supply side of the model assumes independence in production (i.e., the quantity of cage-free eggs supplied does not depend on the price of conventional eggs and vice versa):

(5.3) $$\hat{Q}_C = \varepsilon_C \hat{P}_C$$

(5.4) $$\hat{Q}_{CF} = \varepsilon_{CF} \hat{P}_{CF}$$

where $\varepsilon_j > 0$ are own-price elasticities of supply.

Equations (5.1) through (5.4) represent a system of four equations and four unknowns. Once elasticity values are assigned and demand shocks, δ_C and/or δ_{CF}, are assumed, then the equations can be solved for the four endogenous variables, changes in quantities and prices: $\hat{Q}_C$, $\hat{Q}_{CF}$, $\hat{P}_C$, $\hat{P}_{CF}$. Once these values are known, it is possible to calculate changes in total revenue/expenditure and egg producer profitability.

We use this framework to consider a simple thought experiment. For a given reduction in conventional egg demand, $-\delta_C$, how much would cage-free egg demand, δ_{CF}, have to rise to hold total egg expenditure constant? This "expenditure constant" calculation assumes retailers want to continue to spend the same amount on eggs and they adjust their demands accordingly. In this case, we identify the levels of δ_C and δ_{CF} that force the following equality to hold:

(5.5) $$P_C^0 Q_C^0 + P_{CF}^0 Q_{CF}^0 = P_C^0(1+\hat{P}_C)Q_C^0(1+\hat{Q}_C) + P_{CF}^0(1+\hat{P}_{CF})Q_{CF}^0(1+\hat{Q}_{CF})$$

where P_j^0 and Q_j^0 are the initial equilibrium price and quantity levels for egg type *j* = conventional © or cage-free (CF), making the left-hand side of equation (5.5) total expenditure on eggs in the initial equilibrium and the right-hand side of equation (5.5) total expenditure on eggs in the new equilibrium after the demand shocks. Even though total revenue/expenditure is being held constant in this thought experiment, producer profitability is not, and one can calculate changes in producer profitability (or producer surplus) as:

(5.6) $$\pi = \sum_{j=C,CF} P_j^0 Q_j^0 \hat{P}_j(1+\hat{Q}_j).$$

Producer profits can fall even as retailers spend the same amount on eggs if the switch in demand results in more egg production coming from higher cost-of-production systems.

Figure 5.1 below shows the market effects of the offsetting demand shocks considered in this thought experiment. The left-hand side figure shows the market for conventional eggs. The quantity of conventional eggs demanded by retailers is assumed to fall from D_C^0 to D_C^1. This moves the market from the equilibrium at point A to point B, as conventional egg prices and quantity produced both fall. The right-hand side of the figure shows the offsetting effects in the cage-free market as retailers increase the quantity of eggs demanded from D_{CF}^0 to D_{CF}^1, moving the equilibrium from point C to point D as cage-free egg prices and quantity both rise. The changes in conventional egg prices affect cage-free demand, creating a feedback loop between the figures on the left and right, which is accounted for in the model in equations (5.1) and (5.2). Looking at Figure 5.1, it is important to note that the magnitude of the horizontal quantity demand shifts (the red arrows, which are equal to δ in the mathematical model) is more prominent in absolute value than the equilibrium change in quantities. This is a result of the fact that δ measures how much more/less retailers are willing to buy *at constant prices*. But as these shifts occur, prices change, which affects the ultimate quantity of eggs produced and purchased.

Within this framework, we can also consider a second thought experiment. Rather than determining the magnitudes of the two demand shocks, $-\delta_C$ and δ_{CF}, that hold retailer expenditures constant, we can instead determine the magnitudes of the shocks required to hold producer profitability (equation 6) unchanged. In this setting, we can ask how much retailers would have to spend on eggs to leave egg producers unharmed by the switch from conventional to cage-free egg demand.

