The Food Safety Performance of Chicken Suppliers to the National School Lunch Program

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• More than 30 million lunches and 12 million breakfasts are served to school children in the United States each day.

•Chicken is a major component of those meals.

• Recent outbreaks of foodborne illnesses caused by drug-resistant *Salmonella* at Foster Farms and other chicken processing plants have resulted in hundreds of illnesses and caused concern among health authorities about the food safety of meat and poultry.

• Those most at risk of foodborne illness are the young and the elderly, raising questions about the food safety of the meat and chicken served in the National School Lunch Program (NSLP).

Purpose of the Paper

• Examine the food safety performance of chicken slaughter plants that supply chicken to the NSLP.

Previous Research

•Ollinger (2013) showed that plants approved to supply ground beef to the NSLP and that bid on ground beef contracts performed better on *Salmonella* testing than plants approved to supply the NSLP but not bidding on contracts.

•There is no previous research on the food safety performance of chicken slaughter plants supplying raw chicken to the NSLP.

Bulk Chicken Purchases for Schools Participating in the National School Lunch Program

•Agricultural Marketing Service (AMS) buys millions of dollars of chicken products each year for the NSLP.

• AMS solicits bids for contracts to supply a school system with chicken products and selects the lowest cost bid.

• Any plant approved by AMS to supply chicken to the NSLP can bid on any contract.

•To be eligible to bid on contracts to supply chicken products to the NSLP, chicken producers must meet the food safety standards established by the Food Safety and Inspection Service (FSIS) and comply with other non-food safety requirements stipulated by AMS.

FSIS Regulations

• Must comply with Sanitation Standard Operating Procedures (SSOPs) and Pathogen Reduction Hazard Analysis and Critical Control Point Program (PR/HACCP) tasks and meet the *Salmonella* standard (See Ollinger and Mueller (2003) for details on these requirements)

•Two types of SSOPs

-Operational: Occurs during operations and includes tasks such as knife cleaning

-Pre-operational: Occurs before or after production and includes sanitizing production lines, etc.

•PR/HACCP tasks

-Tasks required under a plant's HACCP plant – a mandated quality control program required under PR/HACCP

•*Salmonella* standard

-No more than 12 out of 51 samples can test positive for *Salmonella spp*. Failure to meet the standard results in greater regulatory oversight and could lead to severe penalties if performance does not improve.

•Many other regulations, such as cooking times for poultry hams that are specific to particular products.

Economic Environment

The possibility of adverse selection

AMS selects the lowest cost bidder on contracts to supply chicken to the NSLP. As a result, suppliers are under pressure to produce products at as low of a cost as possible. Since the provision of food safety is costly (Antle, 2000; Ollinger and Mueller, 2003), plants have an incentive to lower their costs and increase the probability that they will have the lowest bid by reducing effort devoted toward food safety. As a result, producers with lower food safety standards can drive away plants with stricter food safety standards, leaving only plants that adhere to less food safety strict standards as suppliers to the NSLP. Note, these suppliers must still meet FSIS standards.

What does the Economic Literature Say?

On the One Hand…

1. Holmstrom (1979) and Grossman and Hart (1979) remind us that moral hazard occurs when the seller knows quality better than the buyer.

2. Akerlof (1970) and Stiglitz (1981) point out that adverse selection occurs when quality cannot be adequately disclosed. And low costs and low quality products drive out higher cost and quality products.

3. Starbird (2005) points out that both conditions must be controlled to maintain food safety quality.

On the Other Hand……

1. The Agricultural Marketing Service (AMS) makes repeat purchases from suppliers, giving it a window through which food safety can be revealed.

2. The sale of contaminated chicken to the NSLP is a threat to the reputation of a supplier because

    a. the NSLP is a highly visible program with food safety failures drawing immediate public attention and
    b. Suppliers ship directly to one school, making food safety failures easy to trace to the source.