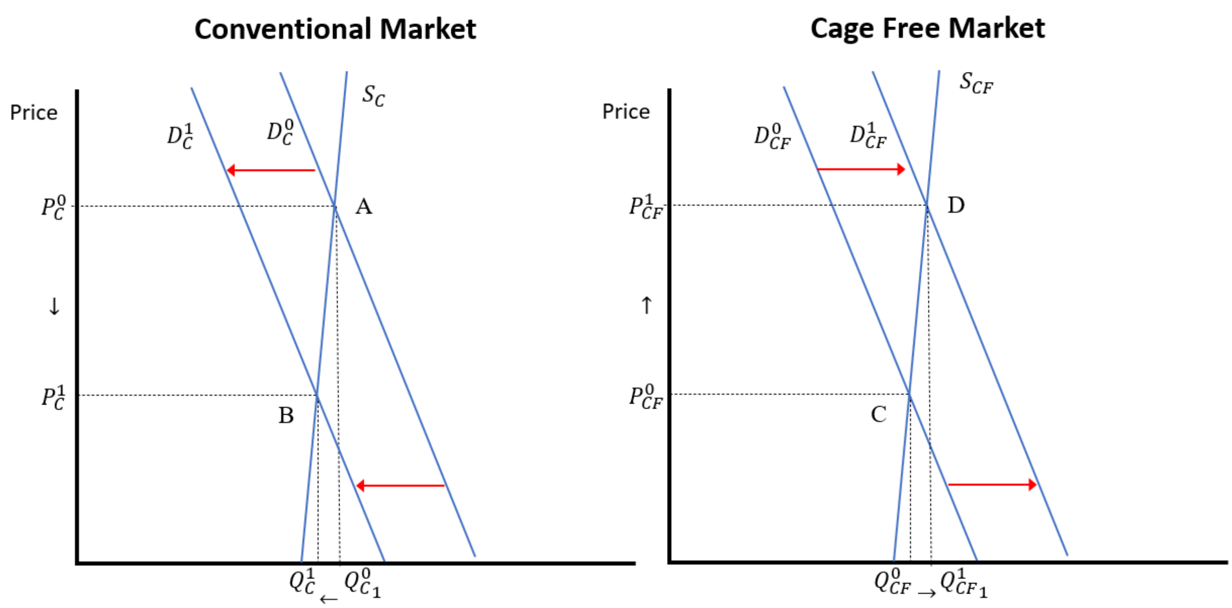


Figure 5.1. Effects of decrease in demand for conventional and increase in demand for cage-free

5.2.1 Data and Parameter Estimation

To implement the model described above, it is necessary to assign values for elasticities. To accomplish this task, we econometrically estimate elasticities using monthly data from January 2017 to September 2022. The start date of January 2017 is chosen because this is the date at which the USDA Agricultural Marketing Service (AMS) began releasing their monthly Cage-Free Shell Egg Report,[22] which contains data on wholesale contract and negotiated loose cage-free egg prices as well as data on cage-free and organic production. The reported cage-free contract price remains fixed for long periods of time, whereas the negotiated price is highly volatile; thus, for empirical analysis, we average these two wholesale prices for large eggs to represent the wholesale market price for cage-free eggs. We utilize the reported cage-free and organic flock sizes and rates of lay from the AMS report to calculate the quantity of cage-free and organic eggs produced each month. For conventional egg prices, we use the Urner Barry farm egg price as reported by the Iowa State Egg Industry Center (EIC).[23] To determine conventional shell egg quantities, we use the quantity of table-type eggs produced reported in the USDA National Agricultural Statistics Service (NASS) Chicken and Eggs monthly report. This is an overestimate of the number of conventional shell eggs sold because it includes eggs that are ultimately broken, and it also includes cage-free and organic eggs produced. Thus, to calculate the quantity of conventional eggs sold in shell form in a given month, we take the total quantity of table-type eggs produced and subtract the reported number of eggs broken and the estimated number of cage-free and organic eggs produced.

The employment rate from the Bureau of Labor Statistics is collected (for use in the demand models), and the consumer price index is collected to deflate prices. For the supply models, we collect data on the cost of feed for egg production reported by the EIC and data on the number of egg-laying hens affected by avian influenza as reported by the USDA Animal Plant Health Inspection Service (APHIS).

[22] The USDA data are available at: https://usda.library.cornell.edu/concern/publications/rj4304553?locale=en [last accessed December 6, 2022].
[23] The Urner Barry data are available at: https://www.eggindustrycenter.org/industry-analysis [last accessed December 6, 2022].

Table 5.1. Descriptive statistics for variables used in regression analysis

Variable	Source	Units	Mean	Minimum	Maximum
Conventional Egg Price (P_C)	Urner Barry farm price	$/dozen	0.917	0.231	2.710
Cage-free Egg Price (P_{CF})	USDA AMS Cage-free Shell Egg Report; Average of contract and negotiated prices	$/dozen	1.462	0.287	1.085
Conventional Egg Quantity (Q_C)	Calculated from data in USDA NASS Chicken & Egg Report and USDA AMS Cage-free Shell Egg Report	million eggs	3910.98	2365.36	4719.70
Cage-free Egg Quantity (Q_{CF})	Calculated using data from USDA AMS Cage-free Shell Egg Report; does not include organic	million eggs	1325.08	512.40	2425.34
Employment Rate	Bureau of Labor Statistics; Percent of the population employed	%	60.7%	52.6%	62.7%
COVID	Calculated; equals 1 for March through June 2020; 0 otherwise	0,1	0.058	0	1
Cost of Feed	Iowa Egg Industry Center; Regional Average	$/lb	0.115	0.092	0.168
Avian Influenza	USDA APHIS; cumulative number of hens affected in 2022	million hens	3.06	0.00	36.70

Given these data, demand elasticities are estimated. We estimate log-log regressions so that the estimated coefficients can be directly interpreted as elasticities. The basic structure of the demand models are as follows:

$$\log(Q_C) = \alpha_{o,C} + \beta_{C,C}\log(P_C/CPI) + \beta_{C,CF}\log(P_{CF}/CPI) + \delta_{C,VID}COVID \ + \delta_{C,EMP}\log(EMPLOY) + \sum_{m=1}^{11} \delta_{C,m}Month_m + \epsilon_C$$

$$\log(Q_{CF}) = \alpha_{o,CF} + \beta_{CF,C}\log(P_C/CPI) + \beta_{CF,CF}\log(P_{CF}/CPI) + \delta_{CF,VID}COVID + \delta_{CF,EMP}\log(EMPLOY) + \sum_{m=1}^{11} \delta_{CF,m}Month_m + \epsilon_{CF}$$

where *CPI* is the consumer price index (normalized so that September 2022 is set to 1). In this framework, $\beta_{i,j}$ are own-and cross-price elasticities of demand equal to $\eta_{j,k}$ in equations (5.1) and (5.2).

Table 5.2 shows the estimated coefficients. Elasticities estimates are of expected sign and of reasonable magnitude. The own-price elasticity of demand for conventional eggs is inelastic, where a 1% increase in the price of conventional eggs results in a 0.321% reduction in the quantity of conventional eggs demanded. Conventional and cage-free eggs are demand substitutes; a 1% increase in cage-free egg price is associated with a 0.307% increase in the quantity of conventional eggs demanded. Cage-free egg demand is, as expected, more elastic; a 1% increase in cage-free egg prices is associated with a 1.065% increase in the quantity of cage-free eggs demanded by retailers. COVID (the period from March to June 2020) was associated with a 27.1% increase in conventional shell egg demand and a 40.5% reduction in cage-free demand. Conventional egg demand is highest in November and December and lowest in May and June.

Supply equations take a similar form, except supply-side shifters are added to the model, including feed prices, an overall time trend (to account for technological change), and the cumulative number of avian influenza cases in 2022. The model also includes a one-period lagged value of the dependent variable to account for asset fixity and partial adjustment to price changes. Including this variable permits a calculation of both short and long-run supply elasticities.

Supply elasticities are shown in Table 5.3. The short-run supply elasticity of conventional eggs is highly inelastic at 0.015. The longer run value is calculated using the lagged dependent variable: 0.015/(1-0.925) = 0.19, which implies that a 1% increase in conventional egg price is associated with a 0.2% increase in the quantity of conventional eggs supplied. Likewise, the short-and long-run supply elasticities for cage-free eggs are 0.098 and 0.32, respectively. We utilize the long-run elasticities in the modeling efforts that follow. The estimated price elasticities are substituted into equations (5.1) through (5.4) to determine the effects of demand shifts.

Table 5.2. Estimates of demand for conventional and cage-free eggs

Parameter	**Conventional Egg Demand** $\log(Q_C)$	**Cage-free Egg Demand** $\log(Q_{CF})$
Constant	2.520 (2.709)[a]	30.590* (7.002)
Conventional Egg Price, $\log(P_C)$	-0.321*[b] (0.058)	0.682* (0.149)
Cage-free Egg Price, $\log(P_{CF})$	0.307 (0.176)	-1.065* (0.455)
Log of Employment Rate	1.374* (0.661)	-5.56* (1.708)
Covid	0.274* (0.097)	-0.405 (0.250)
January vs. December	-0.069 (0.085)	-0.009 (0.220)
February vs. December	-0.149 (0.084)	-0.163 (0.216)
March vs. December	-0.018 (0.085)	-0.097 (0.221)
April vs. December	-0.088 (0.085)	-0.164 (0.220)
May vs. December	-0.207* (0.086)	0.130 (0.223)
June vs. December	-0.257* (0.087)	0.031 (0.224)
July vs. December	-0.108 (0.086)	-0.065 (0.221)
August vs. December	-0.097 (0.085)	-0.058 (0.220)
September vs. December	-0.128 (0.084)	-0.025 (0.216)
October vs. December	-0.078 (0.088)	0.023 (0.227)
November vs. December	0.011 (0.087)	-0.101 (0.226)
$\mathbf{R^2}$	**0.538**	**0.420**

Note: Each regression based on N = 69 monthly observations from January 2017 to September 2022