Economic Model

The provision of food safety is an empirical matter that must be examined through econometric analyses. Below is a model of a food safety production function in which food safety is produced with inputs of capital and labor:

A model

$FS_{it} = S(\mathbf{L_{it}}, \mathbf{K_{i,t}}, \mathbf{Z}_{it}, \text{AMS-approved}_{it})$

Empirically,

$$FS_{it} = \alpha_0 + \sum \beta_i L_i + \delta K + \sum_k \lambda_k Z + \omega AMS - approved + \xi$$

Where

FS (Food safety performance) is a measure of how well plants perform relative to the *Salmonella* standard mandated administered by FSIS. Plants meet the standard if fewer than 12 out of 51 samples of meat from raw chickens test positive for *Salmonella.*

> • Three performance measures -- one-half, one-fourth, and one-tenth of the FSIS *Salmonella* tolerance -- are used. These strict tolerance levels are used to evaluate whether plants are doing just enough to meet the standard or if they are exceeding the standards. We cannot use a food safety measure that equals the FSIS *Salmonella* standard because all plants must meet that standard, suggesting no differences in performance.

K is plant size and should positively affect food safety performance (Ollinger and Moore, 2009; Muth et al., 2007).

$\mathbf{L_{it}}$ is a vector of variables reflecting labor inputs and measured by performance on process regulations mandated by FSIS. Ollinger and Moore (2009) found that better performance of Standard Sanitation Operating Procedures (SSOPs) and Hazard Analysis and Critical Control Program (HACCP) tasks improved performance.

$\mathbf{Z_{it}}$ is a vector of plant and firm characteristics. Age and production of ready-to-eat foods may affect food safety performance (Muth et al., 2007). These variables also include whether the plant slaughtered more than one animal species and whether the plant is part of multi-plant firm.

AMS-approved is an indicator of whether the plant is approved to supply chicken to the NSLP.

Methods

Use a probit regression with panel data.

- Adjust for multiplicative heteroskedasticity if necessary.
- No test available for autocorrelation in limited dependent variables (Becker, Katz, and Tucker, 1998) but Woodridge test for linear regressions rejects autocorrelaton.
- Account for autocorrelation by using a Huber sandwich Beck and Katz (1997) argue that the Huber sandwich method corrects for most autocorrelation error if it exists and does not affect results if there is no autocorrelation.