[a] Numbers in parentheses are standard errors

[b] One asterisk represents statistical significance at the 0.05 level or lower

Table 5.3. Estimates of supply for conventional and cage-free eggs

Variable	Conventional Egg Supply $\log(Q_C)$	Cage-free Egg Supply $\log(Q_{CF})$
Constant	0.496 (0.754)[a]	1.831*[b] (0.504)
Conventional Egg Price, $\log(P_C)$	0.015 (0.012)	---
Cage-free Egg Price, $\log(P_{CF})$	---	0.098* (0.045)
Log Feed Price	-0.076 (0.055)	-0.062 (0.054)
January vs. December	-0.027 (0.020)	-0.065* (0.024)
February vs. December	-0.114* (0.019)	-0.152* (0.023)
March vs. December	0.094* (0.021)	0.043 (0.024)
April vs. December	-0.058* (0.020)	-0.050* (0.024)
May vs. December	0.003 (0.021)	-0.017 (0.025)
June vs. December	-0.078* (0.021)	-0.072* (0.026)
July vs. December	0.060* (0.023)	-0.023 (0.025)
August vs. December	-0.015 (0.020)	-0.020 (0.024)
September vs. December	-0.045* (0.020)	-0.072* (0.024)
October vs. December	0.030 (0.022)	-0.023 (0.024)
November vs. December	0.019 (0.020)	-0.094* (0.024)
Time trend	-0.001 (0.000)	0.007* (0.002)
Cumulative Bird Flu Cases	-0.000 (0.001)	-0.002* (0.001)
$\log(Q_{C,t-1})$	0.924* (0.096)	---
$\log(Q_{CF,t-1})$	---	0.695* (0.084)
R^2	**0.976**	**0.993**

Note: Each regression based on $N = 69$ monthly observations from January 2017 to September 2022
[a] Numbers in parentheses are standard errors
[b] One asterisk represents statistical significance at the 0.05 level or lower

5.2.2 Results for Expenditure Neutral Demand Shifts

As a first thought experiment, we consider a situation where retailers wish to hold total egg purchase expenditures constant, in dollar terms, while converting from conventional to cage-free. Figure 5.2 shows the offsetting demand shifts (and resulting equilibrium quantities) that would produce this expenditure-neutral outcome.

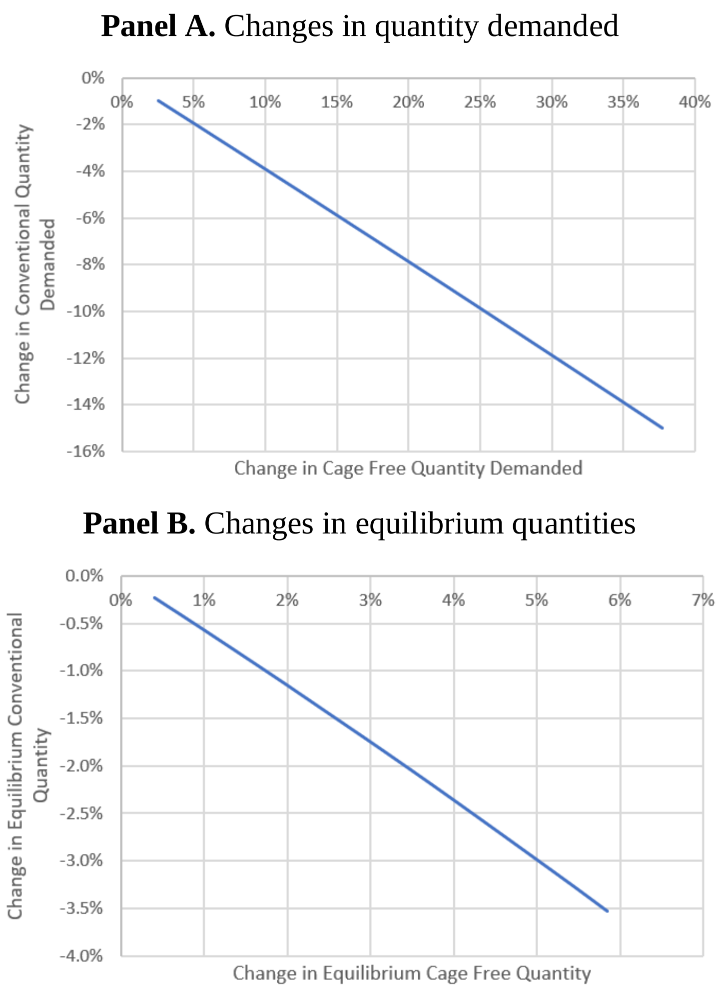


Figure 5.2. Expenditure-neutral shifts in conventional and cage-free egg demand

Panel A of Figure 5.2 shows that for every 1% reduction in the quantity of conventional eggs demanded, a roughly 2.5% increase in the quantity of cage-free eggs demanded is required to hold total spending on eggs constant. For example, if conventional egg demand falls by 5%, cage-free egg demand must increase by 12.7% to keep total spending constant. Panel B of Figure 5.2 shows the same outcomes but in terms of equilibrium quantity changes. As indicated when discussing Figure 5.1, shifts in quantity demanded are larger than the changes in ultimate equilibrium quantities (recall, shifts in quantity demanded are the extra quantities that would be bought at the same prices, whereas the equilibrium quantities are those that result after prices change). Panel B of Figure 5.2 shows that for every 1% reduction in the equilibrium quantity of conventional eggs produced and sold, it takes a roughly 1.7% increase in the equilibrium quantity of cage-free eggs produced and sold to hold total expenditures/revenue constant. For example, if conventional egg purchases fall 2%, it takes a 3.4% increase in cage-free purchases to hold total spending/revenue constant.

What are the impacts of these revenue-neutral demand shifts on egg producers? Using total 2021 prices and production to set initial equilibrium expenditure/revenue, Figure 5.3 shows that these expenditure-neutral changes are harmful for egg producers. For example, if the quantity of conventional eggs demanded by retailers falls by 5% while the quantity of cage-free eggs demanded by retailers increases by 12.7%, retailers will spend the same total amount of money on eggs, but egg producers' profits will fall by $18.69 million per year. This result occurs because fewer total eggs are produced, and those produced are at higher average costs for producers.

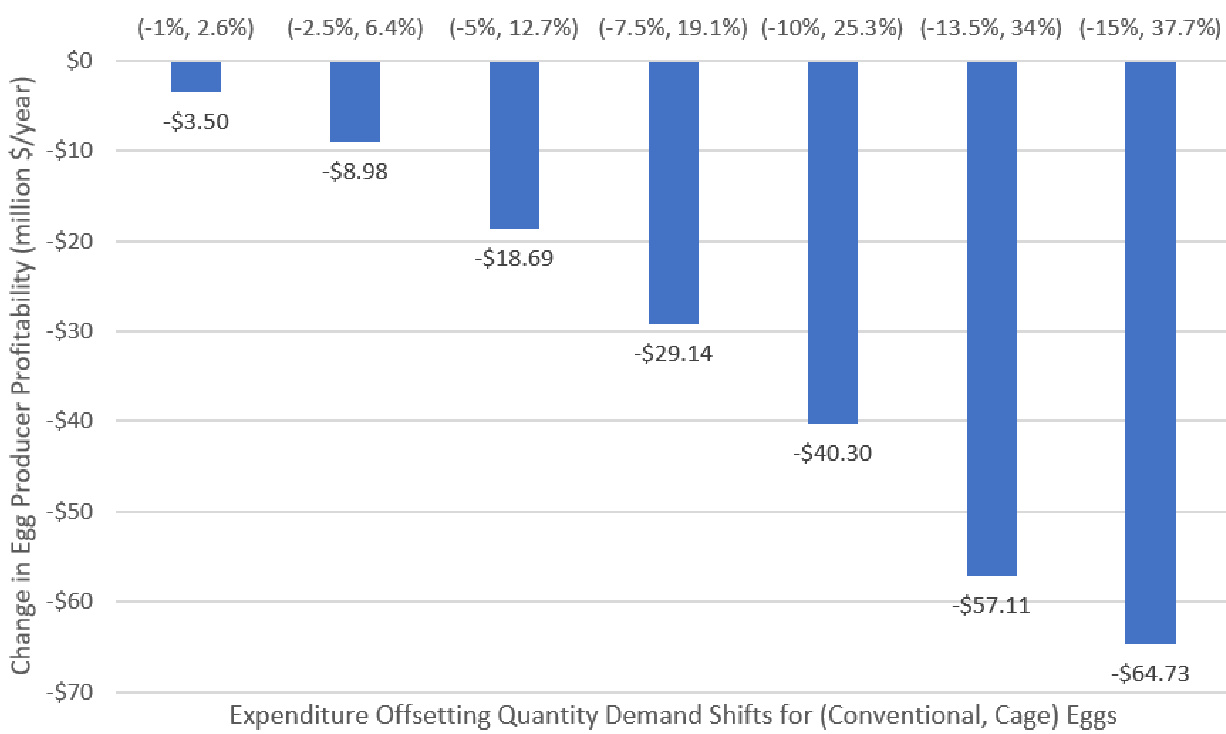


Figure 5.3. Impacts of expenditure-neutral demand shifts on egg producer profitability

5.2.3 Results for Egg Producer Profit Neutral Demand Shifts

Instead of determining the corresponding demand shifts that result in the same total egg spending by retailers, we now explore how much cage-free egg demand would have to rise to leave producers' profits unharmed.

We find that for every 1% reduction in the quantity of conventional eggs demanded, a roughly 2.6% increase in the quantity of cage-free eggs demanded is required to hold producer profit unharmed. For example, if conventional egg demand falls by 5%, then cage-free egg demand must increase by 13.2% to hold egg producer profits constant. As indicated previously, shifts in quantity demanded are larger than the changes in ultimate equilibrium quantities. For every 1% reduction in the equilibrium quantity of conventional eggs produced and sold, it takes a roughly 1.9% increase in the equilibrium quantity of cage-free eggs produced and sold to hold total egg producer profits constant. For example, if conventional egg purchases fall 1.1%, it takes a 2.1% increase in cage-free purchases to hold egg producer profits unharmed.