Data

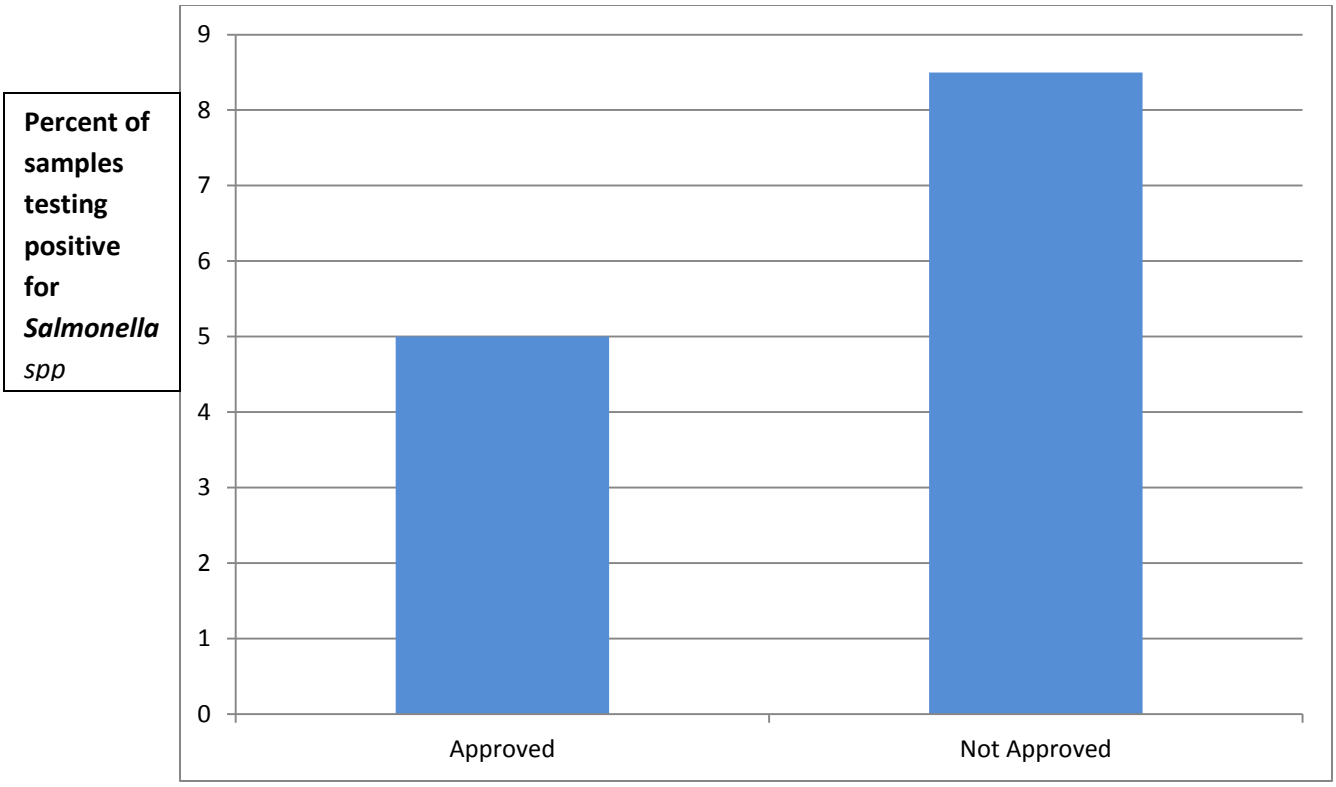
- Includes all chicken slaughter plants that underwent *Salmonella spp* testing by FSIS over 2006-2012.
  - -649 observations of plants not approved to supply the NSLP (plants appear more than once over the time period).
  - -239 observations of plants approved to supply the NSLP (plants appear more than once)
- The AMS website AMS identifies plants approved to supply the NSLP and whether those plants bid on contracts to supply the NSLP**.**
- All other data comes from FSIS sources.

Variable definitions for empirical model

Approved to Supply Raw Chicken to the National School Lunch Program.

Variable	Empirical Variable	Definition	Approved	Not-Approved
FS	One-Half *Salmonella spp* Standard	One if share of samples testing positive for *Salmonella* equals one-half FSIS standard, zero otherwise.	0.874	0.746
FS	One-Fourth *Salmonella spp* Standard	One if share of samples testing positive for *Salmonella* equals one-fourth FSIS standard, zero otherwise.	0.598	0.516
FS	One-Tenth *Salmonella spp* Standard	One if share of samples testing positive for *Salmonella* equals one-tenth FSIS standard, zero otherwise.	0.464	0.345
K	Chicken_lbs	Pounds of raw chicken products produced.	56.2	42.3
L	HACCP_PASS0,	One if plant has no noncompliance reports (deficiencies) for HACCP tasks, zero otherwise.	0.322	0.300
L	SSOP_P_PASS0	One if plant has no deficiencies for Pre-Operation SSOPs, zero otherwise.	0.079	0.154
L	SSOP_O_PASS0	One if plant has no deficiencies for operational SSOPs, zero otherwise.	0.151	0.260
K	Chicken_lbs	Millions of pounds of raw chicken products produced per year.	56.2	42.3
Z	Plant age	Current year minus year meat grant issued	13.0	16.9
Z	Further processing	One if plant further processes meat, zero otherwise	0.125	0.122
Z	Multi-Species	One if plant slaughters more than one animal species; zero otherwise.	0.109	0.203
Z	Multi-Plant	One if plant is part of a multi- plant firm, zero otherwise.	0.084	0.129
Z	Year_2010	One if year after 2009, zero otherwise.	0.481	0.400
NSLP	AMS-approved	One if plant approved to supply raw chicken to NSLP, zero otherwise.	1.000	0.00
	Observations		239	649

Figure 1: Plants approved to supply the NSLP have lower *Salmonella spp* levels than not-approved plants.