As is likely apparent from this discussion, retailers will have to spend more on eggs to hold egg producers unharmed as they shift from conventional to cage-free eggs. Figure 5.4 below shows how much more retailers would have to spend on eggs (in total) to leave producer profitability unharmed as they shift from conventional to cage-free eggs. For example, if the quantity of conventional eggs demanded falls by 5%, retailers would have to increase the quantity of cage eggs demanded by 13.2% and spend $23.81 million/year more on eggs to leave producer profitability unchanged. Stated in equilibrium quantity terms (rather than in terms of quantity-demand shifts), if the quantity of conventional eggs produced and sold falls by 1.1%, retailers would have to increase the quantity of cage-free eggs purchased by 2.15% and spend $23.81 million/year more on eggs to leave producer profitability unchanged.

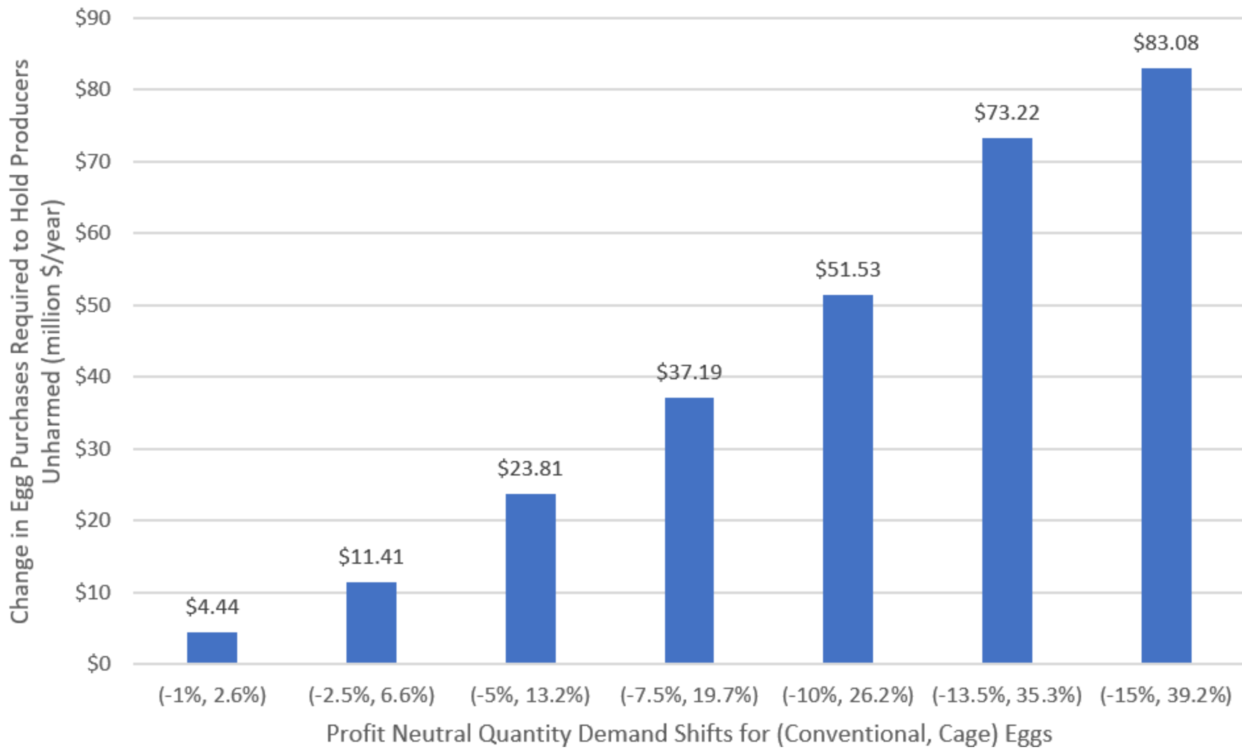


Figure 5.4. Increases in retailer egg spending required to hold egg producers' profits constant

5.3. Aggregate Egg Market Analysis

Rather than separately modeling supply and demand for conventional and cage-free eggs, a simple model of the aggregate egg market is constructed to understand how housing conversions affect overall producer profitability. Equation (5.7) shows changes in total shell egg demand, where $\hat{Q}$ is the total change in the quantity of eggs (both cage and cage-free) demanded, $\eta < 0$ is the aggregate demand elasticity, $\hat{P}$ is the weighted average egg price, and θ is the change in retailer willingness-to-pay for eggs (it is the vertical shift in the demand curve measured relative to the initial equilibrium price). Equation (5.8) shows changes in total shell egg supply, where $\varepsilon > 0$ is the overall own-price supply elasticity and k is the change in marginal cost of egg production.