Results comparing plants approved but not necessarily supplying chicken to the NSLP versus other plants not approved to supply the NSLP

• Larger plants perform better on *Salmonella* tests than smaller plants

• Plants performed better on *Salmonella* tests after 2010.

• AMS approved suppliers performed significantly better than other plants at one-half the tolerance but not for stricter tolerances.

Table 2: The marginal effects of being approved to supply the NSLP on performance on *Salmonella* tests administered by FSIS.

Empirical Variable	One half the *Salmonella* standard	One fourth the *Salmonella* standard	One tenth the *Salmonella* samples	
Log (chicken_lbs)	0.053***	0.076***	0.071***	
HACCP_PASS0,	(+)	(-)	(-)	
SSOP_P_PASS0	0.070*	(+)	(+)	
SSOP_O_PASS0	(-)	(-)	(+)	
Log (Plant age)	(+)	(+)	(+)	
Further Processing	(+)	(+)	(+)	
Multi-Species	(-)	(-)	(-)	
Multi-Plant	(-)	(-)	(-)	
Year_2010	0.192***	0.258***	0.147**	
AMS-approved	0.087**	0.091*	(+)	
Year_2010* AMS-approved	(-)	(-)	(-)	
X^2	99.1***	25.1***	72.0***	
Observations	888	888	888	
X^2 of likelihood of Heteroskedsasticity	2.99	8.84***	5.98**	

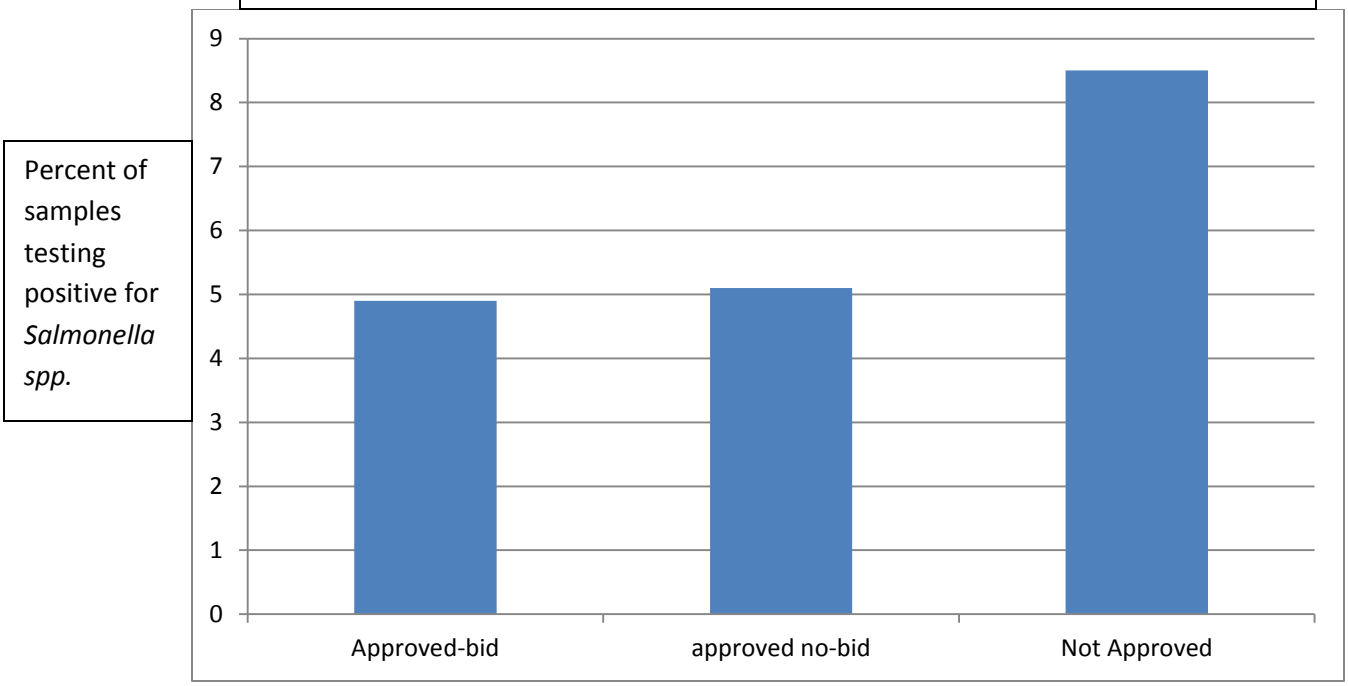
*, **, *** 0.10, 0.05, and 0.01 levels of significance