(5.7) $$\hat{Q} = \eta(\hat{P} - \theta)$$

(5.8) $$\hat{Q} = \varepsilon(\hat{P} - k)$$

Once values for η, ε, θ, and k are assigned, then equations (5.7) and (5.8) can be solved for the equilibrium changes in quantity and price: $\hat{Q}$ and $\hat{P}$. In particular, the equilibrium prices and quantities are:

(5.9) $$\hat{P}^* = (\eta\theta - \varepsilon k)/(\eta - \varepsilon)$$

(5.10) $$\hat{Q}^* = \eta\varepsilon(\theta - k)/(\eta - \varepsilon)$$

Once these values are calculated, changes in producer profitability are calculated as follows:

(5.11) $$\pi = P^0 Q^0(\hat{P} - k)(1 + 0.5\hat{Q}).$$

What is the magnitude of the supply shift, *k*, induced by a conversion from conventional to cage-free eggs? *K* is the change in marginal cost expressed relative to the initial equilibrium price. In a competitive equilibrium, it is also equal to the relative change in per-unit cost, which in perfect competition equals the change in per-unit price, again expressed relative to the initial equilibrium price. Start by defining the initial equilibrium aggregate unit price, which in this context is a quantity-weighted average of conventional and cage-free prices: $P^0 = S_{CF}^0 P_{CF} + (1 - S_{CF}^0)P_C$, where S_{CF}^0 is the quantity share of cage-free eggs and superscript 0 denotes initial equilibrium shares and prices. Now consider a change that shifts the quantity of cage-free eggs supplied, leading to a new weighted-average unit price of: $P^1 = S_{CF}^1 P_{CF} + (1 - S_{CF}^1)P_C$. Thus, the change in price is: $P^1 - P^0 = P_{CF}(S_{CF}^1 - S_{CF}^0) + P_C\ (S_{CF}^0 - S_{CF}^0) = (S_{CF}^1 - S_{CF}^0)(P_{CF} - P_C\ )$. Expressed in relative terms, $k = (S_{CF}^1 - S_{CF}^0)(P_{CF} - P_C\ )/P^0$. Thus, the size of the supply shift depends on the change in the share of the market supplied by cage-free eggs, $(S_{CF}^1 - S_{CF}^0)$, and the extent to which cage-free price/cost is higher than conventional expressed relative to the initial weighted-average price, $(P_{CF} - P_C\ )/P^0$.

5.3.1 Data and Parameter Estimation

To determine aggregate-level supply and demand elasticities, we utilize the conventional and cage-free estimates already reported in Tables 5.2 and 5.3, along with the decomposition results provided in James and Alston (2002), which relate aggregate to disaggregate elasticities. Aggregate-level elasticities that would rationalize the disaggregate elasticities indicate $\eta = -0.103$ and $\varepsilon = 0.205$.

To determine the sizes of the supply shocks, one must evaluate the increase in the share of cage-free eggs and the relative cost of producing cage-free vs. conventional eggs. In our producer survey, respondents indicated a belief that the current cage-free share was about 0.3, and respondents thought, on average, this would increase to 0.5 by 2026. This would suggest an increase of 0.5 – 0.3 = 0.2. Given the uncertainty around this parameter, we consider values that range from a 0.1 to a 0.3 increase in cage-free share.

The additional value that needs to be determined is the increase in cost when going from conventional to cage-free. Survey respondents indicated that cost increases would vary by expense category. However, they state that, on average, variable operating costs would increase by about 15% when going from conventional to cage-free; other costs, such as labor were higher, and responses were truncated at a 20% price increase given the survey response categories, suggesting that respondents beliefs of cost increases could be much higher than 15%. Another point of reference is the actual price differences between conventional and cage-free. From January 2017 to September 2022, the regional average price of Large Grade A conventional eggs delivered in cartons to warehouses was $1.07/dozen, as reported by the USDA AMS (report WA_PY001). By contrast, the cage-free shell egg prices (to first receivers) over this period averaged $1.28/dozen for contracted large carton cage-free eggs and $1.30/dozen for negotiated large, loose cage-free eggs, according to the USDA AMS Cage-Free Shell Eggs Report. Thus, over this period, cage-free eggs commanded a premium of between $0.21/dozen to $0.23/dozen, depending on which cage-free price series is used. These represent a 20% to 22% price premium for cage-free eggs. Given these points of reference, we consider the impacts of a "low" cost increase of 15%, a "mid" of 20%, and a "high" cost increase of 25%.

As in the previous section, when calculating producer profit changes, we use initial revenue values based on 2021 averages and focus only on shell-egg sales.

5.3.2 Results

Table 5.4 shows the impacts on producer profits under different assumptions about the increase in the share of cage-free eggs and the cost of cage-free production relative to conventional. Under the most conservative scenario (a 10% increase in the share of eggs that are produced cage-free and a 15% higher cage-free costs of production), producer profits are projected to fall $27.22 million per year in aggregate. Under the costliest scenario (a 30% increase in the share of eggs produced cage-free and a 25% higher cage-free costs of production), producer profits are projected to fall $135.8 million/year in aggregate. In the middle scenario (a 20% increase in the share of eggs produced cage-free and a 20% higher cage-free costs of production), producer profits are projected to fall $72.51 million/year in aggregate.

An important caveat to note about the producer profit changes reported in Table 5.4 is that they do not include changes in fixed costs of production. Costs that do not vary with the quantity of eggs produced (e.g., fixed capital and infrastructure) that would be incurred with a conversion to cage-free would need to be added to the figure in Table 5.4 to determine the full economic consequences of conversion.

Table 5.4. Change in producer profits from conversion to cage-free housing, varying assumptions

Increase in Share of Eggs from Cage-free	Per-Unit Cost of Cage-free vs. Conventional Egg Production	Change in Egg Producer Profits (million $/year)
10%	15%	-$27.22
20%	15%	-$54.40
30%	15%	-$81.56
10%	20%	-$36.28
20%	20%	-$72.51
30%	20%	-$108.69
10%	25%	-$45.34
20%	25%	-$90.61
30%	25%	-$135.80

Note: Total egg demand is assumed to remain unchanged in all scenarios.
Note: Calculated changes in producer profits do not include changes in fixed costs.

Chapter 6: Conclusion and Implications

Given the pressure from animal advocacy organizations, rising consumer demand, challenges of complying with different state regulations across multiple jurisdictions, and a desire to protect brand image and equity, many food retailers have pledged to phase out the sale of eggs from conventional cage production systems and move toward only selling cage-free eggs. Many retailers have committed to fully convert to cage-free by 2026. While the share of eggs produced in cage-free and organic systems has risen steadily over the past decade, the rate of increase is insufficient to meet all existing pledges by the 2026 deadline. Moreover, final retail egg consumers are not choosing to buy cage-free eggs over conventional at a rate where retailer pledges would be automatically fulfilled by the market alone.

Higher costs are the main challenge producers face in further transitioning to cage-free housing. These costs include greater capital and labor requirements, more feed, and potentially higher mortality and morbidity associated with cage-free vs. conventional housing. In addition to cost, egg producers expressed concern about environmental impact, animal welfare, food safety, and consumer affordability when considering the further transition to cage-free housing. Producers were also concerned about how the transition toward cage-free production might favor large vs. small producers. There was a concern that smaller producers have less access to capital and less ability to negotiate with retailers, which might increase consolidation alongside the transition to cage-free production. Egg producers are sensitive to the needs of retailers and highlighted the fact that retail demand would ultimately drive the transition to cage-free (or not).

Interviews and surveys with egg producers and consumers suggest several factors that might facilitate the conversion to cage-free housing. To the extent there are concerns about inequalities or consolidation, retailers could offer differential terms, including extended timelines that vary by the size of the producer. Access to capital to build new facilities or convert existing facilities is a major barrier to the transition to cage-free. Egg producers with long-term contracts that ensure the volume of purchase from a retailer would be more able to secure financing from lenders. Our survey of egg producers suggests that cost-plus pricing contracts will likely be most attractive to egg producers in encouraging a transition.

Egg producers are skeptical that they can meet all existing pledges by 2026. Extending the pledge deadlines would give egg producers more time to acquire financing from lenders and better coordinate the depreciation of current housing stock with the construction of new facilities.

Extended timelines are unlikely to generate backlash from consumers, as our survey indicates consumers do not anticipate a full conversion to cage-free by 2026. Indeed, most consumers are unaware whether their grocers have committed to being 100% cage-free. Retailers could gain goodwill from their customers by re-announcing commitments (that are mostly unknown to their customers) while re-adjusting details and timelines in a way that is more advantageous for producers.

While our survey indicates that consumers broadly support retailer commitments to go cage-free, their buying patterns do not generally align with their stated policy preferences. More than half of consumers are unwilling to pay any premium for cage-free eggs, and they will likely reduce egg purchases if conventional eggs are unavailable in the marketplace. Such an outcome would be costly for egg producers, retailers, and consumers. While it may be politically infeasible and unpopular among producers, we note that consumers are highly suppsortive of using government subsidies to support the transition to cage-free housing. Given the gap between consumers' stated desires and their actual purchasing behaviors, government support may well be the only way to encourage the shift to cage-free production. Still, there is no free lunch, and soliciting such support may invite unintended consequences.

Overall, this report provides a comprehensive investigation into the challenges associated with the transition from conventional to cage-free housing production systems and, in doing so, provides industry participants with joint insights to better serve investors and consumers.

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