Changes in Testing Strategy

•Plants approved to supply the NSLP but not supplying product may be reluctant to bid on contracts because of poor performance on *Salmonella spp* testing.

Revised Testing Strategy: Use the same econometric methods to examine the performance of plants approved to supply the NSLP and bidding on contracts relative to plants approved to supply the NSLP and not bidding on contracts and plants not-approved to supply the NSLP.

Figure 2: Plants approved and bidding on contracts to supply the NSLP perform marginally better on *Salmonella* spp tests than plants approved and not bidding on contracts and much better than not-approved plants.



Results comparing plants approved and bidding on contracts to supply chicken to the NSLP versus other plants approved but not bidding to supply the NSLP and plants not approved to supply the NSLP

• Larger plants perform better on *Salmonella* tests than smaller plants

• Plants performed better on *Salmonella* tests after 2010.

• Plants approved to supply the NSLP that bid on contracts performed significantly better than plants not approved to supply the NSLP on one-half and one-tenth tolerance tests.

Food for Thought

• Plants approved to supply the NSLP that do not bid on contracts performed significantly better than plants not approved to supply the NSLP on one-half tolerance tests.

•There is only a modest difference in performance between plants approved to supply the NSLP and bidding on contracts and plants approved to supply the NSLP and not bidding on contracts. A much larger difference exists between approved plants and not-approved plants.

Table 3: Marginal Effects of being an AMS-approved supplier that bids on contracts on *Salmonella* tests administered by FSIS.

Empirical Variable	One half the *Salmonella* standard	One fourth the *Salmonella* standard	One tenth the *Salmonella* samples	
Log (chicken_lbs)	0.052***	0.077***	0.074***	
HACCP_PASS0,	(+)	(-)	(-)	
SSOP_P_PASS0	0.071*	(+)	(+)	
SSOP_O_PASS0	(-)	(-)	(+)	
Log (Plant age)	(+)	(+)	(+)	
Further Processing	(+)	(+)	(+)	
Multi-Species	(-)	(-)	(-)	
Multi-Plant	(-)	(-)	(-)	
Year_2010	0.189***	0.259***	0.150**	
Approve_no_Bid	0.077*	(+)	(-)	
Approved_Bid	0.086**	0.131**	0.174***	
Year_2010* Approved_no_Bid	(-)	-0.065*	(+)	
Year_2010* Approved_Bid	(+)	-0.191**	(-)	
X^2	95.6***	24.5**	75.4***	
Observations	888	888	888	
X^2 of likelihood of Heteroskedsasticity	2.99	9.23***	7.00***	

*, **, *** 0.10, 0.05, and 0.01 levels of significance

Conclusion

•There is no evidence of adverse selection.

•Plants bidding on contracts to supply the NSLP perform better on Salmonella tests administered by FSIS, perhaps because

-they fear a loss of reputation for food safety if they sell low quality chicken.

-they serve other markets that have strict food safety standards and they find it in their interest to maintain the same high standards for all their processing operations.

•Plants approved to supply ground beef to the NSLP and bidding on contracts performed much better on *Salmonella* testing than other plants. Yet, only ground beef producers face strict AMS product testing protocols.

•Plants approved to supply ground beef to the NSLP and not bidding on contracts performed much worse on *Salmonella* testing than other plants. This differs markedly from that which occurred in chicken slaughter.

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